THE DENTAL STATUS, NEEDS AND DEMANDS OF THE ELDERLY IN THREE COMMUNITIES

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ABSTRACT

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An age stratified random sample of 2280 adults over the age of 60 years, from three different areas of England, were interviewed and examined by a dentist in order to assess their dental status needs and demands. The towns of Salisbury (representing an urban community in the South of England), Darlington (representing an urban community in the North of England) and Richmondshire in North Yorkshire (representing a rural community) were the areas used. This allowed Salisbury and Darlington, the two towns used in one of the original population studies of adult dental health in 1962, to be revisited after 30 years.

Response rates were around 55%, and a postal follow up of refusers allowed the influence of sampling bias on key dental factors to be established. The final sample was mostly ambulant and severe disability was rare, except in the oldest subjects (75+). Four dentists conducted the examinations, but one examiner (the author) undertook half of the examinations in each area.

Geographical location, age and social class were strongly related to edentulousness. The percentage edentulous ranged from 11% in the younger (age 60-64) Salisbury non-manual workers to 90% in the oldest (age 75+) Darlington unskilled manual workers. A further 10% of the total sample in all three areas was edentulous in one arch. Complete dentures were rarely free of faults, but the relationships between denture faults, as assessed by the dentist, and reported dissatisfaction were weak.

In the dentate sample, partial dentures were worn by 40%. Most of these were made of acrylic and were of a simple tissue supported design. Around 20% had had a partial denture made in the past which they were unable or unwilling to wear. Decay, periodontal attachment loss and tooth wear increased with age, but geographical variations were small. The most important influence on the dental health of the dentate was dental attendance pattern. Subjects who only attend the dentist when driven by pain had about six fewer teeth, six fewer filled teeth, and about twice as much decay (taking into account the number of teeth left) as those who attend for check-ups. 40-50% of the sample had some moderate periodontal attachment loss, but signs of more severe disease were found in only 10-25%. CPITN was an inappropriate measure of periodontal disease in an elderly population; loss of attachment and tooth mobility were preferable. Some moderate tooth wear affected about 40% of the sample, but did not seem to be closely related to functional problems. Most of the teeth with root surface decay, advanced periodontal disease and severe wear were concentrated in a minority of the sample.

Demands and attitudes in the dentate varied with geography, gender and social class. Dental non-attenders were more common among men (particularly in the North) and people from manual backgrounds. A perceived lack of need for treatment was the major reason given for non-attendance. Fear of edentulousness and a preference to have restorative treatment were more common in the south. Few subjects reported difficulty with access to dental care.

The risk factors for dissatisfaction and difficulty with eating were analysed using a model of the factors contributing to oral health and well being. The presence of unfilled anterior spaces and social and demographic variables were the major risk factors for dissatisfaction with aesthetics. Symptoms and the number of missing teeth were the most important factors leading to eating difficulties and dissatisfaction with masticatory function. Partial dentures are much more likely to be worn when there are less than 20 teeth, and where there is an anterior space. Number of posterior contacts and dental attendance pattern were the other major determinants of partial denture wearing. Partial dentures were a major risk factor for having root surface decay and fillings.

Oral health goals for the elderly, taking into account the need to retain sufficient teeth to function through life, are presented. The absence of partial dentures, 20-24 teeth and 2-4 posterior contacts are seen as the desirable minimum, although these requirements may reduce with age.

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A study of this sort, in which over 2000 home visits were undertaken to subjects spread over three areas of the country, and involving a wide variety of different agencies and institutions, depends on the co-operation and co-ordination of a large number of people. Consequently I shall begin the acknowledgements with an apology to anybody who I omit to thank. If anyone has been left out undeservedly it is not through lack of gratitude, but through lack of adequate memory.

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Pat Ludiman, Denise Mattin and Hilary Smith acted as the other examiners (besides myself) during the fieldwork. The 350 or so examinations which they undertook must have stretched their boredom tolerance to the limit, but they all got on with it and completed what was required with good humour and, in view of my paranoid nagging, surprising patience. Five Dental Surgery Assistants took time out from their normal duties in the community service and undertook a job which was new, difficult, often tedious, sometimes awkward or embarrassing and always hard work, and did it superbly and loyally. I enjoyed their company and I cannot express my gratitude strongly enough to Mattie Andrew, Sandra Gates, Val Gunson, Elaine

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At an early stage in the three years or so during which the work was carried out I sought and received advice from many people. I would particularly like to thank Arnd Käyser and Dick Witter from the Dental School in Nijmegen, Aubrey Sheiham and Anna Theresa Leao from UCH in London, John Bond and Graham Farrow from the Centre for Health Services Research in Newcastle, Angus McNay from the Northern Regional Health Authority, and Jean Todd from OPCS/DPB for their help and, in some cases practical support. Stella Saunders and John Stewart deserve thanks for their roles in providing the examiners to undertake the home visits and for dealing sensitively with various local political problems.

The names for the sample came from the computerised lists held by the Family Health Services Authorities for each of the areas concerned. Drawing a sample from these was not a straightforward matter, and for those that constructed the lists of names that I required and had to endure my repeated, anxious, telephone enquiries in the process I would like to express my gratitude.

My colleagues in the Department of Restorative Dentistry have had to put up with my presence, my mess and my continual occupancy of various computers. Despite this they have given me continued help and encouragement which I appreciate. They deserve my thanks.

During the course of the fieldwork 2280 people were visited, interviewed and examined, some of them on two occasions (if they took part in the revisit procedure). Most were pleasant, many were interesting and some had excellent chocolate biscuits, but above all every one of them gave up their own time and allowed two total strangers into their house to ask them questions and poke around inside their mouths. At a time when crime levels are high and the media regularly reports deception and crime against older adults they deserve great praise and thanks, and I hope that some of them (all of them) enjoyed our visits as much as we enjoyed visiting them.

Final thanks must go to my wife Katie and the children - Tom and Jenny. They have endured much over the three years which it took to complete this work, particularly throughout the twelve weeks or so that I spent in Salisbury, and the many other late returns from Darlington, Richmondshire and the computer. Katie also provided loyal support and practical help when desperation set in. Tom and Jenny behaved well (usually) and kept life in perspective.

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Section 1

INTRODUCTION AND AIMS OF THE STUDY

The age structure of the population of the United Kingdom is changing. Life expectancy at birth had increased from 68 years for men and 74 years for women in 1961, to 72 years for men and 78 years for women 25 years later (OPCS, 1991a) and is expected to continue to increase (Thompson, J., 1987). Although birth rates tend to fluctuate considerably, there has been a marked reduction since the "baby boom" of the 1960s (OPCS, 1991a; OPCS, 1991b). The net effect of a steady or reducing birth rate and a reduction in mortality is a general ageing of the population. This is illustrated by an increase in the median age of the British population from 34 years in the late 1970s to 35.5 years in 1987, predicted to increase to as much as 40 years by 2010 (Thompson, J., 1987). The population of pensionable age (at present, 60+ years for women, 65+ for men) is only expected to increase slightly to the end of the century, but this masks a considerable increase in the proportion of the "very old" (85+ years). The actual size of this group is projected to rise from the 1991 figure of 0.8 million to 1.1 million by the end of the century and 1.5 million by 2010 (OPCS, 1993; Thompson, J., 1987). The ratio of dependent elderly to working age adults will change from 30 dependents for every 100 working age adults in 1991 to 47 dependents for every 100 working age adults within 40 years - with considerable economic implications (OPCS, 1993).

The demographic changes which have been described would be of significance to the dental profession irrespective of any future changes in the dental status of the nation. However, evidence from the last three decennial Surveys of Adult Dental Health in the United Kingdom indicates profound changes, most obviously a drop in the rate of edentulousness, but also an increase in the number of sound and untreated teeth in children and young adults (Todd, J.E. & Lader, D., 1991; Todd, J.E. et al., 1982). These changes in prevalence are most evident in the younger age groups, but there is also evidence of a reduced incidence of edentulousness in all age groups (including older adults) compared with the previous surveys . Basing their projections on a continuation of these trends, Todd and Lader have predicted that by the year 2018 only 16% of the population will be edentulous, and if no more tooth loss were to occur between now and then (which seems very unlikely) the figure would be as low as 4%. Even if one considers the older age groups alone the edentulous would comprise only 16% (at "worst") of the 65-74 age group and 34% of the over 75 year olds compared to the 1988 figures of 57% and 80% respectively (Todd, J.E. & Lader, D., 1991). By this time the total population of over 60 year olds will have increased to nearly 12 million from the current figure of just over 10 million. The combination of falling levels of edentulousness, an increase in the elderly population and lower disease levels in the younger age groups will lead to changes in the way dentistry is practised in the United Kingdom over the next fifty years.

The requirement for complete dentures will reduce, and the age of those who require full dentures for the first time will increase. However it is not the reduction in the requirement for complete dentures which is likely to be of greatest significance, but the need for restorative dental care for a large and increasing number of dentate elderly. The need for repair and replacement of existing large and complex coronal restorations (the legacy of high caries levels in the past), the management of partial dentitions and of dentitions extensively and irreversibly damaged by periodontal disease are likely to become of considerable significance. As more teeth are retained, more root surfaces will become exposed due to gingival recession and therefore vulnerable to attack by root surface caries. Other problems which are a feature of the elderly, such as altered salivary function and a reduced capacity to perform adequate oral hygiene, are likely to increase the incidence of root caries in the elderly population further. It has been widely predicted that root surface caries will become an increasing dental problem in the future (Heinrich, R. et al., 1990; Katz, R.V. et al., 1982; Kitamura, M. et al., 1986; Ripa, L.W. & Leske, G.S., 1986), although the significance of such a change has been questioned (Sheiham, A., 1990).

The strategies employed to treat these problems may be complex and expensive, so concepts of priority are likely to become increasingly important, particularly where finances are in any way restricted. Alternative treatment ideologies, such as the "shortened dental arch" (Käyser, A.D. & Witter, D.J., 1985) may provide useful solutions. The patient's own subjective assessment of what constitutes a good or comfortable dentition may differ from that of the professional treating them. However, where resources are limited and life expectancy is short, patient satisfaction may be a more important goal than a clinical result which is technically "ideal".

The edentulous are generally not an expensive group to treat in terms of frequency and duration of maintenance. In the 1988 Adult Dental Health Survey 65% of the edentulous reported last attending the dentist more than 5 years previously, and the figure was higher for the very old. However, when the dentate were asked the same question, overall only 10% reported that it was over 5 years since their last visit (although the figure was 25% for the over 65s). The proportion of dentate older adults (>55 years) in England and Wales who attend for regular checkups has also increased, from 27% in 1968 to 45% in 1988, and was as high as 55% in the 45-54 year old age group (Todd, J.E. & Lader, D., 1991). It would appear that not only will the numbers of elderly people with teeth increase, but the tendency for older people to demand regular treatment also seems set to increase as the middle aged cohorts of today get older. One may expect an increasing proportion of dentists' time to be devoted to the treatment of the elderly, with a corresponding increase in the cost for this sector of the population. The attitudes of older people to dental health and the effect that this has on demand for dental care will be an important factor when planning resources to deal with the projected increase in need for dental care in this age group.

The complex combination of demographic and dental changes which have been described will not be uniform throughout the United Kingdom; geographical and social factors are also important influences. Geographic differences in dental health exist within the UK, well illustrated by higher levels of edentulousness and dental disease in Scotland and the North of England compared to the South of England. Such regional effects were first demonstrated in this country by Bulman (Bulman, J.S. et al., 1968) in a study entitled *Demand and Need for Dental Care* which compared the dental health of adults in two communities "typical" of their area, Darlington in the north of England and Salisbury in the south. *Demand and Need for Dental Care* was distinguished from previous oral health surveys by its inclusion of sociological and socio-dental aspects of oral health and the impact of geography on these, in addition to clinical dental data. This study was described as "in all ways a pilot" by the authors, and many of the methods used were later applied to the first and subsequent British national surveys of adult dental health (Gray, P.G. et al., 1970; Todd, J.E. & Lader, D., 1991; Todd, J.E. et al., 1982).

The sample of Darlington and Salisbury adults studied by Bulman was drawn from all adults of 21 years or over and broadly reflected the age, sex and social make up of the areas covered (Bulman, J.S. et al., 1968). The survey results demonstrated marked differences in dental, sociological and socio-dental variables between the two areas, along geographical lines, and within the respective populations, according to social status. In some cases the geographical differences could be largely or totally attributed to variation in the social structure between the two areas, but for some of the variables measured geographical location itself seemed to be an influencial factor. Comparisons of this sort provide a powerful way of exposing such regional differences. Variations in the dental status and uptake of dental care may also exist between urban and rural communities, for example as a result of different attitudes or problems with access to care.

In addition to technical, practical and financial problems, there will be certain logistic difficulties in the provision of dental care of the dentate elderly. Treatment will be required for an increasing number of people who, for reasons of disability or reduced mobility, find it difficult to attend the surgery, whilst more people with complex medical histories are also likely to require the attentions of a dentist. The 1987 Disability Survey (Martin, J. et al., 1988) found 18% of 65 - 74 year olds were either housebound or could not leave home without assistance, in the 75 years and over group this figure increased to 40%. If these levels of disability are maintained into the next century there will be a problem not only with increase in dental care required, but also with the delivery of that care.

The minimum dental requirements, in terms of the number and distribution of teeth, which allow satisfactory function are unknown. Käyser has introduced the concept of the shortened dental arch which may be an appropriate treatment planning philosophy for the elderly (Käyser, A., 1981). However, true shortened dental arches are uncommon so the importance of the different components of the shortened dental arch philosophy should be established (e.g., number and distribution of teeth, the absence of partial dentures.). Some understanding of the relationship between dental state and satisfaction would allow realistic clinical targets to be identified for older people. Furthermore, some of the most commonly used clinical indices of dental health may be inappropriate in an elderly population.

This study revisits Darlington and Salisbury 30 years after Bulman. A third area, the rural district of Richmondshire in North Yorkshire, has been included to provide a rural contrast to Darlington in the north of England. This time, however, the research is concentrating on the *elderly* population. Although the term *elderly* means different things to different people, this study concentrated on adults over 60 years of age. There is no agreed point at which somebody starts becoming elderly, and few 60 year olds would regard themselves as elderly, nevertheless the inclusion of all adults over the age of 60 years does allow some indication of important trends which will affect older adults in the medium and long term.

The objectives of this study are therefore:

1. To collect information about the oral health of subjects over the age of 60 years living in three areas of England, and to review the effect of social and geographic factors on oral health.
2. To collect data on the attitudes, demands and barriers to dental care among older adults, and to review the effect of social and geographic factors on these.
3. To investigate the relationship between the presence, number and distribution of teeth and partial dentures, and levels of function and satisfaction.
4. To identify goals for oral health in the elderly and to identify the factors, clinical and sociological, which may need to be addressed in order to achieve these goals.

REVIEW OF THE LITERATURE

Section 2.

REVIEW OF THE LITERATURE

The review of the literature is divided into four major sub-sections. Section 2.1 covers data on different aspects of dental health in the population of the United Kingdom. It reports the prevalence and extent of edentulousness, caries, root surface caries, periodontal disease, tooth wear, dentures and disease of the soft tissues, as well as describing the social and geographic factors which affect these. This is followed by a synopsis of the dental health of the elderly put in an international context. Section 2.2. describes the attitudes and demands of the UK public in terms of dental care, as well as access and barriers to care. Section 2.3. addresses the specific problem of the partial dentition and the effect of tooth loss on function and satisfaction, as well as the role of prosthetic replacement in the restoration of function. Finally, in section 2.4. the existing indices for the measurement of oral health are described and their advantages and disadvantages in terms of an older population are discussed. In this review the terms *elderly*, *older adults* and *older populatio*n generally refers to those over the age of 65 years, as this is usually the way in which data are presented, although in some cases the over 55 year olds and over 75 year olds may be referred to separately.

2.1. THE DENTAL HEALTH OF OLDER ADULTS AND ITS RELATIONSHIP TO GEOGRAPHY AND SOCIAL FACTORS.

2.1.1. The relationship of oral health with geography and social factors - an historical perspective

The dental data published by Bulman (Bulman, J.S. et al., 1968) revealed higher levels of edentulousness and untreated decay (particularly among manual workers), and fewer standing and restored teeth in Darlington, even when comparing equivalent social groups. This may have been a reflection of the more favourable patient to dentist ratio in Salisbury, as the authors suggested, or, at least in part, of cultural and behavioural differences between the two populations. However, while dental health was generally better in the Salisbury population, the professionally assessed quality of complete dentures was deemed to be much higher in Darlington. Geographical differences were not restricted to clinical dental data, but also to sociological and socio-dental findings. Although attendance patterns for social classes I and II were similar for the two areas, Salisbury had considerably more regular attenders in social classes III, IV and V. Perhaps the most striking geographical difference found was in the expectation of and attitude to complete denture wearing. A far higher proportion of dentate subjects in Salisbury, in all social classes, expected that they would need complete dentures at some time in the future (55% to 31%), while a higher proportion of the dentate subjects in Darlington (54% to 23%) hoped not to need them. In the context of the generally better dental health in Salisbury, this is perhaps a surprising finding.

It would be incorrect to try to extrapolate these results to give a national picture, indeed the authors emphasised that their findings were only applicable to the two areas investigated. However, it would seem reasonable to investigate the possibility of extending the results, in a limited way, to apply some of the findings at a regional level at least, and to investigate how representative the chosen areas were. Direct comparison of much of the data with the national survey, conducted 6 years after the work of Bulman, is difficult due to different presentation of the statistics. Levels of edentulousness for Darlington and Salisbury can be compared though, and although they were a great deal higher than the national average in both areas, they were broadly in line with their regional levels from the national survey (see tables 2.1.1. and 2.1.2). In the case of all manual workers in Salisbury and Darlington, the 1962 study gave levels of edentulousness between 1% and 10% higher than the respective regional findings in the 1968 national survey. Given the reductions in levels of edentulousness over the following 20 years (Todd, J.E. & Lader, D., 1991), this difference may have been as much a reflection in actual changes in the 6 year period between the two surveys, as it was of Salisbury and Darlington being poorly representative of the national picture (as was suggested in the report of the 1968 national survey). Many of the geographical trends demonstrated by Bulman were reflected in the subsequent national surveys.

Table 2.1.1. Percentage edentulous by social class in Salisbury in 1962 and equivalent areas in Adult Dental Health Surveys 1968 - 88.
* Salisbury was included in the south-west area in 1968, but due to changes in area boundaries was included under "south" in 1978 and 1988.

	Salisbury 1962	South-West 1968	South 1978	South 1988
Non-manual	31	36	17	11
III manual	46	41	19	17
IV/V	57	50	36	28
All	42	43	23	16

Table 2.1.2. Percentage edentulous by social class in Darlington in 1962 and the North of England in Adult Dental Health Surveys 1968-88.

	Darlington 1962	North 1968	North 1978	North 1988
Non-manual	36	30	24	17
III manual	53	43	35	32
IV/V	62	57	38	38
All	51	46	34	27

In *Demand and Need for Dental Care* the geographical differences in dental health between the two areas were far less evident than the enormous impact of social factors within the two populations. In general, a person's social class (according to the occupation of the head of the household) was found to be a much more potent determinant of their dental health and attitudes to dental health, than whether they lived in Salisbury or Darlington. In general, non-manual and skilled manual workers were more likely to be dentate, had more teeth, more restorations, less decay and visited the dentist more regularly than semi- or unskilled manual workers. The existence of these differences has subsequently been borne out by the findings of national and regional surveys both in the U.K. and abroad. *"Demand and need for dental care"* played a pioneering role in dental epidemiology, but reflected the dental priorities of the period. It was published when dental caries rates were high in children and young adults, and when being elderly usually meant being edentulous. To quote directly from the publication "hardly anyone over the age of 65 can be expected to have more than a few of their own teeth", a statement which, in the final decade of the twentieth century in the United Kingdom, is no longer the case. With rates of edentulousness for the very old (75 years and older) forecast to drop below 50% within the next 20 years, and rates of dental disease in the younger age groups falling, the oral health of the elderly will be an important priority in the future.

The following sections describe the pattern of dental disease in the UK population (where data is available) or similar populations (if data is limited) using a variety of measures.

2.1.2. Edentulousness or total tooth loss

The dictionary definition for edentulous is "toothless" (Little, W. et al., 1980) and for the purpose of this discussion "edentulousness" means the complete absence of any standing teeth. It does not pre-suppose the presence of complete dentures or the need for such. Some completely edentulous people never wear dentures, while others, for example those with overdentures, may wear complete dentures but may not be, strictly speaking, edentulous.

In the assessment of the dental status, needs or demands of almost any adult population, the separation into edentulous and dentate is an important initial classification. The dental needs of edentulous people are usually very different from those of the dentate. Data on the proportion of a population which is edentulous is a rather crude measure of oral health, but is very easy to record and free from worries about diagnostic criteria or inter-examiner variability. Consequently, data on levels of edentulousness are fairly widely available and are one of the few reliable indications of the current oral health status of older adults which is available for many countries.

Data on total tooth loss must be interpreted with caution as they do not reflect accurately current levels of dental disease in a population. Many factors may contribute to this simple statistic, for example past disease levels, cultural attitudes, patients' expectations, professional treatment philosophies, economics and government health policy. Changes in these may take many years before their effects become apparent in the edentulous statistic, particularly when considering older adults. It is therefore appropriate to look at all age groups in order to identify trends and anticipate future changes.

Edentulousness and its relationship to age, gender geography and social factors.

The 1988 Adult Dental Health Survey (Todd, J.E. & Lader, D., 1991), as the third decennial assessment of adult dental health in England and Wales (and the second covering all of the U.K.), was able to detect changes in the prevalence of edentulousness over a 20 year period. This section refers only to data from this and previous national surveys. The overall proportion of the adult population who were edentulous in England and Wales has dropped from 37% in 1968, to 20% in the most recent survey. A national reduction of 17 percentage points is impressive, but treating the figures in such a simplistic way conceals important differences according to age, gender, geography, social factors and combinations of these.

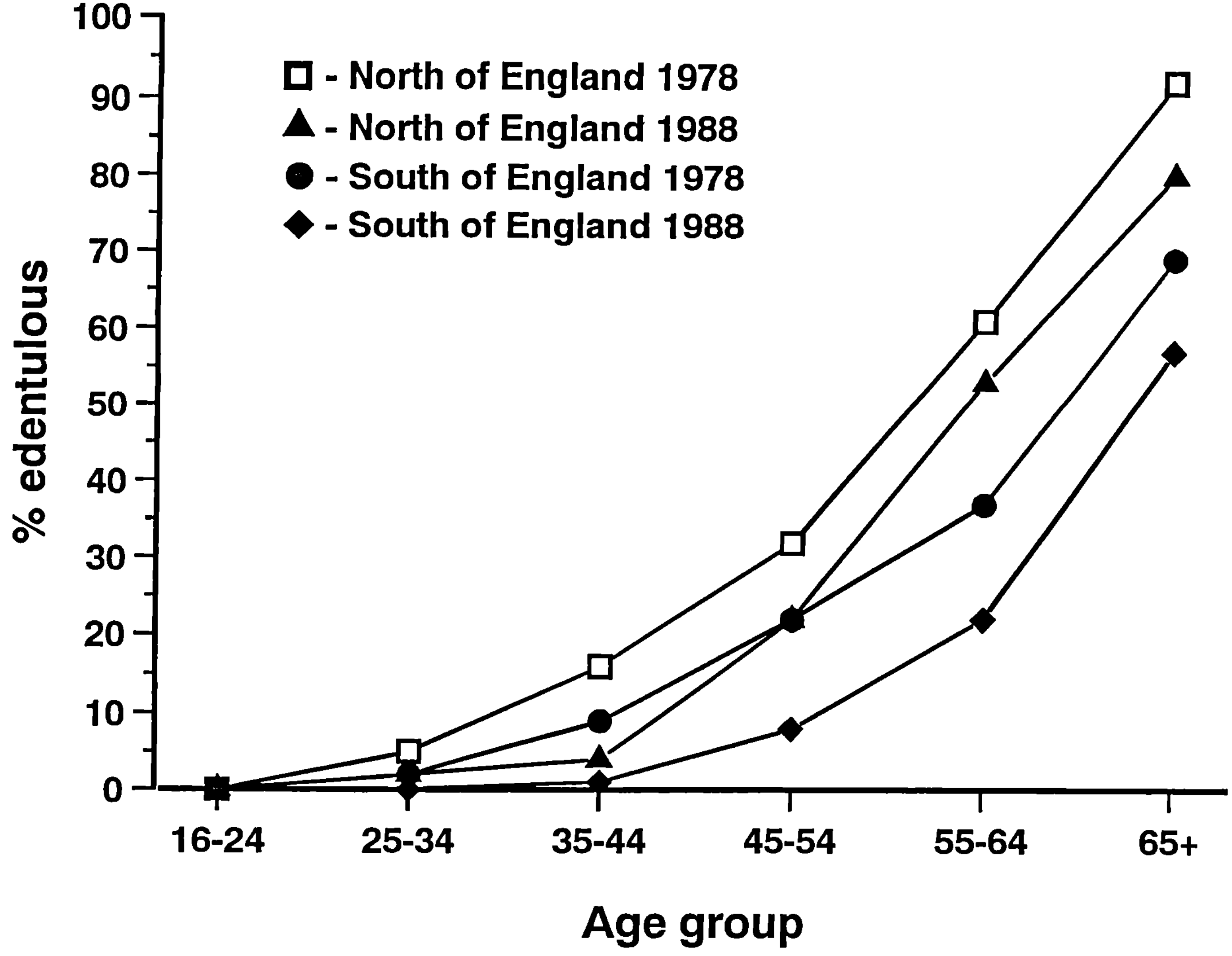
The reductions in levels of edentulousness have affected all age groups. In general these have been most marked in the middle aged and younger elderly (45-74 years) who have shown decreases of between 23 and 28 percentage points over this period. In the under 35s the proportion edentulous was low to start with (in 1968), but the figure has now dropped to almost zero. The least impressive change is among the very old, among whom the last 20 years have only seen an overall reduction of 8 percentage points. However this is better than it looks: if the **incidence** of edentulousness is calculated by following the middle aged groups of 1968 (the three age bands from 35 to 64) through to 1988 (the three age bands over 55 years), it is similar for all three groups. As the younger cohorts work through over the next 20 years or so similar reductions in prevalence may become apparent in the very old as well. This was an interesting finding in the 1988 survey as it became clear that the high levels of total tooth loss seen in the older age groups in the past was not inevitably going to continue. The differences in prevalence that are apparent between the age bands are undoubtedly multifactorial but are probably less to do with a falling incidence in either of the *major* dental diseases than they are to do with changing social attitudes towards dental health combined with (and perhaps related to) the benefits of a lifetime of National Health Service dentistry. The 55 to 64 year olds of 1988 were the 15 to 24 year olds of 1948 and have therefore experienced almost a full life of free or subsidised dentistry. The prevalence of edentulousness in this group was 28 percentage points lower than that of their predecessors at the same age 20 years previously (the 55-64 year olds of 1968), who were already aged 35-44 at the inception of the NHS in 1948.

Table 2.1.3: Percentage edentulous in England and Wales in 1968 and 1988 for three age cohorts, and their ages in 1948.

Age in 1948	Age in 1968	% edentulous '68	Age in 1988	%edentulous '88
Unborn - 4years	16 - 24	1%	35 - 44	3%
15 - 24	35 - 44	22%	55 - 64	36%
35 - 44	55 - 64	64%	75+	80%+

When the effect of geography is considered, the prevalence of edentulousness among over 65 year olds in the north of England was 80% in 1988 compared with 57% for the south of England, although both had reduced by 11-12% from the 1978 figure. This geographical difference was evident across all social classes, and reflects the findings of Bulman et al (Bulman, J.S. et al., 1968) 26 years earlier. Table 2.1.4 shows the **incidence** of edentulousness for each of the 10 year age bands comparing the north of England with the south of England between the 1978 and 1988 surveys. Incidence is calculated by comparing the percentage edentulous for the same population groups 10 years apart, thus the 45-54 year olds of 1978 are the 55-64 year olds of 1988, and in the south there were 22% of them edentulous in 1978 and in 1988 there were still 22% edentulous, so the incidence of new cases of edentulousness was zero for this population group. Figure 2.1.1. plots the percentage of adults recorded as edentulous against age in the north and the south of England in 1978 and 1988. These demonstrate two major findings. Firstly, that the incidence of total tooth loss has reduced to almost nil among young and middle aged people in the south of England. Only in the over 65 year olds of 1988 has there been any suggestion of continuing **incidence** of edentulousness. In the north there have been dramatic reductions in the **prevalence** of total tooth loss, but in all age groups over 45 years (in 1988) there is also a significant continuing **incidence** of total tooth loss. Secondly, there is about a 10 year lag between the north and the south of England among middle aged adults. The **prevalence** of edentulousness in the 45 to 54 year old age group in the north in 1988 was the same as the equivalent age group in the south 10 years earlier. The gulf is greatest among the elderly, and is much less among the young.

Figure 2.1.1. Changes in edentulousness 1978 - 1988



It can be concluded that, whilst the north of England is "improving", it is some way behind the south. Furthermore, if there continues to be significant incidence of total tooth loss in the middle aged groups of the north (as there has been in the last 10 years) it may be a very long time before the middle aged and elderly of the north catch up with their southern equivalents.

Table 2.1.4 Prevalence of edentulousness in 1968 and 1988 in the North and South of England, and incidence of edentulousness over the same period.
* figures cannot be calculated due to lack of data.

	NORTH			SOUTH		
Age	1978	1988	Incidence	1978	1988	Incidence
16 - 24	0%	0%	0%	0%	0%	0%
25 - 34	5%	2%	2%	2%	0%	0%
35 - 44	16%	4%	0%	9%	1%	0%
45 - 54	32%	22%	6%	22%	8%	0%
55 - 64	63%	53%	21%	37%	22%	0%
65+	92%	80%	*	68%	57%	*

The relationship between social class (according to occupation) and edentulousness, demonstrated by Bulman (Bulman, J.S. et al., 1968) and by subsequent national surveys in Britain and other countries (NIH, 1987; Todd, J.E. & Lader, D., 1991) remains important. The national statistics for the UK in 1988 show over 65 year olds from non manual backgrounds (56%) have a prevalence of edentulous 24 percentage points lower than those from unskilled manual backgrounds (80%). When considering all age groups the difference is 18% nationally (14% to 32%). Both groups have experienced equally the reduction in levels of edentulousness with a drop of 6% in the proportions edentulous since 1978. But here again the national statistics conceal the differences in the relationships between social class and edentulousness in different areas of the country, particularly if one looks at the changes over the last ten years.

All areas and social groups have shown a reduction in the prevalence of edentulousness in the 10 years to 1988. This ranged from 2% to 10% and was generally similar in the North and the South of England. However, one sub-group stands out as the exception; over the same period there was no reduction at all in the prevalence of edentulousness in people from unskilled manual backgrounds in the north of England. In other words, while there have been national falls in the prevalence of edentulousness which seem impressive and have been noted in almost all areas and all social classes, there remains one large section of the population (the families of unskilled manual workers in the north of England) who have apparently not experienced these changes and who are being left behind the rest of the country according to this most simple measure of oral health (see table 2.1.5.).

Table 2.1.5.. Percentage point reduction in edentulousness for different social class groups in the three English regions between 1978 and 1988 (Todd and Lader 1991).

	North of England	Midlands	South of England
Non-manual	7%	6%	6%
III manual	3%	2%	5%
IV/V (unskilled)	0%	8%	10%

In all areas fewer males are edentulous than females; the overall national difference is 9% between the sexes. The reductions in prevalence over the past 20 years have been experienced more or less equally by men and women, but with the exception, once again, of the north of England where the gulf between the sexes seems to have widened. The total prevalence has fallen markedly among both sexes in the north over the last 10 years, but by only 5% for women (2% below the national average for women) compared with 9% for men. Women in the north of England have taken over from Scottish women as the group (according to geography and gender) with the highest percentage without any teeth (33%), 8% above the national average for females.

The state of complete dentures in the edentulous elderly

There is likely to be a large discrepancy between the large normative need, reported by most research in this field, and the perceived need of those who are wearing dentures. Clinical experience seems to show that the two are often poorly matched. Studies on older populations have consistently shown a high normative need among older adults as a result of denture faults found on examination by a dentist (Floystrand, F. et al., 1982; MacEntee, M.I. & Scully, C., 1988; Merelie, D.L. & Heyman, B., 1992; Srisilapan, P. et al., 1985), and some studies have reported as few as a tenth to a third of dentures as satisfactory (Manderson, R.D. & Ettinger, R.L., 1975; Martinello, B.P., 1976; Smith, J.M. & Sheiham, A., 1980b). However, although the proportion of denture wearers who are disabled or handicapped as a result of problems with their dentures is high (although the handicap is usually minor), the proportion of those who seek professional help, the demand, is low (MacEntee, M.I. et al., 1988; Smith, J.M., 1979). The difference is particularly apparent in institutionalised compared to non-institutionalised populations (Hoad-Reddick, G. et al., 1987). Furthermore, the relationship between complaints about dentures, satisfaction with dentures and professionally assessed denture quality is not always straightforward. Although Heyinck and Schaub (1986) found significant correlations between these factors in a small group of selected denture wearers, the correlations were fairly weak, and the subjects used may not have been representative of older people generally. In an elderly population the primary objective would seem to be to address the wearers' satisfaction and problems; normative need may be of limited relevance.

The 1988 Adult Dental Health Survey (Todd, J.E. & Lader, D., 1991) did not include a clinical examination of complete dentures, but the subjects were asked about denture problems and levels of satisfaction in the questionnaire. Ninety nine percent of the edentulous reported having complete dentures constructed, but 3% reported not wearing an upper denture and 6% not wearing a lower denture in the previous four weeks. It is likely that in most of these cases the denture was rarely or never worn. Among the denture wearers, reports of problems were commonplace, 10% complaining about aesthetics, 7% about speech problems and 21% reported discomfort on eating. In all 41% had a complaint of some description, although only 11% had any plans to have something done about it. There were markedly fewer people with problems in the 75+ age group (29%) and fewer of them were dissatisfied with their dentures (6% compared to an overall population mean of 10%).

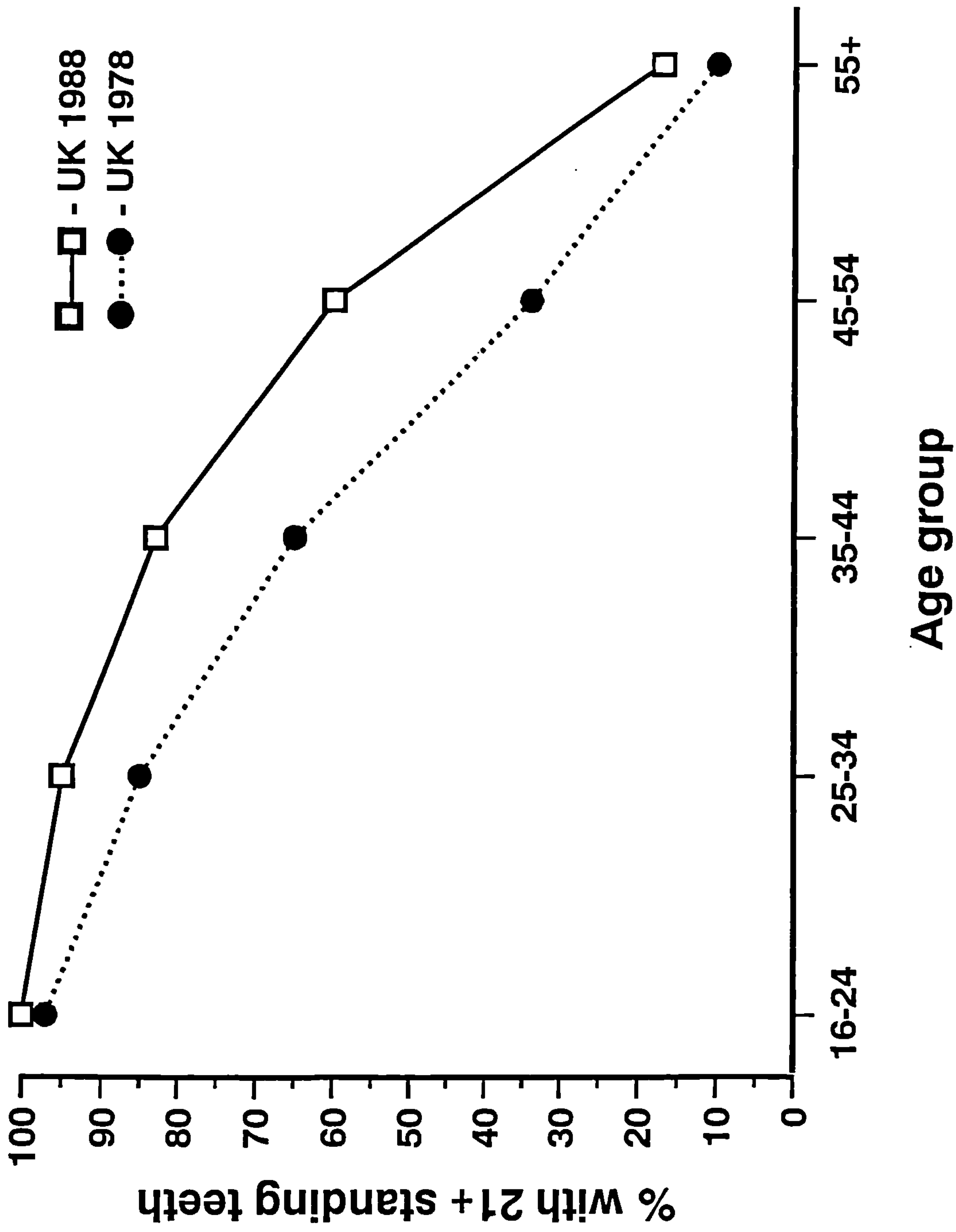
Fewer females reported problems than males, but different social groups showed no consistent patterns. In general though, dentures made under the National Health Service were associated with more problems than private dentures. One important finding was that those who had been edentulous for longest tended to report the fewest problems.

The implications of this relationship between denture problems and wearing experience are important in the context of an increasing proportion of the population retaining natural teeth into old age. This trend has been seen by many to be desirable, but if all that is happening is the delaying of the need for complete dentures into old age, the preservation of a natural dentition may be counter productive. Research into the age related changes of the oral musculature suggest that the muscle bulk and precision of muscle contraction, and hence perhaps the ability to control dentures and to adapt may diminish with age (Newton, J.P. et al., 1987; Yemm, R. et al., 1985). Whilst the current oldest group (the 75+ group in 1988) report fewer problems than their younger counterparts, this may be a reflection of the denture wearing experience of this group. The next generation may be less fortunate. If late onset tooth loss becomes a significant problem the potential for increased morbidity and reduced quality of life will increase in parallel.

2.1.3. The number of standing teeth and the replacement of missing teeth in the UK adult population and the relationship with age, gender, geography and social factors.

Section 2.1.2. showed that age, geography, social class, and to a lesser extent gender are important influences on the prevalence of edentulousness in the UK population. These may also influence the proportion of the population with a "functional" dentition. For the purposes of analysis the figure used to represent a "functional dentition" in the 1978 and 1988 adult dental health surveys was 21 or more standing teeth. This cut off point is rather arbitrary but, if the number of teeth alone is to be used as the means of analysis, 21 teeth is probably reasonable (see section 2.3). As in the last section all data presented here are derived from the 1988 Adult Dental Health Survey (Todd, J.E. & Lader, D., 1991) and previous British national surveys conducted in 1968 and 1978 (Gray, P.G. et al., 1970; Todd, J.E. et al., 1982).

Figure 2.1.2. Changes in 21 standing teeth 1978 - 1988



The influence of age is important. In 1988 the proportion of UK adults with 21 or more standing teeth drops from 100% in the youngest adults (16-24) down to 3% of all those in the 75+ age group. The change is most rapid in those aged 45 years or over. When looked at in isolation it would seem that the period of life when most people are likely to become reliant on some sort of prosthetic replacement is in late middle and old age. However, with the benefit of figures from the previous (1978) survey (Todd, J.E. et al., 1982) it has been possible to examine the trends in each individual cohort. This shows that the rate of loss of subjects from the 21+ standing teeth group in any of the ten year age bands who were 25-64 in 1988 had been between 2% and 5% over the previous ten years (see figure 2.1.2.). As is the case for edentulousness, the apparent effect of age is not only a reflection of progressive loss of teeth with increasing age, but is in large part historical, and the number of people who are currently losing teeth to take them below the 21 tooth threshold is small. It is possible to attempt to predict the changes over the next 30 years or so by extrapolating recent trends. For the 55-64 year old age group this would be predicted to result in 84% of adults having 21 or more teeth in 2018, compared to the 1988 statistic of 30%. For the older age groups (65+) there will probably be similar increases, but projections for the over 65 year olds based on figures for the younger groups may be unsafe in view of additional dental considerations of relevance to older adults (e.g. an increased risk of root caries, perhaps changed treatment preferences or a reduced ability to pay for restorative dental work).

When the number of missing teeth is used as a measure, similar age related trends are illustrated. The oldest cohorts are losing teeth more rapidly than those in the younger groups. Those between 55 and 64 years in 1988 had lost on average 2.9 teeth in the last 20 years, compared with figures of 2.0 and 1.4 for the 45-54 and 35-44 age groups respectively. While tooth loss may be more frequent in older adults, the changes described above are not just age related. There is strong evidence that the tooth loss experienced by any age cohort between 1978 and 1988 was considerably less than that experienced by people of the same age 10 years previously.

The effect of gender on the proportion of the population with 21+ standing teeth is negligible, but geography, social class and dental attendance pattern are more important. Concentrating solely on the current generation of older adults (55+) the North of England was well behind the South in 1988, with 42% of dentate adults having 21+ standing teeth compared to 51% in the south. Looking at the younger age groups there are signs of this difference being diminished. Social class according to occupation of the head of the household demonstrates a surprisingly minor influence among older dentate adults. There are no real differences between the proportions of those from non-manual backgrounds and those from unskilled manual backgrounds who have 21 or more standing teeth, nor are there any large differences in the mean number of missing teeth. In the current generation of older adults, social class seems to be related to the prevalence of edentulousness, but not to the number of teeth that are present.

Dental attendance patterns are closely correlated with the proportion of adults with 21 or more standing teeth, and this is true for all age groups, including the elderly. Even in the 75+ age group 18% more regular attenders have 21 or more standing teeth compared with those who attend only with trouble. It is interesting though that 11% of the dentate adults aged over 75 years have managed to keep more than 21 standing teeth for most, if not all of their life without regular dental visits.

The figure of 21 standing teeth is a rather arbitrary one and its relevance in terms of dental function will be discussed in section 2.3., but for the UK population it does seem to be an important watershed for the reliance on a combination of natural teeth and dentures. Only 5% of those with 21 or more standing teeth in 1988 wore a partial denture. Of those dentate adults with less than 21 standing teeth, 78% wore some sort of a denture, and while the prostheses concerned may in some cases have been a single complete denture (e.g. a complete upper denture opposing natural lower teeth), a high proportion will have been partial dentures.

2.1.4. The state of the crowns of the teeth in older adults

Decay of the crown of the tooth is a common disease. In 1988 the UK Adult Dental Health Survey showed that only 8% of the adult population had no fillings, and it is almost certain that at least some of those without fillings had some carious teeth or teeth lost because of caries. Primary caries affecting the crown of a tooth for the first time appears to be less common in older adults than in children and young adults, but this may be because in the current generation of middle aged and elderly people the most vulnerable sites have been restored early in life. Such restorations may have to be replaced many times during a lifetime. With every replacement comes further destruction of sound tooth tissue and with it the possible threat to pulp vitality, tooth strength and possibly aesthetics. Consequently, while new coronal caries may not be a major problem in the elderly, the potential for restorative treatment among older adults with a past history of caries is large as teeth and restorations crumble and need to be restored. Once again, all of the data in this section are derived from the 1988 Adult Dental Health Survey (Todd, J.E. & Lader, D., 1991).

<u>Teeth with sound and unfilled coronal surfaces in older adults in the UK in 1988</u>

The number of sound teeth unaffected by dental caries gives some impression of the impact of dental caries in a population. In 1988 the mean number of sound teeth in the 55+ age band was 9.4, compared with 21.2 for the 16 - 24 year old age groups. With improving oral health, this statistic is of limited value as it tells us little of the trends taking place in dental health. The number of sound untreated teeth **in any given age band** has actually increased between 1978 and 1988 (i.e. fewer are being filled or extracted in each successive age group), so the 45-54 year olds of 1988 had more sound teeth than the 45-54 year olds of 1978. However, if one follows through the young and middle aged groups of 1978 to 1988 (for example comparing the 45-54 year olds of 1988 with the 35-44 year olds of 1978), the *loss* of sound teeth for any given age group was between 0.6 and 0.9 teeth per person over the ten years. There has been a sharp increase in the proportion of the total population with 18 or more sound teeth between 1978 and 1988 from 25% to 35%. This increase is only occurring in the young and to a lesser extent, middle aged group: the over 55's showed no change in this statistic at all (fixed at around 8%), although the mean number of sound teeth increased slightly.

Overall, males (38%) are more likely than females (32%) to have retained 18 or more sound and untreated teeth, and men have on average about one more sound tooth than women. These differences are not applicable to the 65+ age band where the women are slightly better off than the men.

The relationship between the number of sound and untreated teeth and social class is interesting. The pattern of dental health (as measured by edentulousness or the number of teeth), which generally shows more teeth in the non-manual groups than in the unskilled manual groups, is reversed. Dentate people from unskilled manual backgrounds have, on average, more sound teeth than those from non-manual backgrounds and 8% more of the population from unskilled manual backgrounds have 18+ sound teeth. These differences are particularly evident for the 65+ age group where 13% of unskilled manual workers had 18+ sound, untreated teeth compared to just 1% of their non-manual counterparts. The reasons for such variation are no doubt complex, but may in large part reflect attendance and treatment patterns in these two groups. The figures for the number of sound teeth according to dental attendance pattern give some support to this, with 38% of irregular attenders having 18+ sound teeth compared with only 29% of regular attenders.

Geographical variations in pattern also occur; Scotland and Northern Ireland stand out as areas where the mean number of sound teeth and the proportion of the population with over 18 standing teeth is much lower than the national average (see table 2.1.6.). The north and the south of England also demonstrate unexpected differences. The 65+ year old age groups are different from the population as a whole, and no-one in the 65+ age category in the north of England had 18+ sound teeth. The statistics for these sub-groups must be treated with caution as the total number of cases involved are rather small.

Table 2.1.6.. Geographical variations in the number of sound and untreated teeth in U.K. adults in 1988 (Todd and Lader 1991).

	UK	Scotland	N.Ireland	N.England	S.England
% with 18+ sound teeth	35	26	25	41	33
% (65+) with 18+ sound teeth	5	0	7	0	6
Mean no. standing teeth	14.8	13.0	12.6	15.3	14.5
Mean no. standing teeth (65+)	8.2	8.0	7.5	6.9	8.4

Teeth with filled but otherwise sound coronal surfaces among older UK adults in 1988.

The number of filled teeth is not without problems as a measure of caries experience. The *filled* statistic is a reflection of dental attendance, treatment patterns and of cultural attitudes (both patients' and dentists') as well as of caries experience and differences in diagnosis of the disease.

The 1988 adult dental health survey shows that 31% of all adults had 12 or more filled teeth and the mean number of filled teeth for the population was 8.4 teeth per person. The pattern with age shows a broad peak in the 25-54 age bands with a sharp drop off in the under 25's and the over 55's. Figure 2.1.3. shows that this peak, with the current middle aged groups, is getting gradually larger. At present the older adults have a rather low proportion of the total number of filled teeth. However, if the trends towards a gradual accumulation of filled teeth, currently affecting the 25-54 year olds, continue for the next 20 or 30 years we are likely to see a large increase in the number of filled teeth in older adults. In the younger group there is a dramatic reduction in the number of filled teeth in those born in 1965 or after and this presumably reflects a genuine reduction in (or perhaps a delay in manifestation of) dental caries. The plateau shown in figure 2.1.3. will not reduce until the heavily filled middle-aged generation of today die off and are replaced by the relatively dentally healthy population, currently under 30 years.

The quoted statistics seriously underestimate the scale of the change because they are calculated as a proportion of the **dentate** sample, but the proportion of those who have some standing teeth is rapidly increasing among the middle aged and is starting to increase in the elderly. Figure 2.1.4. calculates the mean number of filled teeth per 100 of the **total** sample, taking into account the differences in the size of the dentate population at any age (mean number of filled teeth x percentage dentate) to give a more meaningful indication of the impact which these trends are likely to have on the provision of dental care to the elderly. At present there are over three times as many filled teeth in the 35-44 age band as there are in the over 55's. If current trends continue in the way they did between 1978 and 1988, which is likely but by no means certain, the increase could be four-fold by the time the current middle aged become elderly. Restorations generally have a limited life expectancy, so the future need and demand in the older age groups, just for maintenance of existing restorations, has the potential for a substantial increase. Of course

Figure 2.1.3. Mean number of filled teeth by age

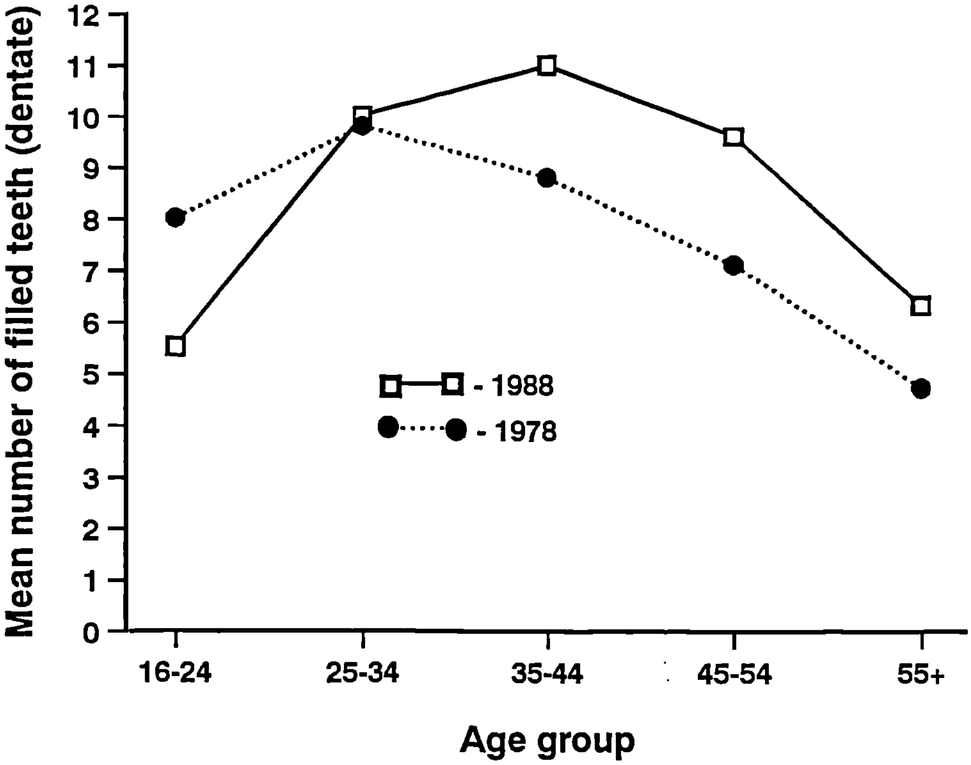
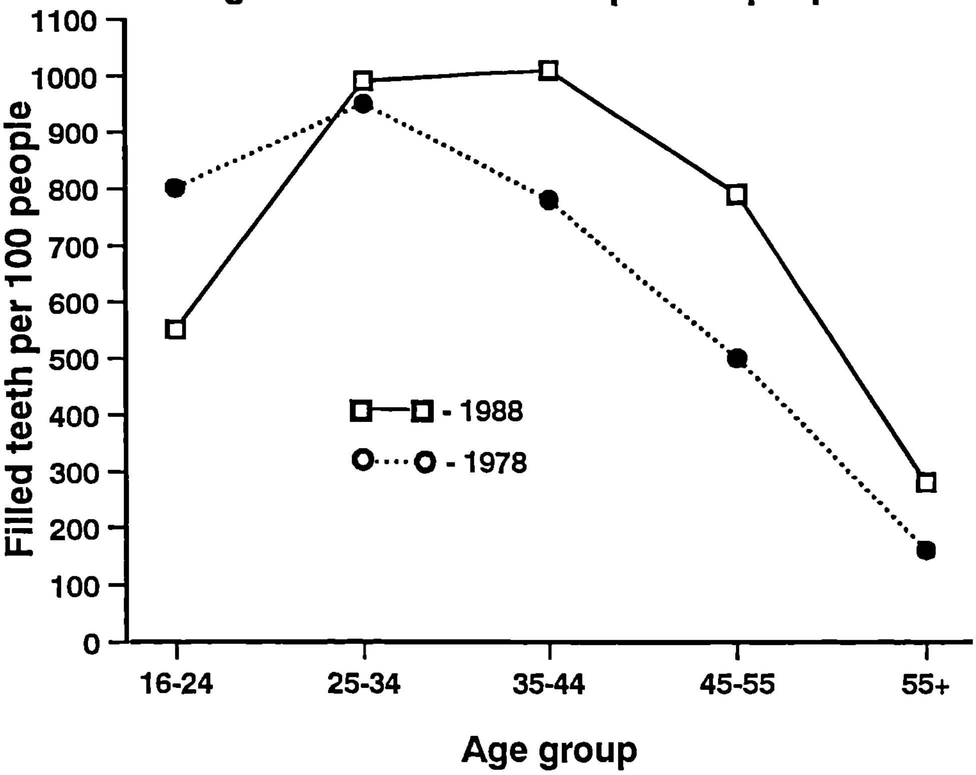


Figure 2.1.4. Filled teeth per 100 people



this calculation does not take into account demographic trends towards an ageing population, nor the additional dental problems arising from the age of the dentition or complicating medical or dental influences, all of which will tend to increase the treatment need further.

In addition to age related and *cohort* differences, the number of filled teeth also demonstrate gender, social and geographic variations. In the population as a whole, women are more likely to have more than 12 filled teeth than men (34% to 28%) and women have on average one more filled tooth than men. Unskilled manual workers have, on average, three fewer filled teeth than non-manual workers. As with the number of sound teeth, this is probably in part related to dental attendance pattern; regular attenders have nearly twice as many filled teeth as irregular attenders. Geographical variations are again evident, with the lowest number of filled teeth in Wales, the Midlands and the North of England, and highest numbers in the South of England. This is likely to be a reflection of a combination of socio-dental, cultural and local treatment factors rather than an actual difference in caries experience. All of these trends are evident in all age groups, including older adults (see table 2.1.7.).

Table 2.1.7.. Mean number of filled teeth and the percentage of teeth which were filled in different gender, geographical, social and attendance groups in UK adults in 1988 (Todd and Lader 1991).

	Males	Females	North of England	South of England	Non-manual	Unskillled Manual	Regular Attender	Irregular Attender
Mn. no. of filled teeth	7.9	8.9	7.8	9.1	9.5	6.5	10.4	5.8
Mean number of teeth	24.4	24.1	24.4	24.5	24.8	23.4	24.9	22.4
% of teeth filled	32%	37%	32%	37%	38%	28%	42%	26%

Teeth with decayed or unsound coronal surfaces in older adults in the U.K. in 1988

Studies of relatively untreated populations show that dental caries is active throughout life, on crowns as well as roots (Manji, F. et al., 1989). In the three Adult Dental Health Surveys conducted from 1968 to 1988 the mean number of decayed or unsound teeth has reduced from 2.2 per dentate person down to 1.0, with this trend present in all age groups (Gray, P.G. et al., 1970; Todd, J.E. & Lader, D., 1991; Todd, J.E. & Walker, A.M., 1980; Todd, J.E. et al., 1982). There is almost no difference in the mean number of decayed or unsound teeth between different age groups. However this does not take into account the reduced number of teeth in older age groups. In table 2.1.8. the mean number of decayed teeth per person has been divided by the mean number of standing teeth per person and then multiplied by 100 to give the percentage of all teeth in the dentate population which are decayed. The proportion of standing teeth which is affected in the over 55's is more than double that for the 16-24 age groups.

Table 2.1.8. Mean number of decayed teeth per person and the proportion of standing teeth which this represents, broken down by age group (derived from data from Todd and Lader, 1991)

	16-24	25-34	35-44	45-54	55+
mean decayed teeth/person	0.8	1.1	1.0	1.1	1.1
percentage of teeth decayed	3.0	4.3	4.4	5.9	6.4

Among the over 65 year olds, slightly more women than men have a dentition free from unsound teeth (55% to 52%), and in the younger age groups this difference is much greater. 60% of non-manual workers had no unsound teeth compared with only 34% for those from unskilled manual backgrounds, with people from skilled manual backgrounds closer to the non-manual workers. Once again this is likely to be, at least in part, a reflection of differences in attendance pattern, regular attenders are more likely to be disease free, and a higher proportion from the non-manual groups are regular attenders. 66% of regular attenders had no unsound teeth as opposed to 41% of those who visit only when they have problems, although in the over 65 age group the difference is smaller. Interestingly, whilst all groups have seen the benefits in the reduction of decay rates since 1968, the reductions of decay in the *non-attenders* (that is those who attend the dentist only when they have trouble) have been much greater.

Among the over 65s, those in the North of England have, on average, more unsound teeth than those in the South (1.7 to 0.9). There is very little difference between the two in the **proportions of the sample** with unsound teeth, suggesting that those in the North who have unsound teeth are likely to have more of them. In the general population the South of England had the highest proportion of the sample (60%) with no unsound teeth, while Northern Ireland had the lowest (40%). The 1988 Adult Dental Health Survey separated out the different categories of "unsound" teeth in the various age bands. The one striking difference between the over 65s and the rest is the much higher proportion of decayed teeth which were coded as "unrestorable", accounting for 15% of all unsound teeth in the 65+ age group, three times the figure for the total population.

2.1.5. Root caries in older adults

Root surface caries is a decay process which begins on root cementum or dentine exposed to the oral environment. Many aspects of its pathology are poorly understood, but it seems that, although the basic processes are similar to those for coronal caries, the location and mineral composition of the tissues involved may lead to differences in chemical behaviour (Mellberg, J.R., 1986) and the vulnerability to microorganisms (Jordan, H.V., 1986).

Inherent in any definition of root surface caries is the availability of vulnerable sites. The exposure of the vulnerable root surface is as a result, one way or the other, of periodontal disease. Root caries is therefore unusual among dental or oral disease in that its development is dependent on another, separate, disease process. Periodontal attachment loss is largely irreversible, and so the tendency is for this to increase with the age of the tooth. Consequently, root surface caries is also likely to be age related. A number of other factors of specific relevance to the elderly, for example altered salivary flow or composition, may also contribute to the problem. It has been suggested (Katz, R.V., 1984) that root surface caries is the commonest type of dental caries in the elderly, and recent work in a population of U.S. men has shown dental caries to be the commonest cause of tooth loss in older age groups (Chauncey, H.H. et al., 1989; Niessen, L.C. & Weyant, R.J., 1989). Therefore root caries is likely to be a significant cause of tooth loss in the older patient.

Root surface caries is microbiological in origin and involves demineralisation of the cementum or dentine by acids produced from fermentable carbohydrate by acidogenic plaque bacteria. Dentine and cementum have a much lower mineral content than enamel, and the decay process is likely to be one of be one of demineralisation, rather than proteolysis although this issue is not resolved (Hoppenbrouwers, P.M.M. et al., 1987). Although root surface caries has a microbiological basis, the organisms responsible are uncertain. Jordan (Jordan, H.V., 1986) considered that, because there is no need to break down a resistant enamel barrier, the range of organisms which are capable of an active role in root surface caries is likely to be wider than for coronal caries. Actinomycosis viscosus, Streptococcus mutans, Lactobacilli and yeasts have all been associated with root caries, but which, if any, plays a causative role is still unknown. Fermentable carbohydrates also appear to play an important part in the development of root surface caries. Animal experiments and human studies have generally shown strong associations between the presence and number of root caries lesions and high sugar diets (Gustafsson, B.E. et al., 1954; Hix, J.O. & O'Leary, T.J., 1976; Jordan, H.V., 1986).

Root caries in U.K. and abroad - relationship with age, gender and social factors

Root surface caries was recorded for the first time in a UK national dental survey in 1988. Although it is not clear what proportion of the population are affected by root surface caries, only 2% of the over 55 year olds had no exposed roots, in other words almost all older adults are vulnerable to root decay. Both of the oldest age groups (55-64 and 65+) had on average 1.9 teeth with decayed or filled root surfaces, compared to less than 1.0 for all age groups under the age of 45. This does not take into account the age related variation in the number of vulnerable teeth, which magnifies the difference (see table 2.1.9.).

Although there are many published reports of epidemiological surveys of root caries, comparison between them is almost impossible due to differences in the populations used (very few report a random adult population), different means of reporting the statistics and variation in diagnostic criteria. This final point can have a profound effect on the results (De Paola et al., 1989). The review which follows attempts to identify consistent trends rather than compare populations.

Almost all epidemiological surveys to date have shown an age related increase in root caries activity, at least through the middle aged population. Root caries appears to be rare in the young, but as more root surfaces are exposed more sites become vulnerable. Banting (Banting, D.W., 1986) observed a relationship with ageing which was more or less linear. This is in contrast to the bimodal age distribution of coronal caries in the primary and permanent dentitions, where there is a peak of new lesions soon after eruption. With an increasing proportion of the population retaining some natural teeth in the future it is likely that the number of root caries lesions will increase markedly. Over sixty percent of the over 65 population of the U.S. in 1985/86 (NIH, 1987) had one or more decayed or filled root surface.

The increase in root caries with age is not solely related to the increased exposure of surfaces. If the root caries index (RCI), which takes into account the number of exposed surfaces, is calculated, there is still an age related increase (Katz, R.V., 1980; Katz, R.V. et al., 1982). This suggests that there are additional factors at work as people age. Table 2.1.9. shows the national root caries data from the 1988 U.K. Adult Dental Health Survey with the gross mean figures and the mean number of lesions divided by the number of vulnerable teeth (Todd, J.E. & Lader, D., 1991). The second statistic corrects for the distorting effect that tooth loss (which is age related) will have on the mean figures. Both show age related increases, but both also show a slowing off of the increase in the oldest age bands. This sort of "plateau" effect was also present in the U.S. national survey, and in a study of a group of over 65 year old people, Beck (Beck, J.D. et al., 1987) found that only a small part of the variance (2%) was due to age, reinforcing the suggestion of a slowing down of activity in old age. He proposed a number of possible reasons for this, including increased mineralisation of older teeth, a reduction in the carious challenge or a reduction of the number of unrestored sites (due to restoration or extraction). Thompson (1990) in a review of the literature proposed that it may just be a cohort effect and as different cohorts age, the pattern will change.

Males have consistently been shown to have more untreated root surface decay than women, and in some studies also a higher RCI, (Beck, J.D. et al., 1987; Fure, S. & Zickert, I., 1990; Heinrich, R. et al., 1990; Katz, R.V., 1980; Locker, D. et al., 1989; Vehkalhati, M.M. & Paunio, I.K., 1988; Wallace, M.C. et al., 1988) and this was the case in both the US in 1985/6 (NIH, 1987) and the UK in 1988 (Todd, J.E. & Lader, D., 1991) national surveys, although the differences were not large. Other authors (Vehkalhati, M.M. & Paunio, I.K., 1988) attributed this to differences in dental health behaviour, such as toothbrushing.

Table 2.1.9. Mean number of decayed and filled root surfaces in U.K. in 1988, with and without taking into account the number of vulnerable teeth.

	16 - 24	25 - 34	35 - 44	45 - 55	55 - 64	65+	All
Exposed	0.8	3.2	6.2	8.9	10.2	9.8	5.3
Filled (F)	0.0	0.2	0.6	0.8	1.2	1.2	0.5
Decayed (D)	0.0	0.1	0.2	0.4	0.7	0.7	0.2
D + F	0.0	0.3	0.8	1.2	1.9	1.9	0.7
% exposed teeth decayed	0.0	3.1	3.2	4.5	6.8	7.1	3.7
% exposed teeth decayed or filled	0.0	9.4	12.9	13.4	18.6	19.4	13.2

The relationship of socio-demographic factors to root caries was examined by Beck (Beck, J.D. et al., 1987), as part of a multiple regression model of the factors affecting root caries prevalence, but they were found to make no significant contribution to the model. The 1988 Adult Dental Health Survey (Todd, J.E. & Lader, D., 1991) did show minor increases in the manual groups compared with the non-manual groups, but the increased number of decayed roots was offset by an increase in the number of filled roots in the non-manual workers. This trend is almost certainly a reflection of attendance patterns; regular attenders had five times as many teeth with filled roots as irregular attenders. Socio-demographic factors appear to be, at most, only a minor contributor to root caries activity. The mean number of decayed or filled root surfaces for the over 65s in the US national survey was 3.2, while in the UK the mean number of teeth with decayed or filled root surfaces was 1.9 (NIH, 1987; Todd, J.E. & Lader, D., 1991).

Despite the growing number of epidemiological studies which are being reported and the development of a meaningful index, most of the data is presented in terms of mean number of decayed teeth or mean RCI for various groups. There is little that describes accurately how the disease is distributed in the population. A total prevalence figure is often given for the population, usually in the order of 60% - 90% in the older age groups, but this gives no indication whether root caries is evenly distributed throughout the older population, or whether the majority of the problems are concentrated in a minority of mouths. One exception to this is the study by Fure (Fure, S. & Zickert, I., 1990) which studied three cohorts of older adults, and found that in the older two groups 20% of the population had 5 or more root caries lesions. This figure suggests that much of the disease may be concentrated in a subgroup of the population, and if this proves to be the case universally then this may have important public health implications for the management of the disease. Identification of at risk individuals and targeting of care and preventive measures may provide the most cost effective approach to management.

<u>Other factors affecting root surface caries.</u>

A multitude of factors have been reported as having a relationship with root caries prevalence. These include microbiological, salivary, psychosocial, medical and dental variables in addition to age, gender and the socio-demographic variables noted above. In discussing the influence, or relationship, of other factors with root caries it is important to distinguish those which are causal, or which have intervening roles, from those which are moderators or antecedents but which have no direct role in the aetiology. Banting (Banting, D.W., 1986) identified specific micro-organisms as causal, while dietary and salivary factors have an intervening role. Antecedents associated with the disease included root caries and periodontal disease experience while age and gender were considered as moderators. Of the factors which have been recorded, several may be of particular relevance to the elderly. Kitamura (Kitamura, M. et al., 1986) found a strong relationship with the use of drugs causing xerostomia in a group of elderly people. Beck (Beck, J.D. et al., 1987) found relationships with a spectrum of debilitating diseases, and associated the increase in root caries prevalence with a general breakdown of health. There are a number of other explanations for this finding, including greater drug use in the medically compromised population. However, a more recent study of a group of adults over the age of 55 actually found a reduction in root caries activity in those subjects who were taking medicines which are known to cause xerostomia, but those who took medications containing sucrose had significantly raised concentrations of all the implicated microorganisms (Beighton, D. et al., 1991).

Fluorides have been shown to have a protective effect. Hunt (Hunt, R.J. et al., 1989) observed a significantly lower incidence of new root caries lesions in long term residents of a fluoridated area, compared to lifelong residents of a non-fluoridated community. This appeared to demonstrate a beneficial effect of fluoride, even when the exposure started late in life. Other authors have demonstrated significantly fewer root caries lesions in almost all age- and gender- specific groups (Stamm, J.W. et al., 1990). In this case, over 15% fewer of the population of the fluoridated area had root caries experience, and in those with root caries experience the RCI was 4.71 for the non-fluoridated community compared to 2.31 for the fluoridated. *In vitro* work has supported the potency of fluoride in preventing demineralisation of dental roots (Hoppenbrouwers, P.M.M. et al., 1987).

2.1.6. Periodontal disease in older adults

Periodontal diseases consist of a group of disorders of the periodontium, including gingivitis and various forms of periodontitis. Although very common, chronic gingivitis is generally non destructive. Prevalence figures for periodontal disease which includes all inflammation of the periodontal tissues (no matter how mild) approach 100% (Johnson, N.W. et al., 1988), but the morbidity of the milder forms is negligible. There is no firm evidence that gingivitis is a necessary pre-requisite for periodontitis, while there is certainly evidence that in some cases there can be long term gingivitis without progression to periodontitis (Listgarten, M.A. et al., 1985; Lovdal, A. et al., 1961). Chronic periodontitis on the other hand, is a destructive and largely irreversible disorder characterised by loss of the tooth's fibrous attachment and potentially loss of the tooth. It has been fairly widely attributed as the principal reason for tooth loss in the over 35 year old population in western countries (Douglass, C.W. et al., 1983; Kay, E.J. & Blinkhorn, A.S., 1986; Reich, E. & Hiller, K.A., 1993). Some authors have cast doubt on this, at least as far as older adults in some populations are concerned (Chauncey, H.H. et al., 1989; Niessen, L.C. & Weyant, R.J., 1989). Whether or not it is *the* most important cause of tooth loss in older adults, it is clearly a major reason for loss of teeth in these subjects.

Severe periodontal disease leading to extensive attachment loss is not uniformly distributed through the population; only a relatively small proportion of people appear to be vulnerable to, and affected by, severe disease (reviewed in Johnston, N.W., et al, 1988). Furthermore, within these individuals severe disease may only be localised to a few sites in the mouth (Goodson, J.M. et al., 1982; Socransky, S. et al., 1984). Much periodontal research has tried to characterise these individuals and sites so that treatment can be targeted appropriately. Moderate, slowly progressing disease is more widespread, but could in time lead to tooth loss, particularly in older adults in whom there has been more time for attachment loss to occur. Periodontal treatment is relatively time consuming, potentially expensive, and successful outcomes cannot be guaranteed. Consequently accurate and appropriate targeting of resources to the individuals and sites most likely to benefit (not necessarily the most severely affected) is an important principal.

When considering periodontal disease and the resulting treatment needs of older adults there are some specific considerations which should be addressed. As the destruction resulting from the disease is largely irreversible, the overall loss of attachment will be greater than for an equivalent younger population. On the other hand the potential life of the teeth in older adults is less (it is limited by the years of life remaining), so even if relatively advanced loss of attachment has occurred, it is the age and rate of progression which will be the major determinants of treatment need, as well as the loss of attachment to date. Finally, both the functional requirements of the dentition, and the desire or ability to undergo prolonged treatment may be reduced and will further influence management.

In this review the *distribution* of periodontal diseases in the population are described in terms of the effect of age, gender and social factors. The role of age as a specific risk factor for *continuing* disease will also be discussed.

Periodontal Disease in older adults - the influence of age, gender and socio-demographic factors.

Prevalence studies to date make clear that severe destructive periodontal disease is restricted to a relatively small subsection of the population and within that subsection to a relatively limited proportion of sites (Johnson, N.W. et al., 1988). This is an important point when considering the results of epidemiological surveys and their impact on the population. Many studies report mean values for pocket depth or attachment loss, and this has a tendency to obscure the nature of the problem. As attachment loss is an irreversible process it would be expected that mean values for attachment loss will tend to increase with age. The size of the proportion of the population who are affected by more severe disease may give a better indication of the impact of age on periodontal disease, but even this could be a misleading measure as it gives no indication of the average extent of the disease in individual subjects.

The 1988 U.K. Adult Dental Health Survey (Todd, J.E. & Lader, D., 1991) found that the older age groups had on average fewer periodontally healthy teeth (without pocketing over 4mm, calculus or bleeding on probing), even taking into account the number of missing teeth, than younger groups; over half of the over 75 year old age groups had no healthy sextants. The proportion of the over 65 year old population with some deep pockets (>6mm) stood at 16%, slightly less than the 45-54 year olds (17%) but the significance of this is difficult to assess as in the older groups there may have been some "natural selection", in other words some of the most severely affected teeth will have been extracted. Only 12% of the over 75 year old age groups had some deep pocketing.

The US national survey showed an age related increase in mean attachment loss (NIH, 1987). Forty six percent of the "seniors" (over 65 year olds who were drawn from those attending senior citizens' centres) had some sites with attachment loss of 6mm or more, compared with only 9.5% of the under 65s. The proportion with deeper pockets (>4mm) dropped off slightly in the oldest age groups from 24% in the 65-69 down to 21% for the 80+ age groups. A number of other prevalence studies have demonstrated similar age related increases in attachment loss or pocket depth (Goodson, J.M. et al., 1982; Lindhe, J. et al., 1983, Albander, J.M. et al., 1986; Beck, J.D. et al., 1984; Hugosen, A. & Jordan, T., 1982; Hugosen, A. et al., 1992). The results were presented differently by Papapanou (Papapanou, P.N. et al., 1988) to give a better indication of the concentration of disease, indicating more widespread severe loss of attachment in the older age groups. Forty five percent of subjects over 75 years of age accounted for three quarters of the sites where attachment loss exceeded 6mm; for the 40 year old age group only 22% of the population accounted for the same proportion of deep pockets. Okamoto (Okamoto, H. et al., 1988) found that advanced attachment loss was experienced more generally by the older population, 25% of their 70-79 year olds had one or more teeth with >8mm of attachment loss, the figure for 50-59 year olds was only 8%.

There is some evidence for changing trends in the distribution of health and disease, at least in some western populations. Douglass (Douglass, C.W. et al., 1983) noted a marked increase in the levels of periodontal health (as evidenced by lack of gingival bleeding and calculus) in the US population through the 1960s and early 1970s, and also a small rise in severe disease. A similar trend has also been noted in Swedish adults (Hugosen, A. et al., 1992). This implies that what may appear to be the influence of age may be confounded by a component of cohort effect; different generations may have levels of disease lower or higher than their predecessors did at the same age.

Prevalence findings are indications of disease experience, not of current risk. In assessing the potential periodontal needs of an enlarging dentate population, an individual's dental history is not particularly helpful. More important is whether there is an increased risk of disease progression or acceleration with age, and also whether simple clinical variables, of the type collected in epidemiological surveys, can be useful in identifying the groups at highest risk. Griffiths claimed that clinical variables were of no use in determining risk (Griffiths, G.S. et al., 1988). Nevertheless, a number of studies have noted age as a risk factor for disease progression (Buckley, R.A. & Crowley, M.J., 1984; Halazonetis, T.D. et al., 1989; Locker, D. & Leake, J.L., 1993; Papapanou, P.N. et al., 1989). Locker used a ten year radiographic follow up of a cohort of patients and found that those patients who were over 70 at the beginning of the study underwent the greatest longitudinal bone loss (Locker, D. & Leake, J.L., 1993). Albander (Albander, J.M. et al., 1986) found that the rate of destruction increased with age but levelled off in the oldest adults (56+). The sample used in that study was less selective in terms of dental history than those used by some later workers (Grbic, J.T. & Lamster, I.B., 1992; Grbic, J.T. et al., 1991; Papapanou, P.N. et al., 1989) and it is likely that loss of affected teeth was an important confounding factor.

More recent work took a sophisticated statistical approach to assess the problem of risk. Over a six month period change in attachment levels were recorded and related to various patient and site variables (Grbic, J.T. & Lamster, I.B., 1992; Grbic, J.T. et al., 1991). Eighty nine percent of 60-69 year olds showed some clinical loss of attachment, compared to only 30% of 30-39 year olds. After the patient's mean attachment loss, age was the most important risk factor for continued attachment loss. In addition some types of sites in some types of mouths were at greater risk than others. The implications of the results were that shallow sites in cases of severe disease in younger adults were at high risk, but in the older groups, moderate to deep sites were generally at greater risk of progression than in their younger counterparts. Using this type of information (age, previous attachment loss, site) to predict the likely progression of disease could be a useful approach for the elderly, both at an epidemiological and at an individual level, although it is insufficiently developed at the moment.

All of the evidence to date indicates that attachment loss correlates with age, but does not indicate whether any of this relationship is a direct result of the ageing process. Research on animal models suggests that there are ageing changes which affect all of the tissues of the periodontium (van der Velden, U., 1984). However separating out true age changes from changes due to long term exposure to plaque is extremely difficult in a human population. Abdellatif (Abdellatif, H.M. & Burt, B.A., 1987) and Papapanou (Papapanou, P.N. et al., 1991) investigated this question differently, but both came to the same conclusion, that the relationship between age and attachment loss is plaque related and not an age change in itself. Findings, such as those by Löe (Löe, H. et al., 1978) and Lindhe (Lindhe, J. & Nyman, S., 1984), where little or no long term attachment loss occurred where plaque control was excellent, tend to support this conclusion. Changes in plaque composition or the response of the periodontium to plaque may well account for some of the age related changes which have been reported in the epidemiological studies described above (van der Velden, U., 1984). It has also been proposed recently that passive eruption, rather than plaque related factors, may be responsible for some of the loss of attachment seen with age (Hirsch, R.S. & Clarke, N.G., 1993).

Compared with age, gender differences in periodontal disease are relatively small. In the 1988 Adult Dental Health Survey (Todd, J.E. & Lader, D., 1991) more males had deep pockets (12% to 9%) and also more males had calculus and shallow pockets, and more sites with each of these conditions; this could be related to the fact that males also tend to have more teeth. Women had slightly more healthy teeth (12.9 - 12.2). In the seniors group in the US national survey (NIH, 1987) there were similar differences between genders with males having more bleeding sites, sites with calculus and sites with attachment loss and over 0.4mm more attachment loss on average than females. There was almost no difference in the mean pocket depth between the two. Grbic (Grbic, J.T. et al., 1991) did not find gender to be a significant risk factor in his selected population of periodontal disease sufferers, and Locker (Locker, D. & Leake, J.L., 1993) did not list gender as a consistent independent risk. It may be that the differences observed are as the result of behavioural variation between the two sexes.

In the 1988 UK Adult Dental Health Survey socio-demographic variables were cross tabulated with measures of periodontal disease. While the families of more non-manual workers generally had healthier periodontal tissues, less calculus and fewer shallow pockets than unskilled manual workers, the proportion with deep pockets (>6mm) hardly varied between the groups (at 10 - 11%). The factor which appeared to have the strongest relationship with the proportion of the population with deep pockets (other than age) was attendance pattern. Thirteen percent of those who attended only with trouble had deep pockets. Regular and occasional attenders had lower proportions (9% and 8%) with deep pockets, as well as more completely healthy mouths (full mouth CPITN scores of 0) (Todd, J.E. & Lader, D., 1991). Locker (Locker, D. & Leake, J.L., 1993) did not rate socio-economic group as a risk factor, but educational background was found to be a consistent factor.

<u>CPITN as a measure of periodontal disease in the elderly</u>

The community periodontal index of treatment need (CPITN) is used widely for the measurement of periodontal disease in populations, although it is not the only means of measurement (Carlos, J.P. et al., 1986; NIH, 1987). It is based on a hierarchical system of recording where bleeding sites, calculus, moderate (4-5mm) and severe pocketing (6mm or greater) are scored and represent different levels of disease or (correctly), treatment need (Ainamo, J. et al., 1982). The whole mouth or specific index teeth can be used to calculate the CPITN scores. The validity of the partial recording system for CPITN has been questioned (Baelum, V. et al., 1993a). There are also concerns about the validity of the assumptions which underpin the hierarchical system, which have been shown to be frequently untrue (Baelum, V. et al., 1993b). There are additional, theoretical, problems about the use of the index in populations of older adults. These are specifically associated with the index's use only of pocket depth, and not of attachment loss, as a measure of periodontal disease. Many older adults may have extensive loss of attachment in association with gingival recession but, without pocketing, this would not be detected using CPITN. Furthermore, tooth loss may well lead to difficulty interpreting the results of CPITN as these are often reported as the number sextants affected by a given condition. Where several sextants are missing (as will be frequently the case in elderly subjects) the interpretation may be less straightforward. Other questions about the appropriateness of CPITN are associated with its relevance to the real needs of older adults, given their greater age and generally larger disease experience. The most appropriate periodontal index for older adults is an area which requires further investigation.

2.1.7. Tooth wear in older adults

Tooth wear is a general term which can be used to describe any non-carious wear of the teeth, regardless of aetiology, and it encompasses three processes (Robb, N.D., 1992):

Attrition	- tooth wear as a result of tooth to tooth contact
Abrasion	- physical wear of the teeth by an object other than the teeth.
Erosion	- The loss of tooth substance by a chemical substance, not involving bacterial action.

Much of the dental literature on tooth wear is made difficult to interpret by poor definitions and variation in terminology. Furthermore work by Eccles (Eccles, J.D., 1982) and Smith (Smith, B.G.N. & Knight, J.K., 1984a) has led to a greater appreciation of the interaction of these three different processes. Attrition, abrasion and erosion frequently co-exist and may all contribute to tooth wear in any given case. The importance of tooth wear to the growing population of older adults is, as yet, uncertain. As the wear of teeth is an irreversible process, and a certain amount of wear can be considered as functionally normal, it follows that the older the teeth, the more worn they are likely to be. However, the treatment of severely worn teeth has the potential to become complex and consequently expensive (Watson, I.B. & Tulloch, E.N., 1985). The question which needs to be addressed would then seem to be related to what proportion of older adults are disadvantaged by tooth wear. In many cases where there is an underlying problem likely to lead to severe wear, the required dental treatment will have been carried out before the person gets "old". The treatment need for these people as they become old is not going to be the management of a primary wear problem, but the maintenance of existing restorations.

Tooth wear in older adults. The influence of age, gender and social factors.

Studies of the prevalence of tooth wear in the population are rare. Many of those which have been conducted relate to either attrition or abrasion or erosion, but not to tooth wear as a composite problem. Hugosen (Hugosen, A. et al., 1988), studying a population of 20 to 80 year olds, found attrition to be more frequent in the older age group, with 77% of 80 year olds affected compared with 65% of 20 year olds. Abrasive lesions, resembling toothbrush abrasion, have also been found to be more common among older adults (76% affected) compared to younger ones (42%) (Kitchen, P.C., 1941). These prevalence figures fit well with the statistics published by Ervin (Ervin, J.L. & Bucher, E.M., 1944) and Hand (Hand, J.S. et al., 1986) showing 56% to 66% of the total population affected by the same types of lesion. Donachie (Donachie, M.D., 1992) and Robb (Robb, N.D., 1992) considered all forms of tooth wear as a composite entity in their samples of English adults, and found an increase with age, although in the former study this was only evident on functional surfaces.

The 1988 Adult Dental Health Survey (Todd, J.E. & Lader, D., 1991) investigated wear of the root surfaces (but not the coronal surfaces) along with the examination for root surface caries and restorations. A population mean of 0.8 worn teeth per person was found, but the age differences were substantial, with the 65+ group having on average 2.4 worn teeth compared with only 0.1 for the youngest group. The statistics presented here probably slightly underestimate the true prevalence of wear of the cervical surfaces as filled surfaces were not included, in some cases these will have been restored as a result of wear. Gender and social class appeared to have no strong relationship with root surface wear. However, attrition of functional tooth surfaces has been found to be greater in men in a number of studies (Hand, J.S. et al., 1987; Hugosen, A. et al., 1988; Pollman, L. et al., 1987; Donachie, M.D., 1992). Robb (Robb, N.D., 1992) found that the pattern of wear was also gender dependent.

Tooth wear - Other aetiological factors

Many factors have been implicated in the causation of tooth wear, including diet, specific medical problems, bruxism and other parafunctional habits, toothbrushing and tooth loss (Fu, D.R., 1940; Holloway, P.J. et al., 1958; Pavone, B.W., 1985; Robb, N.D., 1992; Robb, N.D. & Smith, B.G.N., 1992). The cumulative effect of age has already been discussed, but few other factors are of relevance specifically to an elderly population. The possible exceptions to this are relationships between wear and a reduced number of teeth, and to certain medical conditions which may be more common in the elderly than in certain other groups.

A number of studies have investigated the relationship of tooth loss to tooth wear. It is frequently assumed by clinicians that loss of teeth will result in a greater occlusal load on the remaining teeth and hence more rapid wear of those remaining. The evidence from studies on this subject is contradictory. At least one study finds in favour of the assertion (Ekfeldt, A. et al., 1990), whilst several others could find no evidence for such an association (Hand, J.S. et al., 1987; Poynter, M.E. & Wright, P.S., 1990; Robb, N.D. & Smith, B.G.N., 1992).

Specific medical conditions which may predispose to wear include eating disorders, gastric regurgitation associated with various gastro-intestinal complaints, chronic alcoholism and possibly diabetes (Jarvinen, V. et al., 1988; Robb, N.D., 1992; Robb, N.D. & Smith, B.G.N., 1990; Smith, B.G.N. & Robb, N.D., 1989). Of these, eating disorders are more or less non-existent in elderly populations (Crisp, A.H. et al., 1976) and the role of gastric regurgitation, which may be common in older adults due to pathology such as hiatus hernia, has not been extensively investigated, although there is some evidence to support its relevance (Howden, G.F., 1971; Myllarniemi, M. & Saari, I., 1985). Chronic alcoholism has been shown to increase tooth wear although the mechanism is uncertain (Robb, N.D. & Smith, B.G.N., 1990; Smith, B.G.N. & Robb, N.D., 1989), but this is a problem which affects all age groups in the population including the elderly (Christen, A.G., 1983). Diabetes mellitis type 1 (insulin dependent diabetes) has also been linked with tooth wear, but the relationship is not strong (Robb, N.D., 1992).

2.1.8. Temporo-mandibular dysfunction in older adults

Dysfunction of the temporo-mandibular joint and its associated structures can manifest in a number of ways, from severe chronic pain around the joint, with associated headaches, trismus or locking of the joint, to the mildest muscle tenderness or the most gentle click. Theoretically all of these would register as dysfunction at least using the most commonly applied epidemiological indices. In an elderly population it is important to try and keep these problems in perspective. Against a background of more serious illness or disability, slight tenderness of the lateral pterygoid muscle, or a minor click are of minimal relevance. Joint symptoms are only likely to be of importance if they cause pain or discomfort or interfere with normal function in a large proportion of the population. A multitude of prevalence studies of temporo-mandibular dysfunction have been reported. These have been reviewed by Carlsson (Carlsson, G.E., 1984) and De Kanter (De Kanter, R.J.A.M., 1990). The prevalence of dysfunction depends on what is actually measured. In general, *objective* clinical findings such as muscle tenderness to palpation, deviation and limited opening occur more frequently (20 -88%) than anamnestic or reported symptoms (11 - 58%) (De Kanter, R.J.A.M., 1990). Temporo-mandibular dysfunction is generally perceived to be a problem of younger adults, and some studies have shown a reduction with increasing age. However the relationship with age also depends on what has been measured. Clinical measures have been found to be fairly stable with age while reported severe symptoms showed a general slight decrease with advancing age from a peak in the 20s and 30s (De Kanter, R.J.A.M., 1990).

Only a small number of studies have looked exclusively at older adults. Heloe (Heloe, B. & Heloe, L.A., 1978) investigated a random sample of 65-79 year olds. Eight percent reported *recent* pain, but the actual question used in the study referred only to pain in recent years, so the scope for misunderstanding was high. Clicks and crepitus were reported by 14% of the group and overall there were twice as many females who reported symptoms as males. Österberg (Österberg, T. & Carlsson, G.E., 1979) reported on a cohort of 70 year olds. According to Helkimo's Index (Helkimo, M., 1974) 46% of the subjects reported severe symptoms of dysfunction, while 37% showed clinical signs of moderate or severe dysfunction. However there must be some question of the validity of these data. The questions used in this survey asked about pain in the teeth or jaws when chewing, and ability to open wide to take a large bite. There are multiple reasons why a positive response may be obtained in answer to these questions, quite separate from dysfunction of the temporo-mandibular joint. Well under 10% demonstrated clinical signs of severe dysfunction. In another study on a convenience sample of dental hospital patients over the age of 65, only 2% reported actual joint pain, although over 20% reported pain on chewing (Budtz-Jorgensen, E. et al., 1985). Once again this latter finding is probably more to do with denture or dental problems than temporo-mandibular dysfunction.

The 1988 UK Adult Dental Health Survey recorded symptoms of pain, clicking or locking of the temporo-mandibular joint. All were slightly more common in the younger age groups. Both pain and locking only affected 3% of the over 56 year old population, while clicking was reported by only 9%. As with other studies, women were affected slightly more often than men (5% compared to 3% with pain) (Todd, J.E. & Lader, D., 1991).

2.1.9. Soft tissue pathology and dry mouth in older adults

Pathological lesions of the oral soft tissues constitute a very varied group, from the common to the extremely rare and from those which are almost inevitably fatal to others which are so mild as to be fringing on the limits of normality. Only those which are *serious* (i.e. associated with high mortality or morbidity) and those which are both common and uncomfortable, and present a therapeutic difficulty, constitute a public health problem. Oral cancers and precancers are potentially fatal and occur more commonly in the older age groups, although they are generally rare. Dry mouth is fairly common in the elderly, and can cause considerable problems, particularly in people who retain some natural teeth, so is likely to be an escalating concern as an increasing proportion of the elderly retain their teeth. Denture related pathology is rather common in denture wearers and is consequently a problem in the current elderly, although its impact is relatively minor. A wide variety of other soft tissue lesions may occur in the elderly, but are generally uncommon and do not constitute a major public health problem. These include oral manifestations of a variety of systemic disorders, particularly dermatological diseases such as lichen planus and bullous lesions, as well as a few specific oral lesions which are uncommon (e.g. salivary tumours) or benign and generally symptomless (e.g. geographic tongue).

Oral cancers and precancers

Cancer of the mouth and pharynx is thought to be globally the fourth most common cancer in men and the eighth most common in women. The geographical variation in prevalence is enormous and the pattern of site involvement is complex, with certain sites being much more commonly affected in some populations (Smith, C.J., 1989). Generally males are more frequently affected than females.

In England and Wales the tongue and lip are the most commonly affected sites (excluding major salivary glands). The age standardised incidence per 100,000 of the population is in the region of 4.5 for men and 2 for women (Binnie, W.J. et al., 1972; Waterhouse, J. et al., 1982). Oral malignancies constitute 1.9% of all malignancies. The incidence has shown signs of an increase in recent years (Cowan, C.G. et al., 1992; Hindle, J. & Nally, F., 1991), particularly among females, and there has also been a shift towards the younger age groups. Nevertheless, nearly three quarters of the new cases of oral cancer which arise in males each year are in the 60+ age group and the incidence in this group was found to be around 10 per 100,000 in a recent study in Northern Ireland (Cowan, C.G. et al., 1992). Thus the elderly appear to be an important group in which to monitor oral cancer, but it must be remembered that the total number of new lesions in any one year is relatively small. The average number of new oral malignancies in the UK through the 1970s and early 1980s was 1704 per year, excluding those in the oropharynx and those arising in the major salivary glands (Johnson, N.W. & Warnakulasuriya, K.A.A.S., 1991).

Most oral cancers arise in normal tissue, but a small proportion result from malignant transformation occurring in an existing non-malignant lesion, usually a red or white mucosal patch (leucoplakia/erythroplakia). Data on the prevalence of these lesions is much less widely available than that for oral cancer, and interpreting the information which is available is difficult due to the low proportion of patches which transform. The rate of transformation is reported as 3-6% over ten years (WHO, 1993), so the prevalence of truly premalignant lesions is undoubtedly low (Axell, T., 1987; Pindborg, J.J., 1977).

There is also a suggestion that the rate of transformation may be reducing relative to the apparent increasing incidence of oral cancer (Gregg, T.A. et al., 1992). The reduction in the mortality or the morbidity of oral cancers hinges around early detection. The role of the dental profession in this is obviously important, although by no means exclusive. In a study by Scully (Scully, C. et al., 1986) only about half of the cases referred to his department were referred by dental practitioners, and the major delay in instituting treatment was as a result of patients delaying seeking professional advice. It is towards more rapid presentation and identification of lesions, rather than at population wide screening programmes, that any strategy to reduce the mortality or morbidity of the disease would best seem to be directed.

Dry mouth

Saliva has a protective function, both physical and chemical. Reductions in flow will diminish that protective function. Profound reductions in flow can be extremely uncomfortable, difficult to treat, and may diminish the quality of life. Dentate individuals with decreased salivary flow are likely to be at greatly increased risk of dental caries (Papas, A.S. et al., 1993; Stelling, E. & Gustafsson, G., 1952), particularly where root surfaces are exposed to risk of carious attack. As the population of dentate elderly grows, the problem of dry mouth is likely to increase in practical significance. The reasons for a reduction in the salivary flow are varied and include specific disorders of the salivary glands (e.g. Sjögrens Syndrome), the use of a variety of medications, psychiatric conditions, radiation and many others (Fox, P.C. et al., 1985).

A reduction in salivary flow has also been considered as an age change by some authors, but the role of age in salivary flow is still a vexed issue. There are clear histological changes in the salivary glands with age, characterised by a reduction in the volume of functional tissue (Andrew, W., 1952; Scott, J., 1977a; Scott, J., 1977b; Scott, J., 1980), but whether this translates into a reduction in the production of saliva is less clear. Some early studies suggested a reduction in flow was a part of the normal ageing process (Ericson, S., 1968; Gutman, D. & Ben Aryeh, M., 1974). However salivary flow studies on healthy, non-medicated subjects seem to suggest that flow reduction is not a function of age per se, the changes recorded in many studies may have been as a result of the use of drug medication (Baum, B.J., 1981; Chauncey, H.H. et al., 1981; Heft, M.W. & Baum, B.J., 1984; Parvinen, T. & Larmas, M., 1982). Other recent studies have shown an apparent reduction in resting whole saliva flow (Ben-Aryeh, H. et al., 1984; Navazesh, M. et al., 1992) and resting and post-stimulated submandibular salivary flow as a result of ageing (Pedersen, W. et al., 1985). The situation with stimulated salivary flow (as opposed to resting flow) is a little more confused. Österberg (Österberg, T. et al., 1992) could find no longitudinal change over up to 12 years in a cohort of randomly selected elderly individuals, whilst Navasesh (Navazesh, M. et al., 1992) observed that although resting flow was lower in their older than in their matched younger subjects, stimulated flow was actually higher.

Studies of the prevalence of dry mouth are few. This may be as a result of difficulty in measurement. Dry mouth is not a single entity. Saliva flow may be subjectively assessed by the patient, or objectively measured after collection. Collected saliva may be stimulated or unstimulated, whole saliva or the product of just one of the major glands. It is difficult to know which holds the greatest significance. Furthermore, subjectively assessed dry mouth may give a good indication of the subject's level of discomfort, but it is not clear how, or even whether, this is related to actual saliva production (Thorselius, I. et al., 1988). Two studies have investigated the prevalence of dry mouth in populations of elderly people. Österberg (Österberg, T. et al., 1984) studied a random group of 70 year old subjects. 16% of men and 25% of women reported subjective dry mouth. Thorselius (Thorselius, I. et al., 1988) investigated a group of institutionalised elderly (mean age of 85 years), and 37% of the males and 60% of the females subjectively reported dry mouth. The higher level in the latter study are probably a reflection of greater age, illness and medication usage. Österberg (Österberg, T. et al., 1984) found that over a quarter of his subjects had resting flow rates of less than 0.07ml per minute, the lower border of normality (Bertram, U., 1967). Thorselius (Thorselius, I. et al., 1988) found that one third of their institutionalised population had stimulated whole saliva flow rates less than 0.7ml/min, which is lower than the generally acknowledged cut off for normality, whilst 11% had stimulated flow rates less than 0.3ml/min, consistent with a very dry mouth. If this figure was reflected generally in the population of the very old it would represent a large number of individuals. For the current generation of old elderly (over 75 year olds), the vast majority of whom are edentulous, it may mean considerable discomfort, a decrease in the quality of life, and possibly poorer mucosal health (Kreher, J.M. et al., 1991), although the relationship between salivary flow and reported dry mouth is not clear. Widespread reduced saliva flow does not translate into a large treatment need in these subjects, because there is only limited treatment available. However in future generations, who are more likely to have retained some natural teeth, the management of the resultant dental disease could be a significant problem.

Flow rate studies have consistently shown a gender difference with females displaying lower flow rates than males, and a higher proportion of females reporting a dry mouth (Johnson, G. et al., 1984; Narhi, T.O. et al., 1992; Österberg, T. et al., 1984; Parvinen, T. & Larmas, M., 1982; Thorselius, I. et al., 1988). Other correlates which have been reported include medication usage and, interestingly, dental state as measured by the Eichner index (Narhi, T.O. et al., 1992; Österberg, T. et al., 1984; Thorselius, I. et al., 1988).

Denture related pathology

Pathological lesions of the oral soft tissues, which are caused by the patient's dentures, or in the formation of which the dentures play a key role, appear to be fairly common, but are generally not serious and involve moderate discomfort at worst. The lesions include those which are caused by direct denture trauma (e.g. ulcers and denture hyperplasia) and infections (denture induced stomatitis and some cases of angular cheilitis) where the denture plays a key role in the pathogenesis (Budtz-Jorgensen, E. & Bertram, U., 1970). A number of small scale studies have reported the prevalence of these in a variety of populations and differences in prevalence are frequent. In a review of the literature, Budtz-Jorgensen (Budtz-Jorgensen, E., 1981) found the prevalence of denture related pathology to be generally high although there were wide variations. Angular cheilitis occurred in about 15%, traumatic ulcers in about 5% and denture hyperplasia in around 12% of his denture wearing subjects. In the over 65 year old age group denture stomatitis was recorded at anywhere between 17% and 65%. In a study of a population of institutionalised elderly in Denmark very similar figures were reported. Denture stomatitis was much more common where denture hygiene was poor, or the prosthesis was old or worn at night. Rather surprisingly, the prevalence of problems reduced with age. However it was unaffected by a range of social and geographic factors (Vigild, M., 1987).

2.1.10. Dental health of older adults - an international perspective

In 1982 the World Health Organization and the Federation Dentaire Internationale collaborated to define and adopt 6 global goals for oral health for the year 2000 (FDI, 1982; WHO, 1986). These cover oral conditions which are straightforward to measure and to monitor, and which, when measured, will give a reasonable indication of a country's dental state in an international context. When these conditions are monitored over time they also give a useful indication of change. One of the "goals" relates to the prevalence of edentulousness specifically in older adults. This is

> *A 25% reduction in the present levels of edentulousness at age 65 years and over will be achieved by the year 2000.*

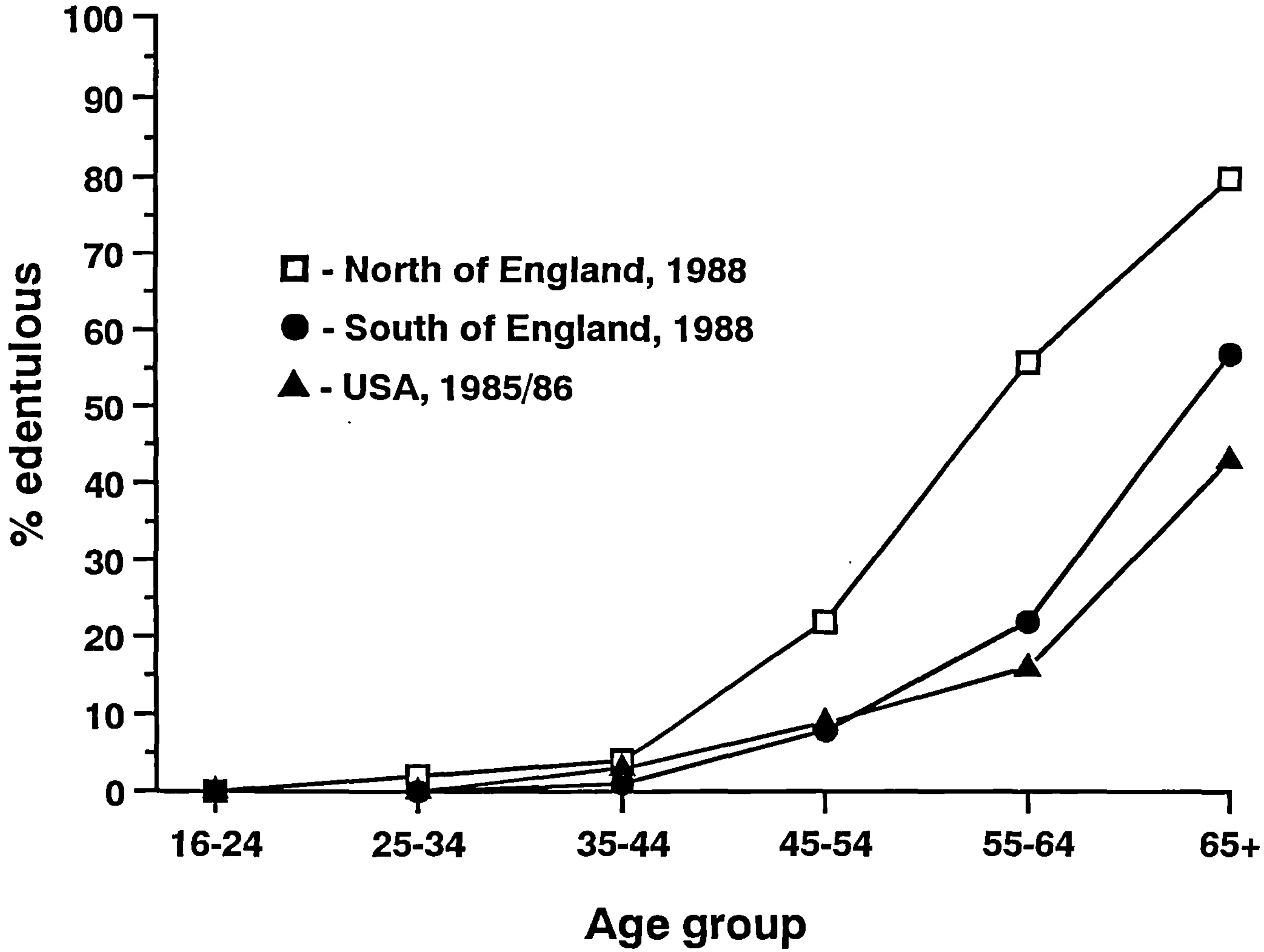
The European regional office of the WHO subsequently published figures for all the nations of Europe for which data was available (WHO, 1986), as a baseline against which progress could be measured. Based on the 1978 (which were used in the document) and the 1988 Adult Dental Health Survey, the United Kingdom has already comfortably achieved both goals (Todd, J.E. & Lader, D., 1991). The WHO European data allows comparison of the United Kingdom with many of our neighbours in Europe, while the *National Survey of United States Employed Adults and Seniors: 1985-86* (NIH, 1987) permits a transatlantic comparison. Table 1.5 shows the proportion of 65+ year olds who are edentulous in a selection of European nations and in the United States. The figures given are for the year 1985 or the most recently available figures up to that year as well as projected figures for the year 2000 where these are available. In terms of the prevalence of total tooth loss, the U.K. as a whole compares rather unfavourably with much of Europe. The figures for Switzerland, Sweden and Hungary are particularly impressive with only 20% or so of their older populations edentulous. However, in terms of the projected figure for the year 2000 the expected reductions in the U.K. are at least in line with other comparable European countries.

More detailed figures are available for the United States of America. Their overall figure for edentulousness in the over 65 year olds lies somewhere in the middle of the European group, not as good as the best, but a great deal better than the United Kingdom. If the younger cohorts (up to age 54) are considered, the US national figures are very similar to those for the south of England, though much lower than the U.K. national average. It is only in the population 55 years and over that the U.S. can demonstrate a much lower level, but as the younger British subjects get older this difference may also be eliminated. It is of interest that, at present, the South of England shows an age related pattern of edentulousness which appears to be closer to that of the United States of America than to that of the North of England (see fig 2.1.5.)

Table 2.1.10. Percentage of the population over the age of 65 who are edentulous in different countries (NOTE: the year for which the data has been recorded is not the same for all countries, so where there are trends towards reduction in the prevalence of edentulousness this may lead to distortion of the relationships between countries) (WHO, 1986).

COUNTRY	% edentulous 1985 or latest	Prediction for year 2000
UK (1978)	79%	-
Ireland	72%	54%
Netherlands	70%	-
UK (1988)	67%	51%
Finland	65%	30%
Denmark	60%	45%
GDR (former East Germany)	58%	20%
Malta	50%	35%
USA	41%	-
Austria	30%	-
Switzerland	25%	-
Sweden	20%	-
Hungary	18%	-

Figure 2.1.5. The percentage edentulous in the UK and the USA



National data on the proportion of the population of other countries with 21 or more standing teeth are not easy to come by. Recent statistics for over 65 year olds in Ireland (O'Mullane, D. & Whelton, H., 1992) showed 10.7% of the total population and 20% of the dentate population to have 21 or more standing teeth, very similar to the United Kingdom. In the 1985/86 US National Survey 24% of the total over 65 year old sample and 40% of the dentate seniors had 21 or more standing teeth (NIH, 1987), roughly double the UK figures. If the percentage edentulous in any way reflects the proportion of a population with a functional dentition, then based on the statistics in the previous section, the UK could be expected to be well behind the rest of Europe.

A higher proportion of older adults in the U.S. are dentate - 45% of over 75 year olds compared with 20% of the equivalent U.K. population. The older adults are not only more likely to have teeth, but to have more of them (mean 17.2 for the U.S. compared with 14.5 for the U.K.). The 1988 U.K. figure was actually very close to the statistic for black Americans. There is a significant "heavily filled" cohort similar to that in the U.K., although not as large, the peak of which is around 10 years ahead of the United Kingdom (see figure 2.1.5.). Table 2.1.11. shows the US in 1985/86 compared to the UK in 1988. There are fewer decayed and more filled teeth in older US adults (NIH, 1987; Todd, J.E. & Lader, D., 1991).

Table 2.1.11. Mean number of decayed, filled and sound teeth in the U.K. and the U.S. for older adults (Todd and Lader 1991, NIH 1987).

	Mean Decayed (D) Teeth	Mean Filled (F) Teeth	Mean Standing Teeth
U.K. (55+, dentate)	1.1	6.3	14.5
U.S. (65+,dentate)	0.7	6.9	17.2

Data for some other countries are available, either directly from national surveys or from the WHO national data bank (table 2.1.12.). There are problems with the comparability of these statistics, and in many cases details of sampling procedure, diagnostic criteria and, most importantly, how the statistics deal with the edentulous, are uncertain. The score given in each case is the DMFT, however much of this data is of limited value as it is frequently not clear whether it refers to the dentate alone or the whole population, dentate and edentulous (the latter will have a DMFT of 28 or 32, depending on whether third molars are counted or not).

Table 2.1.12. DMFT for over 65s in various European countries (WHO, 1986)

Country	DMFT
U.K. (dentate only)	23.8
U.K (total population)	29.3
Czeckoslovakia	28.0
Denmark	27.0
Finland	25.0
German Democratic Republic	24.0
Netherlands	22.8
Malta	20.0
Bosnia Herzogovina	14.7

There is only a very limited amount of data on the periodontal health of randomly selected older populations, which is widely available and directly comparable. In the WHO document "Country profiles on Oral Health in Europe" only 3 out of 34 countries provide any figure for the periodontal health of the over 65 year old age group (WHO, 1986). Some comparison may be made between seniors in the USA and the over 65s in the 1988 UK national survey, but differences in the recording and reporting methods mean that only data for pockets 4mm or greater are directly comparable. Even with this single variable there is an enormous difference between the two countries, which is difficult to explain. In the American population 22% of seniors had pockets of 4mm or deeper, while in the U.K. the figure was 77% of over 65 year olds (NIH, 1987; Todd, J.E. & Lader, D., 1991).

The international distribution of periodontal diseases has been reviewed by Johnson (Johnson, N.W. et al.,

1988) and Miyazaki (Miyazaki, H. et al., 1991). The restriction of severe disease to a subset of the population appears to be consistent in many countries, including those in Europe, the USA and various developing countries for which data are available. However information is generally limited to the young and young middle aged groups. In a small number of the developing countries the proportion of the population with severe disease is much higher but the reasons are uncertain (see table 2.1.13.). More profound racial and geographical differences are evident for some of the less common periodontal disorders (e.g. acute ulcerative gingivitis and juvenile periodontitis). Other studies comparing various different populations using identical criteria may point to potential genetic or nutritional differences to explain some of the variations (Löe, H. et al., 1978; Cutress, T.W. et al., 1982; Löe, H. et al., 1986).

Pilot (Pilot, T. & Miyazaki, H., 1991; Pilot, T. et al., 1992) has reviewed the periodontal conditions throughout Europe, using data from the WHO data bank, mostly collected in the mid 1980s and all using the Community Periodontal Index of Treatment Needs. What is immediately striking is the wide variation between different countries (see table 2.1.13.), but the differences between different studies in the same country are even more telling. One of the French studies reports only 6% of 35 - 44 year olds as having pockets of 4mm or worse, while in another the figure is 65%. Although this is an extreme example it graphically illustrates the problems of trying to compare different studies, even where the means of measurement used are standardised (theoretically). Data from the rest of the world shows similar variation (Miyazaki, H. et al., 1991). Table 2.1.13. is a selection of this data (see next page).

Table 2.1.13. Periodontal conditions around the world in the 35-44 year old age groups, measured by CPITN (from Miyazaki et al 1991).

	Worst score		
Country	Health	Pockets of 4mm+	Pockets of 6mm+
United Kingdom (1988)	4%	62%	13%
USA (1985)	2%	48%*	14%
Netherlands (1986)	4%	56%	8%
Norway (1983)	0%	65%	9%
Spain (1985)	7%	50%	18%
Italy (1985)	3%	48%	12%
Sri Lanka (1984)	5%	38%	10%
Bangladesh (1982)	2%	98%	64%
Japan (1986/87)	6%	50%	8%
Niger (1988)	1%	79%	28%
Zaire (1987)	0%	61%	16%
Burkina Faso (1986)	0%	99%	74%
Tanzania (1982)	1%	71%	7%

* This is NOT the US National Survey data (the equivalent figure for the national survey was only 15%)

2.1.11. Summary -The dental health of older adults and its relationship to geography and social factors.

- The proportion of the adult population of the U.K. who are edentulous has reduced in the last 20 years and is projected to continue falling (the projected national figure for 2038 is 0 - 6%).

- Most of the reduction to date has been in the young and middle aged groups, but in future it will be evident particularly among the old and the very old.

- The national figures conceal combined social and geographical subgroups who appear to be lagging well behind the rest of the population. Women from the families of unskilled manual workers in the North of England appear to be doing least well in comparison with the rest of the country.

- The normative treatment need of older adults who wear complete dentures is high, the level of complaints articulated by the denture wearers is also high, but the proportion who actually seek professional help is low. Complaints occur less frequently in those who have worn dentures for the longest.

- In future denture wearers are likely to be older when they are rendered edentulous and may find it more difficult to adapt to their dentures at that stage.

- The proportion of the population with 21 or more standing teeth is increasing rapidly, and in the 30 years from 1988 to 2018 it is predicted to increase from 30% to 84% of the total UK population. It is difficult to predict confidently the likely changes in older adults, although there will certainly be an increase.

- Older cohorts have lost teeth rather more quickly than their younger counterparts: 55-64 year olds lost on average 2.9 teeth in the 20 years up to 1988, but this figure was 2.0 and 1.4 in the next two younger cohorts.

- Adults in the North of England have a lower proportion of their population with more than 21 standing teeth than the South. The influence of gender and social class appears to be rather minor.

- In the oldest age groups (75+) the influence of attendance pattern is particularly important with 18% more dental attenders than non-attenders retaining over 21 standing teeth. It is worth noting though, that 11% of the population over the age of 75 have been able to retain 21 or more standing teeth in spite of irregular attendance.

- The 21+ standing teeth statistic is an important watershed for denture wearing. 78% of those with less than 21 teeth in 1988 wore a denture compared with only 5% of those with 21 or more.

- An increasing proportion of the population is dentate. Among this dentate population the trend in successive cohorts is for the retention of more teeth, and an increasing number of these are sound and untreated.

- The mean number of decayed teeth has fallen across the entire population. The reason for this is an actual reduction in decay, but perhaps also more teeth are being treated earlier.

- The pattern of decay and restoration at different ages in the population indicates three broad bands. Those aged under 30 are almost all dentate, have a lot of teeth and relatively few restorations. Those between 30 and 65 are mostly dentate and have a lot of teeth, but these are very heavily filled, with a mean of around 10 filled teeth per member of the population aged between 25 and 44 in 1988. The treatment need for these people as they become old could become a drain on resources and a serious problem for health care providers. The final group are those aged over 65. At present, levels of edentulousness are high in this group, particularly in the older age bands (75+). Those who are dentate have relatively few teeth, a high proportion of which are unsound. The people at the younger end of this age group represent the first wave of the predominantly dentate and heavily restored population.

- Males, those from the North of England, people from unskilled manual backgrounds and irregular attenders are likely to have fewer teeth, more decay and fewer restorations than females, those from the South of England and non-manual workers. When considering the average number of sound and untreated teeth, those from the North of England, from unskilled manual backgrounds and irregular attenders generally have more sound teeth.

- Nearly all of the older population are vulnerable to root surface caries by virtue of gingival recession. 60% - 90% of the elderly are affected by root caries, or have a history of the disease. In the United Kingdom 7% of all vulnerable teeth in older adults have decayed or unsound root surfaces, and nearly 20% of teeth have decayed or filled root surfaces.

- Many factors, including age and gender are strongly related to root decay, although the relative significance of many of these to the pathogenesis of root caries lesions requires further investigation.

- There is, as yet, relatively little data which describes how root caries lesions are distributed in the population. Mean figures are frequently quoted, but it may be that a majority of lesions are concentrated in a minority of mouths.

- Periodontal disease is a common disorder and an important reason for tooth loss in older adults. Its distribution in the population is not uniform; severe disease is restricted to a proportion of the population. Interpretation of its importance in the older population is hampered by inappropriate presentation of the data.

- There are signs of changes in the pattern of disease. More people have healthy mouths, but there is also more severe disease than in the past.

- Attachment loss appears to increase with age, which is not surprising considering that periodontal disease is an irreversible process. Advanced attachment loss is much more widespread in older adults than in the young. There is recent evidence that the **rate of progression** may also be greater among older adults.

- Females generally have more healthy sites than males, and males tend to have more severe disease, but there could be a distortion brought about by a reduction in the number of teeth.

- Social factors do not influence the prevalence of severe disease, but the prevalence of mild disease and sites with calculus is increased in unskilled manual groups.

- Some increase in wear is to be expected as a result of normal function. There are relatively few additional factors in an elderly population which make acceleration of wear more likely with age. The most widely relevant factor is loss of occlusal support due to loss of teeth, but the role of loss of support in exacerbating wear is uncertain.

- It is important to relate the patient's satisfaction and ability to function with the level of wear, and to use these non-clinical variables as determinants of treatment need, rather than to regard the presence of wear, even of advanced wear, as an automatic indicator of the necessity for treatment.

- The prevalence of temporo-mandibular dysfunction in older adults is very difficult to evaluate and depends on the measures used. It appears that severe problems are rare, although clinical signs are commonly detected. Put in perspective with the other medical problems of the elderly temporo-mandibular dysfunction would appear to be a rather minor disorder.

- Oral cancers involve a high mortality and morbidity, and although they are most common in older adults, they are still rare in the U.K.

- Up to a quarter of the total population have reported subjective dry mouth whilst up to 11% of institutionalised elderly have been found to have profoundly dry mouth based on measured flow rates. The effect of dry mouth on the teeth in future elderly populations (as a result of dental disease) could be damaging and expensive.

- Denture related pathology is generally associated with relatively low (although possibly significant) morbidity, but appears to be common.

- Directly comparable international data is uncommon as means of presenting and analysing data are not uniform. The UK lags some way behind the USA and most European countries for the variables where comparison is possible (edentulousness, number of teeth, DMFT).

2.2. ATTITUDES TO ORAL HEALTH, ORAL HEALTH BEHAVIOUR AND BARRIERS TO DENTAL CARE IN OLDER ADULTS.

2.2.1. Attitudes to oral health and oral health behaviours in older adults.

Attitudes, behaviour and oral health are inter-related variables. This has been well illustrated by developing and testing an interactional model which includes the motivational and vulnerability factors which influence dental health, dental health behaviour and each other (Maizels, J. et al., 1991). The interactions between these variables are complex. The relationships which were described using the model accounted for only 35% of the variance in the number of filled teeth, whilst other important influences, for example sugar consumption, were not included. Nevertheless, the model illustrated the complicated inter-relationships of psychological, behavioural and biological factors which contribute to "oral health". The factors which may combine to influence social attitudes towards oral health include experience of treatment and disease, social circumstances and cultural background. These will in turn be determined by age, gender, socio-economic status and probably geography (through cultural heterogeneity). Not only will different age cohorts have different attitudes to oral health, but within any given age cohort the attitudes may also be dynamic and change with time according to the dental, social, political and economic environment. As a result, assumptions relating to future changes in oral health or the demand for dental health care as a result of current attitudes must be made with caution. Furthermore, the cultural element makes it inappropriate to place assumptions drawn from studies conducted overseas in the context of the United Kingdom.

This section will cover some of the differences in attitude to oral health according to age cohorts, gender, social class, and geography as they were described by a sample of the population of the United Kingdom in the 1988 Adult Dental Health Survey (Todd, J.E. & Lader, D., 1991). All of the statistics quoted in section 2.2.1. are derived from the 1988 Adult Dental Health Survey, or in a few cases, previous UK surveys of adult dental health. The figures given for different genders, social classes and geographical areas refer to the total population. Statistics for these parameters broken down by age are not available. Important variation affecting subsets of the elderly may lie undetected.

Dental Attendance

Overall figures for dental attendance patterns demonstrate large age and geographical differences, but the figures are distorted in the older age groups by the high proportion of edentulous people, who have quite different treatment needs. When trying to establish differences between groups it is probably prudent to consider only the dentate. A slightly lower proportion of dentate older adults are regular attenders (42% of over 65 year olds) compared with younger age groups, about half of whom attend for regular checkups. A high proportion of the dentate very old (75+) only attend with trouble (57%). This is almost double the figure for those aged 35-44.

Table 2.2.1. sums up the gender, social and geographic variations in attendance pattern. Males, those from unskilled manual backgrounds and people living in the North of England appear to be the groups likely to have the lowest number of regular attenders, and the highest proportion who wait for pain or dental problems to drive them to seek care.

Table 2.2.1. Proportions of total population who attend the dentist for regular checkups and only with trouble according to gender, social class and area of residence (Data from Todd and Lader 1991).

	Males	Females	Non-manual	Unskilled manual	North of England	South of England	All adults
Regular attenders	42%	58%	59%	34%	49%	52%	50%
Only with trouble	42%	29%	26%	52%	38%	32%	34%

Following through the attendance behaviour of single cohorts in England and Wales between 1968 and 1988 may give some indication of trends towards demand for dental care. The proportion of the dentate population who say that they attend for regular checkups has increased during this period for all age groups. As the group ages, the proportion of regular attenders increases (see table 2.2.2.). However a note of caution should be sounded before interpreting all of this rise as a sign of demand increasing with age. The figures refer only to the dentate members of the population, and there will have been some "selecting out" of irregular attenders who have been rendered edentulous. This will tend to exaggerate the rise in demand for regular checkups as only a very small proportion of the edentulous attend for regular checkups. However, even when this is corrected for, the proportion of the total population does show the middle aged cohorts of 1988 attending more regularly than they did when they were younger.

Table 2.2.2. Change in attendance pattern for different groups of the dentate in England and Wales between 1968 and 1988 (Data from Todd and Lader 1991).
* - figure will be artificially low as it applies to all over 55 year olds, not just the age group in question.

Age in 1968	% regular attenders	Age in 1988	% regular attenders	% increase in regular attenders 1968 -1988
16 - 24	46%	35 - 44	59%	13%
25 - 34	45%	45 - 54	55%	10%
35 - 44	42%	55+	45%*	3% *

Table 2.2.2. shows only the data for the dentate population. It can be stated with reasonable confidence that as the proportion of the elderly who are dentate increases, the demand for dental checkups alone (irrespective of the new treatment need) will rise markedly in the first quarter of the next century.

Oral Hygiene

The frequency of tooth brushing and the use of additional oral hygiene aids may give some indications of the variation in social attitudes to oral health throughout the U.K.. The current generation of elderly clean their teeth slightly less frequently overall than the younger age groups. Comparing only dentate elderly with younger groups shows that 11% of the over 75 year olds clean their teeth less than once a day, and 6% said that they never cleaned their teeth. Nobody in the under 44 year old age groups fell into this latter category. Around three quarters of the over 65 year olds used no oral hygiene aids over and above normal toothbrush and toothpaste and less than 8% said that they used dental floss. In some of the younger age groups up to 30% reported using dental floss. Table 2.2.3. shows the variation in oral hygiene practices between the North and the South of England, males and females and people from non-manual and unskilled manual backgrounds. Unskilled manual workers and individuals from the North of England, particularly males, demonstrated the least enthusiasm for oral hygiene practices, whilst those from the South, people from non-manual backgrounds and women showed the most.

Table 2.2.3. Oral Hygiene behaviour according to gender, social class and area of residence (Data from Todd and Lader,1991).

	Males	Females	Non-manual	Unskilled manual	North of England	South of England	All adults
Brushing 2x daily or more	58%	76%	73%	62%	65%	70%	67%
Brushing <1x daily	9%	2%	4%	11%	8%	4%	6%
Use of floss or sticks	19%	31%	34%	10%	21%	32%	25%

Treatment preferences

The sort of treatment which individuals would prefer if they had a choice may give a useful indication of the attitude of a population towards dental treatment. The Adult Dental Health Survey reported the responses of subjects to a number of hypothetical questions. The treatments preferred varied substantially with age. Table 2.2.4. sums up the trends for different age groups, as well as area of residence, social class and gender according to the answers to three such questions

Table 2.2.4.Treatment preferences according to age, gender, social class and area (Data from Todd and Lader, 1991).

	65+	<44	Males	Females	Non-manual	Un-skilled	North	South
Back tooth extracted rather than filled	44%	20%	25%	23%	15%	40%	28%	19%
Front tooth extracted rather than crowned	31%	6%	12%	9%	8%	18%	12%	10%
Back tooth extracted rather than crowned	57%	31%	35%	36%	26%	48%	38%	31%

Older males, those living in the North of England, and people from an unskilled manual background were much less likely to demand restorative care than young females, those from non-manual backgrounds and people living in the South. The Midlands and Scotland shared a similar lack of enthusiasm with the North of England. Generally those with most teeth were more likely to want a tooth restored. Adults with partial dentures were much less likely than those without to want another tooth extracted. In the case of crowning or extracting an anterior tooth only 5% of all partial denture wearers would want it extracted, compared to 28% of those without dentures. The reasons for this are undoubtedly complex, but it may be that the denture wearers realise that the loss of another tooth would imply treatment beyond the extraction (modification of the denture) or that loss of a tooth may (further) reduce the ability of a denture to do its job.

Attitudes to dentures

The 1988 Adult Dental Health Survey included data on the expectation of the need for dentures and the degree of upset that being rendered edentulous and becoming reliant on dentures would cause. The proportion of dentate adults who felt that they would need a partial denture within 5 years was generally low, but increased with age, and accounted for 17-18% of the over 55s. Gender and geographical differences were small, although 4% more manual workers felt that they would need partial dentures than non-manual workers. When the same dentate adults (with no partial dentures) were asked about the prospects for complete dentures, between 13% and 19% felt that they would need them at some time, with the proportion anticipating a short term need (less than 5 years) increasing with age, and those anticipating a need in the long term decreasing. The variation with other factors was much greater, but the North of England stood out as the area with the highest proportion of the population with overall expectation of complete denture need (one fifth), 8% higher than the South of England. A similar number of males and females anticipated edentulousness, but more than twice as many manual workers as non-manual workers (20% to 8%) thought that they would need dentures at some time. Dentate adults who wore partial dentures were much more likely to identify a long term need for complete prostheses (37% overall) than those who did not (15% overall).

The proportion of partial denture wearers who would be very upset at the prospect of complete dentures was between a third and a half and showed a decrease with age (37% of over 55s) after a peak in middle age (44%). Generally, females, those from non-manual backgrounds and residents of the South of England were more likely to be very upset at the prospect of total tooth loss than males, unskilled manual workers and residents of the North of England.

Dentate adults who did not wear dentures were more likely to be *very upset* at the prospect of partial dentures the older they were. 27% of over 65s in this category said that they would be very upset, compared to only 16% for the youngest group. When the same questions were asked about complete dentures the proportion who would be "very upset" was much higher, although the same trends were apparent (see table 2.2.5.).

Table 2.2.5. Proportion of the dentate sample who said they would be very upset at needing partial and complete dentures, by age, gender, social class and area of residence (data from Todd and Lader, 1991).

	65+	Males	Females	NM*	UM*	North	South	All
Very upsetting - partial dentures	27%	14%	29%	23%	21%	18%	22%	22%
Very upsetting - complete dentures	69%	55%	71%	67%	58%	58%	65%	63%

NM = Non-manual, UM = Unskilled manual.

If any individual age group of non-denture wearing dentate adults is followed through from 1978 to 1988 the proportion of people who say they would be very upset if they required partial dentures is almost unchanged (Todd, J.E. & Walker, A.M., 1980; Todd, J.E. et al., 1982). There is no sign of a ground swell change in social attitudes here. However, the proportion who would be very upset by total tooth loss has leapt by between 8% and over 20%, with the biggest increase occurring in the older groups. There should be a degree of caution exercised when interpreting the figures for the older age groups as the incidence of edentulousness may have selected out those who would have been least upset, but this can only partly account for the altered attitudes. Similar changes are evident among those who already wear partial dentures. Reference to figures for all dentate adults in 1968 shows that this trend in public opinion has probably been going on for at least 20 years (Gray, P.G. et al., 1970). During that twenty year period it appears that hundreds of thousands of people must have changed their attitude to complete dentures and become less prepared to accept the inevitability of complete dentures.

2.2.2. Barriers to dental care in older adults

Barriers to dental care could be defined as factors which prevent or discourage individuals from seeking care. Barriers may be psychological, financial or physical. The former will be tied up closely with attitudes and resultant behaviour, and as such will be influenced heavily by cultural variables, age, gender and social circumstances. Financial barriers will be related to these, as well as to the political and economic climate current at the time and consequently may be fairly volatile. Physical barriers will be of little consequence to most of the young and middle aged population, but are likely to parallel the increasing disability associated with old age.

When considering barriers to the provision of dental care in the elderly as a whole, it is worth considering the heterogeneity of the group. The edentulous and the dentate not only have different needs, but also a different perception of their needs, so what they perceive as barriers will also be different. Similarly the definition of what constitutes elderly is crucial. Many people in their sixties and early seventies are very fit and able, but with increasing age the likelihood of being disabled or institutionalised increases. The physical barriers to the fit and able will be minimal, but to the housebound, ill or institutionalised may be considerable. There is also some evidence of differences in attitude between institutionalised and non-institutionalised elderly which are likely to influence psychological barriers as well (Kandelman, D. & Lepage, Y., 1982). Many of the recent studies of barriers relate to institutionalised elderly who constitute a relatively small but potentially important subgroup. Care must be taken not to interpret the findings of such studies in the context of the elderly in general.

In the 1988 Adult Dental Health Survey all dentate subjects were asked whether and how strongly they agreed with a series of 15 statements depicting barriers to dental care. The statements were clumped into three groups of five depending on whether they related to fear, image of the dentist/surgery or cost. These were the three major categories of barrier to care described by Finch (Finch, H. et al., 1988). Other workers have reported on various subgroups of the elderly population and have generally identified similar barriers, but direct comparison is difficult due to differences in sampling and general methodology.

Fear

Agreement with the *fear* statements was generally high in the total sample; a half to two thirds of the sample agreed with four out of the five statements. The one exception was the comment "if I had toothache I would rather take painkillers than go to the dentist" with which 75% disagreed. The other fear statements included references to nervousness about treatment, anxiety about visiting the dentist, dislike of waiting and being able to drop in without an appointment. Age differences were not covered in detail because variation was reported to be small but there were marked gender differences. About 4% more females than males tended to agree with most of the fear statements (perhaps just reflecting greater honesty or less bravado). People from manual backgrounds were consistently more likely than those from non-manual backgrounds to agree with the fear statements. Geographical differences were reported to be small. Respondents were also asked to name the single most important barrier; 45% of the sample identified fear as the most important. Although age differences were again small, there was one important exception; only 30% the 75+ year olds identified a fear barrier as the most important (see table 2.2.6.).

In qualitative research on barriers to dental care in a group of mostly dentate over 65 year olds in Scotland (Schou, L. & Eadie, D., 1991), fear was frequently given as a reason for non-attendance at the dental surgery. Fiske (Fiske, J. et al., 1990), studying a mixed group, mostly of dependent elderly, identified fear as accounting for about a quarter of the deterrents in those who felt a perceived need for treatment, but overall only 3-5% identified fear as a barrier. These figures seem very low, but the sample was dominated by edentulous institutionalised elderly. Wilson (Wilson, M.C., 1991) reported fear as the most important reason for non-attendance, whereas cost was the major factor preventing the receipt of treatment.

Table 2.2.6. Proportion of the population reporting different types of barriers as the single most important barrier by age, gender and social class

	75+	Non-manual	Unskilled	Males	Females	All
Fear	30	42	52	43	47	45
Image of dentist/surgery	30	24	17	22	22	22
Cost	26	20	23	22	21	22

Image of the dentist/surgery

In the UK Adult Dental Health Survey most of the image statements were agreed with by less than half of the sample (Todd, J.E. & Lader, D., 1991). The exception was the statement "I would like to know more about what the dentist is going to do and why" with which two thirds of the sample agreed. Gender differences were small, although twice as many females (20%) as males (10%) strongly agreed that they "do not like lying flat in the dentist's chair". Social class differences were small and geographical differences were not mentioned. When the "most important" statements were analyzed, the 75+ group again showed marked differences from the rest of the sample. Overall 8% more rated an "image" statement as the most important (30% to 22%). The two which stood out were "I don't fancy intricate treatment" (13%) and "I do not like lying flat in the dentist's chair" (8%). Although 13% may seem a rather low proportion it must be seen against the background of 14 other possible choices, and in fact the statement about intricate treatment was rated as the second most important overall.

Cost

Two of the cost statements were agreed with by over half of the population. These were "I would like to be given an estimate without commitment" and "I find NHS treatment expensive". Others related to cost were agreed with by less than half. Gender differences were small, but far more manual workers (about half) than non-manual workers (about 30%) agreed with the statement " it will cost me less in the long term if I only go to the dentist when I have trouble". Whether this represents genuine reasoning or whether there is an element of excuse is difficult to know. When the most important reasons were investigated it was the over 75 year olds who once again stood out. From this group, the statement "I find NHS dental treatment expensive" was rated the most important barrier overall; 16% rated it the most important reason, a much higher proportion than the rest of the population. Again, it is important to note that the 16% figure is seen in the context of 14 other possibilities. This is perhaps a reflection of a general perception of expense among the elderly.

A number of authors (Fiske, J. et al., 1990; Kandelman, D. & Lepage, Y., 1982; Schou, L. & Eadie, D., 1991; Wilson, M.C., 1991) have identified cost as an important barrier to dental care. Quantifying the size of the barrier is difficult as it may change rapidly according to the political and economic situation. Schou (Schou, L. & Eadie, D., 1991) identified widespread confusion about NHS charges and entitlement. This will not have been helped by recent, well publicised, changes to the NHS fee structure and consequent alterations in individual practices' policy regarding patient registrations.

Other barriers to dental care in the elderly

The 1988 Adult Dental Health Survey covered the general population and information relating specifically to the elderly is difficult to glean (Todd, J.E. & Lader, D., 1991). However, the differences exhibited by the over 75 year olds were quite marked and stood out against a rather homogenous background. The elderly are an important subgroup of the population with specific needs and there are likely to be barriers which are unique to this population. Schou (Schou, L. & Eadie, D., 1991) identified two other major reasons for irregular attendance. The lack of any perceived need was one that was stated by many elderly people, but it is difficult to evaluate in a mixed sample (as this was) of dentate and edentulous, as there is good evidence that the latter almost universally only attend when problems force them. The other important barrier was "lack of interest". This may go hand in hand with "don't need to go" but the statements gathered from the group discussions indicated a reduced concern about appearance and a reluctance to get involved with dental care. Wilson (Wilson, M.C., 1991) reported the factors, including barriers, which influenced the receipt of dental treatment of a group of dentate elderly people in Northern England. The main stimulus for dentate individuals was a desire to remain dentate, with peace of mind, a perceived need for scaling and polishing and force of habit being the other determinants. Irregular attenders' reasons for attendance were dominated by the relief of symptoms. The main barriers to care were fear and cost, but various others were noted, the most important of these being "negative attitudes". This study also reported on the barriers that the dentists perceived that their patients felt. These generally accorded reasonably well (qualitatively) with the patients' reports, but the dentists tended to consistently overestimate the scale of the barriers.

Physical barriers may be important to some elderly people. In a random population of those over the age of 65 in Quebec the rural subjects in the sample demonstrated the lowest utilisation of services, suggesting that distance itself may be a very important barrier in certain communities (Kandelman, D. & Lepage, Y., 1982). In a study of a mixed, but mostly dependent, group of elderly subjects in the UK access to the surgery accounted for 44% of the deterrents in those subjects who perceived a need (Fiske, J. et al., 1990).

About 50-60% of over 75 year olds can be classified as disabled and 18% of this disabled population are housebound or can only leave the house with assistance (Martin, J. et al., 1988). Domiciliary dental care is fairly widely available for housebound elderly in the UK, but uptake of such services appears to be low, and Fiske (Fiske, J. et al., 1990) identified a number of reasons for this. One was that dental practitioners waited to be asked, rather than offering their services, and the others included a lack of knowledge of the services available, and possibly insufficient training of dentists and a lack of availability of equipment. The need and demand for domiciliary care is also likely to be higher among the dentate, so is likely to increase over the next few decades.

2.2.3. Summary - Attitudes to oral health, oral health behaviours and barriers to dental care in older adults

- Attitudes to oral health show large variations between population groups. Generally, the attitudes of dentate older adults do not differ greatly from their younger counterparts. There are exceptions to this, the most notable being that more of the very old (75+) attend only with trouble than their younger counterparts, and older adults are much more willing to have troublesome teeth removed rather than restored.

- Despite this, it is the older dental adults who are more likely to be very upset at the prospect of any kind of dentures. Nearly 70% of dentate individuals over 65 year old would be very upset at being rendered edentulous. Comparison between 1988 and 1978 appears to show a substantial (in numerical terms) shift in attitudes to edentulousness with 10% more people saying that they would be very upset at total tooth loss.

- It is consistently males and those from unskilled manual backgrounds who appear to be the most likely to have "negative" attitudes to oral health, hygiene and treatment. Southern England stands out as the area with the highest proportion of the population who will keep their mouths clean (70%), visit the dentist (52%) and have restorative treatment.

- There are no data to compare, for example, older people from manual backgrounds in the North of England with the national picture, and it may be that these types of sub-group display important differences in attitude.

- The elderly may have different and special needs and there is some evidence that the sort of barriers which prevent them attending are different. Fear appears to be less important, while cost and an aversion to complex treatment (and "getting involved") are more important in the elderly than is the case in younger groups. In the population as a whole, gender and social class have a variable influence. Certain sub-groups of the elderly may experience important and specific barriers which require targeted sampling to draw out.

2.3. THE CONCEPT OF A FUNCTIONAL DENTITION

The presence of one or more standing teeth excludes a person from being edentulous, but the mere presence of teeth does not necessarily infer a better state of oral health or a superior ability to function than an edentulous person. When assessing oral health, it is necessary to estimate the potential contribution that a dentate individual's dentition makes to their level of function. Although 32 teeth is the usual maximum dentition, it is certainly possible, and often desirable, to function with fewer than this. Furthermore, if it were felt desirable, from a public health perspective, to aim for a goal of 32 standing teeth across the population in order to bring about an improvement in oral health, this would be both unattainable and clinically undesirable (Käyser, A.F., 1990; Todd, J.E. & Lader, D., 1991). The cost of maintaining a full arch of teeth against the ravages of the two major dental diseases into old age would be prohibitive. It seems clear that the objective for older adults, at both an individual and a public health level, should be to preserve the number of natural teeth that allow a person to function comfortably and without embarrassment for the rest of their life, in line with the definition of oral health given in section 2.4..

In attempting to define what is acceptable, it is necessary to understand what the limitations brought about by tooth loss are likely to be. As the proportion of dentate adults increase, the actual number of those who are partially dentate will increase. Loss of some teeth may be acceptable, but if this occurs in a rather random and uncontrolled way, it may cause more problems and be even less desirable than edentulousness. This section specifically reviews the problems of tooth loss and the partially dentate.

2.3.1. The partial dentition and masticatory function

It would seem obvious that loss of teeth will in turn lead to a diminution of the ability to masticate. Studies of masticatory performance (objectively measured mastication using specific tests) in relation to number of natural teeth, food platform area or the comparison between natural teeth and dentures have shown this statement to be broadly true (Chauncey, H.H. et al., 1984; Helkimo, E. et al., 1978; Jiffrey, M.T.M., 1983; Käyser, A., 1981; Luke, D.A. & Lucas, P.W., 1985; Manly, R.S. & Braley, L.C., 1950; Wayler, A.H. et al., 1984; Oosterhaven, S.P. et al., 1988). All of these studies used test foods of various descriptions and measured pulverization or swallowing threshold in standardised tests. In other words the assessments were completely objective, and the conclusions were that chewing is more efficient the more teeth, or pairs of teeth, which are present. Just because objectively recorded masticatory performance is inferior where a number of teeth are missing it does not necessarily follow that it is insufficient. Although masticatory performance is slightly poorer it may be perfectly adequate when subjectively assessed by the patient, and provide sufficient food pulverisation to be physiologically acceptable.

There are many studies which assess the performance of reduced dentitions by questionnaire or subjectively assessed performance. Whilst objective studies allow the use of standardised experimental techniques amenable to scientific measurement, subjective assessments may be less precise, but are of greater relevance to dental practice. *Masticatory ability*, as this form of measurement is known, reflects a person's ability to function to a level which is acceptable to them. In spite of the consistent finding that complete dentures are much less efficient than a full set of natural teeth (Gunne, H.J., 1985a; Helkimo, E. et al., 1978; Mahmood, W.A. et al., 1992; Wayler, A.H. et al., 1984), a study by Bergman found that most complete denture wearers were satisfied with their chewing ability (Bergman, B. & Carlsson, G., 1972). In studies of masticatory performance (objectively measured), complete dentures are generally found to give a poorer performance than any other dental state, with the possible exception of a single complete denture opposed by natural teeth. Given the satisfaction of complete denture wearers, one may expect most partially dentate individuals to be satisfied with their chewing ability. Findings from studies on people with partial dentitions generally support this although the results are variable depending on experimental differences (Lappalainen, R. & Nyyssonen, V., 1987; Wayler, A.H. et al., 1984). Wayler (Wayler, A.H. et al., 1984) found that subjective ease of chewing hard foods was correlated to dental status, with complete dentitions giving the best performance and complete dentures the poorest. Lappalainen (Lappalainen, R. & Nyyssonen, V., 1987) found that masticatory ability correlated with the number of teeth and age. The worst option in all age/gender groups was a complete denture opposed by natural teeth alone. This scored lower even than complete dentures.

Whilst the previous studies showed a trend related to numbers of teeth, a number of studies have investigated the minimum number of natural teeth required for satisfactory subjective masticatory ability. Haraldson (Haraldson, T. & Carlsson, G.E., 1979), in a small study of 24 subjects with osseointegrated implants concluded that 9 pairs of occluding units (in this case in the form of bridges) seem to provide sufficient masticatory efficiency. A large epidemiological survey of 1100 subjects (Agerberg, G. & Carlsson, G.E., 1981) concluded that 20 well distributed teeth were needed to provide satisfactory chewing ability, and that loss of up to 7 teeth (from a "complete" dentition of 28) did not seem to entail impairment, as assessed by the subject. Even among subjects with only 8-20 teeth as few as 1% rated their chewing ability as poor. Käyser (Käyser, A., 1981) looked not at ability to masticate food, but at the point at which discomfort occurred during chewing and concluded that discomfort begins with less than 4 occluding units, equivalent to 20 standing teeth assuming a complete anterior dentition. This then defines the cut off point for what is acceptable masticatory ability, and also puts some emphasis on the distribution of the teeth, as well as just the number. The importance of the distribution of the teeth for satisfactory function was supported in a study by Battistuzzi (Battistuzzi, P.G.F.C.M. et al., 1987). In a study of 750 adults he showed only a weak correlation between subjectively assessed masticatory ability and the number of teeth or contacting pairs, but, using his own classification system for distribution of teeth, concluded that the distribution of teeth or contacting pairs is of greater significance. Aukes investigated subjectively assessed masticatory ability in the shortened dental arch, that is where there is an un-interrupted, but reduced functional arch, usually, but not necessarily, from premolar to premolar (Aukes, J.N.S.C. et al., 1988). From a study of 97 such subjects his conclusion was that the differences between this group and a control group with complete (second molar to second molar) dental arches were small. Witter took this concept a little further and showed that only 10% of his subjects with shortened dental arches raised any complaints about masticatory ability (Witter, D.J. et al., 1989). Oosterhaven found that subjects with complete arches had more positive feelings and fewer negative feelings about their ability to chew than those with missing molars but no partial dentures, whilst they in turn had more positive and fewer negative feelings than subjects with missing molars and a similar number of teeth, but who wore partial dentures (Oosterhaven, S.P. et al., 1988).

In a short review of this subject, Witter concluded that masticatory ability is generally sufficient as long as 20 or more teeth are present, such as in cases of shortened dental arch (Witter, D.J. et al., 1990). He also schematically illustrated the apparent relationship between masticatory performance (assessed objectively) and masticatory ability (assessed subjectively). While performance decreases in direct proportion to the number of teeth, from an optimum of 12 occlusal units (pairs of teeth, or half teeth in the case of molars), masticatory ability decreases much more slowly, and only when 4 occlusal units remain (equivalent to all 8 premolars, or 20 teeth in shortened dental arches) does masticatory ability start to fall off more rapidly. However plausible this model may be, it is still speculative. Above all it appears that, whilst the average number of teeth required for mastication may be as described, there is considerable individual variation (Kalk, W. et al., 1993).

2.3.2. The partial dentition, digestion and nutrition

If nutrition is impaired by tooth loss, due to inadequate chewing of food, or by altering the person's choice of food as a result of discomfort during mastication, then tooth loss could have serious long term implications. In older people, where diet may be limited by income, illness or disability, this could potentially be of some importance. Farrell (Farrell, J., 1957; Farrell, J., 1956) investigated the effect of mastication on the digestion of food in a series of experiments using chewed and unchewed food wrapped in cotton mesh bags and swallowed. The results illustrated that the amount of digestion which took place inside the bags was highly food dependent, but for at least some foodstuffs some mastication is important for digestion. To investigate the importance of "incomplete" mastication a further analysis was undertaken of a patient with full dentures, a patient with a partial dentition (with and without partial dentures in place) and in a patient with a full dentition who was asked to chew a test food only with the incisors. In all of these patients with reduced masticatory performance, digestion was shown to be no poorer than in those with "complete" mastication. So for even the most difficult foods, incomplete mastication is sufficient for digestion to occur to an acceptable level.

Impaired chewing may not seriously affect digestion, but it may influence food selection, and therefore nutritional status. Perhaps the most obvious group for research into this subject are the edentulous who are known to have among the poorest masticatory performance and efficiency. Dietary interviews or questionnaires have been used on various groups of elderly edentulous subjects (Ettinger, R.L., 1973; Hartsook, E.I., 1974; Heath, M.R., 1972; Neill, D.J. & Phillips, H.J.B., 1970). Whilst all groups described chewing difficulties or some dietary restriction, none displayed any serious dietary inadequacies as a result. A number of other studies have interviewed or used questionnaires on groups of subjects with more varied dental conditions, including dentate and partially dentate mouths, to investigate any dietary or nutritional limitations as a result of a partial dentition. The frequency of ingestion of a number of listed foods, as well as perceptual assessments of taste and texture, was investigated in a group of over 1200 males by Chauncey (Chauncey, H.H. et al., 1984). The frequency of ingestion of the selected list of test foods was highest in fully dentate subjects and lowest in edentulous subjects, with those with a compromised or partial natural dentition lying somewhere in between. Baxter looked at intake of specific nutrients in 4 groups of 20 selected elderly subjects (Baxter, J.C., 1984). Each group had a different dental state ranging from completely edentulous through to fully dentate. Minor nutritional imbalances were common, but were not restricted to any one dental state, and there were no important differences between the groups. Halling (Halling, A. et al., 1988) found slight differences between dentate and edentulous middle aged women when the intake of a wide variety of nutrients was investigated. However none were considered important (except possibly vitamin C), and when groups with different numbers of natural teeth were compared there were no deficiencies identified. Gunne (Gunne, H.J., 1985a) investigated a group of dentate persons before and after placement of a lower removable partial denture and found that intake of a number of key dietary components were unaffected by the change in dental state, in spite of the fact that masticatory efficiency more than doubled with denture provision. Bates (Bates, J.F. et al., 1971) used a variety of physical and haematological indicators, rather than a questionnaire, to indicate nutritional status in a group of 700 elderly people. They compared those who wore dentures for eating or who had natural teeth with those who did not. Only for two of the variables measured were there any significant differences at a 5% level of probability. The variables involved (haemoglobin and haematocrit) are closely related (if one is reduced the other is likely to be), the actual differences were small, and with 30 different comparisons made between the two groups this finding may well have arisen by chance.

The previous studies have investigated a wide variety of different groups, rarely randomly selected or fully representative. Probably the most detailed study was reported by Österberg (Österberg, T. & Steen, B., 1982). They investigated the relationship between dietary intake, assessed by a validated interview technique, and dental state according to the Eichner Index (Eichner, K., 1955) in a representative sample of 368 Swedish 70 year olds. As this index correlated very strongly with both number of teeth and tooth contacts it was felt that it would accurately reflect masticatory performance and "dental invalidity". Insufficient intake of some nutrients was significantly higher in edentulous compared to dentate persons. The intake of some nutrients was related to the degree of dental invalidity but the relationship was weak and confounded by socio-economic factors. This appears to reinforce the findings of previous studies that partial loss of the dentition is unlikely to affect the nutritional status of older people at a population level. However there is the possibility, which the authors identify, that in a few individuals or vulnerable subgroups of the population, particularly those who are edentulous in one or both arches and in whom the medical or financial status may be unfavourable, that the dental state could have an important contributory role in nutritional deficiency.

Taken together, the results of these studies imply that, although choice of foods may be affected by a reduced dentition and the resultant reduced masticatory efficiency, this may not necessarily alter the nutritional balance of the diet. However, there remains a possibility that reduced masticatory efficiency may predispose to certain gastrointestinal disorders. Increased frequency of gastric symptoms was reported among patients with impaired masticatory efficiency (Rodrigues-Olleros, A., 1947). The same problem has subsequently been investigated in a more controlled manner and no increased frequency of such symptoms was found (Mumma, R.D.jr. & Quinton, K., 1970; Sirus, W. & Prescott, R.J., 1985).

2.3.3. The partial dentition and other aspects of function and health

Agerberg (Agerberg, G. & Carlsson, G.E., 1981) noticed that reduced chewing ability was reported more frequently by people who considered their state of general health to be impaired than by healthy subjects. Österberg (Österberg, T. et al., 1990) used the Eichner index to compare the number and distribution of contacting teeth with a number of physical measurements of general health in 1380 seventy year old subjects. Dental functional impairment was found to be significantly associated with cognition, visual and hearing ability, lung and heart volume, muscle strength and bone mineral content, as well as self assessed health. Even with possible confounding factors, such as socio-economic group and tobacco smoking, it was found that the most predictive factor for dental state was an index of seven functional capacities (including measurements such as lung and heart volume). These findings do not imply a causative role to the loss of teeth in the degeneration of general health, or vice versa, but probably reflect a common functional ageing which affects the oral cavity as well as other systems.

It is self evident that an anterior space, particularly one in the upper arch will usually have a detrimental impact on aesthetics, and that any clinician or patient would regard filling the space with a bridge or denture as a reasonable course of treatment. Statistics to support this assumption are difficult to come by, but it may be of significance that of the dentate population in the UK in 1988 who rely on a combination of natural teeth and dentures, 93% wore an upper denture of some description as opposed to 32% who wore a lower. Furthermore, only 57% of those supplied with a lower denture actually wore it, compared with 80% of those supplied with an upper (Todd, J.E. & Lader, D., 1991). While these statistics are, no doubt, related in part to different patterns of tooth loss and specific difficulties with the wearing of lower dentures, they almost certainly also reflect the greater aesthetic importance of the upper arch.

The 1988 Adult Dental Health Survey also investigated the reasons for dissatisfaction with aesthetics among adults in the United Kingdom. Gaps and spaces were overall the third most frequently quoted reason for dissatisfaction (13%) after colour and irregularity. However, amongst the over 65 year old group, gaps and spaces were the second most frequently listed source of dissatisfaction and were considered a problem by far more people than irregularities were (21% to 16%). Colour was still rated the most important source of dissatisfaction (29%). Missing teeth are a potentially important source of dissatisfaction in the elderly, although the over 75 year olds were the group most likely to be satisfied with the appearance of their dentition overall.

Beside mastication and the social function of aesthetics, the other major function of the dentition is speech. Missing anterior teeth may seriously impair a persons ability to pronounce certain sounds, specifically "f", "th" and "v" (Chierici, G. & Lawson, L., 1973; Grant, A.A. & Johnson, W., 1983). Loss of posterior teeth seems to be of less importance in terms of speech.

Temporo-mandibular dysfunction (TMD) is often not perceived to be a problem of the elderly and has been reviewed in section 2.2.. However, loss of posterior teeth has been implicated as an important aetiological factor in temporo-mandibular dysfunction by a number of authors, but the whole area of temporo-mandibular function and occlusion is controversial. Many studies have investigated the relationship between the number and distribution of teeth and symptoms, clinical and anamnestic findings of temporo-mandibular dysfunction. For every study which reports a correlation between number of teeth lost or extensive tooth loss in certain areas and temporo-mandibular dysfunction, there are at least three which find no such relationship (De Kanter, R.J.A.M., 1990). Only one study to date has specifically looked at temporo-mandibular dysfunction and tooth loss in an elderly population (Österberg, T. & Carlsson, G.E., 1979). This research was conducted on a group of 384 70 year olds and used indices described by Eichner (Eichner, K., 1955) and Helkimo (Helkimo, M., 1974) for measurement of dental invalidity and TMD respectively. Only a very weak correlation (if any) was found between the two measures. Given that only 3% of the sample reported any painful symptoms attributable with certainty to the temporo-mandibular joint, it seems unlikely that temporo-mandibular discomfort is a significant problem following loss of teeth in older adults.

2.3.4. The replacement of missing teeth and the restoration of function and aesthetics.

Having discussed the effect of tooth loss leading to a partial dentition, the success and side effects of their artificial replacements will be discussed. Studies of masticatory performance in relation to wearing partial dentures or bridges are not clear cut. Masticatory performance is diminished when teeth are lost, but this appears not to influence subjective ability to chew or oral comfort until a large number of the posterior teeth have been lost (Käyser, A., 1981). The value of artificially replacing these posterior teeth will depend largely on the success of prosthetic replacement in restoring lost masticatory function (if enough teeth have been lost to make a difference), comfort and pleasure. One of the problems of research to investigate the role of partial dentures in restoring masticatory function and ability, particularly in population studies, is that of matching groups according to the number and distribution of teeth. The enormous heterogeneity in the dental state of any partially dentate population makes it difficult to draw any proper conclusions from most research in this field. Nevertheless a number of studies have attempted to tackle the issue.

A study by Jemt (Jemt, T. et al., 1983) investigated the form and number of chewing cycles of a test food before and after placement of a lower removable partial denture opposing a complete upper denture. Their conclusion was that, although the number of chewing cycles were reduced and there were minor changes in mandibular movements after partial denture placement, the overall masticatory function was little changed. Improvements in function in partial denture wearers compared to non-wearers with similar levels of tooth loss, or with the same patients before tooth replacement, have been described by several authors (Battistuzzi, P.G.F.C.M. et al., 1987; Gunne, H.J., 1985b; Ranta, K. et al., 1987). In two of these studies the subjects wore a complete upper denture and had extremely shortened arches in the lower. Lappalainen and Nyyssonen also looked at those with a limited number of teeth in only one arch and found that those with partial dentures were more likely to rate their masticatory ability as good (Lappalainen, R. & Nyyssonen, V., 1987). In a study of over 1200 healthy males Chauncey (Chauncey, H.H. et al., 1984) split the subjects into groups according to dental status and then into one of two groups according to their masticatory performance. This design allowed different dental states to be compared for subjective assessments of taste and texture acceptability, frequency of ingestion of certain foods and ease of chewing, while controlling for masticatory performance. They found that inefficient partial dentures were poorer than compromised dentitions unrestored by dentures for certain subjective assessments of eating. The likelihood of a denture being efficient is probably influenced in turn by number of natural teeth; the more teeth that are missing the less likely it is that a partial denture will be efficient, as there is less support and retention available. However, the inference from this paper was that an efficient combination of natural teeth and partial dentures giving good masticatory performance may increase the enjoyment of eating and thus perhaps the quality of life.

Witter (Witter, D.J. et al., 1989) compared 99 patients with shortened dental arches, that is 3 - 5 occlusal units (pairs of opposing premolars or half molars), split into three groups according to whether they were partial denture wearers, previous partial denture wearers or had no history of wearing partial dentures. The group with partial dentures and those without partial dentures and with no history of them demonstrated no significant differences when the frequency of impaired chewing or anterior chewing were assessed subjectively. The group who had previously worn partial dentures stood out as having a much higher frequency of impaired chewing capacity, anterior chewing and, interestingly, aesthetic dissatisfaction, than the other two groups. It should be noted however that the total numbers in each of the groups were relatively small (only 25 in the current denture group and 19 in the previous wearers category).

Although there is considerable variation between these studies, there does seem to be a general suggestion that masticatory efficiency and ability are improved by partial dentures where mastication is already likely to be seriously hampered by tooth loss, but where a few functional posterior units remain, the benefits are less easy to demonstrate. The improved acceptability of taste and food texture by the wearers of efficient partial dentures found by Chauncey (Chauncey, H.H. et al., 1984) may add an extra and unexpected dimension.

It seems self evident that if teeth are lost from an area of the mouth which has aesthetic importance, then artificial replacement must go some way to restoring the aesthetics. Although artificial teeth may not be a perfect representation of their natural predecessors, if the appearance of the natural teeth was poor, there is even the possibility that they could improve the aesthetics. The 1988 United Kingdom Adult Dental Health Survey investigated some of the factors which affected people's perceptions of the aesthetics of their own teeth, including the provision of artificial replacements. In general older adults (55+) were more likely to be satisfied than younger adults, and men were more likely to be satisfied than women. These differences probably demonstrate the importance of people's expectations in the assessment of aesthetics. When respondents who relied upon a combination of natural teeth and upper and lower partial dentures were compared with those relying only on natural teeth, the denture wearers reported satisfaction with their appearance more frequently than those with natural teeth (75% compared to 70%). This suggests that dentures play an important role, not just in maintaining aesthetic satisfaction, but in improving it. The number of natural anterior teeth replaced by a partial denture also seemed to have an important bearing on overall aesthetic satisfaction. In general subjects with a partial denture were more likely to be satisfied with their appearance if they had fewer natural teeth, while the reverse was true for non-denture wearers. In cases where all 6 anterior teeth were replaced by a partial denture 84% of respondents said that they were satisfied with their appearance, but where no anterior teeth were replaced (presumably implying 6 natural teeth in most cases) only 70% reported being satisfied, while only 66% of people with two artificial anterior teeth were satisfied. These findings suggest that a combination of natural and artificial anterior teeth is less satisfactory than either alone, a hypothesis borne out by very similar results for crowned teeth (Todd, J.E. & Lader, D., 1991).

It is of interest that the reasons given for dissatisfaction are different depending on whether the respondents rely on dentures and natural teeth or natural teeth alone. For both groups the most important reasons were colour and irregularities of the teeth, although fewer of the denture wearers were concerned about the latter (22% of denture wearers compared with 39% of those without). Gaps and spaces were more often a cause of dissatisfaction with denture wearers than with dentate subjects (18% to 12%). However 20% of all the denture wearers gave the reasons for dissatisfaction as "other", compared to only 8% of the dentate group suggesting that those who were unhappy about their prostheses often had problems relating to their dentures.

Taken together, these findings imply that, in the opinion of the wearer, artificial teeth are often very successful replacements for the real thing, that a high proportion of the population who wear partial dentures are satisfied with the aesthetics, but that the size and distribution of restored spaces may be very important.

There are other reasons for the replacement of missing teeth in addition to the restoration of function and aesthetics. These include the prevention of tilting, drifting and overeruption of the remaining teeth, and to provide a transitional prosthesis prior to edentulousness. This subject has recently been discussed by Devlin (Devlin H., 1994), but there is no indication of how successful partial dentures are in these cases, particularly in the latter rôle.

2.3.5. Tooth replacement as a factor in dental disease

Both wearing a partial denture and preparing teeth for a bridge to replace missing teeth carry potential risks. These may be of particular relevance to the older patient where oral hygiene may be imperfect, and there is a greater risk from, for example, root surface caries. Increased plaque accumulation, gingival and periodontal breakdown have been observed in patients with removable partial dentures by a number of authors (Carlsson, G.E. et al., 1962; Chandler, J.A. & Brudvik, J.S., 1984; Derry, A. & Bertram, U., 1970; El Ghamrawy, E., 1976; Lappalainen, R. et al., 1987). Well controlled longitudinal research by Bergman (Bergman, B. et al., 1982; Rissin, L. et al., 1979) studied periodontal damage in the presence of partial dentures where plaque control was kept at a very high level by patient oral hygiene and intensive professional support over a 10 year period. The result was no progression of periodontal destruction no matter what measure was used to assess it, although more recently, degeneration in the gingival condition has been shown, even where plaque control is good, although this change appeared to be transient (Orr, S. et al., 1992).

Damage to the periodontium by the unnatural physical forces exerted on remaining teeth by partial dentures, either independent of or potentiating the effects of existing plaque is also a possibility. This subject was reviewed by Berg (Berg, E., 1985) and his conclusion was that many of the assumptions related to the role of denture design (specifically distal extension prostheses) in direct periodontal damage did not stand up to critical analysis, and where it occurred, damage was more likely to be plaque related.

Data on plaque accumulation and periodontal disease as a result of the placement of fixed prostheses is very sparse. A longitudinal study of two fairly well matched groups with a complete upper denture opposed by a few lower natural teeth and either a distal extension cantilever bridge or a lower partial denture has been reported (Isidor, F. & Budz-Jorgensen, E., 1987). Although higher plaque scores were recorded in the former group, neither showed any significant progression of the existing periodontal disease over a two year period.

As plaque also has a major role in dental caries, the increased plaque accumulation and stagnation areas found associated with partial dentures and fixed bridges could contribute to the development dental caries. In a large cross sectional survey of Finnish adults, Tuominen (Tuominen, R. et al., 1988) found that the proportion having one or more carious teeth was slightly greater among those wearing a partial denture, compared to those without. However, where carious teeth were present the presence of a removable partial denture did not appear to lead to an increase in the number of teeth involved. Some progression of carious activity over a 10 year period in his denture wearing group was reported by Bergman (Bergman, B. et al., 1982), but with no control group for comparison the role of the denture in this is uncertain. Chandler (Chandler, J.A. & Brudvik, J.S., 1984) also showed caries progressing over a nine year period, but there was no difference between those who had worn a partial denture over this period and those for whom a partial denture had been made but not worn. Two recent studies have shown an association between partial denture wearing and root caries (Wright, P.S., et al., 1992; Drake, C.W. & Beck, J.D., 1993). Although the sample groups in the studies were different, abutment teeth were found to be particularly prone to disease in both.

In summary, partial dentures do lead to an increase in plaque accumulation where oral hygiene is not optimal, and this may accelerate periodontal destruction in some individuals. The role of partial dentures in dental caries is less clear, but again could be significant in some individuals. Caries specifically affecting the root surfaces in relation to partial denture wearing has only been investigated recently, but there is mounting evidence that it may play a rôle. In terms of plaque accumulation, and hence both diseases, avoiding a removable partial denture and restoring anterior spaces with a fixed bridge would seem to be a preferable option where possible.

2.3.6. The shortened dental arch

The expected increases in the number of older dentate adults and the number of teeth these people will have has already been discussed in some detail. Despite the advantages regarding function, the cost of maintaining a full arch of teeth into old age may be high as the cumulative effect of a lifetime of dental disease has to be managed. Extraction of teeth which require extensive and expensive care may be an attractive option to both patient and dentist. However, tooth loss will lead to a diminution of function, possibly impaired aesthetics and in the long term perhaps even the breakdown of the dental arch, although these changes are unlikely to have any seriously detrimental effect on health or nutrition. In many cases the artificial replacement of extracted teeth with partial dentures is likely only to improve masticatory function marginally (unless only very few teeth remain). These prostheses could have a role in the acceleration of periodontal disease and dental caries, and they may be rather costly both for an individual and for a health care system.

Käyser has described a problem based treatment planning philosophy, aimed at the targeting of resources to key areas of the dental arch to prevent haphazard tooth loss and preserve a continuous, but shortened dental arch (Käyser, A., 1981; Käyser, A.D. & Witter, D.J., 1985; Käyser, A.F. et al., 1990). The strength of this concept lies in its pragmatic approach to dental health care in older adults. Shortened dental arch (SDA) philosophy acknowledges that a complete dental arch of 28 teeth (third molars are disregarded) is the most desirable dentition, but where teeth are lost due to disease, or where the burden of managing the disease becomes excessive and resources are limited, then priority should be given to anteriors and pairs of occluding premolar teeth. These are the most aesthetically important teeth, they have been shown to provide sufficient function for comfortable and efficient mastication without the need for dentures (Aukes, J.N.S.C. et al., 1988; Witter, D.J. et al., 1990), and above all are more straightforward to maintain than large, inaccessible and multi-rooted molars. If molar teeth are expendable, as some of this research suggests, it seems inappropriate to spend time and money and cause patient discomfort attempting to maintain them where the long term benefit is in doubt. Shortened dental arch theory involves maintaining a continuous but reduced dental arch, generally from premolar to premolar, without removable partial dentures, but possibly with fixed bridges to maintain the integrity of the shortened arch where necessary.

The actual number of teeth in the shortened arch is not absolute, but Käyser has proposed that the requirement reduces with age, and for those aged 70 and over it may be as few as 2 occluding pairs, effectively first premolar to first premolar. This figure is, in fact, hypothetical and based on clinical experience and extrapolation of some research data (Käyser, A., 1981; Witter, D.J. et al., 1990).

All the studies to date into the effect of shortened dental arches on the function and potential for long term breakdown of the dentition have been cross-sectional and based on a small and highly selected group of about 70 patients (regular attenders to a dental hospital) who have been restored to a classical shortened dental arch. This group has generally been compared to an age and sex matched control group for a number of factors. Studies of shortened dental arch in relation to mastication, food selection and oral comfort reflect the findings of the many studies already described relating tooth loss to oral function, that is that tooth loss causes some mild impairment of chewing function, food perception and selection (Aukes, J.N.S.C. et al., 1988; Witter, D.J. et al., 1990; Witter, D.J. et al., 1990). These problems were mild however, and only 8% of the SDA patients reported impaired chewing ability, and only 11% aesthetic complaints. Interestingly among the partial denture wearers who also had a shortened dental arch 20% had some complaint about their prosthesis, whilst another 20% did not wear theirs.

Loss of posterior teeth may be expected to result in drifting of the premolars with a consequent reduction of posterior support and an increase in anterior loading and anterior interdental spacing. Cross sectional data from Witter's group of patients demonstrated that there was more spacing anteriorly and between premolars in the SDA group compared to those with a full dental arch, but the differences were small (Witter, D.J. et al., 1987). Additional studies into periodontal support and mandibular dysfunction have shown little difference between those with shortened dental arches and those with a full arch of teeth, but firm conclusions are difficult to draw due to difficulty matching controls (Witter, D.J. et al., 1992; Witter, D.J. et al., 1988).

2.3.7. Summary - the concept of a functional dentition.

- One of the major problems likely to be faced by the dental profession in the UK over the next thirty years is the emergence of a dentate population of elderly people with a high treatment need and loss, or impending loss of part of the dentition. In many cases resources will be limited and the resultant upkeep and management of the partially dentate mouth are likely to prove difficult.

- Such evidence as exists suggests that 20 or 21 standing teeth is the threshold at which impairment of masticatory function becomes apparent. If further teeth are lost beyond this level, masticatory function and ability, and the capacity to chew comfortably, are reduced. The distribution of teeth and the presence of posterior occlusal contacts may be an important factor as well as the number of teeth.

- Although masticatory function is impaired with tooth loss, and food choice may be restricted, even very limited mastication (where there are very few remaining teeth) is quite sufficient for acceptable digestion and nutrition given a modern diet.

- It is reasonable to assume that some aesthetic impairment will result from tooth loss, and spaces in the anterior region are an important source of dissatisfaction in the elderly. Evidence for a relationship between temporo-mandibular dysfunction and tooth loss is still inconclusive.

- The greatest benefit in masticatory performance and ability to accrue from partial dentures seem to occur in extremely limited dentitions. Where there are fewer missing teeth, particularly where the patient has a shortened but unbroken arch from premolar to premolar in both jaws, the masticatory benefit of partial dentures is more difficult to demonstrate.

- Efficient and comfortable partial dentures appear to increase the enjoyment of eating, but no partial dentures may often be preferable to inefficient ones.

- Partial dentures do appear to be successful in restoring aesthetics, and levels of satisfaction are generally higher the more teeth that are replaced.

- Where oral hygiene is not optimal, the plaque accumulation resulting from the stagnation areas associated with partial dentures can lead to an increase in periodontal disease and possibly dental caries. The increased risk appears to be generally small, and the problem is preventable if oral hygiene is excellent. However in older adults the combination of exposed root surfaces and increased plaque retention and stagnation associated with a partial denture could cause problems with root surface caries. This problem has not been fully investigated.

- Shortened dental arch theory is based on the preservation of unbroken, but reduced dental arches, without the reliance on partial dentures. It is a treatment planning philosophy which is based on the finding that significant impairment of function does not result from the loss of the molars, provided sufficient other teeth remain. The evidence to date suggests that shortened dental arches are viable, and may prove a useful approach in the management of the heavily restored and difficult to manage natural dentition in the older population.

- Despite the apparent potential of the shortened dental arch as a treatment philosophy and as a public health measure its ultimate usefulness will depend on its long term success and it's adoption by the dental profession.

2.4. IDENTIFYING GOALS FOR ORAL HEALTH

Any index which is used to measure the oral health of a population will be imperfect to a greater or lesser degree. When such indices, many of which were developed for use in younger subjects, are applied to an elderly population the imperfections can be magnified by some of the specific considerations relating to oral health in the elderly. In addition, the pattern of disease, functional requirements and ability to pay may be altered, and may have a bearing on what is a meaningful measure of oral health and what is a realistic goal.

2.4.1. Defining oral health

A number of bodies have attempted to define oral health, or at least to provide a goal for oral health towards which the population should be moving. A selection of the available definitions and goals are given below.

> "To provide the opportunity for everyone to retain a healthy functional dentition for life by preventing what is preventable and containing the remaining disease (or deformity) by the efficient use of treatment resources" (Dental Strategy Review Group, 1981).

> "The optimal function of the teeth and jaws and supporting structures" (FDI, 1982).

> "The retention throughout life of a functional aesthetic natural dentition of not less than 20 teeth and not requiring a prosthesis" (WHO, 1982).

> "Such a standard of health of the teeth, their supporting structures and other tissues of the mouth, and of dental efficiency, as in the case of any patient is reasonable having regard to the need to safeguard his general health" (National Health Service, England and Wales, 1992, in the National Health Service, General Dental Services, regulations).

> "Oral health consists of having no active oral disease and sufficient natural teeth to enable an

individual to eat, speak and socialise without discomfort or embarrassment and thereby to contribute to general well being. It is desirable that this be achieved by a lifetime reliance on the natural teeth with minimal disease experience." (proposed definition of oral health from the working group on the oral health of the nation, J.J.Murray, pers comm.).

Some of these are definitions, some may be better described as goals. Some of them may also be more appropriate than others, but the reason for listing them is not to offer a considered critique of each, but to try to identify a consensus as to the most important elements of "oral health". Only when these components have been defined can an attempt be made to measure this in a population.

The following basic elements appear in all or some of the definitions:

1.	Clinical	- An absence of disease.
		- The presence of natural teeth
2.	Functional (mastication)	- The ability to function mechanically
3.	General/social function	- The absence of discomfort and embarrassment and a contribution to well being.

The inclusion of functional and social aspects are not universal, but are an important element if we are to meet the needs of the population. In terms of the elderly, these general themes are still appropriate, and it could be argued that those relating to social function may take on a relatively increased importance.

Some definitions include the necessity for a natural dentition, or in the case of the 1982 WHO definition, a minimum number of natural teeth. Whilst this may be useful and appropriate as a goal (provided that the requirement is justified), as a means of measuring the proportion of the population who currently enjoy oral health the stipulation of a minimum number of teeth has drawbacks. These are primarily that it may exclude some people who would otherwise fulfil the criteria for oral health and, if no mention is made of social functioning or satisfaction, that it may include many who would not.

The ability of the dental profession to increase the proportion of the population who could be defined as *enjoying satisfactory oral health* may depend as much on being able to keep in touch with changed attitudes and expectations as being able to control disease. Goals for oral health should not just cover clinical disease, but should try to take into account functional and social roles, and satisfaction with these, if they are to record meaningfully the health of the population.

2.4.2. Disease and clinical variables as measures of oral health

Measurement of the extent and severity of dental disease is the traditional way of recording oral health in the population, and goals or targets for oral health are usually set in these terms. Dental disease and its sequelae (tooth loss and discomfort) lead to alterations in the impacts on social function and satisfaction which are discussed in the next section. However, most of the clinical indices which are used to measure dental health are really measures of dental disease and are disease specific, that is they measure only one condition, and do not relate it to any other. Furthermore the available indices all have serious shortcomings, even within the limited context of the disease that they are intended to measure. Some are particularly inappropriate for the measurement of dental health (or disease) in the elderly. Setting oral health targets for the elderly purely in the terms of these indices would be short sighted, but some indication of disease is important. The shortcomings of individual measures are described briefly below.

DMF, the conventional measure of caries, becomes less relevant with age as teeth are lost for reasons other than caries (Murray, J.J., 1971). It also gives no positive value for the restoration of normal function which results from satisfactory restoration. The latter issue has been addressed with the development of the Tooth Health and the Functioning Teeth indices (Jakobsen, J.R. & Hunt, R.J., 1990; Marcenes, W.S. & Sheiham, A., 1993; Sheiham, A. et al., 1987) which may be a more appropriate way of presenting this sort of data for older adults as they take into account the value of restored or restorable teeth compared with missing teeth. The Root Caries Index (RCI) is appropriate for older adults, but suffers from problems with diagnostic criteria (which have not been standardised) and the components combined in its construction. De Paola (De Paola et al., 1989; De Paola, P.F., 1990) described in detail the variation in the index according to what criteria were used to determine the presence of fillings and caries of the root surfaces. The problems with CPITN are covered elsewhere, but it is another measure which is not entirely appropriate for application to the elderly. The tooth wear index does not suffer from being inappropriate for the elderly, but it does tend, in its original form, to be over-complex, and there is as yet no indication of what role tooth wear plays in terms of the subjects well being.

2.4.3. Sociological measures of oral health.

In most research into the oral health of the population the measures used are purely clinical, and usually record disease, as opposed to health. They have been designed by dentists to measure the prevalence or severity of the diseases which are felt by the dentists to be of importance in terms of dental health. Many of them measure disease history rather than the need for preventive care, and none of them record the subject's perceived need. The dental problems which individual subjects identify as important may often differ from those recognised using the conventional clinical indices alone, although the two may be related.

An analytical approach which takes into account the subject's social and psychological needs and handicaps as a result of oral disease could be of particular value for the elderly, not only because the clinical indices may be inappropriate, but also because the health care priorities are altered. In older adults life expectancy is less and the financial situation, the ability to tolerate treatment, the reasons for seeking treatment and the attitudes to oral health may all be substantially different from those of younger groups. For these reasons, an oral health measure based on the patient's ability to eat, speak and function socially without discomfort or embarrassment would be a useful adjunct to the conventional clinical measures.

Indicators of the social impact of ill health have been developed over many years (Andrews, F.M., 1981). White (White, K.L., 1974) has reported on the use of such indicators in epidemiological studies but interest in their development for dental research has been relatively limited. The early work by Bulman (Bulman, J.S. et al., 1968) was unique at the time in its enlistment of sociological support in a survey of dental health. Their findings included a clear indication of the gulf between professionally assessed need and the patient's perceived need. They also indicated a widespread ignorance about oral health among the general population. Subsequent national surveys have continued the sociological input, but the amount of information on the impact of dental disease on normal life and on levels of satisfaction with various aspects of the dental state has been limited. Reisine (Reisine, S., 1981; Reisine, S., 1985) reviewed the status of socio-dental indicators and the social impacts of dentistry, and found that most measures related to the effect of acute dental problems, with most of the remainder concentrating on malocclusion and dento-facial abnormalities (Baldwin, D., 1980; Rutzen, S., 1973; Schroeder, C., 1972).

That dental and oral disease has a social and psychological dimension has been shown by a number of authors. Smith (Smith, J. & Sheiham, A., 1979) looked at a random sample of 254 adults of 65 years of age or older. One third had experienced recent pain and 30% had difficulty chewing. A high proportion reported some sort of social handicap as a result of these difficulties; 9% felt uncomfortable eating with others and 13% felt embarrassed during social contact. Cushing (Cushing, A.M. et al., 1986) investigated the social impact arising from various dental conditions in a group of 414 factory workers in England aged between 16 and 60. Five categories of impact were measured according to what aspect of life was affected, these included eating, communication, pain, discomfort and aesthetics. Overall 71% recorded one or more "impacts", with the commonest being discomfort (due to food packing) or cold sensitivity. 20% reported some difficulty eating. When the social and functional dimensions of oral health were compared with clinical data it became clear that the two were not always well matched. In many cases oral health and satisfaction with oral health were rated as high by the subject, who at the same time acknowledged that there was a treatment need. There is a gulf between patient's and dentist's perceptions. Burgersdijk (Burgersdijk, R. et al., 1991) has noted this trait in a study of aesthetics. In many cases the clinician identified problems where none was perceived by the patient and vice versa.

Heyinck (Heyinck, J.W. & Schaub, R.M.H., 1986) reported the impacts of dental problems in a group of complete denture wearers and found them to be minimal. The effect of TMJ disorders, periodontal disease and denture problems on various scales covering social functioning, well being and symptoms have also been investigated (Reisine, S.T. et al., 1989; Reisine, S.T. & Weber, J., 1989). These studies found that all of the sociological measures were able to detect impacts as a result of the temporo-mandibular dysfunction, but denture problems only affected social functioning while periodontal disease had no impact on any of the three measures used.

Davis has argued that the impact of dental and oral disease on daily life is small (Davis, P., 1976). Nevertheless, if the WHO goals (which include a reference to social functioning) are to be addressed, this is an area which requires consideration. Despite the lip service paid to the concept of socio-dental measures (Miller, W.A., 1987; Thines, T. et al., 1987) there are relatively few signs of their development and widespread adoption. Recently a "dental activities of daily living" index has been described (Sheiham, A. & Rosenouer, L.M., 1992). This has been reported to measure dental satisfaction quantitatively in a reproducible manner and may prove a useful starting point for addressing the dental problems of the elderly. Very recently a measure of the "propensity" of adults to adopt oral self care behaviours has been tested with a view to the detection of different treatment need groups (Maizels, J. et al., 1993). Locker (Locker, D., 1988) has laid out a conceptual framework for the development of socio-dental indicators, but at present no single all encompassing instrument exists. Development of such a comprehensive measure of oral health will require a substantial input of time and resources and may be unattainable. Until such a tool is available it would be prudent to collect information on a range of indicators which broadly cover all of the categories and concepts of ill health, including both biophysical and sociomedical dimensions.

From the preceding review, problems with eating, dissatisfaction with aesthetics and aspects of oral discomfort are the most often quoted impacts of dental disease on normal life and social function. At a population level, it would seem appropriate to attempt to identify the factors which influence these and their relationship to each other, including measures of disease, social and demographic variables. In this way targets for oral health may be better directed: it would be all very well having a population in which nobody was edentulous, but if they were unable to eat or loathed the appearance of their teeth, then the system for providing the means to achieve oral health would be a failure. However, one of the problems of identifying risk factors for dissatisfaction and difficulty eating is separating out a mass of inter-related variables. For example, the number of teeth a person has, the subject's age and the presence of loose teeth may all correlate with eating problems, but they almost certainly also correlate with each other. Such problems require complex multivariate statistical techniques, such as multiple linear or logistic regression. The nature of the dependent variables one may wish to examine (often *categorical* in nature rather than continuous measurements) and the independent variables one may wish to enter into the model (which may vary from risk factor to risk factor) rather limits the possibilities. Logistic regression provides an attractive option for data of this type (Altman, D.G., 1991). Such analysis is widely used in epidemiology and has been applied to dental data, for example to identify the risk factors for root caries and other dental disease (Locker, D. et al., 1989; Pullinger, A.G. et al., 1993; Vehkalhati, M.M. & Paunio, I.K., 1988).

2.4.4. Summary - Identifying goals for oral health

- The measurement of a population's progress towards a goal for oral health should cover all of the important elements given in any definition of oral health. These comprise of the presence of natural teeth, the extent and severity of dental disease and the ability to function mechanically and socially without discomfort.

- In a population of the elderly the dental conditions required to fulfil these criteria, and the balance between them may be different from the rest of the population.

- To date most assessments of oral health have been concerned with the presence of clinical disease.

- There is no single measure which gives an assessment of the level of health of a dentition, or its potential to contribute to oral health.

- An essential element common to most definitions of oral health, but often overlooked due to the distraction of clinical disease, is the contribution of oral health to social well being. Although there is some research to indicate the presence and magnitude of the social impact of oral health and disease, there are relatively few attempts to measure this element consistently.

- There may be merit in the measurement of oral health being, in part, determined by the subject. An assessment of the interaction of clinical with sociological and socio-dental factors should be a reasonable starting point for setting realistic targets for the oral health of the elderly.

MATERIALS AND METHODS

Section 3

MATERIALS AND METHODS

3.1. SAMPLING

3.1.1. Selection of areas

In order to satisfy the objectives of this study (listed in section 1.1.) three separate areas were chosen for sampling. The requirements of these were:

- one discrete urban area in the North of England.
- one discrete urban area in the South of England, preferably outside the influence of London commuting.
- one discrete rural area, without any major conurbations, lying close to one or other of the urban sites.

The use of such a sampling design allows comparison between the dental health and attitudes of the North and the South of England, and between rural and urban communities. After consultation with an expert in the social geography in the University of Newcastle upon Tyne, three areas were chosen:

- Darlington, County Durham. Darlington is a large town (population around ninety thousand) lying just north of the River Tees in the south of County Durham. It is primarily an industrial town but also has an important role as a market and service centre for the surrounding area. The industry has been built largely around the railways, and associated heavy engineering works.
- Salisbury, Wiltshire. Salisbury is a substantial town of eighty thousand people. It is primarily a market town and a provider of services to the local area, although it has some light industry. The town is dominated by its ancient cathedral and consequently has an important tourist industry. As an attractive and accessible centre of population, there is probably a marked inward influx of older people after retirement.
- Richmondshire, North Yorkshire. Richmondshire is a very large rural area in North Yorkshire with a population of around forty five thousand. It lies between the main east coast road and rail routes and the North Sea watershed of the central Pennines. It includes the two large dales of Swaledale and Wensleydale. The area is largely agricultural with a number of scattered small market towns,

the largest of which is Richmond itself. Whilst, traditionally, the local economy has been centred around farming, it also has an important tourist industry, and a large part of the upland area is a National Park.

Salisbury and Darlington were the two areas studied by Bulman et al in the early 1960s (Bulman, J.S. et al., 1968), when they were selected for similar reasons. The inclusion of Salisbury and Darlington has the advantage of allowing some limited comparison between the two studies, separated by 30 years.

3.1.2. Age groups

A sample was drawn to represent all adults over the age of 60 in each area, but stratified into 3 groups depending on age. The date which was used for calculating ages was 1st January 1992. This had the advantage of falling in the middle of the study period, and of making calculation of ages very straightforward (they could be calculated by year of birth).

The age groups were as follows:

60-64 - as a representative group of the old middle aged population, who are at the oldest end of the dentate but heavily restored generation.
Year of Birth 1927-31.

65-74 - this group represents a transitional cohort between the heavily filled older middle aged and the still largely edentulous elderly.
Year of Birth 1917-26.

75+ - this group represents the predominantly edentulous elderly. The dentate in this group should give some qualitative indication of the dental problems of the future.
Year of Birth 1916 or earlier.

When the data from all 3 age groups in each area has been reweighted to correct for the natural age distribution of the population of 60+ year olds (see section 3.11.2.), it can be directly compared with that from the 55+ group from the 1988 Adult Dental Health Survey (which represents the same age cohort 4 years earlier).

3.1.3. Sample size

The size of the sample in each group was decided on the basis of advice from the Department of Medical Statistics at the University of Newcastle upon Tyne, and Miss Jean Todd from the Dental Practice Board (Eastbourne). The final estimate took into account the likely proportions of edentulous, gender variations and the combined prevalence of the major dental diseases as well as mortality rates and the expected response rate among those contacted.

The response rate was very difficult to predict in advance. A large study undertaken in Newcastle (Donachie, M.A., 1992) acted as a pilot for many of the techniques used in this research, including some aspects of sampling. This work had reported a response rate of around 50% and it was considered that this was the minimum that would be acceptable. A further important consideration was the number of deaths and likely absences from home over the period of the survey. These were taken into account in advance by using available mortality and census statistics and were added to the total. Table 3.1.1. shows the required sample size based on a final sample of 800 for each area. Due to the diminishing population size in the over 60 age group (as a result of the increase in mortality rate with age), it was necessary to stratify the sample into the three bands described above with similar numbers in each to ensure adequate representation of the oldest age group. The required sample was drawn on the basis of a target acceptance rate of 70%, with a reserve sample to be used if the acceptance rate was as low as 50% or if the sampling frame used contained inaccuracies leading to non-contacts. The latter was an unknown quantity and would remain unknown until a large number of subjects in all areas had been contacted.

Table 3.1.1. Required sample size for each area taking into account response rates, deaths and absences from address.

	60-64	65-74	75+	Total
Aim (intended final sample)	**250**	**250**	**300**	**800**
Required Sample				
- if response rate 70%	**357**	**357**	**429**	**1143**
- if response rate 50%	**500**	**500**	**600**	**1600**
Difference (=contingency)	**143**	**143**	**171**	**457**
Additional weighting to account for deaths and absences from home occurring after sampling				
- if response rate 70%	**12**	**25**	**90**	**127**
- if response rate 50%	**18**	**35**	**126**	**179**
Difference (= weighting for contingency sample)	**6**	**10**	**36**	**52**
Required sample (including weightings for deaths and absences)				
- if response rate 70% (=initial working sample)	**369**	**382**	**519**	**1270**
- if response rate 50%	**518**	**535**	**726**	**1779**
Difference (=final contingency sample	**149**	**153**	**207**	**509**
Total number of names	**518**	**535**	**726**	**1779**

The total sample list of names was drawn (i.e. assuming a 50% response), and then the contingency sample was removed, to be used if the response rate was below 70%.
In all cases the contingency sample was used in full

The numbers for the base sample were increased in advance to take account of deaths and absences from the address given. Deaths were estimated using mortality statistics. Absences from home (e.g. due to illness or institutionalisation) were estimated from census data.

Error due to list accuracy was an unknown factor and could not be estimated in advance.

3.1.4. Sampling frame and procedure

The sampling frame used was the register of the Family Health Service Authority (FHSA) for each of the three FHSA areas involved (Durham, Wiltshire and North Yorkshire). These contained all of the information required to make initial contact. The registers depend on the individuals concerned being registered with a local General Medical Practitioner. In the case of the over 60s this was felt not to present a problem as it was likely that almost everyone over the age of 60 would be registered locally, so the lists would represent an almost complete list of the over 60 year old population. The proportion of names on the register belonging to those who had died or moved in the recent, or even distant, past or whose details had been wrongly entered, was perceived to be more of a concern, but there was little that could be done to establish the scale of this in advance.

3.1.5. Localisation of the Sample

Boundary limits for all three areas were determined by using postcode areas. This was necessary as the FHSA boundaries for both the urban areas included substantial rural fringes which would be likely to alter the profile of the samples. For Salisbury and Darlington the lists of **all** medical practitioners whose practice addresses were in either of the towns were used. For Darlington this resulted in a sample almost totally limited to the town itself. In the Salisbury sample, a number of names with rural addresses (SP3, 4 and 5) also appeared on the lists. Further cleaning of the samples was undertaken by removing names with rural postcodes and replacing them with randomly sampled urban ones. These names were removed before the final sample was drawn so that the final list consisted solely of those whose addresses were in Salisbury town.

Richmondshire, being a large rural area, presented different problems. There was a possibility of missing a significant proportion of the population to be sampled in peripheral areas as a result of people being registered with medical practices lying outside its geographical boundaries. Consequently, rather than using the GMP's practice address as the basis of the sample, this sample was drawn using the postcode prefixes

DL8, DL10 and DL11. This ensured that the whole population was included in the sampling frame without compromising the principal of random selection. These areas cover almost the whole of Richmondshire with a small part of the adjacent rural Hambleton District. The one area not included was Catterick Garrison, which is a discrete district dominated by, and providing housing for, military personnel attached to the Catterick military base. Catterick Garrison is covered by postcode DL9, and because it was felt to be very atypical, it was excluded from the sampling procedure.

3.1.6. Randomization

The two urban FHSAs presented three complete lists, one for each age group. These were in the form of computer ASCII files and the details were transferred to protected files on the University's central computing facility. With the help of the Department of Medical Statistics, the lists were randomized by assigning a random number set equal to the total number of names, and then sorting the names in numerical sequence. Names and details could then be removed from the list in sequential batches as required. North Yorkshire FHSA were able to perform a similar randomization procedure (by assigning random numbers) to their register themselves. They then presented three finite samples (one for each age band) of the dimensions indicated in Table 3.1.1..

The names required for the samples were converted into a Database format. This was then mail merged using a word processing package in order to print out the initial introduction letter to the sample subjects.

3.2. ETHICAL APPROVAL AND CONTACTING LOCAL BODIES

After the full study protocol had been prepared, a number of local bodies were contacted both to inform them about and request their support for the study. Ethical approval was sought initially from the joint University and District Health Authority Ethics Committee in Newcastle upon Tyne. Once this had been obtained the three relevant District Health Authority ethics committees were approached, and their approval obtained. All of the appropriate Local Dental Committees and Local Medical Committees were informed of the survey. The General Medical Practitioners whose lists were to be used as a sampling frame were informed by individual letters and their support was canvassed. Local police, social services and branches of the charity "Help the Aged" were also informed about the study at the beginning of fieldwork. It had been intended, in the preparation stage, that the survey should be publicised widely (using the local press for example) so that some potential subjects could be familiarised with the concept of the study before they were contacted by the survey team. However, in view of advice from the police in one area where there had been a spate of "bogus callers", it was felt that although the risk of the survey being abused in such a way was small, the result (in terms of public trust and response rates) could be catastrophic. Copies of the letters sent to General Medical Practitioners and the Local Medical and Dental Committees are included as appendices 1 to 3, and a copy of the information sheet sent to all other bodies is enclosed as appendix 4.

3.3. PILOT WORK

Pilot work consisted of several parts. A previous study of a substantial sample of older adults living in Newcastle upon Tyne was conducted by Donachie in 1989 (Donachie, M.A., 1992). This acted as a path finder for much of the examination procedure and some aspects of sampling. The questionnaire was piloted separately.

3.3.1.Pilot work: sampling

The Newcastle study had used general medical practitioners' lists as a sampling frame and found that they provided a workable sample, containing all of the information required for a study of the elderly, specifically age and gender as well as names and addresses. Similarly the response rate obtained was found to be as good as could be expected for such a group (and it provided a reasonable guide to the final response rate in this study). One potential problem which was identified was that the use of only a limited number of practice lists (as was the case in the Newcastle study) could not be guaranteed to give a representative social mix of an area, particularly one as large as Richmondshire. This issue was addressed prior to the sampling procedure already described and led to the use of the regional FHSA lists.

3.3.2. Pilot work: clinical examination and diagnostic criteria

The study of Newcastle subjects (Donachie, M.D., 1992) used many of the diagnostic criteria used in this study. A number of specific problems were raised in the light of the Newcastle work and these were subsequently remedied. These concerned difficulty in distinguishing between low tooth wear scores, problems with the measurement of loss of attachment and recession, and over complexity in the scoring of complete dentures. A general tightening of the criteria was also required to ensure that there was less room for misinterpretation when they were used by more than one dentist. New criteria were developed and piloted for areas which the Newcastle study had not covered, these included some aspects of the periodontal examination, tooth contacts and soft tissue pathology. When changes were made in the light of previous experience, they were then piloted on a selection of older patients drawn from the treatment clinics of the dental hospital, to ensure that the alterations were appropriate and workable.

3.3.3. Pilot work: questionnaire

A number of questions were specifically designed for the survey but many of those used had been validated and used in previous studies. Minor modifications to some of these questions were required in order to make them more appropriate for the present study, but this was kept to a minimum. Details of the sources of questions are given in section 3.8.. The full questionnaire was piloted on a selection of older individuals. Initially these were patients in the Newcastle Dental Hospital, but subsequently a number of elderly people who attended clubs for the over 60s were interviewed in the field. This process allowed all questions (particularly the new ones), to be assessed, and a number of questions were deleted, reworded or moved following this procedure.

3.4. PERSONNEL AND TRAINING

3.4.1. Personnel

A study of this magnitude required personnel to undertake much of the clerical work, to act as Dental Surgery Assistants (DSAs) during visits, and to conduct the questionnaire. In addition, with around 2,400 detailed examinations to be undertaken within an acceptable time scale, two dentists were required in each area. In all cases the author undertook around half of the examinations. The other half were performed by a dentist from the local community dental service (a senior dental officer in each case). They were as follows:

Darlington	- Hilary Smith
Richmondshire	- Pat Ludiman
Salisbury	- Denise Mattin

Two DSAs for each of Richmondshire and Salisbury worked part time to share the workload of clerical and visiting duties. In Darlington, one DSA (working 4 days a week) undertook almost all of this work herself with some clerical assistance provided in the second half of the survey period.

3.4.2. Training the examiners

All four examiners attended a four-day intensive training block in Newcastle Dental School in late May 1991. For the last two days of this period they were joined by the dental surgery assistants who were to work on the project.

Training for the clinical examination was split into four main sections, and one full session was devoted to each. These were:

1) Coronal and root surface caries
2) Tooth wear, tooth contacts and spacing
3) Periodontal disease

4) Complete denture assessment

The subject of soft tissue disease was considered to be too wide to cover in sufficient detail, but where cases of denture related pathology were found, these were included as part of the training. For each assessment the training was co-ordinated to coincide with an appropriate consultant referral clinic to attempt to ensure sufficient throughput of patients. Additional dentate elderly subjects were recruited from a number of local over 60s clubs and centres. Nevertheless, finding sufficient elderly patients with teeth and dental disease who were willing to be examined by four different dentists was a problem.

After preliminary discussions and training using dental models and suitable photographic material, clinical cases were examined. Each examiner rotated around three or four patients and completed an examination form. The forms were examined and levels of agreement were compared. Patients remained in the chairs so that the group could return together to discuss and re-examine areas of disagreement. This process was then repeated on at least two further groups of three or four patients, with the diagnostic process being repeated each time. After each of the four specified sessions, two further sessions were used to tighten up the diagnostic procedure in areas where disagreement had been highest (root caries, periodontal disease and tooth wear were covered again).

One final "field" session was undertaken at a work centre for the elderly in Elswick, Newcastle. Further denture examinations were undertaken in addition to examination of dentate individuals in field conditions. Seventeen denture wearers were examined by all clinicians on this occasion. A final meeting was held to clarify various problem areas in both the examination and questionnaire procedure with both dentists and assistants present.

Examiners were encouraged to regularly practice examinations with their DSAs until the survey began. This was important as there were last minute delays to the start of the fieldwork in all areas due to sampling difficulties.

3.4.3. Training of the Dental Surgery Assistants

The assistants scheduled to work on the project attended for the second two days of the training period. Training was given in interview technique and the questionnaire was examined and explained in detail. All DSAs then had the opportunity to run through the questionnaire in pairs with the elderly individuals who took part in the clinical training exercise. The DSAs could then offer a critique of each others performance. Further experience in interviewing was gained during the field exercise.

Further tightening of questionnaire technique was undertaken during the first few days of the survey when the author sat in on some of the early interviews and was able to sort out any remaining misunderstandings or problems of technique. This monitoring process was maintained on an occasional basis throughout the survey period to ensure that standards and standardisation were maintained.

3.5. ARRANGING THE DENTAL VISIT AND FOLLOW UP OF REFUSERS.

The data collection period ran as follows:

Darlington:	September 1991 to August 1992
Salisbury:	July 1991 to May 1992
Richmondshire:	July 1991 to August 1992

3.5.1. Contact

Each subject in the sample was sent an initial letter inviting them to take part in the survey and explaining it's purpose briefly. A copy of this letter is included as appendix 5. Letters were sent out in batches in order to allow reasonable control of the appointment system. All of the local general medical practitioners, from whose lists the names were drawn, were contacted and asked for a letter of support which could be copied and sent out with the introductory correspondence to the patient. The primary reason for this letter was to reassure the patient that the study was *bona fide*. In most cases this letter was supplied and the beneficial effects were often apparent at the time of the visits. One practice in Richmondshire (two doctors), one in Darlington (two to three doctors), and two in Salisbury (three doctors) did not supply letters despite follow up. In addition, due to an early administrative problem, only a small proportion of the first batch of letters sent out in Salisbury included a doctor's letter. This batch was exclusively sent to over 75 year olds and may have affected the response rate in this sample significantly. About two to three weeks after the letters were sent out, subjects for whom a telephone number could be found (using the local telephone directory) were called and asked if they would be willing to take part. Those who accepted were given an appointment time, and refusers were noted.

In the event of being unable to contact the subject, the telephone call was repeated on a minimum of two **further** occasions, at different times of the day. If no contact could be made after three telephone calls, at least one personal call was made by the dental surgery assistant. If the subject still could not be contacted no further attempt was made and the subject listed as a "non-contact". In cases where no telephone number was available (either because the individual did not have a telephone or because they were ex-directory) a further letter was sent to name a date and time (usually just given as am or pm) when one of the assistants would call to arrange a full dental visit. In the high proportion of cases this elicited a response before the call was made (the subject contacted us) which streamlined the procedure. If no contact was received the visit was made. If the person was still not contactable after one visit, at least one more house call was made, usually without prior warning. If there was still no contact the person was listed as a "non-contact". In some cases, additional enquiries could be made with neighbours or the local post office (the latter was particularly useful in remote Richmondshire villages) to establish the person's whereabouts. Where such information was forthcoming it was followed up in the same way as before, providing it was appropriate to do so.

3.5.2. Information on refusers

A fairly high proportion of the sample were expected to refuse to take part in the survey, and this raised the possibility of substantial sampling bias. In order to assess the scale of this, a simple, anonymous, two question questionnaire with a covering letter was sent to the refusers at the end of the study. These are included as appendices 6 and 7. Initially this was only sent to the one group with a very poor response rate (75+ in Salisbury), but the high response rate to this questionnaire and the results from this group suggested that more widespread circulation would be valuable. This was a relatively expensive and time consuming procedure so this exercise was limited to six of the nine age/area sub-groups. This accounted for all refusers aged 65 or over in all areas. The refuser profile of those in the 60-64 age group was expected to be similar to that for the 65-74 year olds (who had a very similar response rate). It also ensured that all of the groups with the lowest response rates were included.

In order to maximise the response rate to this postal enquiry, the questionnaire was limited to two key questions: one to establish whether or not the subject was dentate, and the second to determine the normal dental attendance behaviour of the refusers. The wording of the latter question was identical to that used on the main study questionnaire. Data on the gender, age and postcodes of the refusers was already available. Although information on social class would have been desirable, obtaining sufficient information to determine this accurately from the questionnaire would have complicated the document considerably and ran the risk of reducing the response rate.

3.6. THE PROCEDURE FOR THE DENTAL VISIT

Once an appointment for a dentist to visit had been made, the procedure followed was standardised. Each visit lasted around half an hour (if the patient was edentulous) and three quarters of an hour if they were dentate, but times varied enormously, between 20 minutes (for the busy or curt) and well over an hour (for the lonely, deaf or conversational). On arriving at the home, the dentist would give a brief description of the nature of the study and explain the background to it. Written consent was then obtained using a consent form separate from the main questionnaire (see appendix 8). This was followed by Section 1 of the questionnaire conducted by the dentist, an examination of the mouth and denture (where present), and then a final questionnaire conducted by the assistant. At this point it was normal for the examiner to leave the house in order to avoid the possibility of biased responses as a result of the dentist's presence.

The full examination was undertaken in every case, unless the patient was in one or more of the following categories:

- any history of rheumatic fever
- any history suggesting valvular heart disease
- any history of a joint replacement

If the subject fell into any of these groups the periodontal examination was not carried out in view of the risk of inducing a bacteraemia. Although this may seem unnecessarily restrictive, it was felt that where the patient was not going to benefit directly from the examination, no risk was ethically acceptable if it was avoidable, even if it is barely significant.

Each examination covered the following areas, usually in the order given, although different examiners may have varied the sequence slightly to suit individual preferences.

1) Coronal surfaces of all natural teeth for caries and restorations
2) Root surfaces of all natural teeth for caries and restorations
3) Wear of cervical and coronal surfaces of all teeth
4) Pocket depth, loss of attachment, the presence of calculus and bleeding on probing were recorded for two sites on each tooth. The presence of furcation involvement and mobility were also recorded for each natural tooth.
5) Contacts between natural lower posterior and natural upper posterior teeth.
6) Presence of spacing in the anterior region
7) Clicking, crepitus or tenderness of the temporo-mandibular joint
8) Soft tissues of the oral cavity
9) Partial dentures
10) Complete dentures

A list of instruments and equipment is given in appendix 9. Clean instruments were required for each examination and sufficient kits were carried to allow this. All instruments were then cleaned, autoclaved and bagged at the end of the day, ready for the next days examinations. Only a limited number of Willis and Alma Gauges were available and as these were for extra-oral use only, these were wiped down with alcohol wipes after each use.

3.7. THE DIAGNOSTIC CRITERIA FOR THE EXAMINATION

Where possible and appropriate, existing diagnostic criteria were used as a basis for the criteria in this study. However, whilst those available are appropriate for the groups for which they have been designed, usually children or younger adults, they often required modification for use in an elderly population. The examination form is included at the end of the questionnaire as appendix 10.

3.7.1.Coronal decay and restoration

Diagnostic criteria for coronal surfaces were based on those given in the WHO document *Oral Health Survey; Basic Methods* (WHO, 1987), those used in the Adult Dental Health Survey (Todd, J.E. & Lader, D., 1991) and those described in the British Association for Community Dentistry (BASCD) document *Information needs for monitoring dental health and for planning local dental services* (BASCD, 1991). The criteria for identifying decayed teeth and unsound restorations are very similar in all three documents. Some categories used in the publications above were not required, specifically a code for sealant restorations and a group of codes used to identify materials used for various restorations was felt unnecessary. As surface data was being recorded, no code for "decayed plus filled" was included, for simplicity only one code was used for all cases where caries and restorations occurred together. Similarly, no code for "arrested dentinal decay" was used, any such surfaces were coded as sound. However, it was felt necessary to introduce one code, to distinguish between satisfactory and unsatisfactory crowns. This part of the examination was conducted with a sickle probe blunted to 0.2-0.3mm.

For this part of the examination the coronal and root surfaces were examined separately. Each surface was coded according to the criteria given below. The examination was primarily visual with the blunted sickle probe used solely for the removal of plaque and debris and for gentle probing of certain lesions. The probe was not routinely inserted into the pit and fissure systems of the teeth and was intended for the removal of plaque and debris and to detect the surface texture of certain lesions.

Coronal surfaces were scored as follows (the number or symbol indicates the code inserted on the form).

Missing: - (dash or minus sign)

Indicated that the tooth was missing, for whatever reason.

Sound:(0)

Surface was present, but was not carious or restored as defined by codes below.

Carious - restorable: (2)

A carious cavity was present which, taking into account the patients oral status, was deemed to be restorable. The criteria for diagnosis of a carious cavity were :

Pits and fissures - Breakdown of the walls of a pit or fissure or shadowing beneath the enamel surface, detected visually after cleaning with a probe. Stained fissures were not necessarily designated as carious.

Approximal surfaces - A cavity with a soft floor detected by gentle probing, or brown/grey shadowing detected visually from the buccal or lingual, or occlusal aspects.

Smooth surfaces - A cavity with a soft floor detected by gentle probing.

Arrested caries, appearing dark brown/black and having a hard floor was not designated carious, neither were hard floored hypoplastic pits.

Carious - exposed/unrestorable: (3)

A carious cavity, as defined above, which was considered to be so extensive that (a) there is pulp involvement or (b) restoration is not possible, bearing in mind the present dental health status of the subject. This may include frank pulpal exposure or deep decay without visible exposure or obvious pulpal involvement. This should include teeth which are so carious or broken down that they are deemed to be unrestorable, even where little or no coronal tissue remains. All surfaces involved were coded in these cases.

Restored - needs replacement: (4)

Presence of one or more restorations which require further treatment. This may have been due to:

a) Caries, whether or not it was associated with the restoration.

b) The presence of a temporary filling

c) Grossly defective permanent restoration, with deficient or overhanging margins that could not be satisfactorily improved by adjustment, or the presence of a fracture, whether or not the restoration was mobile.

<u>Restored - satisfactorily</u>: (5)

One or more restorations whose margins were intact and not associated with caries, and which did not require further treatment as defined by the code above. A permanent restoration may have been amalgam, composite, glass polyalkenoate, gold or porcelain.

<u>Crown - satisfactory</u>: (6)

Presence of a satisfactory full or partial veneer crown which did not fulfil any of the criteria listed below.

<u>Crown - unsatisfactory</u>: (7)

A full or partial veneer crown is present which was considered to be unsatisfactory. This could be due to:

a) Caries at the margin

b) A positive margin which could not be satisfactorily reduced with a bur (in the opinion of the examiner).

c) A grossly overcontoured crown.

d) A crown preparation was present and satisfactory, or could be made to be satisfactory, but the crown had been lost.

e) A deficient margin into which a probe could be inserted.

<u>Bridge pontic</u>:(8)

The presence of a bridge pontic replacing a single tooth.

<u>Root retained but surface missing/unscorable</u>: (*)

This included overdenture abutments or (for example) severe wear where the surface has been completely lost. This should not include cases where there has been extensive carious destruction leading to complete surface loss (e.g. gross caries or large filling missing). In these cases the appropriate caries/restoration code should be applied.

In cases where the tooth was rotated, the anatomical surfaces were scored, not the position that the surfaces had assumed. If a permanent restoration extended onto more than one surface, it was scored as present on all surfaces on which it appeared.

3.7.2. Root surface decay

Coding for root surface caries and restorations was rather more of a problem. A number of specific problem areas exist for which there were no standard guidelines when the study was in preparation. These problems were:

1) Root surfaces which are exposed but completely or partially covered by calculus.

2) Root surfaces which are restored, but where the restoration extends onto the crown. In these cases it may often be unclear where the disease (for which the restoration was placed) originated.

3) Root surfaces which have been restored as a result of cervical wear rather than root surface caries.

These problems required specific criteria to be formulated using existing literature and considering the needs of the survey. The diagnostic criteria used to distinguish non-carious, from carious, and sound restorations from unsound ones were based on those used by Katz (Katz, R.V., 1986) and the UK Adult Dental Health Survey (Todd, J.E & Lader, D., 1991).

This part of the examination was conducted using the same sickle probe as was used for coronal surfaces. The 0.2-0.3mm tip was found to give sufficient tactile information to judge the texture of root surfaces during pilot work on extracted teeth. The criteria used were as follows:

Missing:(0)

As for crowns

Gingival recession/exposed root - sound: (1)

The gingival margin was below the CEJ exposing some root surface. The exposed root surface was sound, with no evidence of restoration or caries.

Gingival recession/exposed root - caries: (2)

Exposed root surface was carious as detected visually by yellow/brown discolouration and a softened floor on gentle probing. In the case of a large lesion which crossed the CEJ, the observer was asked to make a judgement about its origins and code it appropriately.

Gingival recession - root surface caries with exposure:(3)

Root surface caries was present which clearly involved, or was strongly suspected of directly involving the pulp.

Gingival recession - surface restored - requires replacement: (4)

Exposed root surface contained one or more permanent restorations which required complete replacement. This may have included:

a) Caries associated or not associated with the restoration(s).

b) Temporary restoration (e.g. Zinc Oxide and Eugenol, polycarboxylate).

c) Grossly defective or overhanging restoration which would need to be replaced to make them satisfactory.

Further details of what restorations were classed as being *root surface* are given below under code 5.

Gingival recession - satisfactorily restored: (5)

Exposed root surface containing one or more permanent restorations whose margins were intact and were not associated with caries. A permanent restoration was defined (regarding material) as for crowns above. Coronal restorations (with the important exception of full veneer crowns) which extend onto the root surface for 3mm or more were coded as a filled root surface, coronal restorations extending onto the root surface for less than 3mm were coded as purely coronal, and the root surface dealt with separately.

Where a restoration, which is primarily a root surface restoration, encroached onto the coronal tissue (above the CEJ), it was coded as a root surface restoration but not as a coronal one. In some cases where a restoration straddled the cement-enamel junction a subjective decision had to be made as to whether it is primarily a crown or a root restoration.

Gingival recession - arrested caries:(6)

Exposed root surface contains an area of decay which was considered to be arrested, as indicated by the presence of a hard dark brown/black floor, resistant to gentle probing.

Present - unscorable: (*)

The tooth was present, but the presence of recession could not be judged. If any root surface was visible it was scored appropriately, even where there is extensive calculus, as caries is considered rare under calculus. Only if it was unclear whether any recession had taken place was the unscorable code used. This may have been because there was a crown or total coverage of calculus making it impossible to assess the status of the root. If some exposed root surface is present, clearly recession has taken place.

In some cases there was more than one possible code per surface. As it was impossible to multicode, a convention for priority was worked out. This was as follows:

Primary caries > Secondary caries/restoration requiring replacement > Sound restoration > Exposed root > no recession > unscorable.

3.7.3. Tooth wear

The index and diagnostic criteria used for the measurement of tooth wear were a modified version of those devised by Smith and Knight (Smith, B.G.N. & Knight, J.K., 1984b). Cervical, buccal, occlusal and lingual surfaces were scored, although in the analysis cervical data is presented separately. The original index has five grades (0–4) to indicate the amount of tooth substance lost due to wear. It is intended to compare the score for each surface of each tooth with a matrix of normal scores for each age band, to detect "pathological" wear. The existing index was simplified considerably after discussions with Dr Nigel Robb and Mr Martin Donnachie who had recently used it in two large population studies including studies of tooth wear. The 3 lowest scores were combined to make just two. The criteria used are presented below. The teeth are gently dried with a piece of gauze, and then examined visually, a probe may be used to remove loose deposits and to aid diagnosis, particularly where there may be difficulty scoring in the cervical region. Teeth are examined surface by surface, in the order: cervical, buccal, occlusal, lingual. The teeth were scored as follows:

Score	Surface	Criteria
-	All	Tooth missing
0	All	Wear not into dentine or no distinct cervical cavity.
2	B/L/Occ	Loss of enamel just exposing dentine
	C	A definite defect present but less than 1mm in depth.

3	B/L/Occ	Loss of enamel exposing dentine for more than one third of the surface.
	I	Loss of enamel and extensive loss of dentine, but not exposing secondary dentine or pulp.
	C	A defect 1-2mm deep
4	B/L/Occ	Complete loss of enamel, or pulp exposure, or exposure of secondary dentine.
	I	Pulp exposure or exposure of secondary dentine
	C	A defect more than 2mm deep, or pulp exposure or exposure of secondary dentine.
*	B/L/I	>75% of the surface obscured by decay, calculus, fracture or restoration.
	Occ	>75% obscured and no remaining functional cusp.
	C	If any restoration, decay or calculus is present at the depth of a cervical abrasion, then this is scored *. If the depth of any abrasion lesion does not coincide with an existing restoration or lesion this may be scored 0-4 as above.

Where doubt existed the lower score was given. Where tooth wear was present on two or more contiguous surfaces, all the surfaces were scored separately.

3.7.4. Periodontal Disease

Pocket depth, loss of attachment, the presence of calculus and bleeding after probing were measured at two sites on each tooth. In the upper arch mesio-buccal and mid-buccal sites were probed, in the lower mesio-lingual and mid-lingual sites were examined. the choice of sites was made after careful consideration of the sites used in the Adult Dental Health survey and the work of a number of other authors (Ainamo, J. et al., 1982; Carlos, J.P. et al., 1986; Pritchard, J.R. & Laws, A.J., 1984; Todd, J.E. & Lader, D., 1991). Probing and measurement were carried out using a CPITN type C probe. These have markings at 0.5, 3.5, 5.5, 8.5 and 11.5mm. Where pocket or loss of attachment measurements lay between the probe gradings, the recordings were estimated, but in the final data analysis the probe gradings were used as the thresholds for analysis, so there should have been no loss of accuracy. In addition to the measures noted above, mobility and furcation involvement were also recorded. The diagnostic criteria are described below:

Pocket depth and loss of attachment: (in mm)

Probing was very gentle (25g force). When necessary, loose debris was cleared from the gingival margin using the probe. For pocket depth measurements the unscorable code was used only where the pocket could not be probed due to discomfort or difficulty with access. In the case of loss of attachment, the surface was recorded as unscorable if the CEJ could not be located accurately due to gross decay, wear or the presence of a restoration. If the position of the CEJ could be reasonably assessed, the total loss of attachment was measured. For surfaces where either of these measurements were 10, 11 or 12mm the codes W, X, or Y should be recorded. If any measurement was 13mm or greater it was coded Y.

Calculus: (present - 1, absent - 0, unscorable - *)

Calculus was detected using the ball on the tip of the CPI probe at each examination site, and by direct vision. Sometimes it was difficult to differentiate between sub-gingival calculus and a restoration with a poor margin, if this was the case it was scored as "present", as both can predispose to plaque retention.

Bleeding: (present - 1, absent - 0, unscorable - *)

The presence of bleeding was looked for after probing a quadrant as it may take several seconds for blood to appear at the gingival margin. The patient was discouraged from swallowing before the scoring of bleeding had been completed.

Furcation involvement: (Absent - 0, Present but not through and through - 1, Through and through lesion - 2 , Unscorable - *)

Clearly furcation involvement could usually only be recorded easily for molar teeth, however if a furcation was present on any other tooth the space was available to record it on the form. One furcation score was recorded for each tooth.

Mobility: (Less than 1mm movement horizontally - 1, Greater than 1mm, horizontal only - 2, Horizontal and vertical movement - 3, Unscorable - *)

This was measured using a finger at one side of the tooth to detect movement while a rigid instrument (e.g. a mirror handle) was applied to the other, the tooth was then very gently wiggled.

3.7.5. Posterior tooth contacts (present - 1, absent - 0)

A visual examination of the teeth in contact was made with the help of the mouth mirror and the teeth in the lower arch which had an opposing contact were noted on the chart. The presence and position of any contacts between upper and lower teeth were recorded. This was restricted to premolar and molar teeth only. The lower arch was used as the "index" arch. Lower teeth with an opposing contact were coded as 1, those with no contact, or where the tooth was missing, were coded as zero. A *contact* was defined as "a contact between the lower tooth and an opposing upper tooth in intercuspal position, except on rare occasions where there is a *scissors* like occlusion and the point of contact would not provide any occlusal stop".

3.7.6.Spacing (none - 0, unrestored - 1, restored - 2)

All anterior spacing was recorded. An anterior space was defined as any space of greater than a half the width of the tooth expected in that position, in the upper and lower anterior regions (between upper and lower second premolars). Spaces were recorded in relation to their position, not according to the missing tooth (assuming there was a missing tooth). In other words, a space at upper left canine position does not necessarily mean that the upper left canine is missing. Spaces were recorded as restored if the space was normally filled by a partial denture or bridge, or unrestored if it was not.

3.7.7. TMJ examination and soft tissues (scoring system given below)

The temporo-mandibular joints were palpated to detect tenderness and then the jaw opened and closed two or three time with the observer's index or middle fingers touching the skin over the joint to feel for clicks or crepitus. In all cases code 0 represents a negative finding, 1 represents left side only, 2 the right side only, and 3 bilateral.

A brief visual examination of the lips and perioral tissues preceded intra-oral examination. Most intra-oral areas can be visualised easily during the dental examination, however several areas were visualised specifically. These were: -

1. Floor of mouth. A piece of gauze is used to hold the tongue and it is gently lifted and deflected to right and left.

2. Mucosal surface of lips. The upper and lower lips are gently inverted to visualise.

3. Buccal sulci. The mouth is half closed and the cheeks gently retracted.

4. Soft palate - visualise directly.

The examination procedure was based on that recommended by WHO (WHO, 1980), although one mouth mirror and a gloved finger were used in preference to two mirrors.

Only a small number of conditions were listed specifically, and these were all *denture related* lesions. The coding was Yes (present) - 1, No (absent) - 0.

The three types of denture stomatitis were based on a classification first described by Newton and modified by Budtz-Jorgensen (Budtz-Jorgensen, E. & Bertram, U., 1970; Newton, A.V., 1962). Denture stomatitis was classified as patchy (simple localised inflammation - type I), generalised (simple diffuse inflammation - type II), or granular (papillary hyperplasia - type III).

Angular cheilitis was defined as inflammation with or without cracking localised to one or both commissures.

Denture hyperplasia was defined as a firm enlargement of the vestibular mucosa, clearly related to the flange of a denture.

"Ulcer associated with denture trauma" applied to any ulcerated lesion which was believed to be due to trauma alone and not any other pathological process (e.g. malignancy).

Other soft tissue disease was noted and where possible a provisional diagnosis was made, but it was impractical to train the examiners in diagnosis for this part of the examination due to the diversity of possible lesions, and the rarity of many of them. Furthermore, the previous experience of the examiners varied enormously, so the ability to make a diagnosis based on clinical experience was obviously inconsistent. However, examiners were asked to note and describe anything, even if they did not feel confident to give a provisional diagnosis.

3.7.8. Partial Dentures

Diagnostic criteria for these partial denture data where criteria were required, is given below:

Do the dentures replace all missing teeth? (no - 0, yes - 1)

If extractions had been undertaken since the denture was constructed, without alteration to the denture, this was scored "no". This question did not mean that the denture had to replace third molars, or even second molars for that matter, but referred to gaps that were unfilled for the reason given above.

Are the soft tissues affected? (no - 0, yes - 1)

The denture bearing area was examined, and any destructive effect that the denture was having on these tissues was noted. Only conditions related to the wearing of partial dentures were assessed (e.g. marked periodontal destruction, tilting, caries on abutment surfaces), not those conditions common to both complete and partial dentures (e.g.denture stomatitis). The findings were recorded separately for each jaw.

Kennedy Class (I - 1, II - 2, III - 3, IV - 4)

Kennedy classification (Kennedy, E., 1942) was recorded but, in order to keep it simple, only the basic divisions (I to IV) were used. The codes recorded did not include provision for modifications.

- I (two free end saddles)
- II (one free end saddle)
- III (no free end saddles, one or more posterior teeth replaced)
- IV (Anterior teeth only replaced)

The other partial denture variables recorded were material, support, retention, and the presence of missing anterior teeth (canine to canine). These are self explanatory (see examination form; appendix 10).

3.7.9. Complete Dentures

Diagnostic criteria for the complete denture (data where criteria were required), are given below:

Ridge form (adequate - 1, poor - 2)

Adequate ridges were recorded where there was a definite bony ridge which could resist lateral and anter-posterior movement of the dentures, even if the ridge was relatively low or irregular. Poor ridges were those which were atrophic, flabby or inverted.

Matching set (no - 0, yes - 1)

This referred to whether the dentures which were normally worn were made to match each other (i.e. they were made as a pair, or one denture was made against an existing opposing denture). A non-matching pair was where a lower from one set was worn against an upper from a different set. Where there was any doubt this question was scored as yes.

Occlusal wear (satisfactory - 1, excessive -2)

Upper and lower were scored separately. Excessive wear of the denture teeth was where all occlusal morphology was lost on the posterior teeth, or only the remnants of the fissure pattern remained. Alternatively, wear of the anterior teeth, such that over one third of the crown height was lost was also considered excessive.

Defects (none - 1, missing anterior teeth - 2, rectifiable by repair or rebase - 3, requires remake - 4)

This refers to actual physical defects of the substance of the denture, i.e. fractures, missing teeth, rather than to any fault which had already been scored. *Missing anterior teeth* referred to where there were artificial teeth missing from the denture between first premolar and first premolar. *Rectifiable by repair or rebase* was where missing teeth occurred (up to 3) or there was a simple fracture or minor defect in the denture base. *Requires remake* implies an irretrievable situation where the denture defect cannot be satisfactorily repaired.

Upper anterior tooth position (adequate - 1, too anterior - 2, too posterior - 3)

The tips of the central incisors should be 5 -10mm anterior to the centre of the incisive papilla. Greater than this was scored as too anterior, less as too posterior. This was measured using an Alma Gauge.

Lower posterior tooth position (adequate - 1, lingual - 2)

The lower posterior teeth should be aligned over the ridge without any lingual undercut. Although buccal placement is technically incorrect, the clinical implications are limited. For this reason the tooth position was recorded as adequate (which included buccally placed teeth) or lingual. *Lingual* was scored where the tooth position was lingual uni- or bilaterally. In the cases of lingual tooth position, the presence or absence of any cross bite was noted.

Adaptation (adequate - 1, inadequate - 2)

The scoring in this case was highly subjective. The dividing line between what was acceptable and what was not was not clearly defined, and account was taken of the quality and mobility of the ridges and the denture bearing areas. Index fingers and thumbs were placed either side of the premolars and rotatory, and lateral forces applied. Where movement over the tissues was greater than considered acceptable, taking into account the denture bearing area, then the adaptation was considered inadequate. Clearly the denture bearing areas were examined prior to this assessment.

Retention (Adequate, Inadequate, Unrecordable)

In the upper, index fingers were carefully placed in the premolar areas, taking care not to stretch the cheek excessively and break the peripheral seal, and gentle vertical downward pressure exerted. Retention was coded as adequate when resistance to removal was felt and when there was audible or tactile evidence of the peripheral seal being broken. In the lower the index finger and thumb of one hand were used to grip either side of the central incisors and gentle upward force exerted. Retention was coded as adequate when some resistance to removal was felt. No evidence of the seal breaking was required.

Extension (adequate / underextended - 1, overextended - 2)

The denture was examined *in-situ* by gentle manipulation of the cheeks and direct visual examination of the distal extension. The patient was also asked to protrude the tongue. The denture was scored as overextended where overextension leading to displacement of the denture on examination, or soft tissue damage was present. Criteria were identical for upper and lower denture.

Occlusal relationship (adequate - 1 , inadequate - 2)

The occlusal relationship was recorded by establishing the rest position of the mandible and then supporting the lower denture with the index fingers and asking the patient to close together, where necessary with gentle guidance to ensure that closure was along the retruded arc. The relationship was recorded as inadequate if there was a slide of greater than one quarter cusp length (1 - 1.5mm approx.) into intercuspal position from first contact OR if first contact was uneven, leading to displacement of the dentures on further closure.

Free way space (satisfactory - 1, excessive - 2, too little - 3)

Free way space was measured with a Willis Gauge. A measurement was taken with both dentures in place and in intercuspal position, and then a measurement was recorded with the lower denture out, and the patient in the rest position. 2-6mm was considered as normal range, <2mm as too little, and >6mm as excessive.

3.8. THE QUESTIONNAIRE

The questionnaire recorded information on some one hundred and twenty variables, although no subjects were asked every question. Some sections only applied to the dentate, others to the edentulous and many to both. A copy of the questionnaire is included as appendix 10. It comes in 9 sections which are briefly described below

Section 1 includes the subject's basic details (age, gender, postcode, identification number and record number for computing purposes). The identification numbers were designed so that the first digit was constant for each area and examiner, and the remaining three digits are the subject's personal identification. The remaining questions covered various medical conditions, drug usage, the presence of specific symptoms, self assessments of health and an index of disability. The questions on medical health and drug usage were formulated specifically for this survey. Those on disability were derived from Isaacs (Isaacs, B. & Neville, Y., 1976) and Bond (Bond, J. & Carsairs, V., 1982) after advice from Dr John Bond and Mr Graham Farrow in the Centre for Health Services Research at Newcastle University. The question on medication usage asked the examiner to enter a code specifically to indicate whether any of the drugs used had a known, potent, xerostomic effect. The criteria used to determine this are given in appendix 11.

Section 2 was split into two parts, the first asking about complete dentures, the second about various aspects of edentulousness. Most of the denture questions refer either to specific aspects of history, or to levels of discomfort and satisfaction. This was completed by anyone who wore a complete denture, even if it is only in one arch. The second part referred only to those with no teeth. Inevitable problems of interpretation arose with individuals who had dentures but never wore them. In these cases, if the patient literally never wore the dentures, any dentures the patient owned were not examined, but the questions were asked (there is provision to note their non-wearing in the questionnaire). Upper and lower dentures were considered separately for most aspects of history. Questions in this section were designed specifically for this survey or were previously used in the Adult Dental Health Survey.

Section 3 and 5 only applied to dentate individuals and covered various aspects of history and behaviour of relevance only to the dentate, including history of dental pain, hygiene behaviour and partial denture wearing. Some questions were designed specifically for this survey others came from the 1988 Adult Dental Health Survey.

Sections 4, 6, 7 and 8 applied to all subjects and came from three sources. Some were designed specifically for the survey and, as above, some came from the 1988 Adult Dental Health Survey. Questions on satisfaction and function were derived from a questionnaire on the dental impacts of daily living, kindly given by Anna-Theresa Leao, from the Department of Epidemiology and Public Health, University College London.

Section 9 concerns various aspects of the subjects social position, specifically relating to age, income, marital status and employment. Problems arise when attempting to socially classify elderly people. The 1981 Registrar General's classification (OPCS, 1980) was used as it was straightforward, appropriate and directly compatible to the 1988 Adult Dental Health Survey. Advice on exactly how this classification should be applied was given by sociologists at the Centre for Health Services Research of Newcastle. Normally, it is applied to the head of the household, but many individuals, particularly elderly women, would live alone and their own occupation (or previous occupation), if any, may not be an accurate reflection of their social status through most of their lives. Consequently, the classification was made according to last full-time occupation (if male or had been a single woman living independently throughout life), or husband's last full time occupation in the case of married women or widows. Only long term widows and divorcees presented any problem and in these cases, if the husband's last full time job was felt inappropriate, then the classification was based on their own occupation. Single women who had been dependent through life were classified according to the head of the household through life.

These criteria worked satisfactorily, both in pilot work and in the field. The occupation was entered on the form by the interviewer and was then classified by the examiner after the visit. It was then double checked by the author prior to entry onto computer.

3.9. INTER-EXAMINER VARIABILITY

A proportion of the subjects in each area were re-examined by the other examiner. A minimum of twenty dentate and 10 edentulous subjects were examined by both dentists in each area to measure inter-examiner variability.

A proportion of the subjects were asked at the time of the first visit whether they would mind a revisit. If they agreed they were subsequently contacted to arrange a visit and were at that time instructed about the procedure. The revisits were conducted "blind" to try to minimise any bias introduced because it was a revisit. Almost all revisits were conducted within a month of the original visit and if dental treatment had been carried out in the interim, the examination was not undertaken (unless the subject had only received a check-up or very minor treatment). The revisit could either be conducted by the author or the "regional" examiner.

The procedure followed was identical to that for the original visit, but was terminated by the dental surgery assistant at the end of the clinical examination. All relevant clinical data were collected. Statistical analysis of these data is covered in section 3.11.1..

3.10. DATA ENTRY, VERIFICATION, CLEANING AND CONSISTENCY CHECKING

Data from the survey was entered onto the University's central computing facility as it arrived between August 1991 and August 1992 by the data preparation service at Newcastle University.

The data files completed by the data preparation service were in the form of straightforward ASCII text files. In order to facilitate analysis these were converted in to system files which could be analysed by the statistical programme SPSSx (SPSS inc., Chicago Illinois, 60611, USA). A series of such files were produced to ensure flexibility of working and file security.

Data cleaning and verification took place at four separate stages.

1. All forms were checked by the examiner after the examination. This was to ensure that every box which required to be completed was completed, and that all the key variables had been entered correctly (e.g. age, social class, gender and dental status). This procedure normally took place in the car after the visit.
2. At the data entry stage all forms were entered and then verified (i.e. re-entered) and any inconsistencies between entries were corrected. This procedure is intended to minimise keystroke errors and was undertaken by the data preparation service.
3. Data files were then checked visually. This was done by checking pages on screen to ensure there were no missing lines, searching for incorrect symbols using a text editor and checking printouts of key variables to ensure that all of these were present.
4. A series checking programmes were run. These included consistency checks on key variables (to check for non-logical code combinations), and programmes to check ranges to detect any *out of range* codes.

3.11. DATA ANALYSIS AND PRESENTATION

Once the data files were cleaned and ready for use, most of the analysis was done using SPSSx on the central computing facility at Newcastle University. The only analysis conducted without using this facility was the reweighting of data which, for reasons of convenience, were conducted using the arithmetic function of a spreadsheet programme. The different aspects of data analysis are covered below in the order in which they are encountered in the results section

3.11.1. Sampling bias and examiner bias

Sampling bias was likely to be dependent on response rates - bias will increase with the number of people in the sample who refuse to take part. When data collection was finished, refusers (classed as those who had been contacted but had refused a dental visit) in six of the nine age/area sub-groups were circulated with a brief questionnaire. The details of this process are given in section 3.7.2.. Data from this questionnaire, which covered edentulousness and attendance, were combined with data from the main survey to give an estimate of the size and direction of the bias for these two key variables. The results tables presenting these data are the only ones which present clinical or questionnaire information which does not come from the visited sample.

Data on examiner bias was generated from two sources: Data recorded during the revisits and data analysed on the basis of different examiners in each area. Cohen's Kappa analysis (Hunt, R.J., 1986; Landis, J.R. & Koch, G.C., 1977) was performed on *revisit* data for decayed, missing and filled coronal surfaces, decayed, missing, filled and vulnerable root surfaces, coronal tooth wear, cervical tooth wear, pocket depth and loss of attachment. The computer programme was one written by Dr P.H. Gordon from the Department of Child Dental Health in Newcastle for this purpose. The analyses were made in such a way as to reflect the final analysis of the main body of the data, so, for example, tooth scores were used for coronal and root caries data and loss of attachment scores were graded as, mild (<4mm), moderate (4-5mm), severe (6-9mm) and very severe (9mm+). Where data was graded along a scale of severity (wear and periodontal disease) a weighted Kappa was used. The weighting matrix is shown with the results of the Kappa analysis in the results section.

The survey design ensured that one examiner (the author) examined around half of the subjects in all areas, and there was no conscious selection of subjects for each examiner, so that the profile of the sample for both examiners should have been similar. The information collected on the subject forms allowed all data to be separated out by examiner so that the final data could be analysed separately for each of the examiner/area combinations. Where there was a risk of inter-examiner variation leading to artificial differences between the three areas, data for the author was considered alone in order to assess the presence of these. Use of this form of survey design allowed some steps to be taken to address the problems of inter-examiner variability, rather than just measuring it.

3.11.2. Reweighting of data

The sample was designed to give roughly equal numbers in each of the three age groups *ie* 60-64, 65-74, 75+ so the sample does not reflect the structure of the population as a whole where there would be a reducing number of individuals within the age groups with age. Consequently, it would be inappropriate just to combine the three age groups to give an "over 60" total, without first correcting for the differences between the age structure of the sample and that of the population at large. Generally the 60-64s were over-represented while the 65-74s were under-represented, and the 75+ group varied between under- and over-representation depending on the area. The correction is made by *reweighting* the base figures (multiplying them by a mathematical correction factor based upon the actual profile of the population studied) in each of the age groups before combining them to get an over 60's total. The reweighting factors are given in table 3.1.1.. These factors only give a correct result when the full samples are considered. Where sub-samples which have different age structures (for example *the edentulous*) are reweighted the resultant percentages become inaccurate. In these cases the reweighting factors are corrected by multiplying them by a constant which maintains the ratios of the reweighting factors to each other but corrects the shortfall (which arises as a result of a different age structure in the sub-group). Maintenance of the arithmetic relationships of the reweighting factors with each other is the critical factor in these cases. Reweighting of data was carried out using the arithmetic capability of a spreadsheet programme during the preparation of the results tables.

The figures given in the tables for individual age groups are not reweighted (there is no need to correct these as they stand), but where tables give a figure for the over 60's the data has been reweighted to represent the general population. This is the data which appears in the *Rwt* 60+ column.

3.11.3. Presentation of data in tables

Much of the data presented in this thesis are in the form of straightforward percentages. These are usually given for each age group broken down by gender social class and attendance pattern, as well as an *all* total for each age group. In some cases the demographic breakdown was felt to be unnecessarily complex and is not included. For all of the data relating to the dentate sample the total sample size for social class IV/V was too small to be meaningful and data has been combined with those in social class III manual to give a single manual group. The three non-manual classes have also been combined to give a single non-manual group, so in most of the tables data is split by social class simply into manual and non-manual. The base numbers for the *all* total are also given. In almost every case an overall reweighted total for all age groups considered together (labelled as "Rwt 60+" in the tables) is also presented.

3.11.4. Confidence limits and reweighted confidence limits

Confidence limits for the proportion (presented here as a percentage) have been calculated and give a very useful indication of the *margin of error* of the percentages given. Because confidence limits for the proportion (or percentage) vary according to the proportion (or percentage) of the sample affected and the sample size in a consistent way (see figure 3.11.1.), calculation of confidence limits for every percentage presented subsequently would result in tables which are unnecessarily complex. For this reason a selection of confidence limits were calculated and are presented separately in table 3.11.2..

Table 3.11.1. Correction factor matrix for reweighting to correct for population age structure.

	60-64	65-74	75+
Richmondshire	**0.827**	**1.297**	**0.878**
Darlington	**0.83**	**1.227**	**0.917**
Salisbury	**0.711**	**1.191**	**1.095**

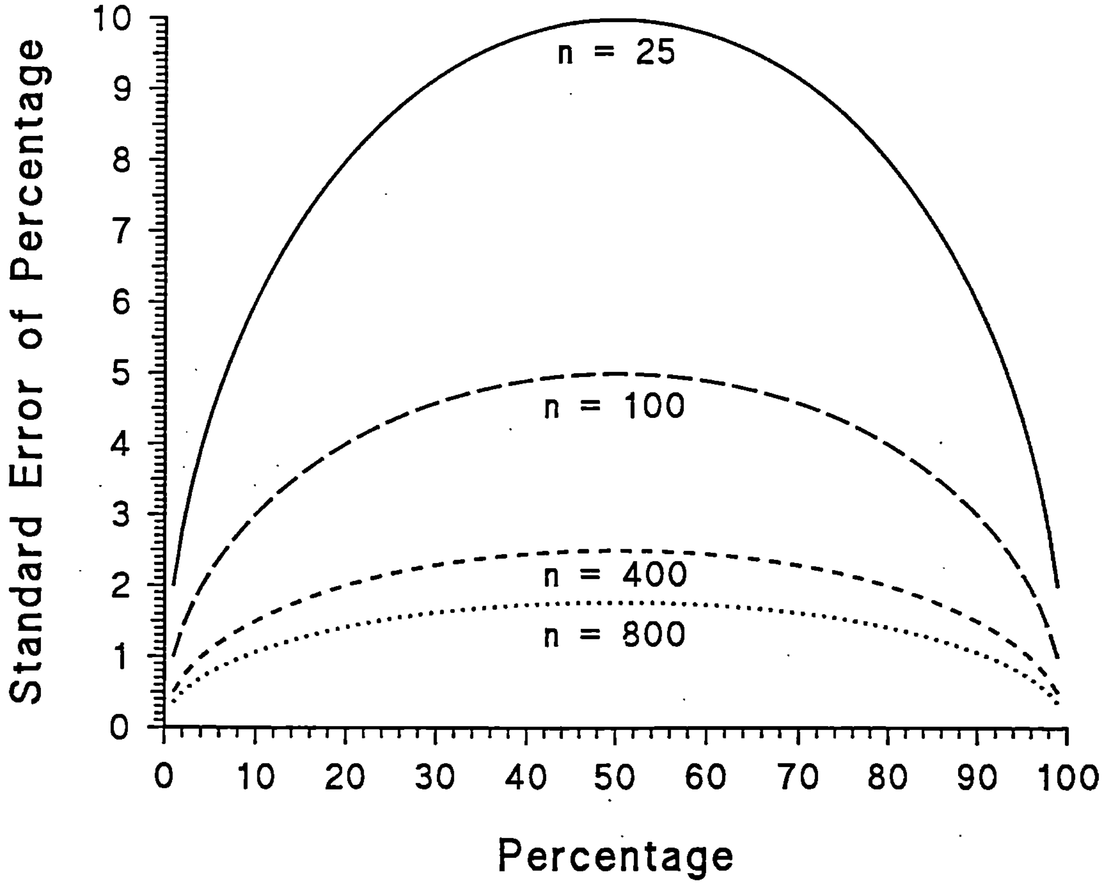
Formula for the calculation of the reweighting factors
= Expected sample size/Actual sample size
where "expected sample size" is calculated from population data.

The figures given here are the basic reweighting factors, and the reweighting procedure was always according to these relative proportions. In some cases, where sub-samples were being used (for example the dentate), reweighting factors had to be multiplied by a constant to maintain accurate statistics, but the relationship between the reweighting factors was always the same.

Table 3.11.2. 95% Confidence intervals for different sample sizes and percentages of the sample affected

		Percentage of sample affected				
		10%	**25%**	**50%**	**75%**	**100%**
	25	11.8%	17.0%	19.6%	17.0%	11.8%
	50	8.3%	12.0%	13.9%	12.0%	8.3%
	75	6.8%	9.8%	11.3%	9.8%	6.8%
Sample	**100**	5.9%	8.5%	9.8%	8.5%	5.9%
Size (n)	**150**	4.8%	6.9%	8.0%	6.9%	4.8%
	200	4.2%	6.0%	6.9%	6.0%	4.2%
	300	3.4%	4.9%	5.7%	4.9%	3.4%
	400	2.9%	4.2%	4.9%	4.2%	2.9%
	800	2.1%	3.0%	3.5%	3.0%	2.1%

Figure 3.11.1. Standard error of the percentage plotted against percentage affected for four different sample sizes (n).



95% confidence limits are obtained by multiplying the standard error by 1.96. Thus for a sample size of only 25 the confidence limits will be + or - 19.6 when the percentage affected is 50%. The reliability of the confidence limits decreases as the percentage affected approaches 0 and 100%.

The standard error of sample means does not vary in such a predictable way and instead is dependent on the distribution and variance of the values used to calculate the mean. For this reason, standard errors or confidence limits have to be presented for each mean value given. In the tables where mean values are given, an overlay has been provided which gives the figure from which the confidence interval (95%) can be calculated. The mean plus or minus the value given on the overlay represents the 95% confidence limits.

Where reweighted totals are given, the confidence intervals should also, theoretically, be reweighted. This is done using the formula:

$$1.96 \times \sqrt{(w_1 \times SEp_1)^2 + (w_2 \times SEp_2)^2 + (w_3 \times SEp_3)^2}$$

where w_1, w_2 and w_3 represent the weights for each of the three age groups, and SEp_1, SEp_2 and SEp_3 the standard error of the percentage for each of the three age groups (Sneder, G.W. & Cochran, W.G., 1967). Reweighted confidence limits not only vary according to the total sample size and final reweighted proportion, but also to the combination of sample size, weight and proportion for each component part. For this reason it is impractical to present confidence limits for a selection of proportions and sample sizes. The effect of reweighting the confidence limit was tested using a number of examples, and comparing these with the confidence limits obtained using the reweighted data but not reweighting the confidence interval. The findings are presented in table 3.11.3. and, in view of the very small difference between reweighted and unreweighted confidence intervals, it is recommended that the confidence intervals presented in table 3.11.2. are also appropriate for reweighted data.

Standard errors for mean values have also been reweighted using the same basic procedure, and the figures from which the 95% confidence limits can be calculated (the mean +/- the figure given) are presented on the overlays in the *Rwt 60+* column.

Table 3.11.3. Reweighted and non-reweighted 95% confidence intervals and the data used to calculate them for three different examples.

Reweighting the confidence limits for all over 60 year olds is complex, and the result will vary slightly depending on the size of each age group and the percentage in each age group, as well as the overall sample size. The differences between the reweighted and the non-reweighted confidence intervals are generally very small. Three worked examples are shown here to illustrate this. Given the small difference it is recommended that, for most purposes, the figures given in table 3.11.2. are used for a rapid indication of the expected. 95% confidence limits.

The three examples used here are edentulousness in all adults in Richmondshire (largest sample size), edentulousness in Darlington males (mid-range sample size) and edentulousness in a single arch in unskilled manual workers in Salisbury (smallest sample size).

	60+ base	60+Rwt Percent	60+Rwt Conf.int	60+Un-rwt Conf.int	Difference
Largest sample size	828	52.1%	3.3%	3.4%	0.1%
Mid-range sample size	336	52.5%	5.2%	5.3%	0.1%
Smallest sample size	80	18.1%	8.3%	8.4%	0.1%

Data used to re-weight confidence intervals as shown above.

	60-64 base	60-64 percent	60-64 weight*	65-74 base	65-74 percent	65-74 weight*	75+ base	75+ percent	75+ weight*
Largest sample size	255	0.29	0.254692	272	0.507	0.426068	301	0.724	0.319176
Mid-range sample size	114	0.351	0.255385	120	0.517	0.434169	102	0.716	0.310369
Smallest sample size	23	0.174	0.235392	33	0.212	0.416931	24	0.125	0.349152

* Weight is the same as the expected population fraction and is calculated by the formula:

Weight = (correction factor x base number for age group)/total sample number for all ages

Correction factors can be found in table 3.11.1.

3.11.5. Manipulation of clinical data

For some of the clinical dental data specific manipulation had to be undertaken to make them concise and meaningful. The methods used are covered below.

Decayed missing and filled teeth (coronal and root surfaces).

Data on the condition of the crowns of the teeth were collected on a surface by surface basis, but for presentation, were converted to tooth scores. An hierarchical recoding system was used so that the worst surface score dictated the category into which the tooth was put. Teeth were classed as decayed if any surface was decayed or had an unsound filling, as filled if there was no decay or unsound restoration but there was a sound filling, and as sound if there was no decay or filling but at least one surface was recorded as sound. Teeth were classed as unscorable only if all surfaces were unscorable, otherwise they were classed according to the scorable surfaces. A tooth was missing if no scorable or unscorable surface was recorded, in all such cases all of the surface codes will have indicated a missing tooth.

The decayed category includes teeth with caries, teeth with unsound restorations (including unsound artificial crowns) and teeth with temporary restorations. Consequently the decayed component of the coronal data gives an indication of treatment need. Data on the different constituents of the decayed component were calculated and presented separately. The filled component includes teeth which are otherwise sound but have any restorations, including full coverage artificial crowns.

A coronal caries index (CCI) has also been calculated and is given in tables 4.2.7. and 4.2.8.. This is a straightforward calculation based on the sample means according to the following formula:

$$CCI(\%)=\frac{decayed+filled\ teeth}{Standing\ teeth}\times 100$$

The CCI is presented as a percentage and so represents the percentage of all teeth which are decayed or filled. A Coronal Caries Index for decayed teeth alone is also given and marked as CCI(d) on the tables, this is calculated in the same way as the CCI but considers only decayed (not decayed and filled) teeth.

These indices are included simply to allow the reader quickly to take into account the effect of variation in the number of missing teeth found in different subgroups.

Root caries data are treated in a similar way to the coronal data and tables 4.2.12. and 4.2.13. relate to root surface data. As not all teeth are vulnerable to root surface decay (not all teeth have gingival recession), it is appropriate to give some indication of the proportion of at risk surfaces which are affected. Although treatment need may be indicated by giving the sample mean for decayed or filled teeth alone, there will be no indication of the differences in relative risk of root caries in different sub-samples if the number of vulnerable surfaces are not accounted for. In order to correct for variations in the number of *at risk* teeth the Root Caries Index (RCI) is calculated. The formula used is:

$$RCI(\%) = \frac{decayed + filled\ roots}{decayed + filled + exposed(but\ sound)roots} \times 100$$

Once again the sample means are used in this calculation and the index is expressed as a percentage. The decayed component in these cases does not include arrested decay. An RCI(d) has been calculated for decayed roots alone, using the same formula but excluding filled roots from the top line.

Crown and root data have also been combined in order to give a total tooth score. Once again an hierarchical recoding system was used so that if either crown or root were decayed the tooth was recoded as decayed, if neither were decayed but either was filled (but otherwise sound) it was recoded as filled and if neither crown nor root were decayed or filled the tooth was recoded as sound.

Manipulation of data for tooth wear

Tooth wear data were collected for four tooth surfaces; cervical, buccal, incisal/occlusal and palatal/lingual. In view of the different pathogenesis and treatment implications of cervical wear, data on cervical and coronal wear were separated for the purpose of analysis and presentation. Data on coronal wear were collected on a surface by surface basis for buccal, incisal/occlusal and palatal/lingual surfaces. However where severe wear was present, all surfaces were often affected and it can be difficult to score individual surfaces separately. For this reason, and for simplicity of reporting, the worst score of the three is used to give an overall tooth score.

For both cervical and coronal wear a threshold score of three on the tooth wear index was used, so the data was analysed on the basis of the percentage of the population with wear of grade three or worse. In the case of cervical surfaces this is the minimum amount of wear consistent with a possible treatment need. In the case of coronal surfaces, grade three wear represents a substantial loss of tooth substance, but not enough to expose secondary dentine.

Manipulation of data for periodontal disease

A variety of periodontal data were collected in the field, including pocket depths, bleeding and calculus scores, a measurement of loss of attachment (LoA) and data on mobility and furcation involvement. With the exception of the last two, these data were collected at two points on the tooth (mesio-buccal and mid-buccal on the uppers and mesio-lingual and mid-lingual on the lowers). In order to make the presentation of these data more straightforward, a tooth score was recoded by taking the worst of the two measurements. Standard WHO recommended tables of CPITN were calculated for this data (WHO, 1987), but additional tables were generated relating to loss of attachment and mobility. This is presented as frequency tables for those with certain thresholds of disease. For loss of attachment (LoA) the thresholds used were at 6mm or greater and 9mm or greater as these correspond to the marks on a CPITN type C probe.

3.11.7. Logistic Regression Analysis

Logistic regression analysis is a multivariate statistical technique which can be used for estimating the probability of an event occurring, or the probability of an individual falling into any given category, on the basis of a set of independent variables. It allows the effect of each independent variable to be assessed in the context of a model including a range of other potentially contributory factors. Logistic regression analysis was carried out in this study to identify the independent variables which play a role in dissatisfaction and problems with function, denture wearing and certain dental diseases (with particular reference to the role of partial denture wearing).

The LOGISTIC REGRESSION command of the statistics programme SPSSx was used to conduct the analysis for this study (Norusis, M.J., 1990). All variables to be used in the analysis were selected, converted into a separate data file and recoded for the purpose. A forward stepwise procedure was used in all cases. This involves the individual logistic regressions for the full range of independent variables being tested separately. Then the most significant factor is entered into the statistical model created by the computer and the logistic regressions are recalculated taking its contributory effect to the model into account. The most significant of the remaining independent variables is then included and once again the contribution of each factor is recalculated. This procedure is repeated with variables being added to the model if they are significant, and removed from the model if they become non-significant until no more significant factors can be included or non-significant ones removed, when the model is deemed to be complete. In some cases interactions of a combination of different independent variables were included in the list of independent variables.

The results of this procedure are presented in a series of tables. The data given in each table includes the following:

1. The dependent variable. This is given in terms of the presence of a problem, a disease or a condition. The data given for each independent variable indicate the change in the likelihood of this problem, disease or condition being present.
2. The number of cases (subjects) used in the analysis (n). Where periodontal data was included as a variable only those subjects who underwent a periodontal examination could be included.
3. A constant is sometimes included (by the computer programme) in the model. The values for this constant have been given where one was used.
4. The significant independent variables. These are expressed in terms of risk factors, so that where gender (for example) is significant it is expressed in terms of "being female", and where dental attendance is significant it is "being a dental non-attender".

5. A description of the type of independent variable being reported in each case, for example dichotomous (e.g. male/female, partial denture present/no partial denture present), discrete quantitative (e.g. age in years, number of missing teeth) or categorical variables (e.g number of missing teeth divided into 3 categories, 0-7, 8-15, 16+). Most of the variables present are dichotomous and in these cases the odds ratio which is subsequently reported, is the relative odds of that risk factor (e.g. being female). For discrete quantitative variables (e.g. age, number of teeth) the odds ratio reports the odds change when the variable increases by an increment of one (e.g. one more tooth or one more year of age). This is an important distinction and should be borne in mind when interpreting the tables. In one case (denture wearing) categorical variables with more than two categories are included. These were used for tooth number and the number of posterior contacts because the data clumped neatly into three or four categories. The odds ratios here indicate the odds change for that group compared to a reference category. In these cases the nature of the group and the reference category are both given.

6. The value of "B", which is the logistic coefficient and represents the change in the log odds for a one unit change in the independent variable.

8. The standard error of "B".

9. The significance (p) of the correlation for each independent variable in the list with the dependent variable. Independent variables are included in the list and in the model if they are significant at the 0.05 level.

10. The partial correlation of each independent variable with the independent variable is given in the column marked "R". This can vary between -1 and 1, a negative score indicating a negative correlation with the risk factor. It should be noted that this is the correlation, taking into account the effect of other independent variables in the model.

11. The odds ratio is given in the column marked exp (B). This represents the predicted change in the odds comparing the odds where the risk factor is present with the odds where it is not. This figure then represents the predicted change in the odds in the presence of the risk factor (independent variable). This is the key indicator of the effect of any of the independent variables.

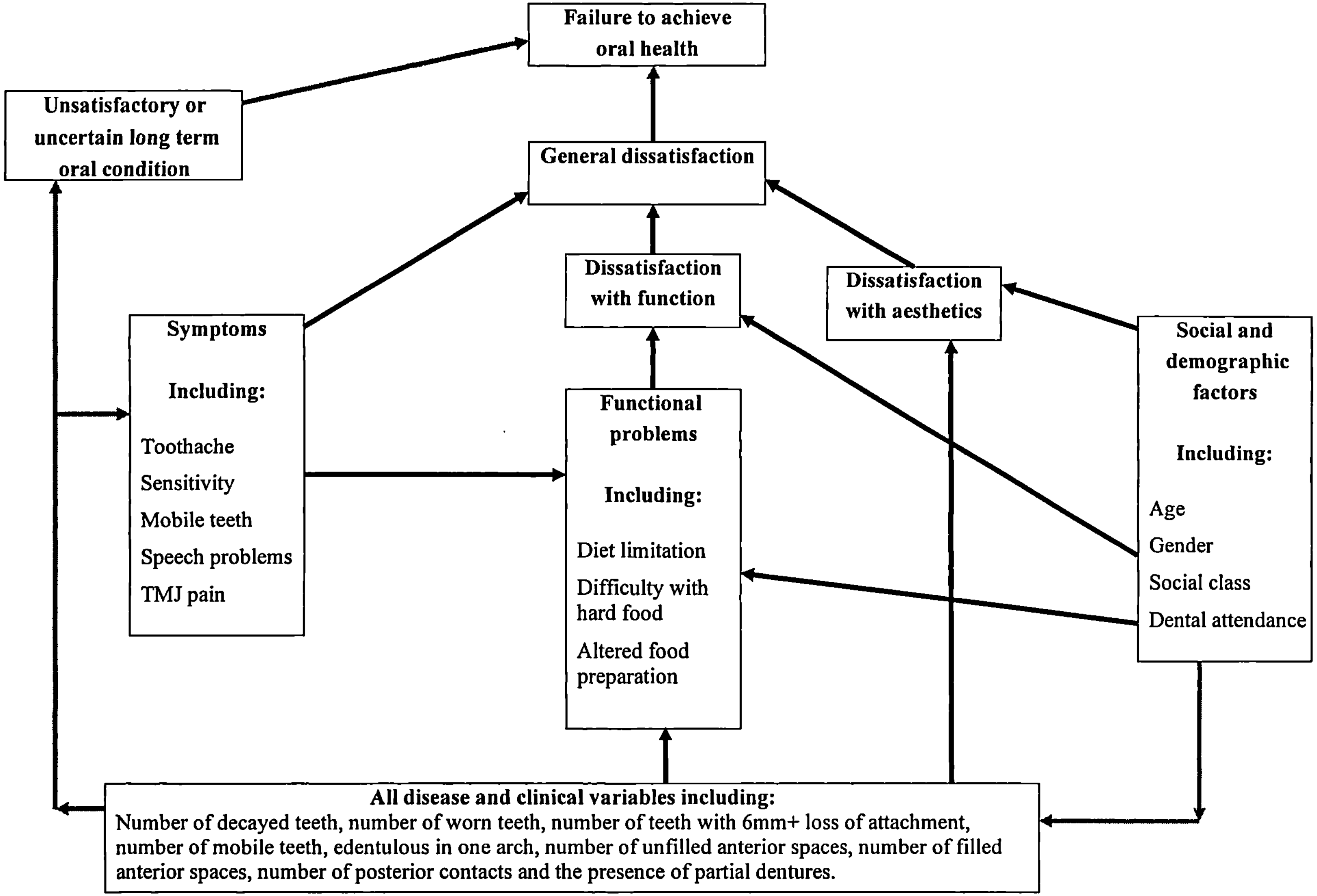
12. A list of non-significant variables which were tested but not included in the final model.

In order to provide a structure to look for likely contributory factors for dissatisfaction and eating problems a model was designed illustrating possible theoretical relationships between groups of factors to be tested. The design of the model was based on the findings of previous analysis of the data (for example differences in frequencies in different sample groups), research findings published elsewhere and logical, but untested, relationships. This is illustrated in figure 3.11.2.. The factors included as independent variables in each procedure varied according to possible predicted relationships.

Several statistics relating to how well the model fits the data were also calculated during the procedure. These include the *% correct classifications*, the *-2 Log Likelihood* and the *Goodness of Fit*. Their inclusion in the tables would have made them unnecessarily complex, but they have been referred to in the text where appropriate.

The logistic regression procedure examining the factors contributing to partial denture wearing included variables covering socio-demographic factors as well as clinical factors. The procedures conducted to identify the role of partial dentures in coronal and root caries and periodontal disease included a set of factors indicating disease history, as well as partial denture wearing and various socio-demographic variables.

Figure 3.11.2. Theoretical model of oral health in the elderly



RESULTS

Section 4.

RESULTS

4.1. THE SAMPLE

This section is divided into 5 parts. The first presents response rates and the final sample size and profile, as well as data on sampling bias and inter-examiner variations. The remaining four parts reflect the subject matter covered in the four sub-sections of the literature review. These are clinical data (4.2.), and questionnaire data, including data on demands, attitudes, barriers and access to dental care (4.3.). Section 4.4. covers the relationships between dental condition and the ability to function in the partially dentate, including the results of investigations into the role of partial dentures. Section 4.5. presents the results of analysis of the interaction of a variety of influences on the oral health of the elderly within an overall model.

4.1.1. Response rates

Response rates are shown in table 4.1.1.. These were calculated from those subjects with whom contact was made at some stage. Individuals who had died or moved home, whose names were on the sample list due to a list error in the sampling frame, or who were completely non-contactable were assumed to be randomly distributed, in terms of their dental health, and were excluded from the figures for acceptance rate.

Response rates were between 53% and 62% for individual age/area groups, with one exception, Salisbury 75+, which achieved only 39.4%. The highest rate obtained was from the Darlington 65-74 year olds (61.6%) and the overall response rate (for all areas and all age groups combined) was 54.4%. Those subjects with whom contact was made, but who refused to be visited, are reported as *refusers* in the subsequent results. This does not include subjects who had died, moved or with whom no contact could be made for some other reason.

Table 4.1.1. Response rates for different sections of the sample

Richmondshire

	60 - 64 yr	65 - 74 yr	75+ yr	Total
Names drawn	518	533	723	1774
Letters sent	505	521	703	1729
Died	5	11	37	53
Moved/not known	34	38	89	161
Not able to contact	40	26	28	94
Contact made	426	446	549	1421
Refused	171	174	248	593
Seen	**255**	**272**	**301**	**828**
% accepted (of contacts)	**59.9%**	**61.0%**	**54.8%**	**58.3%**

Darlington

	60 - 64 yr	65 - 74 yr	75+ yr	Total
Names drawn	518	534	726	1778
Letters sent	510	525	718	1753
Died	9	12	46	67
Moved/not known	53	43	110	206
Not able to contact	75	59	105	239
Contact made	373	411	457	1241
Refused	153	158	215	526
Seen	**220**	**253**	**242**	**715**
% accepted (of contacts)	**59.0%**	**61.6%**	**53.0%**	**57.6%**

Salisbury

	60 - 64 yr	65 - 74 yr	75+ yr	Total
Names drawn	513	535	720	1768
Letters sent	506	531	708	1745
Died	2	5	23	30
Moved/not known	27	25	44	96
Not able to contact	29	16	50	95
Contact made	448	485	597	1530
Refused	204	227	362	793
Seen	**244**	**258**	**235**	**737**
% accepted (of contacts)	**54.5%**	**53.2%**	**39.4%**	**48.2%**

All areas

	60 - 64 yr	65 - 74 yr	75+ yr	Total
Names drawn	1549	1602	2169	5320
Letters sent	1521	1577	2129	5227
Died	16	28	106	150
Moved/not known	114	106	243	463
Not able to contact	144	101	183	428
Contact made	1247	1342	1603	4192
Refused	528	559	825	1912
Seen	**719**	**783**	**778**	**2280**
% accepted (of contacts)	**57.7%**	**58.3%**	**48.5%**	**54.4%**

Table 4.1.2. shows the numbers in various demographic groups in order to indicate the sample size (or base) from which percentages were calculated. Where the sum of the base totals for subgroups does not match the overall total exactly, it indicates that there have been a small number of cases where the data was not recorded or was unscorable (e.g. some occupations were not classifiable on the information given). To keep the base number of sufficient size, the social class III Manual and social class IV/V groups were aggregated for most of the analyses of the dentate population, the only exception being for data on attendance pattern which were used as a major variable to split the data in all other tables, so it was felt that the more detailed breakdown may be appropriate.

4.1.2. Sampling Bias

Initial checks on selection bias were possible by comparing this sample with 1991 census data. Male to female proportions were compared with 1991 census data and were generally very similar with a slight tendency to under-sampling of women for this survey (generally 0% - 4% fewer than predicted by census data). This tendency was greater in the oldest age groups living in the urban areas. The trend is shown graphically in figure 4.1.1..

The results of the follow-up postal investigation to establish the impact of refusers on the make-up of the final sample, are presented in tables 4.1.3. to 4.1.5.. By including these data from the postal questionnaire, the proportion of the sample for whom information on edentulousness and attendance is available, increases to around 87% for the 65-74 year old groups and 80% for the 75+ groups. These figures would have been a little higher still but for deaths and house moves between the first letter and the postal questionnaire which accounted for at least 3% of those who were sent a refuser's questionnaire.

The edentulous were consistently under-represented, but only in Salisbury is the difference large (6% and 10% for the two groups), otherwise it is between 1.4% and 4.2% (for the two Northern areas).

Table 4.1.2. Base numbers in the total sample by area, age, gender, social class and attendance pattern

Richmondshire

	60-64	65-74	75+	Total
Male	119	133	114	366
Female	136	139	187	462
Non-Manual	164	162	182	508
III Manual	52	53	62	167
IV/V	33	55	46	134
Attenders	147	104	49	300
Non-Attenders	106	160	231	497
All	**255**	**272**	**301**	**828**

Darlington

	60-64	65-74	75+	Total
Male	114	120	102	336
Female	106	133	140	379
Non-Manual	104	117	115	336
III Manual	82	102	81	265
IV/V	34	34	41	109
Attenders	96	87	44	227
Non-Attenders	124	165	195	484
All	**220**	**253**	**242**	**715**

Salisbury

	60-64	65-74	75+	Total
Male	117	115	99	331
Female	127	143	136	406
Non-Manual	159	154	150	463
III Manual	62	71	59	192
IV/V	23	33	24	80
Attenders	177	146	97	420
Non-Attenders	67	111	136	314
All	**244**	**258**	**235**	**737**

Fig 4.1.1. Sample and Census data

Percentage males and females aged 75+

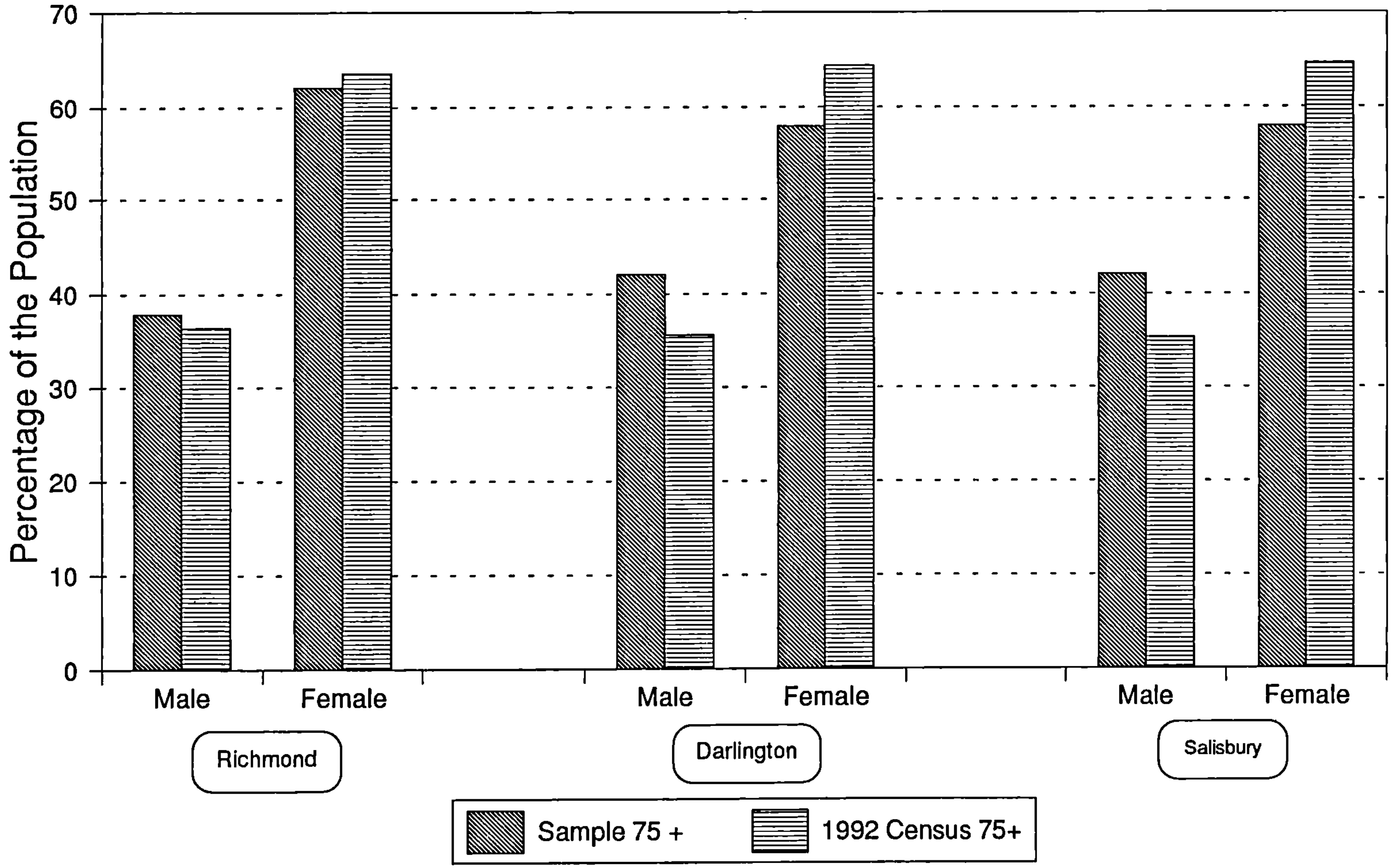


Table 4.1.3. Response rate with and without data from the postal questionnaire

	65 - 74 visited	v or q	75+ visited	v or q
Richmondshire	**61.0%**	**88.6%**	**58.4%**	**80.7%**
Darlington	**61.6%**	**86.4%**	**53.0%**	**80.5%**
Salisbury	**53.2%**	**87.6%**	**39.4%**	**79.9%**

"v or q" stands for visited OR responded to questionnaire

Note: postal questionnaires were not sent to those in the 60-64 age group - see text

Table 4.1.4. Percentage edentulous with and without including the data from the postal questionnaire.

		65 - 74			75+		
		visited	+ ques	difference	visited	+ ques	difference
Richmondshire	males	44.4%	51.1%	6.7%	67.5%	70.6%	3.1%
	females	56.8%	58.3%	1.5%	75.4%	78.1%	2.7%
	all	**50.7%**	**54.9%**	**4.2%**	**72.4%**	**75.4%**	**3.0%**
Darlington	males	51.7%	53.5%	1.8%	71.6%	71.8%	0.2%
	females	57.9%	61.6%	3.7%	79.3%	81.0%	1.7%
	all	**54.9%**	**58.0%**	**3.1%**	**76.0%**	**77.4%**	**1.4%**
Salisbury	males	30.4%	34.7%	4.3%	49.5%	55.8%	6.3%
	females	33.6%	41.7%	8.1%	44.9%	57.6%	12.7%
	all	**32.2%**	**38.8%**	**6.6%**	**46.8%**	**57.0%**	**10.2%**

"+ques" means that questionnaire data is included

Table 4.1.5. Percentage of dentate who attend only with trouble, with and without data from the postal questionnaire.

	65 - 74			75+		
	visited	+ ques	difference	visited	+ ques	difference
Richmondshire	**26.1%**	**29.0%**	**2.9%**	**43.9%**	**45.9%**	**2.0%**
Darlington	**24.8%**	**32.8%**	**8.0%**	**29.3%**	**42.2%**	**12.9%**
Salisbury	**16.6%**	**20.8%**	**4.2%**	**25.8%**	**34.5%**	**8.7%**

In almost all of the tables in this report the attendance pattern has been used to split the data into dental *attenders* (those who attend for check ups) and *non-attenders* (those who say that they only go to the dentist when in pain). It was therefore important to establish whether the attendance pattern of the sample who were examined, reflected accurately that of the random sample which was drawn originally. Whilst the term *non-attender* may not be strictly accurate (these subjects may attend if they are in pain) it is probably the best of a number of alternative terms and is the one used in the tables.

The study of refusers showed that the **dentate** non-attenders had been consistently under-represented in the sample who were visited. In Richmondshire this tendency was small - the discrepancy was only about 2-3%, in Salisbury it was higher (4-9%) and in Darlington it was higher still (8-13%). As non-attenders have been shown in this study to have very different oral health to attenders, it is likely that the oral health of the population as a whole is a little *poorer* than is presented here (because there are fewer non-attenders than there should be), although for Richmondshire the difference is probably marginal. However, most of the tables present data for attenders and non-attenders separately to allow the effect of this bias to be taken into account by the reader.

Table 4.1.6. gives some additional data on the educational and economic status of the sample. Salisbury had the highest percentage of the sample who had undertaken some sort of higher education (21% compared to only 10% in Darlington), and the youngest age groups were generally more likely to have had some higher education. The majority of the subjects in all age groups had retired, although, for obvious reasons, there were fewer retired people in the 60-64 year olds than in the other groups. In Richmondshire there was a small but significant proportion still working in the older age groups (4-11%): this was a little higher than both of the other areas. In Darlington, 30% of the sample relied entirely on state benefits, compared with 24% in Richmondshire and 18% in Salisbury. Far more of the over 75 year old subjects (28-41% for the reweighted samples) relied on state benefits than the under 75 year olds (9-29%) in all areas.

Tables 4.1.7. and 4.1.8. give an indication of the general health and levels of disability of the sample. In all three areas the sample were generally healthy and reasonably mobile, although the proportion who had

Table 4.1.6. Income and education of the total sample, by area and age.

Richmondshire

	60-64	65-74	75+	Rwt 60+
base	255	272	301	828
% having had higher education	29.0%	12.1%	16.8%	**17.9%**
% retired	68.2%	88.9%	95.6%	**85.8%**
% with no private income	17.3%	21.7%	32.0%	**23.9%**

Darlington

	60-64	65-74	75+	Rwt 60+
base	220	252	243	715
% having had higher education	15.9%	10.7%	5.4%	**10.4%**
% retired	76.8%	96.0%	97.9%	**91.7%**
% with no private income	28.6%	23.7%	41.4%	**30.4%**

Salisbury

	60-64	65-74	75+	Rwt 60+
base	244	258	235	737
% having had higher education	28.3%	15.9%	22.6%	**21.2%**
% retired	57.8%	91.9%	99.1%	**86.5%**
% with no private income	9.1%	14.0%	27.5%	**17.6%**

These data are based on questions 1, 2 and 4 in section 9 of the questionnaire

Table 4.1.7. Percentage of all subjects with various relevant medical conditions by age and area

Richmondshire

	60-64	65-74	75+	60+ rwt
Base	255	272	301	828
Any heart problems	14.5%	18.5%	27.7%	**20.4%**
Artificial joints	2.4%	5.6%	8.7%	**5.8%**
Any history of arthritis	41.2%	47.4%	55.7%	**48.5%**
Taking some medication	52.0%	59.0%	76.0%	**62.6%**

Darlington

	60-64	65-74	75+	60+ rwt
Base	220	253	242	715
Any heart problems	20.6%	22.1%	26.9%	**23.2%**
Artificial joints	1.8%	1.2%	7.4%	**3.3%**
Any history of arthritis	46.4%	57.5%	54.1%	**53.6%**
Taking some medication	54.1%	65.9%	74.7%	**65.6%**

Salisbury

	60-64	65-74	75+	60+ rwt
Base	244	258	235	737
Any heart problems	10.7%	15.9%	27.7%	**18.8%**
Artificial joints	3.3%	4.3%	8.5%	**5.5%**
Any history of arthritis	38.9%	45.3%	57.9%	**48.3%**
Taking some medication	45.5%	57.4%	73.2%	**60.2%**

These data are derived from questions 1, 4, 5 and 10 in section 1 of the questionnaire.

Table 4.1.8. Percentage of the sample with long term illness or disability by area and age.

Richmondshire

	60-64	65-74	75+	60+ rwt
Long term illness	37.9%	42.7%	45.7%	**42.4%**
Long term illness which limits daily activity	22.7%	25.0%	36.5%	**28.1%**
Housebound or requires assistance to leave home	0.8%	1.1%	18.9%	**6.7%**
Completely housebound	0.0%	1.1%	4.3%	**1.8%**
Frail (disability score of 6 or less)	0.8%	1.9%	12.3%	**4.9%**

Darlington

	60-64	65-74	75+	60+ rwt
Long term illness	53.4%	60.6%	64.6%	**60.0%**
Long term illness which limits daily activity	33.6%	29.6%	40.1%	**33.9%**
Housebound or requires assistance to leave home	5.0%	4.4%	20.3%	**9.5%**
Completely housebound	0.0%	0.8%	2.5%	**1.1%**
Frail (disability score of 6 or less)	4.1%	4.7%	16.9%	**8.3%**

Salisbury

	60-64	65-74	75+	60+ rwt
Long term illness	37.0%	39.5%	47.0%	**41.6%**
Long term illness which limits daily activity	20.5%	22.1%	31.9%	**25.2%**
Housebound or requires assistance to leave home	2.0%	2.7%	18.3%	**8.0%**
Completely housebound	0.4%	0.4%	3.8%	**1.6%**
Frail (disability score of 6 or less)	1.6%	1.6%	13.7%	**5.8%**

This table is based on data from questions 12 to 15 in section 1 of the questionnaire.

The disability score is calculated from an eight item index (question14), the overall score for each person could range from 0 to 16, where 0 represents the most severe disability and a score of 16 indicates no disability. A score of 6 or less is considered as frail.

problems with mobility increased with age. Heart complaints were reported by 19-23% of the reweighted samples and arthritis affected around half of all subjects. Both tended to increase with age. Between 60% and 66% of the sample used some form of regular prescribed medication, again increasing with age.

Although long term illnesses were reported by a rather high proportion of the samples (60% in Darlington and 42% in the other two areas) the housebound, partially housebound and frail constituted a rather small part of the sample, although the number affected was much higher in the over 75 year old groups (see table 4.1.8.). The sample from Darlington appeared to be consistently less *well* than those from the other two areas, with heart problems, arthritis, medication usage, long term illness with and without associated disability were all found to be more common. Reduced mobility and frailty were also more common in Darlington, sometimes much more common. In summary, although the samples were not in perfect health, they were generally fit, mobile and independent.

4.1.3. Examiner bias

Inter-examiner variation is inevitable in this sort of research. Because of the design of this study, where different examiners covered different areas, consistent over or under scoring by one examiner, relative to the rest, could suggest differences between areas which are simply due to the examiner bias. Table 4.1.9. shows the variation in scores recorded by separate examiners in the parts of the sample that they examined. However, to ensure that inter-area comparisons of clinical data could be made, one examiner (the author) carried out around half the examinations in each area. There was no conscious selection of subjects seen by each of the examiners.

Kappa scores, based on repeat examinations, were also calculated for a variety of clinical dental variables. Table 4.1.10. presents data for variables which had low kappa scores and gives data recorded for examiner JGS alone, as he examined similar numbers of subjects in all areas. The variables presented in this table cover root surface caries, tooth wear and periodontal disease. The kappa scores themselves and the weighting matrix used in the calculation of some of these are presented as table 4.1.11. It is evident that

Table 4.1.9 Reweighted (60+) totals by observer and area for key variables (clinical data).

Variable		Richmondshire		Darlington		Salisbury	
Root caries		base		base		base	
Mean no. of teeth	JGS	205	17.03	142	17.31	270	17.90
	Other	193	16.26	164	16.24	237	17.40
Mean no of decayed roots	JGS	205	0.87	142	0.79	270	0.82
	Other	193	0.43	164	1.24	237	0.57
Mean no of d or f roots	JGS	205	2.19	142	2.28	270	2.15
	Other	193	1.59	164	3.09	237	2.27
Mean no of teeth vulnerable to root caries	JGS	205	10.23	142	10.43	270	11.01
	Other	193	8.56	164	11.95	237	9.61
% with no root decay	JGS	205	32.0%	142	31.7%	270	27.8%
	Other	193	40.9%	164	19.3%	237	29.1%
RCI	JGS	205	21.4%	142	21.8%	270	19.6%
	Other	193	18.4%	164	25.6%	237	23.6%
Wear							
% with cervical wear	JGS	205	44.2%	142	41.7%	270	46.1%
	Other	193	14.6%	164	31.1%	237	42.9%
Mean no of teeth with cervical wear lesions	JGS	205	2.29	142	2.52	270	2.65
	Other	193	1.91	164	2.86	237	3.60
% with coronal wear	JGS	205	41.9%	142	39.7%	270	45.1%
	Other	193	21.5%	164	51.6%	237	63.2%
Mean number of teeth with coronal wear	JGS	205	3.11	142	3.71	270	3.06
	Other	193	2.92	164	3.49	237	3.97
Periodontal							
% with deep pockets	JGS	174	22.6%	132	24.9%	243	22.6%
	Other	163	23.0%	140	22.5%	199	1.1%
% with LOA >6mm	JGS	174	41.8%	132	44.3%	243	47.8%
	Other	163	49.5%	140	57.9%	199	21.5%
% with LOA > 9mm	JGS	174	11.4%	132	11.0%	243	12.9%
	Other	163	12.1%	140	15.3%	199	3.7%
% with any mobile teeth	JGS	174	17.8%	132	22.9%	243	25.0%
	Other	163	16.5%	140	39.4%	199	15.1%

Table 4.1.10. Total area scores for clinical dental data calculated from the data collected by one examiner, by age.

Variable	Area	60-64	65-74	75+	base (60+)	Rwt 60+
Mean no. of teeth	Richmondshire	19.45	15.48	15.63	205	**17.03**
	Darlington	18.53	17.09	14.90	142	**17.31**
	Salisbury	19.92	17.61	16.14	270	**17.90**
Root caries						
Mean no of decayed roots	Richmondshire	0.58	1.15	0.80	205	**0.87**
	Darlington	0.55	0.88	1.16	142	**0.79**
	Salisbury	0.64	0.72	1.20	270	**0.82**
Mean no of d or f roots	Richmondshire	2.19	2.05	2.54	205	**2.19**
	Darlington	1.85	2.39	3.00	142	**2.28**
	Salisbury	1.79	2.17	2.53	270	**2.15**
Mean no of teeth vulnerable to root caries	Richmondshire	10.50	10.03	10.11	205	**10.23**
	Darlington	10.23	10.61	10.42	142	**10.43**
	Salisbury	11.19	10.86	11.06	270	**11.01**
% with no root decay	Richmondshire	28.7%	40.7%	17.1%	205	**32.0%**
	Darlington	36.3%	33.3%	15.8%	142	**31.7%**
	Salisbury	32.7%	29.4%	19.6%	270	**27.8%**
RCI	Richmondshire	20.8%	20.4%	25.1%	205	**21.4%**
	Darlington	18.1%	22.6%	28.8%	142	**21.8%**
	Salisbury	16.0%	19.9%	22.9%	270	**19.6%**
Wear						
% with cervical wear	Richmondshire	41.2%	40.7%	60.0%	205	**44.2%**
	Darlington	43.7%	45.5%	26.3%	142	**41.7%**
	Salisbury	45.8%	42.4%	52.9%	270	**46.1%**
Mean no of teeth with cervical wear lesions	Richmondshire	2.18	2.33	2.44	205	**2.29**
	Darlington	2.52	2.20	3.40	142	**2.52**
	Salisbury	2.71	2.55	2.74	270	**2.65**
% with coronal wear	Richmondshire	36.3%	47.5%	40.0%	205	**41.9%**
	Darlington	37.5%	33.3%	63.2%	142	**39.7%**
	Salisbury	35.6%	38.8%	66.7%	270	**45.1%**
Mean number of teeth with coronal wear	Richmondshire	2.24	3.71	3.50	205	**3.11**
	Darlington	3.70	3.64	3.91	142	**3.71**
	Salisbury	2.78	3.15	3.20	270	**3.06**
Periodontal						
% with deep pockets	Richmondshire	22.5%	23.7%	20.0%	205	**22.6%**
	Darlington	21.2%	33.3%	10.5%	142	**24.9%**
	Salisbury	23.4%	27.1%	13.7%	270	**22.6%**
% with LOA >6mm	Richmondshire	40.0%	44.1%	40.0%	205	**41.8%**
	Darlington	36.3%	48.5%	52.6%	142	**44.3%**
	Salisbury	35.6%	47.1%	62.7%	270	**47.8%**
% with LOA > 9mm	Richmondshire	10.0%	13.6%	8.6%	205	**11.4%**
	Darlington	10.0%	12.1%	10.5%	142	**11.0%**
	Salisbury	10.3%	11.8%	17.6%	270	**12.9%**
% with any mobile teeth	Richmondshire	10.0%	23.7%	20.0%	205	**17.8%**
	Darlington	18.7%	27.3%	21.1%	142	**22.9%**
	Salisbury	17.8%	27.1%	29.4%	270	**25.0%**

Table 4.1.11. Kappa scores for major clinical variable

Variables	Darlington (JGS/HS)	Richmondshire (JGS/PL)	Salisbury (JGS/DM)
Decayed and filled teeth (crowns)	0.94	0.89	0.94
Root caries (decayed and filled teeth)	0.66	0.50	0.63
Pockets (<4mm, 4-5mm, 6mm+)*	0.49	0.57	0.10
LoA (<4mm, 4-5mm, 6-8mm, 9mm+)*	0.63	0.67	0.58
Cervical wear (<grade 3, grade 3, grade 4)*	0.66	0.38	0.70
Coronal wear (<grade 3, grade 3, grade 4)*	0.88	0.55	0.84

* Indicates where a weighted Kappa was used. The weighting matrices are shown below, the size. of the matrix (i.e. 3 x 3 or 4 x 4) depends on the number of categories used for each variable (3 or 4).

Weighting matrices for calculation of Kappa

a) 3 x 3 (pockets, cervical and coronal wear	1.0	0.3	0.0	
	0.3	1.0	0.7	
	0.0	0.7	1.0	
b) 4 x 4 (loss of attachment)	1.0	0.6	0.2	0.0
	0.6	1.0	0.8	0.4
	0.2	0.8	1.0	0.8
	0.0	0.4	0.8	1.0

for a number of clinical variables the comparison **between areas** using combined data (i.e. that from both examiners in each area) may be unsafe due to differences between the *second* examiners. This has been indicated in the text and inter-area comparisons have generally been made using the data for the author alone.

4.2. DATA FROM THE CLINICAL EXAMINATION

4.2.1. Edentulousness

Tables 4.2.1. and 4.2.2. give the patterns of edentulousness as recorded in the sample who were examined. Edentulousness was an area where there was a substantial known sampling bias ascertained from the follow up questionnaire. The edentulous appeared to be more likely to refuse to take part than the dentate leading to an underestimation of the proportion edentulous in the results. Table 4.1.4. gives the proportions edentulous for the age and gender groups including data from the postal questionnaires. This should give a more accurate reflection of the proportions edentulous in the three populations sampled.

For the purposes of analysis of the proportion edentulous, the sample was divided into non-manual workers, skilled manual workers and unskilled manual workers. This data **does not** take into account the results of the postal questionnaire of refusers. The proportion edentulous ranged from 15.2% for 60-64 year olds in Salisbury to 76% for the over 75 year olds in Darlington. There was greater variation in some of the sub-groups with totals ranging from 11.3% (non-manual, 60-64, Salisbury) to 90.2% (unskilled manual, 75+, Darlington), however, given the small sample sizes, the confidence limits for these data will be very wide. Salisbury generally had a far smaller proportion of the population who were edentulous than either of the two areas in the north. It was consistently around 20 percentage points lower than Darlington, even taking into account data from the postal questionnaire. The proportion edentulous increased steadily with age in all areas, with about 20% more edentulous in the 75+ group than in the 65-74 year olds, and about a 15-20% difference between the latter and the 60-64 year olds. Women and subjects from the families of manual workers were more likely to be edentulous than men and non-manual workers. Subjects from the

Table 4.2.1. Percentage of the sample edentulous by age, area, gender and social class

Richmondshire

	60-64	65-74	75+	Rwt 60+
Male	25.2%	44.4%	67.5%	**46.2%**
Female	32.4%	56.8%	75.4%	**56.8%**
Non-Manual	18.9%	42.0%	67.0%	**43.5%**
III Manual	40.4%	54.7%	79.0%	**58.7%**
IV/V	54.5%	72.7%	84.8%	**75.4%**
Base for "All"	255	272	301	828
All	**29.0%**	**50.7%**	**72.4%**	**52.1%**

Darlington

	60-64	65-74	75+	Rwt 60+
Male	35.1%	51.7%	71.6%	**52.5%**
Female	43.4%	57.9%	79.3%	**61.9%**
Non-Manual	26.0%	41.9%	67.0%	**45.6%**
III Manual	50.0%	64.7%	80.2%	**65.9%**
IV/V	52.9%	70.6%	90.2%	**71.8%**
Base for "All"	220	253	242	715
All	**39.1%**	**54.9%**	**76.0%**	**57.4%**

Salisbury

	60-64	65-74	75+	Rwt 60+
Male	17.1%	30.4%	49.5%	**33.1%**
Female	13.4%	33.6%	44.9%	**33.5%**
Non-Manual	11.3%	23.4%	36.7%	**25.0%**
III Manual	22.6%	46.5%	55.9%	**44.5%**
IV/V	21.7%	42.4%	87.5%	**54.0%**
Base for "All"	244	258	235	737
All	**15.2%**	**32.2%**	**46.8%**	**33.3%**

Base figures for other sub-groups may be found in Table 4.1.2.

Table 4.2.2. Percentage of the sample edentulous in one arch by area, age, gender and social class.

Richmondshire

	60-64	65-74	75+	Rwt 60+
Male	16.0%	20.3%	7.9%	**16.0%**
Female	7.3%	10.8%	6.4%	**8.3%**
Non-manual	9.1%	15.4%	6.5%	**10.8%**
III Manual	13.5%	17.0%	6.5%	**12.6%**
IV/V	21.2%	14.5%	6.5%	**14.0%**
Base for "All"	255	272	301	828
All	**11.4%**	**15.4%**	**7.0%**	**11.7%**
% of dentate	**16.0%**	**31.0%**	**25.3%**	**24.3%**

Darlington

	60-64	65-74	75+	Rwt 60+
Male	10.5%	10.9%	8.8%	**10.2%**
Female	13.2%	6.0%	7.1%	**8.1%**
Non-manual	16.3%	9.4%	9.6%	**11.2%**
III Manual	7.3%	6.9%	7.4%	**7.2%**
IV/V	8.8%	8.8%	4.9%	**7.3%**
Base for "All"	220	253	242	715
All	**11.8%**	**8.3%**	**7.9%**	**9.1%**
% of dentate	**17.8%**	**18.4%**	**32.9%**	**20.8%**

Salisbury

	60-64	65-74	75+	Rwt 60+
Male	9.4%	8.7%	12.1%	**9.9%**
Female	9.4%	10.5%	12.5%	**11.1%**
Non-manual	6.9%	8.4%	14.0%	**10.0%**
III Manual	12.9%	7.0%	13.6%	**10.6%**
IV/V	17.4%	21.2%	12.5%	**18.1%**
Base for "All"	244	258	235	737
All	**9.4%**	**9.7%**	**12.3%**	**10.6%**
% of dentate	**11.1%**	**14.3%**	**23.1%**	**16.6%**

Base figures for other sub-groups are given in tables 4.1.2. and 4.2.3.

families of **unskilled** manual workers were by far the most likely subgroup to be edentulous.

A proportion of dentate subjects were edentulous in one arch, almost always the upper, these results are presented in table 4.2.2.. This group represented between 9% and 12% of the total sample for each of the three areas. There was no consistent age trend, although as a proportion of the dentate sample (as opposed to the total sample which is presented in table 4.2.2.) those who were edentulous in one arch increased with age. Gender and social class trends were also complex. Far more men than women in Richmondshire were edentulous in one arch, while in Salisbury there was a slightly higher proportion of women in this condition. In Richmondshire and Salisbury there was a tendency for manual workers to be more likely to be edentulous, particularly those in social class IV/V, whilst in Darlington it appeared to be non-manual workers who were most likely to be edentulous in one arch.

Of the edentulous subjects, 1% never wore complete upper dentures and between 2% and 4% never wore a complete lower denture. A further 1-2% of the edentulous only wore their dentures socially.

All dentures which were regularly worn were assessed for faults. On average each set of complete dentures had about 3 faults recorded (from a possible maximum of 15), and this was consistent between areas and showed a tendency to increase slightly with age. Only between 3.8% and 13.8% (depending on the area and age group) of complete dentures were assessed by the examiners as having no faults, whilst overall 29% of sets had 5 or more faults and 10% had 7 or more. The most commonly recorded faults were incorrect occlusal relationships, excessive free way space, poor lower retention, poor adaptation (upper and lower) and excessive occlusal wear. The relative abundance of these faults depended on the area and age group concerned with the most common faults present in about 35% to 50% of cases. The relationships between the type and number of faults and satisfaction are covered in section 4.3.1..

4.2.2. Dentate subjects: The number of teeth and tooth replacement

Table 4.2.3. gives the base numbers from which the percentages and means in subsequent tables for the

Table 4.2.3. Base Numbers for the Dentate Sample

Richmond

	60-64	65-74	75+	Total
Male	89	74	37	**200**
Female	92	60	46	**198**
Non-Manual	133	94	60	**287**
Manual	46	39	18	**103**
Attenders	145	98	46	**289**
Non-attenders	35	35	36	**106**
All	**181**	**134**	**83**	**398**

Darlington

	60-64	65-74	75+	Total
Male	74	58	29	**161**
Female	60	56	29	**145**
Non-Manual	77	68	38	**183**
Manual	57	46	20	**123**
Attenders	92	85	36	**213**
Non-attenders	42	28	21	**91**
All	**134**	**114**	**58**	**306**

Salisbury

	60-64	65-74	75+	Total
Male	97	80	50	**227**
Female	110	95	75	**280**
Non-Manual	141	118	95	**354**
Manual	66	57	29	**152**
Attenders	174	146	92	**412**
Non-attenders	33	29	32	**94**
All	**207**	**175**	**125**	**507**

dentate sample are calculated. Periodontal data is drawn from a slightly smaller base due to exclusion of some patients from the periodontal examination as a result of specific problems in their medical history. The periodontal base figures are given in table 4.2.16., just before the tables of periodontal data.

Data are presented in this section for the percentage of the sample with 21 or more standing teeth, the mean number of teeth and data on the types and frequency of prostheses used to replace missing teeth. The *21 or more standing teeth* statistic is one that has been used as a measure of oral health in previous national surveys and which appears to be a reasonable measure of what constitutes a *functional* natural dentition. This is discussed in more detail in sections 2.3., 4.4 and 5.4..

Statistics for the percentage with 21+ standing teeth in each part of the dentate sample are given in table 4.2.4.. The proportion of the dentate sample with 21 or more standing teeth varies between 64.5% for the youngest non-manual workers in Salisbury, and 5.9% in the oldest non-attenders in Darlington. The proportion is generally highest for those in Salisbury, males, non-manual workers and regular attenders. At the time of the study, only the dentate *attenders* in the youngest age groups (60-64, in all three areas) had more than 50% in the 21+ standing teeth group. If the edentulous subjects are taken into account, only 22% of the 2280 subjects examined had 21 or more standing teeth.

The reweighted mean number of teeth (see table 4.2.8.) for the over 60 year olds was around 17, although the mean *number of teeth* was very age dependent, from 19 in the youngest group down to only 14 in the oldest. Inter-area differences were rather small, as were gender differences, except in Richmondshire where women had on average, nearly two more teeth than men. Non-manual workers had more teeth than manual workers, and attenders had on average between 4 and 7 more teeth than non-attenders.

Tooth replacement and the prevalence of partial dentures

Table 4.2.5. shows the distribution of partial dentures in the three areas by demographic variables. Partial dentures were worn by around 40% of dentate over 60 year olds. The percentage increases with age (from around 35% to about 50%). In the northern samples, females were more likely to wear partial dentures than

Table 4.2.4. Percentage of the dentate sample with 21 or more teeth, by area, age, gender social class and attendance pattern.

Richmondshire

	60-64	65-74	75+	Rwt 60+
Male	53.9%	24.3%	24.3%	**35.4%**
Female	53.3%	35.0%	30.4%	**40.4%**
Non-Manual	59.4%	33.0%	30.0%	**42.3%**
Manual	37.0%	20.5%	25.0%	**27.6%**
Attenders	59.3%	35.7%	41.3%	**46.1%**
Non-attenders	28.6%	11.4%	11.1%	**16.0%**
Base for "All"	181	134	83	398
All	**53.6%**	**29.1%**	**27.7%**	**37.9%**

Darlington

	60-64	65-74	75+	Rwt 60+
Male	48.6%	36.2%	13.8%	**36.8%**
Female	33.3%	41.1%	13.8%	**33.4%**
Non-Manual	42.9%	45.6%	15.8%	**38.8%**
Manual	40.4%	28.3%	10.0%	**30.0%**
Attenders	52.2%	43.5%	15.0%	**42.3%**
Non-attenders	19.0%	25.0%	5.9%	**18.0%**
Base for "All"	134	114	58	306
All	**41.8%**	**38.6%**	**13.8%**	**35.2%**

Salisbury

	60-64	65-74	75+	Rwt 60+
Male	55.7%	40.0%	34.0%	**41.9%**
Female	56.4%	41.1%	33.3%	**42.1%**
Non-Manual	64.5%	44.9%	38.9%	**47.5%**
Manual	37.9%	31.6%	17.2%	**29.4%**
Attenders	63.2%	45.2%	39.1%	**47.6%**
Non-attenders	18.2%	17.2%	18.8%	**17.9%**
Base for "All"	207	175	125	507
All	**56.0%**	**40.6%**	**33.6%**	**42.0%**

Base figures for other sub-groups are given in table 4.2.3.

Table 4.2.5. Partial dentures by area, age, gender, social class and attendance pattern

Richmondshire

	60-64	65-74	75+	60+ rwt
Male	25.8%	44.6%	48.6%	**38.4%**
Female	39.1%	50.0%	47.8%	**45.3%**
Non-manual	34.6%	52.1%	51.7%	**45.3%**
Manual	26.1%	35.9%	35.0%	**32.2%**
Attender	31.0%	49.0%	56.5%	**42.5%**
Non-attender	40.0%	42.9%	38.9%	**40.9%**
Base for 'All'	181	134	83	398
All	**32.6%**	**47.0%**	**48.2%**	**41.8%**

Darlington

	60-64	65-74	75+	60+ rwt
Male	31.1%	32.8%	44.8%	**34.1%**
Female	41.7%	42.9%	58.6%	**45.4%**
Non-manual	37.7%	42.6%	57.9%	**43.8%**
Manual	33.3%	30.4%	40.0%	**33.0%**
Attender	34.8%	38.8%	50.0%	**39.3%**
Non-attender	38.1%	35.7%	52.9%	**39.8%**
Base for 'All'	134	114	58	306
All	**35.8%**	**37.7%**	**51.7%**	**39.5%**

Salisbury

	60-64	65-74	75+	60+ rwt
Male	35.1%	51.2%	52.0%	**46.3%**
Female	35.5%	43.2%	52.1%	**43.7%**
Non-manual	34.0%	45.8%	51.6%	**44.1%**
Manual	37.9%	49.1%	44.8%	**44.6%**
Attender	33.3%	48.6%	52.2%	**44.8%**
Non-attender	45.5%	37.9%	46.9%	**43.2%**
Base for 'All'	207	175	125	507
All	**35.3%**	**46.9%**	**50.4%**	**44.4%**

Base number for sub-groups can be found in table 4.2.3.

males (for example 45% to 34% in Darlington), but in Salisbury the trend was reversed. In the north, non-manual workers were more likely to wear partial dentures than manual workers, but in the south there was no real difference while there was also little difference between attenders and non-attenders in any area.

Table 4.2.6. shows the distribution of partial dentures between upper and lower jaws. Most partial dentures are uppers alone, although in the over 65 year olds in Salisbury partial upper and lower dentures together were the most common finding. However the distribution of denture provision (according to arch restored) does not conform to any consistent pattern. Partial dentures in combination with complete dentures were worn by 8-10% of the reweighted dentate samples, equivalent to just under half of the 17-24% who were edentulous in one arch.

The majority of partial dentures were made of acrylic resin (62% to 73% of uppers, 45% to 61% of lowers), had no clasps (65% to 71% of uppers, 56% to 70% of lowers) and were tissue supported (74% to 81% of uppers, 68% to 76% of lowers). In most cases (about 55%) the dentures were acrylic **and** had no clasps **and** had no tooth support. Many of those which were classed as metal based were lower dentures where the connector was a wrought metal bar, rather than a cast metal framework.

Fixed bridges were reported for only 3-6% of the samples, and in all three areas the percentage with bridges was highest in the youngest age group (as high as 9.2% of the 60-64 year olds in Salisbury). More detailed breakdown on bridges is given with data on multiple crowns in table 4.2.11..

4.2.3. Dentate subjects: Data on the condition of the crowns of the teeth

The state of the crowns of the teeth varied widely between groups (tables 4.2.7. and 4.2.8.). The mean number of filled teeth (including crowned teeth) ranged from as low as 1.39 (the oldest non-attenders in Richmondshire) up to over 11 (for the youngest females in the same area). There was a slight decrease with age and it is consistently women, non-manual workers and regular attenders who have the most fillings. The number of decayed teeth was between 0.76 and 0.97 for the major age/area groups with little variation

Table 4.2.6. Distribution of partial dentures by area and age.

Richmondshire

	60-64	65-74	75+	60+ rwt
Base	181	134	83	398
Any partial denture	32.6%	47.0%	48.2%	**41.8%**
Partial upper only	19.9%	26.1%	31.3%	**24.7%**
Partial lower only	7.7%	12.7%	8.4%	**10.0%**
Partial upper and lower	5.5%	7.7%	12.0%	**7.7%**
Complete + partial	6.6%	13.4%	9.6%	**10.2%**

Darlington

	60-64	65-74	75+	60+ rwt
Base	134	114	58	306
Any partial denture	35.8%	37.7%	51.7%	**39.5%**
Partial upper only	24.6%	22.8%	20.7%	**23.1%**
Partial lower only	6.7%	7.9%	17.2%	**9.1%**
Partial upper and lower	4.5%	5.3%	13.8%	**6.5%**
Complete + partial	6.0%	9.6%	17.2%	**9.6%**

Salisbury

	60-64	65-74	75+	60+ rwt
Base	207	175	125	507
Any partial denture	35.3%	46.9%	50.4%	**44.4%**
Partial upper only	21.3%	17.7%	17.6%	**18.7%**
Partial lower only	5.8%	10.3%	16.0%	**10.5%**
Partial upper and lower	8.2%	18.9%	20.8%	**16.2%**
Complete + partial	4.8%	6.9%	12.0%	**7.7%**

Table 4.2.7. 95% Confidence limits

Richmondshire

	60-64					65-74					75+				
	Present	Sound	Decayed	Filled	Missing	Present	Sound	Decayed	Filled	Missing	Present	Sound	Decayed	Filled	Missing
Male	1.64	1.17	0.18	1.11	1.64	1.57	0.93	0.31	1.06	1.57	2.55	1.76	0.38	1.66	2.55
Female	1.27	0.83	0.26	1.08	1.27	1.87	1.21	0.37	1.29	1.87	2.06	1.39	0.37	1.69	2.04
Non-Manual	1.17	0.87	0.19	0.95	1.17	1.43	0.80	0.25	1.01	1.43	1.92	1.05	0.25	1.45	1.92
Manual	1.98	1.41	0.32	1.41	1.98	2.22	1.63	0.55	1.24	2.22	3.33	3.16	0.74	1.96	3.25
Attenders	0.99	0.75	0.18	0.82	0.99	1.26	0.85	0.19	0.88	1.26	1.56	1.14	0.34	1.35	1.56
Non-attenders	2.94	2.21	0.39	1.36	2.94	2.39	1.51	0.68	1.28	2.39	2.28	2.06	0.43	0.84	2.26
All	1.03	0.74	0.16	0.82	1.03	1.20	0.74	0.24	0.83	1.20	1.62	1.09	0.26	1.20	1.61

Darlington

Male	1.46	1.16	0.34	1.29	1.46	1.72	1.29	0.49	1.15	1.72	2.40	1.51	0.74	1.65	2.40
Female	1.76	1.22	0.32	1.42	1.76	1.71	1.32	0.28	1.34	1.71	2.15	1.32	0.38	1.48	2.15
Non-Manual	1.54	1.20	0.29	1.20	1.52	1.62	1.21	0.30	1.14	1.62	1.97	1.12	0.44	1.38	1.97
Manual	1.75	1.23	0.40	1.55	1.75	1.84	1.41	0.57	1.40	1.84	2.80	1.98	0.88	1.86	2.80
Attenders	1.26	1.02	0.21	1.02	1.25	1.32	1.06	0.26	0.96	1.32	1.77	1.17	0.55	1.22	1.77
Non-attenders	2.04	1.62	0.58	1.28	2.04	2.54	1.82	0.75	1.64	2.54	2.78	2.04	0.53	1.59	2.78
All	1.15	0.86	0.24	0.95	1.14	1.22	0.92	0.29	0.92	1.22	1.60	1.00	0.41	1.10	1.60

Salisbury

Male	1.47	1.13	0.23	1.12	1.47	1.56	1.14	0.20	1.05	1.56	2.39	1.51	0.45	1.32	2.39
Female	1.24	0.87	0.23	1.05	1.24	1.35	0.99	0.31	1.04	1.35	1.52	1.07	0.37	1.17	1.52
Non-Manual	1.07	0.79	0.20	0.90	1.07	1.26	0.94	0.22	0.94	1.26	1.58	0.99	0.32	1.05	1.58
Manual	1.83	1.43	0.29	1.33	1.83	1.69	1.23	0.37	1.06	1.69	2.24	1.82	0.64	1.06	2.24
Attenders	0.92	0.76	0.17	0.78	0.92	1.07	0.79	0.17	0.76	1.07	1.47	0.96	0.27	0.99	1.47
Non-attenders	2.43	1.83	0.50	1.33	2.43	2.57	2.18	0.74	0.94	2.57	2.51	1.97	0.68	0.98	2.51
All	0.95	0.71	0.16	0.77	0.95	1.02	0.75	0.19	0.74	1.02	1.31	0.88	0.29	0.88	1.31

Table 4.2.7. Mean number of decayed, missing and filled teeth (coronal surfaces) ,CCI and CCI(d) for the dentate sample, by area, age, gender, social class and attendance pattern.

Richmondshire

	60-64							65-74							75+						
	Present	Sound	Decayed	Filled	Missing	CCI	CCI(d)	Present	Sound	Decayed	Filled	Missing	CCI	CCI(d)	Present	Sound	Decayed	Filled	Missing	CCI	CCI(d)
Male	18.47	10.42	0.73	7.32	13.54	43.6%	4.0%	14.77	8.26	0.96	5.55	17.23	44.1%	6.5%	13.68	8.05	0.84	4.78	18.32	41.1%	6.1%
Female	19.91	7.96	0.84	11.12	12.09	60.0%	4.2%	16.25	8.78	0.80	6.67	15.75	46.0%	4.9%	15.83	8.13	0.98	6.72	16.18	48.6%	6.2%
Non-Manual	20.25	9.22	0.82	10.21	11.75	54.5%	4.0%	15.96	8.06	0.92	6.98	16.04	49.5%	5.7%	15.32	7.82	0.67	6.83	16.68	49.0%	4.4%
Manual	16.03	9.02	0.72	6.28	15.97	43.7%	4.5%	14.05	9.41	0.82	3.82	17.95	33.0%	5.8%	14.45	9.55	1.55	3.35	17.55	33.9%	10.7%
Attenders	20.43	9.08	0.70	10.65	11.57	55.6%	3.4%	17.07	8.83	0.76	7.48	14.94	48.3%	4.4%	18.85	8.59	0.78	9.48	13.15	54.4%	4.1%
Non-attenders	14.62	9.51	1.71	3.40	17.38	34.9%	11.7%	11.05	7.71	1.11	2.23	20.95	30.3%	10.1%	9.98	7.53	1.06	1.39	22.02	24.5%	10.6%
All	19.21	9.17	0.79	9.25	12.80	52.2%	4.1%	15.43	8.49	0.89	6.05	16.57	45.0%	5.8%	14.87	8.10	0.92	5.86	17.13	45.5%	6.2%

Darlington

	60-64							65-74							75+						
	Present	Sound	Decayed	Filled	Missing	CCI	CCI(d)	Present	Sound	Decayed	Filled	Missing	CCI	CCI(d)	Present	Sound	Decayed	Filled	Missing	CCI	CCI(d)
Male	19.57	10.72	1.03	7.82	12.43	45.2%	5.2%	16.81	9.60	1.31	5.90	15.19	42.9%	7.8%	12.86	6.48	1.10	5.28	19.14	49.6%	8.6%
Female	17.12	8.43	0.82	7.87	14.88	50.7%	4.8%	18.71	9.43	0.57	8.71	13.29	49.6%	3.1%	12.79	7.07	0.83	4.90	19.21	44.7%	6.5%
Non-Manual	18.48	9.44	0.83	8.21	13.52	48.9%	4.5%	18.49	9.32	0.75	8.41	13.51	49.6%	4.1%	12.63	6.50	0.90	5.24	19.37	48.5%	7.1%
Manual	18.46	10.04	1.07	7.35	13.54	45.6%	5.8%	16 65	9.80	1.24	5.61	15.35	41.1%	7.4%	13.20	7.30	1.10	4.80	18.80	44.7%	8.3%
Attenders	18.84	9.58	0.70	8.57	13.16	49.2%	3.7%	18.88	9.67	0.65	8.57	13.12	48.8%	3.4%	13.93	6.83	1.10	6.00	18.08	51.0%	7.9%
Non-attenders	15.02	9.95	1.43	3.64	16.98	33.7%	9.5%	14.67	9.35	1.68	3.64	17.33	36.3%	11.4%	9.53	6.53	0.65	2.35	22.47	31.5%	6.8%
All	18.48	9.69	0.95	7.84	13.52	47.6%	5.1%	17.75	9.52	0.95	7.28	14.25	46.4%	5.3%	12.83	6.78	0.97	5.09	19.17	47.2%	7.5%

Salisbury

	60-64							65-74							75+						
	Present	Sound	Decayed	Filled	Missing	CCI	CCI(d)	Present	Sound	Decayed	Filled	Missing	CCI	CCI(d)	Present	Sound	Decayed	Filled	Missing	CCI	CCI(d)
Male	19.44	10.10	0.77	8.57	12.56	48.0%	4.0%	17.41	8.65	0.73	8.04	14.59	50.3%	8.3%	14.82	7.88	1.12	5.82	17.18	46.8%	7.6%
Female	19.88	9.16	0.75	9.97	12.12	53.9%	3.7%	17.47	9.03	0.88	7.56	14.53	48.3%	10.5%	15.55	7.91	0.84	6.80	16.45	49.1%	5.4%
Non-Manual	20.63	9.57	0.79	10.27	11.37	53.6%	3.8%	18.06	8.69	0.81	8.57	13.94	51.9%	8.6%	15.72	7.43	1.02	7.26	16.28	52.7%	6.5%
Manual	17.64	9.67	0.70	7.27	14.36	45.2%	4.0%	16.18	9.21	0.83	6.14	15.82	43.1%	11.8%	13.97	9.45	0.76	3.76	18.03	32.3%	5.4%
Attenders	20 93	9.86	0.67	10.39	11.08	52.9%	3.2%	19.36	9.86	0.71	8.80	12.64	49.1%	7.4%	16.60	7.98	0.76	7.86	15.40	51.9%	4.6%
Non-attenders	13.08	8.24	1.21	3.63	18.92	37.0%	9.3%	12.24	8.24	1.35	2.66	19.76	32.7%	33.6%	11.56	7.91	1.28	2.38	20.44	31.6%	11.1%
All	19.68	9.60	0.76	9.31	12.32	51.2%	3.9%	17.45	8.86	0.81	7.78	14.56	49.2%	9.4%	15.26	7.90	0.95	6.41	16.74	48.2%	6.2%

Base numbers can be found in Table 4.2.3.

Table 4.2.8. 95% Confidence limits

Richmondshire

	Present	Sound	Decayed	Filled	Missing
Male	1.39	1.05	0.49	1.07	1.39
Female	1.41	1.07	0.52	1.15	1.41
Non-Manual	1.24	0.87	0.41	1.01	1.24
Manual	1.71	1.46	0.69	1.19	1.70
Attenders	1.12	0.90	0.42	0.95	1.12
Non-attenders	1.76	1.37	0.67	1.05	1.75
All	1.11	0.85	0.41	0.90	1.11

Darlington

Male	0.91	0.74	0.46	0.73	0.91
Female	0.90	0.73	0.33	0.75	0.90
Non-Manual	0.86	0.68	0.35	0.70	0.86
Manual	0.97	0.81	0.50	0.81	0.97
Attenders	0.78	0.65	0.36	0.64	0.78
Non-attenders	1.11	0.90	0.49	0.82	1.11
All	0.74	0.60	0.34	0.61	0.74

Salisbury

Male	0.92	0.74	0.34	0.70	0.88
Female	0.78	0.65	0.36	0.68	0.75
Non-Manual	0.77	0.63	0.31	0.64	0.74
Manual	0.94	0.80	0.43	0.68	0.90
Attenders	0.72	0.59	0.28	0.59	0.69
Non-attenders	1.14	1.00	0.53	0.64	1.11
All	0.69	0.57	0.30	0.57	0.66

Table 4.2.8. Mean number of decayed missing and filled teeth, CCI and CCI(d) for the reweighted (60+) sample, by area, age, gender, social class and attendance pattern.

Richmondshire

	Present	Sound	Decayed	Filled	Missing	CCI	CCI(d)
Male	15.94	9.01	0.86	6.07	16.06	43.5%	5.4%
Female	17.60	8.32	0.85	8.42	14.40	52.7%	4.8%
Non-Manual	17.50	8.46	0.83	8.20	14.50	51.6%	4.8%
Manual	14.83	9.29	0.89	4.65	17.17	37.4%	6.0%
Attenders	18.72	8.90	0.74	9.08	13.28	52.5%	3.9%
Non-attenders	11.71	8.15	1.26	2.30	20.29	30.4%	10.8%
All	**16.75**	**8.68**	**0.85**	**7.22**	**15.25**	**48.2%**	**5.1%**

Darlington

	Present	Sound	Decayed	Filled	Missing	CCI	CCI(d)
Male	17.21	9.51	1.17	6.54	14.79	44.7%	6.8%
Female	17.08	8.65	0.70	7.72	14.92	49.3%	4.1%
Non-Manual	17.36	8.83	0.81	7.73	14.64	49.2%	4.6%
Manual	16.83	9.52	1.15	6.16	15.17	43.5%	6.8%
Attenders	18.03	9.16	0.74	8.13	13.97	49.2%	4.1%
Non-attenders	13.87	9.08	1.38	3.41	18.13	34.5%	10.0%
All	**17.16**	**9.10**	**0.95**	**7.10**	**14.84**	**46.9%**	**5.5%**

Salisbury

	Present	Sound	Decayed	Filled	Missing	CCI	CCI(d)
Male	17.40	8.92	0.84	7.65	14.60	48.8%	4.8%
Female	17.58	8.73	0.83	8.02	14.42	50.3%	4.7%
Non-Manual	18.10	8.57	0.86	8.67	13.90	52.7%	4.8%
Manual	16.16	9.41	0.77	5.99	15.84	41.8%	4.8%
Attenders	19.15	9.39	0.71	9.05	12.85	51.0%	3.7%
Non-attenders	12.20	8.12	1.29	2.80	19.80	33.5%	10.6%
All	**17.50**	**8.81**	**0.83**	**7.86**	**14.50**	**49.6%**	**4.8%**

Base numbers can be found in Table 4.2.3.

between areas and a slight age related increase (despite a reduction in the total number of teeth present). It is the non-attenders who have by far the highest number of decayed crowns (around 1.3 in all areas). As this is the group with the fewest fillings, they stand out as having a rather low Coronal Caries Index (CCI), but a high Coronal Caries Index for decay (CCI(d)). The calculation of these indices is presented in section 3.11.5.. Overlays, giving the figure from which the 95% confidence intervals for each mean value can be calculated, are presented.

The decayed component constituted teeth with new decay, teeth with unsound restorations (this may be decay around restorations or fractured fillings), teeth which are sufficiently broken down by dental decay to expose the pulp or make them unrestorable, and unsound artificial crowns. Table 4.2.9. shows the relative abundance of these different categories in different areas and age groups. Using the reweighted data for the three samples 33-39% of all teeth categorised as decayed were unsound fillings, and 42-56% were unsound restorations (either fillings or crowns). New or untreated decay (not including grossly decayed or broken down teeth) constituted only 24-37% of all decayed teeth. Heavily broken down teeth accounted for an additional 21% of the decayed component in all areas. The proportion of the decayed component accounted for by unsound fillings showed a tendency to decrease with age, whilst the proportion which was accounted for by gross decay or breakdown increased consistently with age.

Artificial full coverage crowns were present in around a third (32-36%) of the *reweighted 60+* sample in all three areas, but it was women, non-manual workers and attenders who were most likely to have crowns, with a 60+ maximum of 43.9% (for attenders in Richmondshire), and a minimum of 6.8% (non-attenders in the same area). Manual workers in Darlington were much more likely to have crowns than their fellows in either of the other areas (29% compared with 16 - 18%). These data are presented in tables 4.2.10. and 4.2.11. (with an overlay for the latter table, to allow the calculation of the confidence limits for the mean values). Between 9% and 15% of all artificial crowns were recorded as unsound.

Table 4.2.9. Percentage of the coronal decay component in different categories, by area and age.

Richmondshire

	60-64	65-74	75+	Rwt 60+
Mean number of "decayed" teeth	0.79	0.96	0.84	**0.85**
% new decay	23.6%	21.7%	36.8%	**25.3%**
% unrestorable	10.4%	23.3%	32.9%	**20.7%**
% unsound fillings	44.5%	40.8%	22.4%	**38.5%**
% unsound crowns	21.5%	14.2%	7.9%	**15.5%**

Darlington

	60-64	65-74	75+	Rwt 60+
Mean number of "decayed" teeth	0.95	0.95	0.97	**0.95**
% new decay	26.6%	47.7%	31.0%	**37.0%**
% unrestorable	21.0%	19.2%	24.1%	**20.8%**
% unsound fillings	39.9%	27.5%	31.0%	**32.6%**
% unsound crowns	12.5%	5.5%	13.8%	**9.6%**

Salisbury

	60-64	65-74	75+	Rwt 60+
Mean number of "decayed" teeth	0.76	0.81	0.95	**0.83**
% new decay	29.1%	20.4%	22.3%	**23.4%**
% unrestorable	10.1%	22.5%	27.3%	**20.7%**
% unsound fillings	44.3%	40.1%	29.8%	**37.9%**
% unsound crowns	16.5%	16.9%	20.7%	**18.0%**

Table 4.2.10. Percentage of the dentate sample with one or more crowned teeth, by area, age social class and attendance pattern.

Richmondshire

	60-64	65-74	75+	Rwt 60+
Male	34.8%	27.0%	18.9%	**28.5%**
Female	45.7%	33.3%	37.0%	**38.9%**
Non-manual	48.1%	34.0%	38.3%	**40.2%**
Manual	17.4%	17.9%	5.0%	**15.8%**
Attenders	47.6%	39.8%	45.7%	**43.9%**
Non-attenders	11.4%	2.9%	8.3%	**6.8%**
Base for "All"	181	134	83	398
All	**40.3%**	**29.9%**	**28.9%**	**33.6%**

Darlington

	60-64	65-74	75+	Rwt 60+
Male	31.1%	15.5%	20.7%	**22.4%**
Female	53.3%	41.1%	20.7%	**41.5%**
Non-manual	44.2%	30.9%	18.4%	**33.2%**
Manual	36.8%	23.9%	25.0%	**29.1%**
Attenders	51.1%	32.9%	27.5%	**38.4%**
Non-attenders	19.0%	14.3%	0.0%	**13.6%**
Base for "All"	134	114	58	306
All	**41.0%**	**28.1%**	**20.7%**	**31.5%**

Salisbury

	60-64	65-74	75+	Rwt 60+
Male	32.0%	38.7%	28.0%	**33.9%**
Female	48.2%	31.6%	34.7%	**37.3%**
Non-manual	48.2%	44.1%	37.9%	**43.4%**
Manual	24.2%	15.8%	13.8%	**18.1%**
Attenders	46.7%	40.4%	39.1%	**42.0%**
Non-attenders	9.1%	6.9%	12.5%	**9.6%**
Base for "All"	207	175	125	507
All	**40.6%**	**34.9%**	**32.0%**	**35.8%**

Base figures for other sub-groups are given in table 3.1.2.

Table 4.2.11. 95% Confidence limits

Richmondshire

	60-64	65-74	75+	Rwt 60+
Mean number of crowns	0.49	0.54	0.84	0.38

Darlington

	60-64	65-74	75+	Rwt 60+
Mean number of crowns	0.56	0.47	0.66	0.32

Salisbury

	60-64	65-74	75+	Rwt 60+
Mean number of crowns	0.53	0.64	0.86	0.42

Table 4.2.11. Percentage of dentate sample with multiple crowns and bridges, and the mean number of crowns in those with crowns, by area and age.

Richmondshire

	60-64	65-74	75+	Rwt 60+
Base	181	134	83	398
% with bridges	4.4%	3.0%	2.4%	3.4%
% with multiple crowns	26.0%	20.9%	19.3%	22.5%
*mean number of crowns	2.86	2.68	2.83	2.78

Darlington

	60-64	65-74	75+	Rwt 60+
Base	134	114	58	306
% with bridges	6.0%	0.9%	0.0%	2.6%
% with multiple crowns	27.6%	13.2%	12.1%	18.3%
*mean number of crowns	2.71	1.9	2.08	2.23

Salisbury

	60-64	65-74	75+	Rwt 60+
Base	207	175	125	507
% with bridges	9.2%	5.7%	3.2%	6.1%
% with multiple crowns	28.0%	23.4%	16.0%	22.7%
*mean number of crowns	3.02	2.72	2.78	2.83

* the mean number of crowns are calculated only in those with crowns.
The base numbers for this group are given below:

	60-64	65-74	75+	Rwt 60+
Richmondshire	73	40	24	137
Darlington	55	32	12	99
Salisbury	84	61	40	185

4.2.4. Dentate subjects: Data on decay and fillings on the roots.

On average most sample sub-groups had between 8 and 12 teeth vulnerable to root surface caries, and the proportion of these affected (RCI) increased with age (tables 4.2.12. and 4.2.13, plus overlays). Overall the RCI was around 20-24%. Much of the apparent inter-area differences can probably be accounted for by inter-examiner differences (see table 4.1.10.) and it is recommended that this table should be used for comparisons between areas. Non-attenders stand out as the group with the lowest RCI, but by far the highest number of decayed roots (and RCI(d)), mirroring the situation on the coronal surfaces. A significant proportion of the sample in all areas were unaffected by root caries or root surface fillings, around 30% or more and highest in Richmondshire (see also table 4.1.10.).

Most of the roots classed as decayed were new decay, accounting for 76-80% of the decayed root component of the reweighted samples. Between 11% and 21% were unsound restorations and 3-11% were sufficiently broken down to have indicated frank pulpal involvement. There were no clear or consistent age related trends. These data are presented in table 4.2.14..

Figures 4.2.1. and 4.2.2. demonstrate the concentration of the disease in a small proportion of the population. These plot the percentage of the dentate sample, starting with the most severely affected at the left hand end of the x-axis, against the percentage of all lesions, and the percentage of all lesions and fillings combined, in the dentate sample. These graphs illustrate that the most severely affected 10% of the sample account for over 50% of all of the teeth with root surface lesions or unsound restorations and over 35% of all of the decayed or filled roots. The worst 20% account for over 70% of all of the lesions, and nearly 60% of all of the decayed or filled roots.

Root and crown data have been combined in table 4.2.15. to give a whole tooth score. These figures mirror the ones for roots and coronal surfaces, and once again it is the non-attenders who stand out as having more decay, fewer fillings and fewer teeth. The reweighted mean numbers of teeth with decay or fillings of the coronal and root surfaces are given in the same table as the *combined* root and crown data. This allows the

Table 4.2.12. 95% Confidence limits

Richmond

	60-64				65-74				75+			
	At Risk	Sound	Decayed	Filled	At Risk	Sound	Decayed	Filled	At Risk	Sound	Decayed	Filled
Male	1.16	1.48	0.24	0.39	1.26	1.23	0.28	0.44	1.87	1.57	0.44	0.78
Female	1.12	1.57	0.18	0.50	1.32	1.67	0.38	0.42	1.51	1.83	0.27	0.64
Non-Manual	0.99	1.31	0.14	0 35	1.37	1.58	0.44	0.74	1.11	1.27	0.26	0.42
Manual	1.60	1.65	0.30	0.22	1.42	1.56	0.28	0.65	2.37	1.86	0.53	0.33
Attenders	0.93	1.21	0.16	0.37	1.09	1.15	0.25	0.40	1.54	1.79	0.28	0.67
Non-attenders	1.58	2.28	0.36	0.40	1.49	1.95	0.49	0.12	1.64	1.15	0.42	0.63
All	0.81	1.10	0.15	0.32	0.91	1.02	0.23	0.31	1.19	1.23	0.25	0.49

Darlington

	60-64				65-74				75+			
Male	1.32	1.49	0.38	0.53	1.49	1.11	0.52	0.76	1.59	1.45	0.77	0.76
Female	1.35	1.68	0.29	0.59	1.49	1.51	0.21	0.54	1.84	1.08	0.42	0.59
Non-Manual	1.14	1.56	0.29	0.48	1.39	1.41	0.21	0.52	1.63	1.11	0.57	0.64
Manual	1.63	1.45	0.43	0.67	1.62	0.99	0.64	0.86	1.67	1.53	0.68	0.69
Attenders	1.19	1.41	0.24	0.53	1.25	1.14	0.30	0.57	1.43	1.10	0.58	0.61
Non-attenders	1.77	1.26	0.58	0.36	1.84	1.80	0.70	0.44	1.73	1.66	0.60	0.59
All	0.99	1.11	0.25	0.39	1.06	0.97	0.29	0.46	1.21	0.90	0.44	0.48

Salisbury

	60-64				65-74				75+			
Male	1.20	1.61	0.19	0.43	1.29	1.37	0.28	0.52	1.67	1.67	0.50	0.74
Female	1.16	1.27	0.12	0.35	1.00	1.40	0.22	0.36	1.28	1.04	0.31	0.44
Non-Manual	1.01	1.20	0.13	0.36	1.03	1.20	0.20	0.37	1.25	1.03	0.34	0.49
Manual	1.49	1.77	0.22	0.42	1.26	1.75	0.35	0.55	1.60	2.03	0.31	0.57
Attenders	0.92	1.08	0.12	0.32	0.87	1.09	0.18	0.35	1.19	1.14	0.33	0.50
Non-attenders	1.96	1.92	0.30	0.25	2.13	1.87	0.54	0.39	1.83	1.21	0.46	0.28
All	0.83	1.01	0.11	0.28	0.81	0.99	0.18	0.31	1.03	0.91	0.27	0.40

Table 4.2.12. Mean number of teeth affected by root caries, sample RCI and sample RCI(d), by area, age, social class and attendance pattern

Richmond

	60-64							65-74							75+						
	At Risk	Sound	Decayed	Filled	No D/F	RCI	RCI(d)	At Risk	Sound	Decayed	Filled	No D/F	RCI	RCI(d)	At Risk	Sound	Decayed	Filled	No D/F	RCI	RCI(d)
Male	10.28	8.24	0.63	1.42	27.5%	19.89%	6.12%	9.65	7.80	0.70	1.15	40.9%	19.19%	7.29%	8.65	6.19	1.11	1.35	24.1%	28.43%	12.81%
Female	8.98	7.07	0.41	1.50	42.7%	21.31%	4.60%	9.33	7.68	0.73	0.92	49.0%	17.68%	7.85%	10.44	8.15	0.76	1.52	15.8%	21.88%	7.29%
Non-Manual	9.64	7.72	0.44	1.48	35.0%	19.89%	4.52%	9.82	7.75	0.73	1.34	36.1%	21.12%	7.48%	9.78	7.07	0.87	1.85	18.8%	27.77%	8.86%
Manual	9.87	7.63	0 78	1.46	29.6%	22.70%	7.93%	8.64	7.80	0.49	0.36	63.6%	9.79%	5.64%	9.90	8.50	1.00	0.40	27.3%	14.14%	10.10%
Attenders	9.90	7.76	0.45	1.69	34.1%	21.62%	4.55%	10.37	8.33	0.66	1.38	39.0%	19.70%	6.39%	11.48	8.54	0.74	2.20	7.9%	25.58%	6.45%
Non-attenders	8.43	7.11	0.83	0.49	40.0%	15.66%	9.85%	7.17	6.23	0.80	0.14	58.1%	13.15%	11.15%	7.36	5.75	1.08	0.53	35.7%	21.88%	14.67%
All	9.62	7.64	0.52	1.46	35.2%	20.56%	5.40%	9.51	7.75	0.72	1.05	44.4%	18.52%	7.53%	9.64	7.28	0.92	1.45	19.4%	24.50%	9.50%

Darlington

	60-64							65-74							75+						
	At Risk	Sound	Decayed	Filled	No D/F	RCI	RCI(d)	At Risk	Sound	Decayed	Filled	No D/F	RCI	RCI(d)	At Risk	Sound	Decayed	Filled	No D/F	RCI	RCI(d)
Male	12.54	10.10	1.01	1.43	27.1%	19.50%	8.09%	12.97	9 52	1.45	2.00	19.2%	26.59%	11.17%	9.72	6.07	1.62	2.03	11.5%	37.59%	16.67%
Female	9.13	7.13	0.65	1.35	37.7%	21.90%	7.12%	11.77	9.27	0.52	1.98	28.6%	21.24%	4.40%	9.93	7.00	1.21	1.72	22.7%	29.51%	12.15%
Non-Manual	9.71	7.52	0.81	1.39	31.9%	22.60%	8.29%	11.93	9.10	0.69	2.13	24.6%	23.67%	5.79%	10.11	6.63	1.47	2.00	19.4%	34.38%	14.59%
Manual	12.77	10.46	0.91	1.40	33.3%	18.13%	7.14%	13.00	9.83	1.44	1.74	15.6%	24.41%	11.04%	9.30	6.35	1.30	1.65	7.7%	31.72%	13.98%
Attenders	11.21	8.71	0.71	1.79	28.6%	22.31%	6.31%	13.06	9.78	0.79	2.49	20.0%	25.13%	6.03%	10.58	6.80	1.53	2.25	11.8%	35.70%	14.42%
Non-attenders	10.60	8.91	1.17	0.52	38.5%	15.96%	11.01%	10.57	8.57	1.46	0.54	36.0%	18.92%	13.85%	7.47	5.29	1.24	0.94	28.6%	29.13%	16.53%
All	11.02	8.77	0.85	1.40	31.7%	20.40%	7.73%	12.38	9.40	0.99	1.99	29.8%	24.09%	8.01%	9.83	6.53	1.41	1.88	16.7%	33.51%	14.39%

Salisbury

	60-64							65-74							75+						
	At Risk	Sound	Decayed	Filled	No D/F	RCI	RCI(d)	At Risk	Sound	Decayed	Filled	No D/F	RCI	RCI(d)	At Risk	Sound	Decayed	Filled	No D/F	RCI	RCI(d)
Male	10.59	8.55	0.59	1.45	30.7%	19.29%	5.55%	10.99	8.33	0.81	1.85	26.8%	24.24%	7.40%	10.14	7.24	1.26	1.64	23.1%	28.60%	12.43%
Female	9.77	8.13	0.35	1.30	35.1%	16.83%	3.53%	9.79	7.78	0.54	1.47	31.4%	20.54%	5.49%	11.81	9.19	0.88	1.75	19.7%	22.24%	7.45%
Non-Manual	10.15	8.24	0.45	1.45	31.3%	18.80%	4.47%	10.58	8.47	0.62	1.49	31.8%	19.96%	5.85%	11.47	8.44	1.17	1.86	20.0%	26.42%	10.18%
Manual	10.17	8.50	0.47	1.20	35.9%	16.40%	4.62%	9.84	7.12	0.75	1.97	22.9%	27.63%	7.66%	10.14	8.31	0.62	1.21	27.3%	18.03%	6.13%
Attenders	10.42	8.53	0.39	1.51	34.8%	18.15%	3.69%	10.43	8.01	0.58	1.84	28.2%	23.13%	5.52%	11.94	8.69	1.08	2.17	15.1%	27.23%	9.02%
Non-attenders	8.76	7.24	0.85	0.67	22.2%	17.30%	9.68%	9.90	8.10	1.10	0.69	34.6%	18.12%	11.15%	9.19	7.88	0.91	0.41	37.0%	14.28%	9.86%
All	10.16	8.32	0.46	1.37	33.0%	18.03%	4.52%	10.34	8.03	0.66	1.65	29.3%	22.34%	6.41%	11.14	8.41	1.03	1.70	21.0%	24.55%	9.26%

"sound" means vulnerable (i.e. root exposed) but sound
"No D/F" gives the percentage of the population with no decayed or filled root surfaces
"RCI" indicates Root Caries Index calculated using decayed and filled teeth as components
"RCI(d)" indicates Root Caries Index calculated using only decayed teeth as components

Base numbers can be found in Table 4.2.3.

Table 4.2.13. 95% Confidence limits

Richmondshire

	At Risk	Sound	Decayed	Filled
Male	0.86	0.82	0.19	0.33
Female	0.79	1.00	0.19	0.30
Non-Manual	0.73	0.86	0.21	0.36
Manual	1.05	0.98	0.22	0.30
Attenders	0.72	0.81	0.15	0.29
Non-attenders	0.91	1.08	0.27	0.23
All	0.58	0.65	0.13	0.22

Darlington

Male	0.88	0.76	0.34	0.43
Female	0.93	0.85	0.17	0.33
Non-Manual	0.84	0.81	0.21	0.32
Manual	0.97	0.74	0.36	0.46
Attenders	0.76	0.70	0.23	0.34
Non-attenders	1.06	0.99	0.39	0.28
All	0.64	0.58	0.20	0.27

Salisbury

Male	1.65	1.76	0.42	0.69
Female	1.31	1.47	0.28	0.45
Non-Manual	1.29	1.33	0.29	0.48
Manual	1.65	2.16	0.37	0.62
Attenders	1.16	1.28	0.28	0.47
Non-attenders	2.33	1.95	0.56	0.39
All	1.04	1.12	0.24	0.39

Table 4.2.13. Mean number of teeth affected by root caries, sample RCI and RCI(d) for the reweighted dentate (60+) sample by area, age, social class and attendance pattern.

Richmondshire

	At Risk	Sound	Decayed	Filled	No D/F	RCI	RCI(d)
Male	9.72	7.70	0.74	1.28	33.3%	20.78%	7.63%
Female	9.42	7.54	0.61	1.27	39.6%	20.00%	6.51%
Non-Manual	9.74	7.61	0.64	1.49	32.5%	21.89%	6.60%
Manual	9.28	7.84	0.67	0.77	45.7%	15.49%	7.25%
Attenders	10.33	8.12	0.58	1.62	32.6%	21.39%	5.66%
Non-attenders	7.57	6.33	0.89	0.35	46.5%	16.44%	11.78%
All	**9.57**	**7.62**	**0.68**	**1.28**	**36.3%**	20.40%	7.09%

Darlington

	At Risk	Sound	Decayed	Filled	No D/F	RCI	RCI(d)
Male	12.26	9.16	1.31	1.79	21.0%	25.25%	10.68%
Female	10.53	8.12	0.69	1.72	30.6%	22.87%	6.55%
Non-Manual	10.80	8.07	0.88	1.85	26.2%	25.25%	8.15%
Manual	12.36	9.55	1.21	1.60	21.3%	22.72%	9.81%
Attenders	11.99	8.90	0.88	2.21	21.6%	25.78%	7.37%
Non-attenders	10.01	8.11	1.30	0.61	35.7%	19.03%	12.98%
All	**11.43**	**8.67**	**1.01**	**1.75**	**28.2%**	24.21%	8.87%

Salisbury

	At Risk	Sound	Decayed	Filled	No D/F	RCI	RCI(d)
Male	10.65	8.12	0.85	1.67	27.1%	23.72%	8.02%
Female	10.39	8.30	0.59	1.51	28.9%	20.12%	5.63%
Non-Manual	10.72	8.39	0.74	1.59	28.1%	21.72%	6.87%
Manual	10.01	7.82	0.63	1.55	28.0%	21.87%	6.34%
Attenders	10.81	8.34	0.64	1.82	26.9%	22.78%	5.95%
Non-attenders	9.34	7.80	0.96	0.58	32.4%	16.50%	10.32%
All	**10.51**	**8.22**	**0.70**	**1.58**	**28.1%**	21.75%	6.71%

"sound" means vulnerable (i.e. root exposed) but sound
"No D/F" gives the percentage of the population with no decayed or filled root surfaces
"RCI" indicates Root Caries Index calculated using decayed and filled teeth as components
"RCI(d)" indicates Root Caries Index calculated using only decayed teeth as components

Base numbers can be found in Table 3.2.3.

Table 4.2.14. Percentage of the root decay component in different categories, by area and age

Richmondshire

	60-64	65-74	75+	Rwt 60+
Mean number of "decayed" teeth	0.52	0.72	0.92	**0.68**
% new root surface decay	72.0%	89.3%	73.7%	**80.3%**
% unrestorable	4.3%	1.0%	6.6%	**3.4%**
% unsound root surface fillings	23.7%	9.7%	19.8%	**16.3%**

Darlington

	60-64	65-74	75+	Rwt 60+
Mean number of "decayed" teeth	0.85	0.90	1.41	**1.01**
% new root surface decay	80.5%	80.5%	68.6%	**77.6%**
% unrestorable	9.7%	8.0%	18.1%	**11.0%**
% unsound root surface fillings	9.7%	11.5%	13.3%	**11.4%**

Salisbury

	60-64	65-74	75+	Rwt 60+
Mean number of "decayed" teeth	0.46	0.66	1.03	**0.7**
% new root surface decay	72.7%	73.5%	79.1%	**75.6%**
% unrestorable	3.1%	6.0%	1.6%	**3.6%**
% unsound root surface fillings	24.2%	20.5%	19.4%	**20.8%**

Figure 4.2.1. Percentage of sample accounting for percentage of all root caries lesions or unsound restorations (data for all areas pooled).

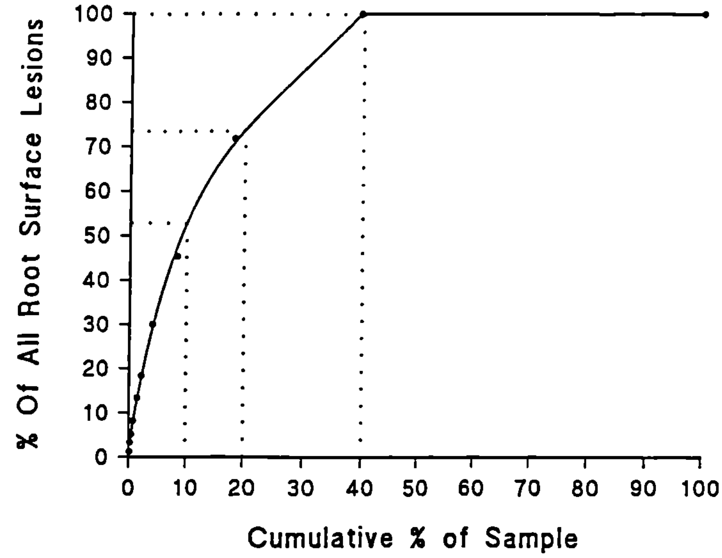


Figure 4.2.2. Percentage of sample accounting for percentage of all root caries lesions and all root surface restorations (data for all areas pooled).

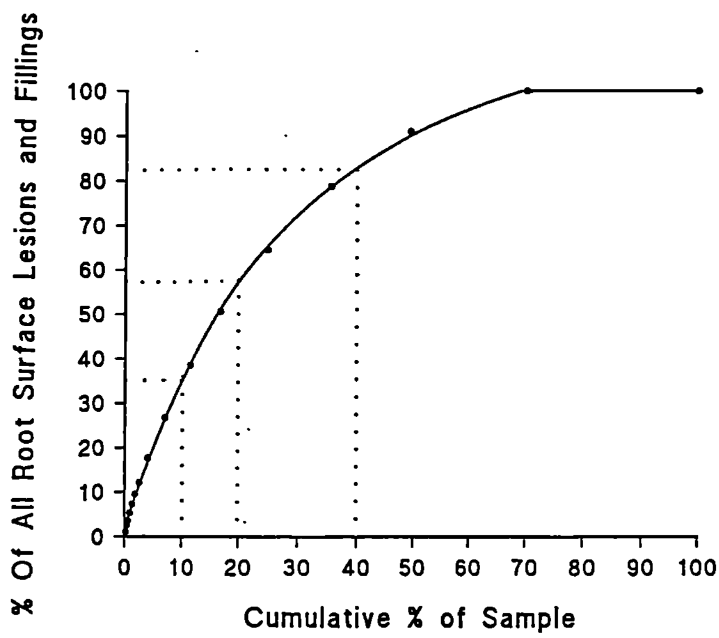


Table 4.2.15. Confidence limits

Richmondshire

	Present	Sound	Decayed	Filled
Male	1.50	0.62	1.17	1.15
Female	1.44	0.59	1.23	1.08
Non-manual	1.30	0.50	1.10	0.91
Manual	1.81	0.83	1.30	1.57
Attender	1.16	0.53	1.01	0.91
Non-attender	1.75	0.72	1.05	1.43
All	1.17	0.50	0.98	0.90

Darlington

Male	1.48	0.81	1.25	1.17
Female	1.44	0.63	1.16	1.13
Non-manual	1.36	0.65	1.11	1.05
Manual	1.60	0.88	1.36	1.32
Attender	1.24	0.69	1.04	1.01
Non-attender	1.79	0.78	1.28	1.49
All	1.16	0.61	0.97	0.92

Salisbury

Male	1.49	0.77	1.13	1.19
Female	1.21	0.61	1.05	1.00
Non-manual	1.20	0.63	0.99	0.95
Manual	1.50	0.72	1.06	1.33
Attender	1.13	0.61	0.93	0.92
Non-attender	1.80	0.84	0.96	1.61
All	1.07	0.57	0.88	0.88

Table 4.2.15. The mean number of decayed, missing and filled teeth (crown and root) for reweighted (60+) dentate sample, by area, age, gender, social class and attendance pattern

Richmondshire

	Present	Sound	Decayed	Filled
Male	15.96	8.10	1.49	6.36
Female	17.58	7.66	1.37	8.55
Non-manual	17.52	7.66	1.41	8.45
Manual	14.75	8.58	1.38	4.80
Attender	18.72	8.07	1.26	9.39
Non-attender	11.56	7.48	1.83	2.26
Base for "All"	181	398	134	83
All	**16.75**	**7.89**	**1.43**	**7.43**
Coronal data	*	*	0.85	7.22
Root data	*	*	0.68	1.28

Darlington

	Present	Sound	Decayed	Filled
Male	17.24	8.48	1.99	6.76
Female	17.09	8.06	1.29	7.73
Non-manual	17.39	8.04	1.52	7.83
Manual	16.83	8.64	1.86	6.33
Attender	18.50	8.32	1.43	8.75
Non-attender	13.82	8.30	2.17	3.34
Base for "All"	134	306	114	58
All	**17.17**	**8.28**	**1.66**	**7.23**
Coronal data	*	*	0.95	7.1
Root data	*	*	1.01	1.75

Salisbury

	Present	Sound	Decayed	Filled
Male	17.42	7.97	1.59	7.86
Female	17.59	8.02	1.36	8.22
Non-manual	18.11	7.79	1.52	8.80
Manual	16.17	8.49	1.34	6.34
Attender	18.67	8.07	1.29	9.30
Non-attender	12.68	7.78	2.09	2.81
Base for "All"	207	507	175	125
All	**17.52**	**8.00**	**1.46**	**8.06**
Coronal data	*	*	0.83	7.86
Root data	*	*	0.7	1.58

* represents data not applicable
Base figures for other sub-groups are given in table 4.1.2.

amount of overlap of root and crown decay and fillings to be estimated. A mean of 0.1 to 0.3 teeth had decay on both crown and roots, whilst a mean of 1.1 to 1.6 teeth had fillings in both crown and root surfaces, accounting for the majority of teeth with root surface fillings.

4.2.5. Dentate subjects: Periodontal disease

The subject base for the measurement of periodontal disease was smaller than that for other aspects of clinical disease, and is given in table 4.2.16., while the percentage of the total dentate sample who were excluded from the periodontal examination is given in table 4.2.17..

Periodontal data was affected by the problems of inter-examiner variability, specifically in terms of the measurements of pocket depths. In view of these problems data recorded for deep pocketing (the most severe CPITN code) and loss of attachment by the author alone are given in table 4.1.10.. Where comparisons have been made between areas, it is referring to these data. The problems with trying to compare areas using data from all examiners are illustrated in table 4.1.9., which shows that the variations between the second examiners and the author were sometimes large, and the direction of the discrepancy was different according to the area. Despite concerns about its value (see the results presented later in this section) tables of CPITN data of the type recommended by the WHO are given for each area separately (tables 4.2.18. to 4.2.20.). The reason that these have been included is to allow some comparison with any previous studies which used this index. Additional tables presenting data for loss of attachment, furcation involvement and mobility are also presented (tables 4.2.21. to 4.2.24.).

When considering differences between areas it is probably most appropriate to consider the statistics for the author alone (table 4.1.10.). The proportion of the population with one or more deep pockets (6mm or greater) was consistent between areas at around 23% overall, those with any loss of attachment of 6mm or greater accounted for 42-48% and those with any severe loss of attachment (9mm or more) accounted for 11-13% (see table 4.1.10.). 18-25% of the sample had 3 or more teeth with loss of attachment of 6mm or greater. The low figures for periodontal variables found in Salisbury in tables 4.2.20., 4.2.21 and 4.2.22.

Table 4.2.16. Base numbers of sample for periodontal data.

Richmondshire

	60-64	65-74	75+	Total
Male	80	59	29	**168**
Female	82	49	38	**169**
Non-manual	120	72	48	**240**
Manual	40	35	16	**91**
Attenders	132	76	38	**246**
Non-attenders	30	31	28	**89**
All	**162**	**108**	**67**	**337**

Darlington

	60-64	65-74	75+	Total
Male	70	52	26	**148**
Female	53	49	22	**124**
Non-manual	69	61	31	**161**
Manual	54	40	17	**111**
Attenders	84	75	34	**193**
Non-attenders	39	25	14	**78**
All	**123**	**101**	**48**	**272**

Salisbury

	60-64	65-74	75+	Total
Male	89	71	39	**199**
Female	97	86	62	**245**
Non-manual	132	107	76	**315**
Manual	54	50	25	**129**
Attenders	158	131	73	**362**
Non-attenders	28	26	27	**81**
All	**186**	**157**	**101**	**444**

Table 4.2.17. Percentage of dentate subjects not periodontally examined due to medical history, by area and age.

	60-64	65-74	75+	Total
Richmondshire	10.5%	19.4%	23.9%	**15.3%**
Darlington	8.2%	11.4%	17.2%	**11.1%**
Salisbury	10.1%	10.3%	19.2%	**12.4%**

Table 4.2.18. CPITN - Richmondshire, by age, gender, social class and attendance.

			% of sample with worst score...					Mean number of sextants with worst score...				
		Base	Health	Bleeding	Calculus	Moderate Pocketing	Deep Pocketing	Health	Bleeding or worse	Calculus or worse	Moderate or worse	Deep or worse
60-64	Male	80	3.8%	0.0%	33.8%	35.0%	27.5%	1.03	3.38	3.15	2.66	0.49
	Female	82	3.7%	3.7%	25.6%	45.1%	22.0%	1.35	3.57	3.09	2.77	0.32
	Non-manual	120	1.7%	1.7%	30.0%	43.3%	23.3%	1.13	3.75	3.38	2.98	0.41
	Manual	40	2.5%	0.0%	20.0%	20.0%	25.0%	1.25	2.75	2.40	2.00	0.40
	Attenders	132	3.8%	1.5%	28.0%	40.9%	25.8%	1.37	3.68	3.28	2.86	0.42
	Non-attenders	30	3.3%	3.3%	36.7%	36.7%	20.0%	0.43	2.57	2.40	2.10	0.30
	All	162	**3.7%**	**1.9%**	**29.6%**	**40.1%**	**24.7%**	**1.19**	**3.48**	**3.12**	**2.72**	**0.40**
65-74	Male	59	11.9%	1.7%	33.9%	28.8%	23.7%	0.73	2.70	2.49	2.14	0.36
	Female	49	10.2%	0.0%	32.7%	34.7%	22.4%	1.00	2.82	2.61	2.29	0.33
	Non-manual	72	6.9%	1.4%	33.3%	34.7%	23.6%	0.78	2.97	2.69	2.35	0.35
	Manual	35	8.6%	0.0%	17.1%	22.9%	14.3%	1.03	2.23	2.17	1.89	0.29
	Attenders	76	9.2%	1.3%	31.6%	32.9%	25.0%	0.99	3.07	2.80	2.43	0.37
	Non-attenders	31	16.1%	0.0%	35.5%	29.0%	19.4%	0.52	2.03	1.97	1.68	0.29
	All	108	**11.1%**	**0.9%**	**33.3%**	**31.5%**	**23.1%**	**0.85**	**2.75**	**2.50**	**2.20**	**0.34**
75+	Male	29	6.9%	0.0%	48.3%	34.5%	10.3%	0.69	2.69	2.52	2.41	0.10
	Female	38	5.3%	2.6%	42.1%	26.3%	23.7%	0.84	2.87	2.55	2.29	0.26
	Non-manual	84	6.3%	2.1%	54.2%	27.1%	10.4%	0.98	2.77	2.50	2.40	0.10
	Manual	16	0.0%	0.0%	12.5%	25.0%	31.3%	0.13	3.06	2.81	2.38	0.44
	Attenders	38	5.3%	0.0%	47.4%	31.6%	15.8%	1.08	3.45	3.11	2.92	0.18
	Non-attenders	28	7.1%	3.6%	39.3%	28.6%	21.4%	0.39	1.90	1.75	1.54	0.21
	All	67	**6.0%**	**1.5%**	**44.8%**	**29.9%**	**17.9%**	**0.78**	**2.79**	**2.54**	**2.34**	**0.19**
Rwt 60+	Male	168	8.0%	0.8%	36.0%	32.1%	23.2%	0.84	2.97	2.75	2.39	0.37
	Female	169	6.5%	2.0%	31.7%	37.3%	22.5%	1.11	3.14	2.80	2.49	0.31
	Non-manual	240	4.6%	1.7%	35.7%	37.0%	21.1%	0.96	3.26	2.95	2.63	0.33
	Manual	91	5.1%	0.0%	17.4%	22.2%	20.7%	0.97	2.54	2.35	2.00	0.35
	Attenders	246	6.2%	1.2%	32.2%	36.3%	24.1%	1.17	3.40	3.06	2.69	0.37
	Non-attenders	89	10.1%	1.9%	36.9%	31.0%	20.1%	0.46	2.14	2.03	1.76	0.27
	All	337	**7.2%**	**1.4%**	**33.8%**	**34.7%**	**22.8%**	**0.97**	**3.05**	**2.76**	**2.43**	**0.34**

Base figures for other subgroups are given in Table 4.2.16.

Table 4.2.19. CPITN - Darlington, by age, gender, social class and attendance.

			% of sample with worst score...					Mean number of sextants with worst score...				
		Base	Health	Bleeding	Calculus	Moderate Pocketing	Deep Pocketing	Health	Bleeding or worse	Calculus or worse	Moderate or worse	Deep or worse
60-64	*Male*	70	0.0%	2.9%	20.0%	47.1%	30.0%	0.43	4.34	3.86	3.23	0.63
	Female	53	1.9%	0.0%	26.4%	56.6%	15.1%	0.49	3.47	3.09	2.88	0.21
	Non-manual	69	0.0%	2.9%	21.7%	53.6%	21.7%	0.51	3.99	3.57	3.17	0.39
	Manual	54	1.9%	0.0%	14.8%	35.2%	20.4%	0.39	3.94	3.48	2.96	0.52
	Attenders	84	0.0%	2.4%	19.0%	59.5%	19.0%	0.51	4.33	3.81	3.48	0.33
	Non-attenders	39	2.6%	0.0%	30.8%	33.3%	33.3%	0.33	3.18	2.92	2.23	0.69
	All	123	**0.8%**	**1.6%**	**22.8%**	**51.2%**	**23.6%**	**0.46**	**3.97**	**3.53**	**3.08**	**0.45**
65-74	Male	52	0.0%	0.0%	15.4%	61.5%	23.1%	0.15	3.85	3.65	3.38	0.27
	Female	49	0.0%	2.0%	26.5%	46.9%	24.5%	0.47	4.08	3.84	3.41	0.43
	Non-manual	61	0.0%	1.6%	21.3%	54.1%	23.0%	0.39	4.03	3.75	3.38	0.38
	Manual	40	0.0%	0.0%	17.5%	45.0%	17.5%	0.18	3.85	3.73	3.43	0.30
	Attenders	75	0.0%	1.3%	16.0%	57.3%	25.3%	0.36	4.25	4.03	3.65	0.37
	Non-attenders	25	0.0%	0.0%	36.0%	40.0%	20.0%	0.61	3.16	2.96	2.68	0.28
	All	101	**0.0%**	**1.0%**	**20.8%**	**54.5%**	**23.8%**	**0.31**	**3.96**	**3.74**	**3.40**	**0.35**
75+	Male	26	0.0%	0.0%	42.3%	42.3%	15.4%	0.31	3.15	3.04	2.89	0.15
	Female	22	4.5%	0.0%	18.2%	54.5%	22.7%	0.46	2.77	2.68	2.14	0.55
	Non-manual	31	3.2%	0.0%	29.0%	54.8%	12.9%	0.36	3.00	2.87	2.58	0.29
	Manual	17	0.0%	0.0%	23.5%	29.4%	23.5%	0.41	2.94	2.88	2.47	0.41
	Attenders	34	2.9%	0.0%	35.3%	47.1%	44.1%	0.50	3.15	3.03	2.71	0.32
	Non-attenders	14	0.0%	0.0%	21.4%	50.0%	28.6%	0.07	2.57	2.50	2.14	0.36
	All	48	**2.1%**	**0.0%**	**31.3%**	**47.9%**	**18.8%**	**0.38**	**2.98**	**2.88**	**2.54**	**0.33**
Rwt 60+	Male	148	0.0%	1.2%	21.6%	52.6%	24.6%	0.29	3.93	3.63	3.24	0.39
	Female	124	1.4%	1.0%	25.1%	51.6%	20.9%	0.48	3.65	3.39	3.02	0.37
	Non-manual	161	0.6%	1.8%	22.8%	54.0%	20.7%	0.43	3.83	3.53	3.16	0.37
	Manual	111	0.8%	0.0%	17.2%	38.8%	19.5%	0.30	3.76	3.51	3.10	0.41
	Attenders	193	0.5%	1.5%	20.2%	56.4%	26.1%	0.44	4.10	3.79	3.44	0.35
	Non-attenders	78	1.1%	0.0%	31.3%	38.8%	27.1%	0.40	3.07	2.87	2.40	0.47
	All	272	**0.6%**	**1.1%**	**23.3%**	**52.2%**	**22.9%**	**0.38**	**3.80**	**3.52**	**3.14**	**0.38**

Base figures for other subgroups are given in Table 4.2.16.

Table 4.2.20. CPITN - Salisbury, by age, gender, social class and attendance.

			% of sample with worst score...					Mean number of sextants with worst score...				
		Base	Health	Bleeding	Calculus	Moderate Pocketing	Deep Pocketing	Health	Bleeding or worse	Calculus or worse	Moderate or worse	Deep or worse
60-64	Male	88	3.4%	2.3%	33.0%	46.6%	14.8%	1.19	3.50	3.12	2.90	0.23
	Female	97	9.3%	7.2%	40.2%	29.9%	13.4%	1.73	3.08	2.57	2.40	0.17
	Non-manual	*131*	6.9%	4.6%	35.9%	37.4%	15.3%	1.60	3.34	2.86	2.63	0.23
	Manual	54	5.6%	3.7%	29.6%	25.9%	7.4%	1.17	3.13	2.76	2.65	0.11
	Attenders	128	6.3%	5.7%	36.7%	36.7%	14.6%	1.61	3.39	2.89	2.69	0.11
	Non-attenders	57	7.4%	0.0%	37.0%	44.4%	11.1%	1.17	3.13	2.76	2.65	0.11
	All	185	**6.5%**	**4.9%**	**36.8%**	**37.8%**	**14.1%**	**1.48**	**3.28**	**2.83**	**2.64**	**0.18**
65-74	Male	71	7.0%	2.8%	36.6%	35.2%	18.3%	1.00	3.35	2.96	2.69	0.27
	Female	86	7.0%	5.8%	45.3%	29.1%	12.8%	1.38	2.84	2.51	2.30	0.21
	Non-manual	107	6.5%	3.7%	42.1%	31.8%	15.9%	1.25	3.11	2.71	2.47	0.24
	Manual	50	8.0%	6.0%	22.0%	22.0%	12.0%	1.16	2.98	2.72	2.50	0.22
	Attenders	131	7.6%	5.3%	40.5%	32.1%	14.5%	1.35	3.12	2.73	2.50	0.22
	Non-attenders	26	3.8%	0.0%	46.2%	30.8%	19.2%	0.50	2.81	2.65	2.35	0.31
	All	157	**0.6%**	**4.5%**	**41.4%**	**31.8%**	**15.3%**	**1.21**	**3.07**	**2.71**	**2.48**	**0.24**
75+	Male	39	17.9%	5.1%	35.9%	35.9%	5.1%	0.92	2.40	2.13	2.05	0.08
	Female	61	6.6%	3.3%	55.7%	26.2%	8.2%	1.02	2.90	2.52	2.43	0.10
	Non-manual	75	12.0%	4.0%	42.7%	34.7%	6.7%	1.04	2.76	2.37	2.28	0.09
	Manual	25	8.0%	4.0%	56.0%	12.0%	8.0%	0.80	2.56	2.36	2.28	0.08
	Attenders	73	13.7%	4.1%	45.2%	31.5%	5.5%	1.18	2.81	2.37	2.30	0.07
	Non-attenders	27	3.7%	3.7%	55.6%	25.9%	11.1%	0.40	2.44	2.37	2.22	0.15
	All	100	**11.0%**	**4.0%**	**48.0%**	**30.0%**	**7.0%**	**0.98**	**2.71**	**2.37**	**2.28**	**0.09**
Rwt 60+	Male	198	8.2%	3.1%	35.2%	39.1%	14.2%	1.05	3.19	2.83	2.62	0.21
	Female	244	7.5%	5.5%	46.8%	28.5%	11.7%	1.38	2.93	2.53	2.37	0.17
	Non-manual	313	8.1%	4.1%	40.4%	34.3%	13.2%	1.30	3.09	2.66	2.47	0.20
	Manual	129	7.3%	4.9%	31.8%	21.0%	9.7%	1.08	2.93	2.65	2.50	0.16
	Attenders	362	8.6%	5.2%	40.4%	33.4%	12.5%	1.39	3.14	2.70	2.52	0.15
	Non-attenders	80	4.7%	1.4%	47.4%	32.4%	14.2%	0.63	2.75	2.57	2.38	0.20
	All	442	**5.1%**	**4.5%**	**41.7%**	**33.2%**	**12.8%**	**1.23**	**3.04**	**2.66**	**2.48**	**0.18**

Base figures for other subgroups are given in Table 4.2.16.

Table 4.2.21. Percentage of the dentate sample with different thresholds of attachment loss, by area, age, gender, social class and attendance pattern.

	60-64			65-74			75+		
	any tooth	any tooth	3+ teeth	any tooth	any tooth	3+ teeth	any tooth	any tooth	3+ teeth
Richmondshire	>6mm	>9mm	>6mm	>6mm	>9mm	>6mm	>6mm	>9mm	>6mm
Males	61.2%	15.0%	31.2%	45.8%	16.9%	23.7%	62.1%	10.3%	17.2%
Females	25.6%	6.1%	11.0%	44.9%	6.1%	12.2%	42.1%	15.8%	18.4%
Non-manual	39.2%	9.2%	16.7%	45.8%	12.5%	20.8%	43.7%	6.2%	18.7%
Manual	57.5%	15.0%	35.0%	42.9%	8.6%	11.4%	75.0%	37.5%	18.7%
Attenders	39.4%	10.6%	10.1%	43.4%	10.5%	19.7%	42.1%	5.3%	18.4%
Non-attenders	60.0%	10.0%	23.3%	48.4%	12.9%	12.9%	64.3%	25.0%	17.9%
All	**43.2%**	**10.5%**	**21.0%**	**45.4%**	**12.0%**	**18.5%**	**50.7%**	**13.4%**	**17.9%**
Darlington									
Males	51.4%	14.3%	27.1%	57.7%	7.7%	23.1%	72.7%	23.1%	28.5%
Females	34.0%	7.5%	15.1%	26.7%	8.2%	16.3%	39.3%	27.3%	44.5%
Non-manual	34.8%	7.2%	13.0%	45.9%	8.2%	18.0%	67.7%	32.3%	41.9%
Manual	55.6%	16.7%	33.3%	50.0%	7.5%	22.5%	76.5%	11.8%	41.2%
Attenders	39.3%	7.1%	15.5%	44.0%	5.3%	16.0%	67.6%	20.6%	38.2%
Non-attenders	53.8%	20.5%	35.9%	56.0%	16.0%	28.0%	78.6%	35.7%	50.0%
All	**63.9%**	**11.4%**	**22.0%**	**47.5%**	**7.9%**	**19.8%**	**70.8%**	**25.0%**	**41.7%**
Salisbury									
Males	36.0%	10.1%	18.0%	43.7%	12.7%	19.7%	46.2%	17.9%	17.9%
Females	15.5%	4.1%	5.2%	26.7%	5.8%	11.6%	53.2%	3.2%	14.5%
Non-manual	22.0%	6.8%	9.8%	34.6%	5.6%	13.1%	47.4%	6.6%	15.8%
Manual	33.3%	7.4%	14.8%	34.0%	16.0%	20.0%	60.0%	16.0%	16.0%
Attenders	22.2%	6.3%	8.9%	31.3%	6.1%	12.2%	46.6%	4.1%	11.0%
Non-attenders	42.9%	10.7%	25.0%	50.0%	23.1%	30.8%	63.0%	22.2%	29.6%
All	**25.3%**	**7.0%**	**11.3%**	**34.4%**	**8.9%**	**7.6%**	**50.5%**	**8.9%**	**15.8%**

Base figures for other subgroups are given in Table 4.2.16.

Table 4.2.22. Percentage of the reweighted (60+) sample with different thresholds of periodontal attachment loss by area, age, gender, social class and attendance pattern.

		60+		
		any tooth	any tooth	3+ teeth
Richmondshire	base	>6mm	>9mm	>6mm
Males	168	54.3%	15.2%	25.7%
Females	169	36.4%	8.1%	13.0%
Non-manual	240	42.6%	10.0%	18.7%
Manual	91	53.0%	15.3%	20.9%
Attenders	246	41.4%	9.8%	15.2%
Non-attenders	89	56.0%	15.4%	17.2%
All	337	**45.5%**	**11.6%**	**19.4%**
Darlington				
Males	148	57.6%	12.9%	25.6%
Females	124	31.3%	11.1%	20.5%
Non-manual	161	45.8%	12.1%	20.4%
Manual	111	56.1%	11.9%	29.6%
Attenders	193	46.1%	8.4%	19.4%
Non-attenders	78	58.9%	21.3%	35.1%
All	272	**57.5%**	**12.0%**	**24.2%**
Salisbury				
Males	199	41.7%	13.0%	18.7%
Females	245	31.0%	4.6%	10.6%
Non-manual	315	34.2%	6.2%	12.8%
Manual	129	39.5%	13.4%	17.5%
Attenders	362	31.9%	5.7%	10.9%
Non-attenders	81	53.0%	19.7%	28.9%
All	444	**35.7%**	**8.3%**	**10.8%**

Base numbers can be found in table 4.2.16.

Table 4.2.23. Percentage of the dentate sample with mobile teeth by area and age.

Richmondshire

	60-64	65-74	75+	60+
Base	162	108	67	337
% any mobility	12.3%	22.2%	16.4%	**17.2%**
% 2+ mobile teeth	6.8%	12.0%	10.4%	**9.6%**
Mean number mobile*	2.25	2.79	1.91	**2.42**

Darlington

	60-64	65-74	75+	60+
Base	123	101	48	272
% any mobility	24.4%	37.6%	35.4%	**32.3%**
% 2+ mobile teeth	13.8%	23.8%	22.9%	**19.9%**
Mean number mobile*	2.80	2.73	2.82	**2.77**

Salisbury

	60-64	65-74	75+	60+
Base	186	157	101	444
% any mobility	16.7%	19.1%	30.0%	**21.2%**
% 2+ mobile teeth	8.6%	9.6%	20.0%	**12.0%**
Mean number mobile*	2.00	2.73	2.43	**2.43**

* Only in those subjects who had mobile teeth

Table 4.2.24. Percentage of the dentate sample with molar furcation involvement by area and age.

Richmondshire

	60-64	65-74	75+	Rwt 60+
Base	162	108	67	337
% with involved molar furcations	42.0%	29.9%	39.8%	**36.5%**
% of sample vulnerable (with molars)	87.7%	75.9%	77.6%	**80.9%**
% of vulnerable sample affected	50.7%	46.3%	59.6%	**50.4%**
* % of molars with involved furcations	16.1%	18.0%	33.0%	**19.9%**

Darlington

	60-64	65-74	75+	Rwt 60+
Base	123	101	48	272
% with involved molar furcations	45.5%	42.1%	36.2%	**42.4%**
% of sample vulnerable (with molars)	86.2%	84.2%	66.7%	**82.1%**
% of vulnerable sample affected	67.5%	56.8%	62.5%	**61.8%**
* % of molars with involved furcations	26.0%	27.1%	40.5%	**28.9%**

Salisbury

	60-64	65-74	75+	Rwt 60+
Base	186	157	101	444
% with involved molar furcations	51.2%	44.0%	41.6%	**45.6%**
% of total sample vulnerable (with molars)	89.8%	87.9%	80.2%	**86.5%**
% of vulnerable sample affected	62.3%	55.8%	61.7%	**59.3%**
* % of molars with involved furcations	27.7%	31.4%	38.9%	**32.2%**

* This is calculated by dividing the mean number of affected molars by the mean number of molars for the whole sample/sub-sample.

may be due to examiner bias (see tables 4.1.9. and 4.1.10.).

Although the data may be subject to examiner related differences **between** the areas, they are able to indicate trends according to demographic variables **within** each area, and the statistics here relate to the pooled data for both examiners in each area. All areas show a reduction in the proportion with deep pockets with age. Conversely the proportion with 6mm or more loss of attachment (LoA) appears to increase with age, and this also applies to the two other thresholds given (i.e. 9mm LoA and 3 or more teeth with 6mm LoA). Males are more likely to have deep pockets than females in the younger age groups although the position is reversed in the oldest group. The trends for social class are inconsistent as they are for attendance pattern. The picture is clearer when the proportion with loss of attachment is considered. Men, manual workers and non-attenders are all much more likely to have moderate attachment loss, multiple teeth affected by moderate attachment loss and severe attachment loss.

Around 18-25% of the sample had some mobile teeth (JGS data only). There was no consistent age related trend regarding mobility. Those with mobile teeth generally had more than two (table 4.2.23.). Considering the reweighted data, 50-62% of all subjects with molars had some furcation involvement, and 20-32% of all molars were involved. The percentage of subjects with furcation involvement (see table 4.2.24.) showed signs of a reduction in the older age groups, at least in the two urban areas, but the proportion of teeth which were vulnerable (i.e. the number of molars) decreased with age. In all but a very small number of cases the furcation involvement was grade 1 (i.e. not *through and through*).

The measurement of periodontal disease using CPITN

A variety of indices have been for the measurement of oral health, most of these have been designed with the younger population in mind, and some may not be appropriate for older populations. One commonly used index for the measurement of periodontal disease (CPITN), seems to be particularly inappropriate as it relies on the measurement of pocket depth alone, not loss of attachment, to detect the most severe cases. The design of the data collection in this survey allowed alternative means of collecting measurements of periodontal disease, so that CPITN could be directly compared with other measures.

Two sites on each tooth were probed, the mesio-buccal and mid-buccal on the upper teeth, and the mesio-lingual and mid-lingual on the lowers. Pocket depth and estimated loss of attachment were recorded at each site. When the worst CPITN score (grade 4, pocketing of 6mm or more) was used as the threshold for severe disease, it was found that:

65% of 441 subjects who had one or more teeth with 6mm or more loss of attachment did not have deep periodontal pockets (i.e. one or more teeth with pockets of 6mm or more).

49% of the 194 subjects with 3 or more teeth with 6mm or more attachment loss did not have any deep periodontal pockets.

44% of the 73 subjects with one or more teeth with very advanced loss of attachment (9mm or greater) did not have any deep periodontal pockets.

5 of the 13 subjects who had 3 or more teeth affected by loss of attachment of 9mm or more did not have any deep periodontal pockets.

59% of 231 subjects with mobile teeth and 57% of 134 subjects with 2 or more mobile teeth did not have any deep periodontal pockets.

It is apparent from these results that when used on its own, CPITN, an index based on pocket depth, failed to detect a large proportion of cases where there had been moderate periodontal attachment loss (probably a more accurate measure of periodontal disease **history**). When the analysis was repeated using loss of attachment of 6mm or more as the primary measure, 21% of 196 subjects with deep pockets (6mm+) and 23% of the 231 subjects with mobile teeth were not detected when using this measure alone. The reasons for this are covered in the discussion.

4.2.5. Dentate subjects: Tooth wear

Cervical wear

Cervical wear statistics are given in table 4.2.25. and 4.2.26., and an overlay is presented to allow the calculation of confidence limits for the mean values in the latter table. The data collected by JGS alone is given in table 4.1.10.. Inter-examiner variation was relatively high and probably accounts for much of the

Table 4.2.26. 95% Confidence limits

	60-64	65-74	75+	60+
Richmond	0.41	0.39	1.02	0.83
Darlington	0.50	0.54	1.32	0.94
Salisbury	0.55	0.60	0.55	0.68

Table 4.2.25. Percentage of the dentate sample with grade 3 or 4 cervical wear, by area and age.

	60-64	65-74	75+	Rwt 60+
Base (R)	181	134	83	398
Richmond	**24.3%**	**27.6%**	**30.1%**	**26.7%**
Base (D)	134	114	58	306
Darlington	**34.3%**	**38.6%**	**25.9%**	**34.6%**
Base (S)	207	175	125	507
Salisbury	**43.5%**	**40.0%**	**51.2%**	**42.9%**

Table 4.2.26. Mean number of grade 3 or 4 cervical wear lesions, by age and area in those with lesions

	60-64	65-74	75+	60+
Base (R)	44	37	25	106
Richmond	**2.22**	**1.96**	**2.96**	**2.24**
Base (D)	46	44	15	105
Darlington	**2.36**	**2.36**	**3.59**	**2.57**
Base (S)	90	70	64	224
Salisbury	**3.31**	**2.90**	**2.99**	**3.05**

See table 4.1.10 for results for one examiner in all areas inter-area differences seen. When the figures for JGS alone are examined the inter-area differences were fairly small. Overall about 40% of the sample in all three areas had grade 3 wear (as assessed by JGS), whilst on average about 2.5 to 3 teeth were affected in those who had some wear.

Coronal Wear

Statistics relating to coronal wear are given in Tables 4.2.27. to 4.2.28., with an overlay to allow the calculation of confidence limits for the mean values in the latter table. A much higher proportion of men than women showed marked coronal wear and, when wear was present, men had more worn teeth than women, whilst the trends for social class are not consistent. Non-attenders appear more likely to have wear than regular attenders. About a third to a half of the dentate sample exhibited wear of grade 3 or worse, and there was a slight increase with age. Those who are affected generally have multiple worn teeth, averaging at about 3, but varying between 2.4 for the youngest non-manual workers in Richmond to 5.9 for 65-74 year old non-attenders in Darlington. A minority of the sample demonstrated wear of grade 3 or worse.

A straightforward chi-squared analysis was undertaken to assess whether more subjects with wear reported being dissatisfied or having difficulty eating than those without (see table 4.2.29.). No significant differences were found when subjects with *some wear of grade 3 or worse* were compared to those with no such wear. When subjects with *some wear of grade 4* were tested in the same way, significantly more reported being dissatisfied generally, and with their ability to eat, than those without such wear ($p<0.05$ in both cases). There was no significant difference when difficulties with eating and dissatisfaction with appearance were tested in the same way.

4.2.6. All subjects: Other oral disorders

Inter-examiner variability was not measured for soft tissue pathology, so the records of these lesions will be subject to some unknown examiner variation. However the results show relatively small inter-area differences, suggesting that these problems are unlikely to be severe. There did not appear to be any really

Table 4.2.27. Percentage of the dentate sample with coronal tooth wear of grade 3 or worse by area, age, gender, social class and attendance. pattern.

Richmondshire

	60-64	65-74	75+	Rwt 60+
Male	33.7%	43.2%	46.9%	**40.8%**
Female	13.0%	30.0%	43.5%	**25.7%**
Non-Manual	22.6%	39.4%	46.7%	**34.0%**
Manual	25.8%	37.5%	31.8%	**32.8%**
Attenders	21.2%	36.8%	44.7%	**31.2%**
Non-attenders	33.3%	35.5%	36.7%	**35.2%**
Base for "All"	181	134	83	398
All	**23.2%**	**37.3%**	**44.6%**	**33.2%**

Darlington

	60-64	65-74	75+	Rwt 60+
Male	40.5%	58.6%	65.5%	**52.2%**
Female	40.0%	32.1%	51.7%	**38.4%**
Non-Manual	36.4%	35.3%	60.5%	**40.3%**
Manual	45.6%	60.9%	55.0%	**53.7%**
Attenders	41.7%	44.0%	52.9%	**44.7%**
Non-attenders	43.6%	52.0%	68.6%	**50.9%**
Base for "All"	134	114	58	306
All	**40.3%**	**45.6%**	**58.6%**	**45.7%**

Salisbury

	60-64	65-74	75+	Rwt 60+
Male	41.2%	53.7%	82.0%	**54.8%**
Female	43.6%	49.5%	60.0%	**49.8%**
Non-Manual	44.0%	50.0%	63.2%	**50.9%**
Manual	39.4%	56.1%	82.8%	**54.5%**
Attenders	42.4%	50.4%	68.5%	**50.8%**
Non-attenders	48.1%	50.0%	70.4%	**56.6%**
Base for "All"	207	175	125	507
All	**42.5%**	**51.4%**	**68.8%**	**52.0%**

Base figures for other sub-groups are given in table 4.1.2.

Table 4.2.28. 95% Confidence limits

	60-64	65-74	75+	Rwt 60+
Richmondshire				
Male	0.74	0.88	1.29	1.15
Female	0.78	0.62	0.62	0.75
Non-Manual	0.54	0.80	0.76	0.86
Manual	1.46	0.88	1.41	1.36
Attenders	0.72	0.72	1.03	0.95
Non-attenders	0.67	1.31	0.72	1.23
All	0.57	0.64	0.67	0.74
Darlington				
Male	1.06	1.06	1.23	1.28
Female	0.80	0.86	0.95	1.01
Non-Manual	0.91	1.14	1.16	1.28
Manual	1.01	1.04	1.22	1.26
Attenders	0.82	0.87	0.93	1.02
Non-attenders	1.28	1.66	1.80	1.90
All	0.68	0.77	0.87	0.91
Salisbury				
Male	0.92	0.73	1.01	1.01
Female	0.89	0.58	0.69	0.79
Non-Manual	0.86	0.56	0.79	0.81
Manual	0.67	0.84	0.69	0.89
Attenders	0.69	0.52	0.73	0.73
Non-attenders	1.76	1.13	1.00	1.41
All	0.64	0.47	0.60	0.63

Table 4.2.28. Mean number of grade 3 or worse teeth in those who have some grade 3 wear, by area, age gender, social class and attendance pattern.

Richmondshire	60-64	65-74	75+	Rwt 60+
Male	2.64	4.07	3.23	**3.41**
Female	2.42	2.39	2.75	**2.48**
Non-Manual	2.36	3.67	2.75	**3.00**
Manual	3.10	2.53	5.19	**3.14**
Attenders	2.73	3.08	3.16	**2.95**
Non-attenders	2.07	4.99	3.41	**3.72**
Base for "All"	42	50	37	132
All	**2.57**	**3.46**	**3.00**	**3.02**

Darlington	60-64	65-74	75+	Rwt 60+
Male	3.70	4.15	4.90	**4.10**
Female	3.35	2.95	2.74	**3.05**
Non-Manual	2.93	3.46	3.74	**3.33**
Manual	3.93	3.96	4.36	**4.01**
Attenders	3.10	3.80	3.40	**3.49**
Non-attenders	3.55	3.57	4.97	**3.82**
Base for "All"	54	52	34	140
All	**3.41**	**3.73**	**3.94**	**3.65**

Salisbury	60-64	65-74	75+	Rwt 60+
Male	4.05	3.86	3.76	**3.90**
Female	3.25	3.17	3.58	**3.32**
Non-Manual	3.85	3.42	4.03	**3.73**
Manual	3.05	3.53	2.91	**3.24**
Attenders	3.66	3.57	3.76	**3.65**
Non-attenders	3.00	3.59	3.46	**3.39**
Base for "All"	88	90	86	264
All	**3.61**	**3.50**	**3.66**	**3.58**

Base figures for other subgroups can be calculated from Tables 4.1.2. and 4.2.27.

Table 4.2.29. The relationship between wear and dissatisfaction/function problems (combined data).

	% dissatisfied - grade 3+		
	no wear	some wear	p
Dissatisfied - generally	5.6%	5.6%	NS
- with appearance	12.7%	11.0%	NS
- with ability to chew	3.8%	4.7%	NS
Difficulty - hard foods	29.0%	29.4%	NS
Dietary restriction	15.7%	13.4%	NS

	% dissatisfied - grade 4		
	no wear	some wear	p
Dissatisfied - generally	**5.1%**	**9.6%**	**0.02**
- with appearance	11.9%	12.2%	NS
- with ability to chew	**3.7%**	**7.6%**	**0.02**
Difficulty - hard foods	28.3%	35.0%	NS
Dietary restriction	14.6%	15.3%	NS

"p" represents the probability value (chi-squared test).

convincing age group or area trends. All 2280 subjects underwent an examination of all visible oral soft tissues. None had suspected malignancies, and none had lesions which the examiners felt merited further investigation.

Dry mouth was reported by a substantial proportion of subjects. Flow rates were not measured so the data presented in table 4.2.30. are based on *reported* dry mouth and associated factors. Considering the reweighted 60+ group as a whole, 16-24% reported dry mouth, and the percentage affected in all age groups was higher in the edentulous than in the dentate (12-20% of the dentate, 22-27% of the edentulous). Only a relatively small percentage of the sample were taking a medication which has been strongly implicated in causing xerostomia (the criteria used are presented in appendix 11) however the percentage was higher in those who suffered from dry mouth, 18-30% in dry mouth sufferers compared to 7-16% of those who did not have a dry mouth. It should be noted that such drugs could only be held responsible for dry mouth in less than a third of cases. The remainder must have had some other reason for their dry mouth (for example disease of the glands, or inhibition of salivary function by drugs or combinations of drugs not included as high risk for xerostomia). Between 4% and 8% of the reweighted samples reported both dry mouth and dry eyes, a combination suggesting Sjögrens syndrome, although clearly not indicating it in every case.

Between 16% and 20% of all complete denture wearers over the age of 60 had pathological lesions associated with their dentures, whilst 1.6% to 1.8% had more than one type of lesion (table 4.2.31.). The majority of denture related lesions were denture stomatitis (grade I, II or III) which occurred in 11-13% of all denture wearers. Ulceration associated with dentures (i.e. occurring in obvious areas of denture trauma) was the next most common occurring in about 3-5% of all complete denture wearers, whilst denture hyperplasia and angular cheilitis were found in less than 3% overall.

Soft tissue lesions which were not obviously denture related were found in between 10.7% and 14.6% of mouths. All were thought to be benign, and few were the source of any discomfort to the subject or concern to the visiting dentist. Small epulides and papillomatous lesions, geographic and black hairy tongue were

Table 4.2.30. Frequency of reported dry mouth in dentate and edentulous groups and frequency of related factors in all subjects by area and age.

Richmondshire

	60-64	65-74	75+	60+ rwt
Dry mouth - all subjects	15.7%	16.7%	20.9%	**17.8%**
Dry mouth - dentate	13.3%	13.4%	7.3%	**12.2%**
Dry mouth - edentulous	21.6%	20.0%	26.0%	**22.9%**
Dry mouth and eyes	3.1%	4.0%	5.3%	**4.2%**
Any medication	52.0%	59.0%	76.0%	**62.6%**
Xerostomic medication	8.2%	7.0%	10.6%	**8.5%**
% of dry mouth subjects on medication	75.0%	73.3%	95.2%	**80.7%**
% of dry mouth subjects on xerostomic medication	28.1%	17.8%	35.5%	**26.1%**

Darlington

	60-64	65-74	75+	60+ rwt
Dry mouth - all subjects	16.4%	23.7%	30.6%	**24.0%**
Dry mouth - dentate	14.2%	22.8%	24.1%	**19.9%**
Dry mouth - edentulous	19.8%	24.5%	32.6%	**27.0%**
Dry mouth and eyes	4.1%	9.9%	9.1%	**8.2%**
Any medication	54.1%	65.9%	74.7%	**65.6%**
Xerostomic medication	10.5%	14.6%	22.7%	**16.1%**
% of dry mouth subjects on medication	77.8%	88.3%	85.1%	**84.6%**
% of dry mouth subjects on xerostomic medication	27.8%	28.3%	33.8%	**29.9%**

Salisbury

	60-64	65-74	75+	60+ rwt
Dry mouth - all subjects	12.8%	11.6%	23.8%	**16.2%**
Dry mouth - dentate	12.6%	10.9%	18.4%	**13.5%**
Dry mouth - edentulous	13.5%	13.3%	30.0%	**21.5%**
Dry mouth and eyes	3.7%	5.0%	6.0%	**5.1%**
Any medication	45.5%	57.4%	73.2%	**60.2%**
Xerostomic medication	4.5%	5.8%	10.2%	**7.0%**
% of dry mouth subjects on medication	71.0%	86.7%	85.7%	**82.8%**
% of dry mouth subjects on xerostomic medication	12.9%	16.7%	23.2%	**18.1%**

Dry mouth and medication usage were based on whether these were reported by the patient

Subjects were recorded as medication users if they had been taking a prescribed medication for over a month. Medications were classed as xerostomic if they fulfilled the criteria given in appendix 11.

Table 4.2.31. Frequency of denture related soft tissue pathology and other pathology, by age and area.

Richmondshire

	60-64	65-74	75+	60+rwt
Base	102	176	237	515
Angular Cheilitis	1.0%	1.7%	0.4%	**1.1%**
Denture Stomatitis	11.8%	10.8%	11.0%	**11.0%**
Denture Hyperplasia	2.9%	1.2%	3.8%	**2.5%**
Ulcer (denture induced)	4.9%	2.9%	2.1%	**2.9%**
Any lesion	18.7%	14.8%	16.1%	**16.0%**
More than 1 lesion	2.0%	1.7%	1.3%	**1.6%**
Other pathology (base=all)	7.1%	12.9%	10.6%	**10.7%**

Darlington

	60-64	65-74	75+	60+rwt
Base	112	157	199	468
Angular Cheilitis	1.8%	3.2%	2.5%	**2.7%**
Denture Stomatitis	20.5%	9.6%	12.6%	**12.7%**
Denture Hyperplasia	1.8%	1.3%	2.0%	**1.7%**
Ulcer (denture induced)	3.6%	5.1%	5.5%	**5.0%**
Any lesion	24.1%	17.2%	20.6%	**19.8%**
More than 1 lesion	2.7%	1.2%	2.0%	**1.8%**
Other pathology (base=all)	20.0%	9.1%	17.8%	**14.6%**

Salisbury

	60-64	65-74	75+	60+rwt
Base	61	108	134	303
Angular Cheilitis	3.3%	2.8%	1.6%	**2.3%**
Denture Stomatitis	21.3%	15.7%	7.5%	**12.5%**
Denture Hyperplasia	1.7%	3.8%	0.0%	**1.8%**
Ulcer (denture induced)	1.6%	5.7%	5.5%	**5.1%**
Any lesion	21.3%	24.9%	13.4%	**19.1%**
More than 1 lesion	4.9%	1.9%	0.7%	**1.7%**
Other pathology (base=all)	13.9%	11.6%	11.5%	**12.1%**

Table 4.2.32. TMJ clicks, crepitus and joint tenderness by area and age.

Richmondshire	60-64	65-74	75+	60+rwt
base	255	272	301	828
Clicks	17.6%	14.0%	10.6%	**13.8%**
Crepitus	9.0%	6.2%	13.3%	**9.2%**
Tenderness on palpation	1.2%	1.5%	0.7%	**1.2%**

Darlington	60-64	65-74	75+	60+rwt
base	220	253	242	715
Clicks	14.5%	24.1%	21.5%	**20.8%**
Crepitus	10.0%	15.4%	22.7%	**16.3%**
Tenderness on palpation	9.0%	1.6%	0.8%	**3.2%**

Salisbury	60-64	65-74	75+	60+rwt
base	244	258	235	737
Clicks	17.2%	15.5%	16.6%	**16.3%**
Crepitus	4.9%	9.3%	10.6%	**8.7%**
Tenderness on palpation	1.2%	0.4%	1.3%	**0.9%**

relatively common and a few cases of lichen planus or lichenoid lesions were also recorded, all of which were non-ulcerated and symptom free.

Table 4.2.32. presents data on temporo-mandibular joint signs and symptoms. Clicks were found in 14-21% of the total reweighted sample, with no strong suggestion of age related differences. Crepitus was found in 9-16% of the total reweighted sample, and here there was an age related increase. Tenderness of the joint area to palpation was found in only 1-3% of subjects, and this is in line with the infrequent reports of discomfort (see table 4.3.9.).

4.3. DATA FROM THE QUESTIONNAIRE

Normative treatment need is covered by the previous data derived from the clinical examination, but what a dentist considers a patient needs, and what the patient really wants are not necessarily the same thing. Furthermore, many individuals' behaviour will be determined by their own perceptions of their needs rather than their dentist's. This section covers the the dental needs and demands of the sample, their attitudes and the barriers to dental care which they experienced.

The treatment needs and demands of the edentulous are likely to differ from those of the dentate, and attitudes, levels of satisfaction and expectation may also differ. Consequently data for the edentulous part of the sample is considered first in tables 4.3.1. to table 4.3.5..

4.3.1. Edentulous subjects

Only a tiny proportion of the edentulous attend the dentist for regular checkups. Of over 1000 edentulous subjects in this study only 33 said that they attended for regular, or even just occasional, checkups. Given that non-attendance or irregular attendance is almost universal, comparison of attendance pattern between areas and groups is meaningless for the edentulous sample, and is not presented.

Table 4.3.1. presents data on the length of time edentulous and the age of dentures, with an overlay giving the figure from which the 95% confidence limits can be calculated. The reweighted edentulous sample had been edentulous for 30-35 years on average. This was highest in Richmondshire and, not surprisingly, increased with age from 23-28 years in the 60-64 year olds up to 32-40 years in the over 75 year olds. The average age of the dentures was 13-14 years in all areas, but once again there was an age related increase (9-13 years for the youngest groups, 16-18 years for the oldest). The percentage of the sample who had been rendered edentulous before the age of 40 was much lower in Salisbury (14% of the reweighted sample) compared to the two northern areas (29-32%) and showed an age related increase, particularly in the north. However, even in the youngest group in Darlington, 26% of the edentulous reported being rendered edentulous before the age of 40, about 3 times the equivalent figure in Salisbury (9%).

Edentulous subjects were asked how they normally paid for their dentures and what they thought of dental charges, this data is presented in tables 4.3.2 and 4.3.3.. Of those who could remember, the majority paid an NHS contribution (about 70% of respondents) but there were variable but substantial numbers of private patients and NHS patients who were exempt from charges. The proportion who said that they thought dentistry was expensive or very expensive decreased with age from about 45% in all areas for the 60-64 year olds down to 22-35% for the 75+ year olds.

Edentulous subjects were asked how satisfied they were with different aspects of function; the figures are given in table 4.3.4.. Around 90% of the edentulous population were satisfied overall with little regional difference. Dissatisfaction was more likely to be due to problems with mastication than aesthetics. Subjects in Salisbury were more likely to be dissatisfied than those in the other areas. No consistent age trend was apparent. Although 90% were satisfied, about 30% reported some dietary restriction (that there were foods they would like to eat but could not). This figure was highest in Darlington (37.3%) and Salisbury (30.1%) and much lower in Richmondshire (21.6%). Despite the high levels of satisfaction, 27-31% of the reweighted edentulous sample reported discomfort eating, 50-58% reported ulcers under their dentures occasionally or often, although less than 5% reported constant ulceration. In total 63-72% reported some oral discomfort, this included discomfort eating, ulceration or other oral discomfort (for example that arising

Table 4.3.1. 95% Confidence limits

Richmondshire

	60-64	65-74	75+	Rwt 60+
Conf. limits - time edentulous	1.4	1.2	1.3	1.5
Conf. limits - age edentulous	1.3	1.2	1.3	1.4
Conf. limits - age of upper	1.2	1.1	1.2	1.3
Conf. limits - age of lower	1.2	1.0	1.1	1.3

Darlington

Conf. limits - time edentulous	1.3	1.2	1.2	1.4
Conf. limits - age edentulous	1.3	1.2	1.1	1.3
Conf. limits - age of upper	1.3	0.9	1.1	1.2
Conf. limits - age of lower	1.3	0.9	1.2	1.2

Salisbury

Conf. limits - time edentulous	1.7	1.4	1.7	1.8
Conf. limits - age edentulous	1.8	1.4	1.7	1.8
Conf. limits - age of upper	1.6	1.3	1.6	1.7
Conf. limits - age of lower	1.5	1.4	1.6	1.7

Table 4.3.1. Mean period and age edentulous, age of dentures worn and percentage of the edentulous sample rendered edentulous at a young age, by area and age.

Richmondshire

	60-64	65-74	75+	Rwt 60+
Base	76	129	177	382
Mean time edentulous (years)	27.8	32.4	39.8	**34.6**
Mean age rendered edentulous	34.7	37.2	41.6	**38.6**
Mean age of upper dentures	10.2	12.4	17.3	**14.0**
Mean age of lower dentures	11.0	11.7	16.1	**13.4**
% edentulous at age 40 or less *	20.4%	31.3%	31.2%	**28.5%**

Darlington

	60-64	65-74	75+	Rwt 60+
Base	86	137	173	396
Mean time edentulous (years)	24.8	29.9	32.0	**29.8**
Mean age rendered edentulous	37.0	40.2	41.2	**40.0**
Mean age of upper dentures	12.7	10.2	16.1	**13.0**
Mean age of lower dentures	12.9	10.0	16.6	**13.1**
% edentulous at age 40 or less *	25.9%	30.0%	39.7%	**32.0%**

Salisbury

	60-64	65-74	75+	Rwt 60+
Base	37	80	98	215
Mean time edentulous (years)	23.1	29.1	31.5	**29.5**
Mean age rendered edentulous	40.1	40.7	47.9	**44.0**
Mean age of upper dentures	10.0	11.0	17.9	**14.1**
Mean age of lower dentures	9.0	11.0	17.6	**13.8**
% edentulous at age 40 or less *	8.6%	15.5%	14.8%	**13.6%**

* Represents the percentage of the whole population (dentate and edentulous)

These data are based on questions 2 and 10 in Section 2 of the questionnaire

Table 4.3.2. Type of payment among the edentulous sample by age and area.

Richmondshire

	60-64	65-74	75+	Rwt 60+
base	103	180	239	522
NHS - exempt	10.8%	8.5%	21.1%	**13.9%**
NHS + contribution	77.2%	75.8%	56.6%	**68.4%**
Private/insurance	11.9%	13.7%	16.3%	**14.4%**

Darlington

	60-64	65-74	75+	Rwt 60+
base	112	160	203	475
NHS - exempt	11.5%	16.3%	23.4%	**18.1%**
NHS + contribution	79.8%	76.4%	69.1%	**74.2%**
Private/insurance	4.8%	4.6%	3.4%	**4.2%**

Salisbury

	60-64	65-74	75+	Rwt 60+
base	60	108	139	307
NHS - exempt	3.5%	7.8%	1.1%	**4.1%**
NHS + contribution	86.0%	79.6%	65.4%	**73.8%**
Private/insurance	10.5%	11.7%	14.1%	**12.7%**

These data are derived from question 1 in Section 7 of the questionnaire

"NHS - exempt" represents all subjects who are exempt from all NHS charges

Table 4.3.3. Percentage of the edentulous sample who say they find dentistry expensive or very expensive by area and age

	60-64	65-74	75+	Rwt 60+
Richmondshire	44.1%	38.5%	22.3%	**33.0%**
Darlington	43.8%	47.5%	29.7%	**39.8%**
Salisbury	45.0%	48.1%	35.0%	**41.5%**

Base figures as for Table 4.3.2. above

These data are derived from question 5 in Section 7 of the questionnaire

Table 4.3.4. Percentage of the edentulous sample who were dissatisfied with different aspects of function or who reported functional difficulties or discomfort, by area and age.

Richmondshire

	60-64	65-74	75+	Rwt 60+
base	74	138	218	430
Dissatisfied - aesthetics	2.7%	10.9%	1.9%	**5.7%**
Dissatisfied - function	5.5%	10.9%	5.60%	**7.8%**
Dissatisfied - overall	9.5%	15.6%	4.70%	**9.9%**
Diet Restriction	20.3%	22.6%	21.10%	**21.6%**
Discomfort when eating	28.8%	26.9%	26.70%	**27.1%**
Ulcers under dentures	54.8%	56.7%	43.00%	**50.4%**
*Any discomfort	62.2%	67.4%	59.60%	**63.2%**

Darlington

	60-64	65-74	75+	Rwt 60+
base	86	139	184	409
Dissatisfied - aesthetics	5.9%	8.1%	3.9%	**6.0%**
Dissatisfied - function	10.5%	15.8%	11.40%	**13.1%**
Dissatisfied - overall	12.9%	12.5%	7.70%	**10.6%**
Diet Restriction	34.9%	39.1%	36.40%	**37.3%**
Discomfort when eating	25.9%	36.0%	23.50%	**29.1%**
Ulcers under dentures	60.0%	64.7%	50.00%	**57.8%**
*Any discomfort	73.3%	78.4%	64.10%	**71.6%**

Salisbury

	60-64	65-74	75+	Rwt 60+
base	37	83	110	230
Dissatisfied - aesthetics	5.4%	7.2%	6.5%	**6.7%**
Dissatisfied - function	18.9%	14.4%	17.50%	**16.4%**
Dissatisfied - overall	18.9%	8.4%	13.90%	**12.2%**
Diet Restriction	37.8%	31.3%	27.50%	**30.1%**
Discomfort when eating	24.3%	33.7%	30.8%	**31.3%**
Ulcers under dentures	56.8%	57.8%	53.3%	**55.5%**
*Any discomfort	62.2%	73.5%	67.3%	**69.2%**

These data are derived from questions 1 to 4 and question 8 in section 4, and questions 5 and 6 in section 2 of the questionnaire.

Percentages for discomfort and ulceration data are based on these occurring sometimes or always. The frequency of constant discomfort on eating and constant ulceration are much lower (3-11% and 0-13% respectively).

* "Any discomfort" is a composite variable derived from questions 5 and 6 in section 2 and question 8 in section 4 of the questionnaire.

Table 4.3.5. Denture faults and their correlation with dissatisfaction (data combined for all areas and age groups).

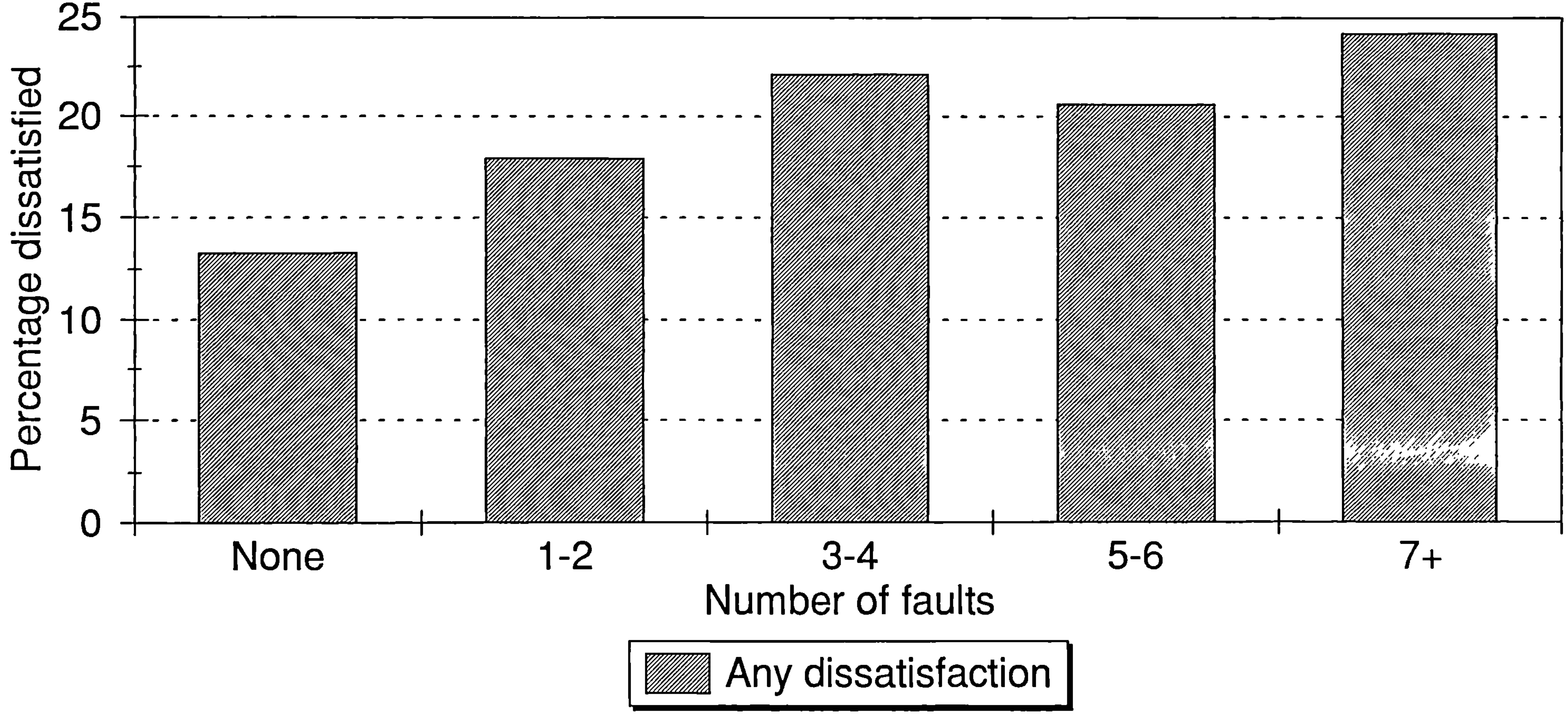
	Dissatisfaction - overall	Phi	- with comfort	Phi	- with appearance	Phi	- with function	Phi
Poor ridge	ns		ns		ns		ns	
Excessive occlusal wear	<0.05	0.07	<0.01	0.08	ns		ns	
Fractures and defects	ns		ns		<0.01	0.10	ns	
Poor adaptation	<0.05	0.07	ns		ns		ns	
Poor retention	<0.01	0.11	<0.01	0.09	ns		<0.01	0.09
Overextension	<0.01	0.10	ns		ns		ns	
Incorrect upper tooth position	<0.01	0.08	<0.05	0.08	ns		ns	
Lingually placed lower teeth	ns		ns		ns		ns	
Non-matching set	<0.01	0.09	ns		ns		ns	
Occlusal fault	<0.01	0.08	ns		ns		ns	
Low/high free way space	ns		ns		ns		ns	
Low free way space	ns		<0.05	0.06	<0.01	0.07	<0.05	0.08

p-values calculated by chi square anlysis of 2x2 tables

Phi values indicate the strength of any significant association between groups. The value of phi may vary between 0 (no association) and 1 (good association). The higher the score the stronger the relationship between two variables.

These data were derived from question 4 in section 2 and questions 1 to 3 in section 5 of the questionnaire as well as clinical data on complete dentures.

Fig 4.3.1. Complete dentures
any dissatisfaction by denture faults



from dry or burning mouth).

The interaction between dissatisfaction and various aspects of dentures, including the number of faults and specific faults, was investigated using a simple chi-squared analysis. Pooled data for all three areas were used for these analyses The findings are presented in table 4.3.5. and figure 4.3.1.. Certain denture faults were significantly associated with specific aspects of dissatisfaction (excessive wear, poor adaptation or retention, overextension, incorrect upper teeth placement, occlusal faults, non-matching set and insufficient free way space) although in all cases the strength of the relationship (indicated by the *phi* statistic) was weak. Some denture related faults or findings which might be expected to be related to satisfaction were not related, specifically the lower ridge form and the position of the lower teeth.

4.3.2. Dentate subjects: Demands

Subjects were asked in the questionnaire whether or not they felt they needed treatment; the findings are presented in table 4.3.6.. Overall a majority did not feel that they needed treatment (54-62% of the reweighted dentate sample), but the proportion was about 5% lower in Darlington than it was in the other two areas. When only those who had some decay were selected the percentage who felt that they did not need treatment dropped a little, but even so around half of the population with some decay felt they did not need treatment. Non-attenders were much less likely to think that they did not need treatment, and only a fifth to a third of non-attenders with decay felt that they were not in need of treatment.

Subjects were also asked to choose the sort of treatment that they would prefer in each of three cases (filling or extraction in an aching back tooth, crown or extraction in an aching front tooth and crown or extraction in an aching back tooth). The findings from this are presented in tables 4.3.7. and 4.3.8.. For the purposes of analysis the dentate population has been divided into those who would always choose restoration, those who would always choose an extraction and those who would pick and choose according to tooth and proposed restoration. Quite large regional differences are apparent. More than 70% of the reweighted sample in Salisbury said they would always choose a restoration (80% in non-manual groups),

Table 4.3.6. Demands: Percentage of the dentate sample who think that they do not need treatment, by age, area, the presence of decayed teeth and non-attendance

Richmondshire

	60-64	65-74	75+	Rwt 60+
All	**62.1%**	**55.2%**	**70.3%**	**60.6%**
Base	181	134	83	398
With some decay	52.7%	48.4%	72.5%	**54.7%**
Non-attenders	33.3%	35.7%	50.0%	**39.0%**
Non-atts with decay	31.8%	*29.4%*	*53.3%*	**36.3%**

Darlington

	60-64	65-74	75+	Rwt 60+
All	**48.8%**	**56.4%**	**59.6%**	**54.2%**
Base	134	114	58	306
With some decay	44.2%	46.2%	61.3%	**47.9%**
Non-attenders	20.5%	28.0%	*42.9%*	**27.2%**
Non-atts with decay	16.0%	19.0%	*50.0%*	**21.8%**

Salisbury

	60-64	65-74	75+	Rwt 60+
All	**59.8%**	**63.1%**	**62.0%**	**61.8%**
Base	207	175	125	507
With some decay	54.3%	55.4%	54.5%	**54.8%**
Non-attenders	22.2%	34.6%	44.4%	**35.2%**
Non-atts with decay	20.0%	*29.4%*	38.1%	**30.6%**

"With some decay" includes all those subjects who had any decayed or unsound teeth.

Sample bases for some of the subgroups are small, the reader is advised to refer to reweighted (60+) and "all" totals shown in bold.
Figures in italics represent those from a sample base <20

These data are based on question 1 in Section 5 and question 3 in Section 6 of the questionnaire.

Table 4.3.7. Demands: Treatment preferences among the dentate sample by area, age, gender, social class and attendance

Richmondshire	60-64			65-74			75+		
	Restore	Extract	Combination	Restore	Extract	Combination	Restore	Extract	Combination
Male	53.8%	12.5%	33.8%	47.4%	28.1%	24.6%	40.7%	25.9%	33.3%
Female	59.3%	6.2%	34.6%	58.3%	10.4%	31.3%	41.7%	13.9%	44.4%
Non-manual	63.0%	6.7%	30.3%	60.6%	15.5%	23.9%	48.9%	14.9%	36.2%
Manual	35.0%	17.5%	47.5%	36.4%	27.3%	36.4%	21.4%	35.7%	42.9%
Attenders	64.1%	3.8%	32.1%	60.5%	11.8%	27.6%	61.1%	0.0%	38.9%
Non-attenders	23.3%	33.3%	43.3%	32.1%	39.3%	28.6%	14.8%	44.4%	40.7%
All	**56.5%**	**9.3%**	**34.2%**	**52.4%**	**20.0%**	**27.6%**	**41.3%**	**19.0%**	**39.7%**

Darlington	60-64			65-74			75+		
	Restore	Extract	Combination	Restore	Extract	Combination	Restore	Extract	Combination
Male	60.0%	15.7%	24.3%	48.1%	15.4%	36.5%	44.0%	24.0%	32.0%
Female	51.9%	5.8%	42.3%	61.7%	8.5%	29.8%	54.5%	13.6%	31.8%
Non-manual	63.8%	8.7%	27.5%	61.0%	6.8%	32.2%	53.3%	20.0%	26.7%
Manual	47.2%	15.1%	37.7%	45.0%	20.0%	35.0%	41.2%	17.6%	41.2%
Attenders	72.3%	3.6%	24.1%	63.0%	5.5%	31.5%	63.6%	9.1%	27.3%
Non-attenders	23.1%	28.2%	48.7%	32.0%	32.0%	63.0%	14.3%	42.9%	57.1%
All	**56.6%**	**11.5%**	**32.0%**	**54.5%**	**12.1%**	**33.3%**	**48.9%**	**19.1%**	**31.9%**

Salisbury	60-64			65-74			75+		
	Restore	Extract	Combination	Restore	Extract	Combination	Restore	Extract	Combination
Male	67.8%	14.9%	17.2%	71.0%	14.5%	14.5%	80.6%	11.1%	8.3%
Female	77.3%	6.2%	16.5%	65.5%	7.1%	27.4%	71.7%	8.3%	20.0%
Non-manual	81.5%	4.6%	13.8%	76.9%	5.8%	17.3%	80.6%	5.6%	13.9%
Manual	51.9%	24.1%	24.1%	49.0%	20.4%	30.6%	58.3%	20.8%	20.8%
Attenders	80.9%	3.8%	15.3%	73.6%	4.7%	21.7%	83.1%	5.6%	11.3%
Non-attenders	25.9%	48.1%	25.9%	37.5%	41.7%	20.8%	52.0%	20.0%	28.0%
All	**72.8%**	**10.3%**	**16.8%**	**68.0%**	**10.5%**	**21.6%**	**75.0%**	**9.4%**	**15.6%**

"restore" means restoration would always be preferred
"extract" means that extraction would always be preferred
"combination" means that the subject would prefer either extraction or restoration according to the site of the tooth and the restoration proposed.

Base figures can be found in Table 4.2.3.

Table 4.3.8. Demands:Treatment preferences in the dentate sample aged 60+ (Reweighted data) by area, age, gender, social class and attendance pattern.

Richmondshire

	base	Restore	Extract	Combination
Male	200	48.7%	22.1%	29.3%
Female	198	55.2%	9.5%	35.3%
Non-manual	287	59.4%	12.0%	28.7%
Manual	103	33.6%	25.0%	41.4%
Attenders	289	62.1%	6.8%	31.1%
Non-attenders	106	24.5%	39.2%	36.2%
All	398	51.9%	15.8%	32.3%

Darlington

	base	Restore	Extract	Combination
Male	161	52.0%	17.0%	31.0%
Female	145	57.0%	8.5%	34.5%
Non-manual	183	60.5%	10.0%	29.5%
Manual	123	45.3%	17.7%	37.0%
Attenders	213	66.4%	5.4%	28.2%
Non-attenders	91	25.1%	32.4%	56.0%
All	306	54.3%	13.1%	32.6%

Salisbury

	base	Restore	Extract	Combination
Male	227	72.4%	13.8%	13.8%
Female	280	70.7%	7.2%	22.1%
Non-manual	354	79.4%	5.4%	15.3%
Manual	152	51.9%	21.7%	26.4%
Attenders	412	78.3%	4.6%	17.1%
Non-attenders	94	40.0%	35.1%	24.8%
All	507	71.4%	10.1%	18.5%

Data for this and the previous table are derived from questions 2 to 4 in Section 5 of the questionnaire.

whilst the figure is 50-55% in both northern areas and there is an age related reduction in the north. Overall 10-15% of the sample in all areas would always choose extraction, but in the sub-groups this ranges from none in the oldest Richmondshire attenders and 4% in the youngest Salisbury attenders up to 48% of the non-attenders in the same sample (60-64 year olds in Salisbury). Generally men, manual workers and non-attenders are more likely to opt for extraction.

Table 4.3.9. reports on the frequency of various dental or oral symptoms in the dentate samples. Of the reweighted sample 21-25% reported sensitivity of their teeth to hot or cold, and 7-10% reported toothache in the previous four weeks. Sensitivity showed signs of an age related decrease in all areas. Data for temporo-mandibular joint pain and tooth mobility were generally in line with the findings of the clinical examination. Gums which frequently bled on tooth brushing were reported by 5-7% of the reweighted sample. The "other oral discomfort" category was generally accounted for by those with uncomfortable oral dryness (at least 80% of these cases). Reports of burning mouth and oral pain other than toothache were restricted to a very few individuals.

4.3.3. Dentate subjects: Attitudes

Results are presented in this section for a variety of variables related to peoples' attitudes to dental health. These include dental attendance, oral hygiene practices, attitudes to becoming edentulous, attitudes to partial dentures, attitude to cost and payment and levels of satisfaction or dissatisfaction with various aspects of oral function.

Non-attendance at the dentist may be an important indicator of attitudes to oral health and table 4.3.10. gives the demographic breakdown of the non-attenders. Non-attenders were found to be under represented in the final (visited) sample; the proportion of the sample who were non/irregular attenders, including those responding to the postal questionnaire of refusers, is given elsewhere (see table 4.1.5.). There are strong social, gender and regional trends among the non-attenders. Men, the families of manual workers (particularly those from unskilled manual backgrounds) and subjects in both of the northern samples were

Table 4.3.9. Demands: Symptoms reported by the dentate sample, by area and age

Richmondshire

	60-64	65-74	75+	Rwt 60+
base	181	134	83	398
Bleeding gums	8.3%	4.5%	0.0%	**5.1%**
Loose teeth	13.9%	21.2%	13.6%	**17.0%**
Sensitivity	27.2%	22.8%	13.6%	**22.8%**
Toothache	5.0%	9.8%	3.7%	**6.9%**
TMJ pain	2.8%	4.5%	4.9%	**3.9%**
Other oral discomfort	8.3%	12.0%	7.3%	**9.7%**

Darlington

	60-64	65-74	75+	Rwt 60+
base	134	114	58	306
Bleeding gums	6.0%	6.1%	10.3%	**6.8%**
Loose teeth	15.7%	15.8%	16.7%	**15.9%**
Sensitivity	21.6%	21.0%	18.5%	**20.8%**
Toothache	6.7%	6.1%	9.3%	**6.9%**
TMJ pain	7.5%	7.9%	0.0%	**6.4%**
Other oral discomfort	13.4%	19.3%	12.1%	**15.9%**

Salisbury

	60-64	65-74	75+	Rwt 60+
base	207	175	125	507
Bleeding gums	5.3%	4.0%	4.8%	**4.6%**
Loose teeth	12.6%	13.1%	11.3%	**12.5%**
Sensitivity	30.6%	23.9%	21.2%	**25.2%**
Toothache	10.7%	7.4%	12.1%	**9.7%**
TMJ pain	9.2%	5.2%	1.6%	**5.4%**
Other oral discomfort	12.6%	8.0%	19.2%	**12.5%**

Data for this table are derived from questions 2 to 5 in Section 3 and questions 8 and 9 in Section 4 of the questionnaire.

Bleeding gums data refers to responses of "always" or "often". Sensitivity data refers to responses of "often" or "sometimes".

Table 4.3.10. Attitudes: Percentage of the dentate sample who attend only when they are having trouble with their teeth, by area, age, gender, social class and attendance pattern.

Richmondshire

	60-64	65-74	75+	Rwt 60+
Male	30.3%	31.1%	50.0%	**33.8%**
Female	8.8%	20.0%	39.1%	**19.6%**
Non-Manual	18.0%	20.2%	33.3%	**21.8%**
III Manual	20.0%	33.3%	69.2%	**34.3%**
IV/V	33.3%	53.3%	14.3%	**40.5%**
Base for "All"	181	134	83	398
All	**19.4%**	**26.1%**	**43.9%**	**26.8%**

Darlington

	60-64	65-74	75+	Rwt 60+
Male	33.8%	31.6%	37.9%	**33.5%**
Female	28.3%	17.9%	20.7%	**22.0%**
Non-Manual	23.4%	19.1%	28.9%	**22.5%**
III Manual	39.0%	27.8%	31.3%	**32.5%**
IV/V	50.0%	50.0%	75.0%	**54.0%**
Base for "All"	134	114	58	306
All	**31.3%**	**24.8%**	**29.3%**	**28.0%**

Salisbury

	60-64	65-74	75+	Rwt 60+
Male	20.6%	16.3%	28.0%	**20.6%**
Female	11.8%	16.8%	24.3%	**17.6%**
Non-Manual	7.8%	13.6%	19.1%	**13.6%**
III Manual	33.3%	13.2%	53.8%	**30.3%**
IV/V	33.3%	42.1%	66.7%	**41.3%**
Base for "All"	207	175	125	507
All	**15.9%**	**16.6%**	**25.8%**	**18.9%**

Base numbers for subgroups can be found in Table 4.2.3.

Data for this table are based on question 3 in Section 6 of the questionnaire.

substantially more likely to be non-attenders. There was a general increase in the proportion of non-attenders with age, and this was particularly evident in Richmondshire where 44% of the over 75 year old sample attended never or only when they had trouble.

Dentate subjects were asked about their toothbrushing frequency; the results are presented in table 4.3.11.. Salisbury had a higher proportion of regular brushers (70% brushing 2x a day or more) than Darlington (61%) and particularly Richmondshire (42%). Both urban areas had a *hard core* of 5-6% of the sample who only occasionally, or never, brushed their teeth, this was doubled (12%) in rural Richmondshire.

The dentate subjects were asked how upsetting they found the prospects of total tooth loss; the percentage who said that they would be *not at all upset* is given in table 4.3.12. In Richmondshire and Salisbury there was a small increase with age in the proportion who would be untroubled by the prospect of edentulousness, with around a quarter of the population over 60 years falling into this category. The age related trend in Darlington seems less clear. Regional differences were small, although Salisbury had fewer who would **not** be upset than the other two areas (about 3-4% fewer). Males and manual workers were much less likely to be upset than females and non-manual workers, particularly in the urban areas (the size of the differences were much smaller in Richmondshire). It was, once again, between attenders and non-attenders that the largest differences lay, 47-52% of non-attenders said that they would not be upset by loss of all of their teeth, compared to only about 18-20% of attenders.

Table 4.3.13. reports on the expectation of the need for full dentures in the future by the dentate sample. Expectation was highest in Darlington (19% of the reweighted sample), and lowest in Richmondshire (11%). Richmond and Salisbury showed a decrease in this expectation with increasing age, in Darlington there were signs of the opposite, but in none of these cases were the trends convincing. Gender and social class differences were generally minor, but it was non-attenders who were by far the most likely sub-group to expect to become edentulous, 27-28% in the two urban areas, although much less in Richmondshire (14%).

Dentate subjects were asked the same questions about payment as the edentulous, these data are presented

Table 4.3.11. Attitudes: Reported frequency of toothbrushing by the dentate sample by area and age.

Richmondshire

	60-64	65-74	75+	Rwt 60+
base for "All"	181	134	83	398
2x or more daily	46.7%	40.5%	35.8%	**42.0%**
1x daily	41.1%	45.1%	47.0%	**43.9%**
< 1x daily/never	11.1%	11.4%	12.3%	**11.5%**
never	**1.1%**	**3.0%**	**4.9%**	**2.6%**

Darlington

	60-64	65-74	75+	**Rwt 60+**
base for "All"	134	114	58	**306**
2x or more daily	56.0%	67.5%	53.7%	**60.9%**
1x daily	39.6%	25.4%	33.3%	**32.0%**
< 1x daily/never	3.7%	5.3%	11.1%	**5.7%**
never	**0.7%**	**1.8%**	**1.9%**	**1.4%**

Salisbury

	60-64	65-74	75+	**Rwt 60+**
base for "All"	207	175	125	**507**
2x or more daily	70.9%	70.9%	65.9%	**69.5%**
1x daily	25.7%	23.5%	22.8%	**24.0%**
< 1x daily/never	2.4%	4.5%	9.7%	**5.3%**
never	**1.0%**	**1.1%**	**1.6%**	**1.2%**

Data for this table were derived from question 8 in section 3 of the questionnaire

Table 4.3.12. Attitudes: Percentage of the dentate sample who would be not at all upset at losing all of their teeth by area, age, gender, social class and attendance pattern.

Richmondshire

	60-64	65-74	75+	Rwt 60+
Male	22.5%	33.3%	37.0%	**30.0%**
Female	14.8%	29.2%	28.9%	**23.5%**
Non-manual	18.5%	31.0%	31.3%	**26.2%**
Manual	17.5%	31.4%	33.3%	**26.6%**
Attenders	13.0%	26.3%	18.4%	**19.6%**
Non-attenders	43.3%	46.4%	51.9%	**47.2%**
Base for "All"	181	134	83	398
All	**18.6%**	**31.4%**	**32.3%**	**26.7%**

Darlington

	60-64	65-74	75+	Rwt 60+
Male	34.3%	30.8%	56.0%	**36.4%**
Female	26.4%	12.5%	13.6%	**17.5%**
Non-manual	29.0%	16.7%	33.3%	**24.2%**
Manual	33.3%	30.0%	41.2%	**33.0%**
Attenders	21.4%	14.9%	27.3%	**19.3%**
Non-attenders	51.3%	40.0%	57.1%	**47.8%**
Base for "All"	134	114	58	306
All	**30.9%**	**22.0%**	**36.2%**	**27.7%**

Salisbury

	60-64	65-74	75+	Rwt 60+
Male	23.0%	35.7%	35.9%	**31.8%**
Female	11.3%	15.1%	29.5%	**18.3%**
Non-manual	11.5%	19.8%	30.7%	**20.7%**
Manual	29.6%	34.0%	36.0%	**33.0%**
Attenders	11.5%	20.0%	21.9%	**17.8%**
Non-attenders	48.1%	46.2%	59.3%	**51.6%**
Base for "All"	207	175	125	507
All	**16.8%**	**21.6%**	**32.0%**	**23.1%**

Base figures for other sub-groups can be found in Table 4.2.3.

These data are derived from question 6, Section 5 of the questionnaire

Table 4.3.13. Attitudes: Percentage of the dentate sample who expect to need full dentures in future, by area, age, social class and attendance pattern.

Richmondshire

	60-64	65-74	75+	Rwt 60+
Male	22.5%	5.6%	8.6%	**12.2%**
Female	11.0%	10.2%	4.3%	**9.3%**
Non-manual	11.4%	7.5%	5.0%	**8.5%**
Manual	25.8%	4.3%	7.7%	**12.6%**
Attenders	11.1%	9.2%	4.3%	**9.3%**
Non-attenders	37.1%	3.1%	8.6%	**14.0%**
Base for "All"	181	134	83	398
All	**16.7%**	**7.6%**	**6.2%**	**10.8%**

Darlington

	60-64	65-74	75+	Rwt 60+
Male	16.2%	20.7%	14.3%	**17.9%**
Female	20.3%	14.5%	34.5%	**20.2%**
Non-manual	14.5%	14.9%	24.3%	**16.6%**
Manual	19.5%	16.7%	25.0%	**19.0%**
Attenders	8.8%	15.5%	25.6%	**14.9%**
Non-attenders	38.1%	21.4%	17.6%	**27.6%**
Base for "All"	134	114	58	306
All	**18.0%**	**17.7%**	**24.6%**	**19.0%**

Salisbury

	60-64	65-74	75+	Rwt 60+
Male	21.9%	16.3%	20.0%	**19.0%**
Female	13.9%	13.7%	6.8%	**11.7%**
Non-manual	17.3%	11.9%	12.9%	**13.8%**
Manual	14.6%	18.4%	11.5%	**15.7%**
Attenders	12.2%	12.3%	12.0%	**12.2%**
Non-attenders	46.9%	27.6%	12.9%	**26.9%**
Base for "All"	134	114	58	306
All	**17.6%**	**14.9%**	**12.2%**	**15.0%**

Base figures for other sub-groups can be found in Table 4.2.3.

These data are derived from question 7 in Section 5 of the questionnaire

in tables 4.3.14. and 4.3.15.. A substantial proportion of all groups felt that dentistry was expensive or very expensive, the lowest overall figure being in Salisbury (41%) and the highest in Darlington (51%). In both urban areas non-attenders were much more likely to think it was expensive than attenders (with a 30% difference between the groups), but in Richmondshire the non-attenders felt quite differently and only 30% said that they thought dentistry was expensive or very expensive. In all areas manual workers were much more likely to feel that dentistry was expensive than non-manual workers. Those who had had a dental visit in the last year were less likely to feel that dentistry was expensive than those who had not, but this only applied to the urban areas, once again the situation was reversed in Richmondshire. Those in the 65-74 year old group in both Northern areas were much more likely to feel dentistry was expensive than those in either the younger or the older age groups, whilst in Salisbury there was a general reduction with age in the percentage who felt this way. Over 85% in all areas (for the reweighted 60+ totals) were NHS patients who paid a contribution, only 2% to 7% received NHS dentistry exempt from all charges, while the proportion having private dentistry was about 7% in Richmondshire and Salisbury, but only 3% in Darlington.

Dentate subjects were asked the same satisfaction questions as the edentulous; the results are presented in table 4.3.16.. Fewer dentate people were dissatisfied with their overall oral condition (a consistent 5-6%) than was the case with the edentulous, but dissatisfaction with aesthetics was more common in the dentate (11-14%) than it was in the edentulous (6-7%). In the dentate it decreased with age in the Northern areas, but not in Salisbury. On the other hand dietary restriction and dissatisfaction with function were much less frequently reported (around 15% and 4% respectively) in the dentate. In both urban areas dietary restriction increased markedly with age, this was not the case in Richmondshire. Further analysis of the factors which contribute to dissatisfaction are covered in sections 4.4. and 4.5.

4.3.4. Dentate subjects: Barriers and reasons for dental non-attendance (non-attenders only)

Dentate subjects who did not attend the dentist for check-ups were asked about the reasons for non-attendance. The results are shown in Tables 4.3.17 and 4.3.18.. Six potential barriers were listed and the subjects asked if they were, or were not, reasons for non-attendance at the dentist. They were then asked

Table 4.3.14. Attitudes: Percentage of the dentate sample who say they find dentistry expensive or very expensive by age, gender, social class and recent experience.

Richmondshire

	60-64	65-74	75+	Rwt60+
Males	40.0%	53.2%	25.0%	**43.9%**
Females	46.3%	55.6%	23.5%	**45.3%**
Non-manual	35.6%	50.7%	22.9%	**39.7%**
Manual	71.9%	63.6%	30.8%	**61.7%**
Attenders	43.9%	59.0%	24.4%	**47.8%**
Non-attenders	36.8%	36.8%	23.5%	**32.8%**
Dental visit in last year	42.4%	58.6%	22.7%	**45.4%**
No dental visit in last year	47.8%	40.9%	29.4%	**40.3%**
NHS contribution and visit'	41.2%	60.0%	22.2%	**45.8%**
base for "All"	181	134	83	398
All	**43.4%**	**54.3%**	**24.2%**	**44.6%**

Darlington

	60-64	65-74	75+	Rwt60+
Males	46.8%	62.2%	30.0%	**50.9%**
Females	52.2%	56.3%	42.1%	**52.3%**
Non-manual	40.0%	52.6%	37.0%	**45.2%**
Manual	60.4%	69.4%	33.3%	**60.5%**
Attenders	42.7%	54.1%	23.3%	**44.9%**
Non-attenders	69.2%	77.8%	75.0%	**73.8%**
Dental visit in last year	45.1%	54.9%	28.1%	**47.0%**
No dental visit in last year	61.5%	72.7%	71.4%	**68.2%**
NHS contribution and visit'	46.7%	54.7%	28.1%	**47.2%**
base for "All"	134	114	58	306
All	**49.1%**	**59.1%**	**35.9%**	**51.4%**

Salisbury

	60-64	65-74	75+	Rwt60+
Males	44.2%	38.6%	39.5%	**40.6%**
Females	42.9%	43.8%	38.6%	**42.0%**
Non-manual	36.2%	28.6%	30.1%	**31.3%**
Manual	61.1%	71.1%	71.4%	**68.0%**
Attenders	41.1%	39.4%	32.5%	**38.2%**
Non-attenders	61.9%	55.6%	66.7%	**61.4%**
Dental visit in last year	42.0%	40.9%	35.0%	**39.8%**
No dental visit in last year	54.9%	43.5%	60.0%	**51.1%**
NHS contribution and visit'	43.4%	39.8%	29.9%	**38.6%**
base for "All"	207	175	125	507
All	**43.5%**	**41.3%**	**38.9%**	**41.3%**

These data are derived from questions 1,2 and 5 in Section 7 of the questionnaire

Table 4.3.15. Attitudes: Type of payment for dental care among the dentate sample by area and age.

Richmondshire

	60-64	65-74	75+	Rwt 60+
base	181	134	83	398
NHS-exempt	2.0%	0.0%	4.8%	**1.6%**
NHS-contribution	92.1%	90.1%	75.6%	**88.2%**
Private/insurance	4.0%	6.6%	12.9%	**6.8%**

Darlington

	60-64	65-74	75+	Rwt 60+
base	134	114	58	306
NHS-exempt	9.3%	8.6%	0.0%	**7.4%**
NHS-contribution	85.2%	87.1%	94.9%	**87.8%**
Private/insurance	1.9%	3.2%	2.6%	**2.6%**

Salisbury

	60-64	65-74	75+	Rwt 60+
base	207	175	125	507
NHS- exempt	2.7%	2.0%	10.5%	**4.6%**
NHS-contribution	88.6%	84.7%	81.1%	**84.9%**
Private/insurance	7.1%	10.7%	2.1%	**7.2%**

"NHS-exempt" represents those who are exempt from all dental charges
"NHS -contribution" represents all those who pay a contribution of the cost.

These data are derived from question 1 in Section 7 of the questionnaire

Table 4.3.16. Attitudes: Percentage of the dentate sample who were dissatisfied with different aspects of function, by area and age.

Richmond

	60-64	65-74	75+	Rwt 60+
base	181	134	83	398
Dissatisfied - aesthetics	13.8%	9.0%	8.5%	**10.7%**
Dissatisfied - function	4.4%	2.2%	3.7%	**3.3%**
Dissatisfied - overall	5.5%	4.5%	6.10%	**5.2%**
Difficulty eating - diet restricted	12.8%	14.4%	12.3%	**13.4%**
Difficulty eating - hard foods	18.4%	28.3%	32.9%	**25.4%**
Altered food preparation	3.3%	0.7%	2.4%	**2.0%**

Darlington

	60-64	65-74	75+	Rwt 60+
base	134	114	58	306
Dissatisfied - aesthetics	16.4%	14.0%	8.6%	**13.9%**
Dissatisfied - function	3.0%	6.2%	8.6%	**5.4%**
Dissatisfied - overall	5.2%	5.3%	6.9%	**5.5%**
Difficulty eating - diet restricted	10.4%	12.3%	19.0%	**12.8%**
Difficulty eating - hard foods	20.8%	28.9%	43.4%	**28.5%**
Altered food preparation	2.2%	3.5%	5.2%	**3.3%**

Salisbury

	60-64	65-74	75+	Rwt 60+
base	207	175	125	507
Dissatisfied - aesthetics	11.6%	10.3%	12.0%	**11.2%**
Dissatisfied - function	5.4%	5.1%	2.4%	**4.4%**
Dissatisfied - overall	7.8%	6.2%	2.4%	**5.6%**
Difficulty eating - diet restricted	14.5%	15.4%	23.2%	**17.3%**
Difficulty eating - hard foods	28.5%	29.1%	41.1%	**32.3%**
Altered food preparation	1.0%	4.0%	4.8%	**3.3%**

These data are based on questions 1 to 4 in Section 4 of the questionnaire.

Table 4.3.17. Barriers: Most frequently quoted barriers amongst dentate non-attenders, by area and age.

Richmondshire

	60-64	65-74	75+	Rwt 60+
base	60	36	36	132
Don't need to	41.7%	86.1%	69.4%	**67.4%**
Too expensive	12.1%	31.4%	22.2%	**22.0%**
Fear	19.0%	33.3%	13.9%	**23.6%**
Travel	0.0%	2.9%	8.3%	**3.2%**
Can't be bothered	17.2%	20.0%	25.0%	**20.5%**
Other	9.8%	0.0%	16.1%	**7.0%**
Mean number reported	1.00	1.74	1.55	**1.44**

Darlington

	60-64	65-74	75+	Rwt 60+
base	42	29	19	90
Don't need to	69.0%	86.2%	84.2%	**79.0%**
Too expensive	33.3%	34.5%	31.6%	**33.4%**
Fear	38.1%	37.9%	38.9%	**38.2%**
Travel	2.4%	3.4%	5.6%	**3.4%**
Can't be bothered	21.4%	27.8%	27.6%	**25.2%**
Other	19.0%	13.8%	16.7%	**16.4%**
Mean number reported	1.83	2.04	2.05	**1.96**

Salisbury

	60-64	65-74	75+	Rwt 60+
base	32	29	33	94
Don't need to	31.3%	48.3%	75.8%	**54.8%**
Too expensive	31.3%	44.8%	34.4%	**37.5%**
Fear	59.4%	24.1%	31.3%	**35.5%**
Travel	0.0%	0.0%	9.4%	**3.6%**
Can't be bothered	15.6%	20.7%	3.1%	**12.8%**
Other	18.8%	17.2%	15.6%	**17.0%**
Mean number reported	1.56	1.55	1.70	**1.61**

These data are based on question 4 section 6 of the questionnaire

Due to the small size of the sub-groups the reader is advised to use the reweighted totals as these will be much more accurate.

Table 4.3.18. Barriers: Single most important barrier among non-attenders, by area and age.

Richmondshire

	60-64	65-74	75+	Rwt 60+
base	55	36	35	126
Don't need to	70.9%	72.2%	60.0%	**68.7%**
Too expensive	7.3%	13.9%	11.4%	**10.8%**
Fear	10.9%	11.1%	5.7%	**9.7%**
Travel	0.0%	0.0%	5.7%	**1.4%**
Can't be bothered	5.5%	2.8%	8.6%	**5.2%**
Other	5.5%	0.0%	8.6%	**4.2%**

Darlington

	60-64	65-74	75+	Rwt 60+
base	41	28	18	87
Don't need to	48.8%	57.1%	57.2%	**53.8%**
Too expensive	17.1%	10.7%	11.1%	**13.3%**
Fear	19.5%	17.9%	5.6%	**16.1%**
Travel	0.0%	0.0%	0.0%	**0.0%**
Can't be bothered	2.4%	3.6%	0.0%	**2.4%**
Other	12.2%	10.7%	11.1%	**11.4%**

Salisbury

	60-64	65-74	75+	Rwt 60+
base	32	28	33	93
Don't need to	51.6%	60.7%	60.6%	**58.4%**
Too expensive	9.7%	17.9%	21.2%	**17.1%**
Fear	2.9%	7.1%	12.1%	**8.0%**
Travel	0.0%	0.0%	0.0%	**0.0%**
Can't be bothered	3.2%	10.7%	0.0%	**4.7%**
Other	6.5%	0.0%	0.0%	**1.6%**

These data are based on question 4 section 6 of the questionnaire

Due to the small size of the sub-groups the reader is advised to use the reweighted totals as these will be much more accurate.

to name the barrier which was the most important reason for non-attendance.

In all areas it was a feeling that they did not need to go which was the most widely quoted reason for non attendance (55-79% for the 60+ groups as a whole), followed by fear (24-38%), expense (22-38%) and "can't be bothered" (13-25%). When looking at these figures it is important to consider the relatively small base numbers, even the reweighted totals will have 95% confidence limits of between 6% and 10%, so interpretation of minor percentage differences, particularly between the age/area sub-groups, should be made with caution. Nevertheless there is a strong suggestion that the proportion who said they did not attend because they did not need to attend was much lower in the 60-64 year olds than in the older age groups. Patterns for the other variables are much less clear. The mean number of barriers reported lay between 1.4 in Richmondshire and 2.0 in Darlington.

When the single most important barriers were examined the findings were similar with 50-60% choosing "don't need to" as the most important reason for non-attendance in the urban areas, increasing to nearly 70% in Richmondshire. Expense and fear were the only other barriers which were reasonably frequently quoted, but at 11-17% and 8-16% respectively they lagged well behind "don't need to" as most important reasons. Too far to travel did not feature at all except for a couple of individuals in the oldest group in rural Richmondshire.

4.3.5. All subjects: Access to care and knowledge of services

Table 4.3.19. presents data on access to care and knowledge of services for all subjects (dentate and edentulous). Only 1-3% of the total sample (reweighted data) reported any problem getting treatment, and only 3-4% reported any difficulty getting to the surgery, although this was age dependent with up to 7% of the 75+ groups reporting difficulty. In the two urban areas only 6-9% of the reweighted samples travelled any more than 5 miles to the dentist, so the problems of getting to the surgery were, in theory, less than those experienced in Richmondshire where 44% travelled more than 5 miles. However in terms of reported difficulty getting to the surgery it appeared to make no difference.

Table 4.3.19. Percentage of sample reporting problems of access to care and knowledge of domiciliary care by area and age (all subjects).

Richmondshire

	60-64	65-74	75+	60+ rwt
Problems getting treatment	2.0%	1.5%	0.7%	**1.4%**
Difficulty getting to surgery	1.6%	3.7%	6.3%	**4.0%**
Travel more than 5 miles	40.2%	40.6%	51.9%	**44.1%**
Difficulty getting an appointment	0.4%	1.2%	0.0%	**0.6%**
Personal experience of domiciliary care	2.4%	3.7%	6.5%	**4.3%**
Think domiciliary care is possible	47.6%	59.7%	48.1%	**52.9%**
Think domiciliary care would be helpful	9.5%	14.6%	24.3%	**16.4%**

Darlington

	60-64	65-74	75+	60+ rwt
Problems getting treatment	4.1%	4.3%	1.2%	**3.3%**
Difficulty getting to surgery	0.9%	2.4%	5.0%	**2.8%**
Travel more than 5 miles	7.0%	4.2%	8.5%	**6.2%**
Difficulty getting an appointment	1.3%	0.8%	0.8%	**0.9%**
Personal experience of domiciliary care	2.7%	3.2%	8.3%	**4.7%**
Think domiciliary care is possible	61.8%	65.2%	60.7%	**62.9%**
Think domiciliary care would be helpful	20.6%	20.3%	23.2%	**21.3%**

Salisbury

	60-64	65-74	75+	60+ rwt
Problems getting treatment	4.1%	1.6%	2.6%	**2.5%**
Difficulty getting to surgery	1.6%	3.5%	6.8%	**4.2%**
Travel more than 5 miles	6.5%	9.5%	10.3%	**9.1%**
Difficulty getting an appointment	2.4%	2.1%	1.4%	**1.9%**
Personal experience of domiciliary care	2.5%	1.9%	5.6%	**3.3%**
Think domiciliary care is possible	49.6%	51.9%	51.3%	**51.2%**
Think domiciliary care would be helpful	8.6%	12.4%	49.8%	**24.6%**

These data are based on questions 1, 2 and 3 in Section 8 and question 1 in Section 6 of the questionnaire.

Only 3-5% had any experience of domiciliary care, and this was age dependent, with up to 8% of the 75+ year olds having previous experience of domiciliary care. Despite low levels of personal experience, more than half of the reweighted samples (51-63%) was aware of the possibility of domiciliary care, with awareness fairly constant between age groups. Between 16% and 25% of the reweighted samples felt it would be helpful to receive domiciliary care. In Salisbury there was the expected age related increase, from 7% in the 60-64 age band up to 50% in the 75+ group. A similar, though less marked increase was apparent in Richmondshire, whilst in Darlington there was only a small age related increase where 21% of 60-64 year olds felt it would be helpful to have domiciliary care, compared with 23% of 75+ year olds.

4.4. THE PARTIALLY DENTATE: MASTICATORY FUNCTION, THE NUMBER OF TEETH AND THE ROLE OF PARTIAL DENTURES

This section reports on the relationship between number and distribution of teeth and various functional problems. The factors which determine whether a subject wears partial dentures to try to restore aesthetics or function is also covered followed by an investigation of the possible detrimental role of partial dentures in various dental conditions. The underlying theme of these analyses is an attempt to identify an appropriate goal or goals for the minimum number of natural teeth in the elderly, and the desirability or otherwise of prosthetic replacements for those that are missing.

4.4.1. Number of teeth and function

A series of logistic regression analyses which tested the relationship between problems with masticatory function and various clinical, socio-demographic and other variables was undertaken. The full results are presented in the Section 4.5.: however, the number of teeth (or specifically the number of missing teeth) were found to have a highly significant relationship with eating problems in all cases, such that more missing teeth increased the odds of problems. These logistic regression models are able to control for the effect of a large number of important variables in assessing the importance of the number of teeth. For each missing tooth the odds of reporting a problem eating increased by a factor of about 1.15 overall. The cumulative effect of this where there were many missing teeth would be large. An alternative measure to the number of teeth was to use the number of posterior contacts. This variable was also provided for inclusion into the model, and when considered on its own outside the statistical model it was highly significantly correlated to problems with function, such that the more contacts that are present, the less likely it is that there will be any problems with the ability to eat. However, *number of missing teeth* was marginally the more significant of the two, and because this and the *number of posterior contacts* are highly correlated with each other, the significance of the latter variable was eliminated when *number of missing teeth* was included in the model. The only exception to this was in the case of the variable indicating altered preparation of food due to problems with eating, where *number of posterior contacts* was the more significant and was included in the model. The four *eating* variables which were tested are listed below and the odds ratio for the effect of number of teeth/posterior contacts given:

Diet limited by difficulty eating	odds ratio 1.09 per missing tooth
Difficulty eating hard foods	odds ratio 1.15 per missing tooth
Altered food preparation (eating problems)	odds ratio 0.65 per contact present
Any difficulty eating (any of the above)	odds ratio 1.14 per missing tooth

Full results of these dependent variables including all other contributory variables are given in table 4.5.1. and are described in section 4.5.

In order to try to illustrate the nature of the relationship in a little more detail, number of teeth has been plotted against percent of the sample who were dissatisfied with function and the percentage of the sample who reported problems eating (figures 4.4.1. and 4.4.2.). The number of tooth contacts has been plotted against the same variables (figures 4.4.3. and 4.4.4.). In both cases only subjects with teeth in both arches have been included. The relationship appears to be basically linear such that the percentage dissatisfied and the percentage with eating problems decrease at an even rate with an increasing number of teeth, at least when the number of teeth lies between 13 and 27 (unfortunately, where the number of teeth lay outside this range, number of subjects were too few to allow plotting of tooth number in the same way). There is no part of the curve which is obviously steeper than the rest, apparently indicating that there is no *critical number* of teeth for satisfactory function. Similarly, although the plot tends towards zero with the more teeth

Figure 4.4.1. Number of teeth by % dissatisfied with function

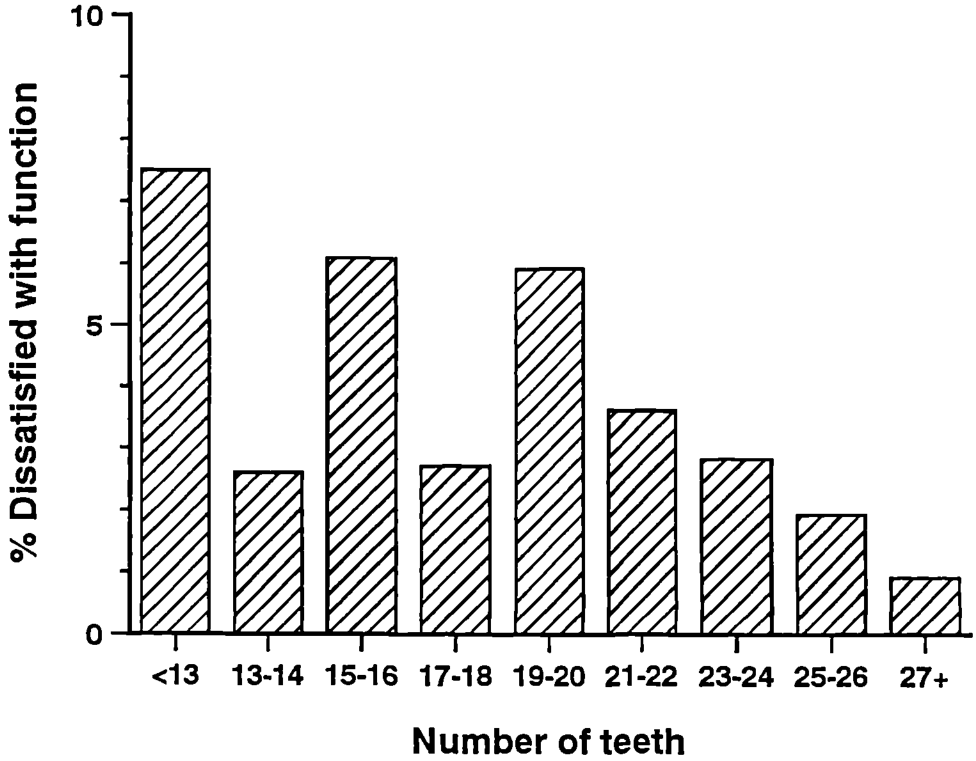


Figure 4.4.2. Number of teeth by % with functional problems

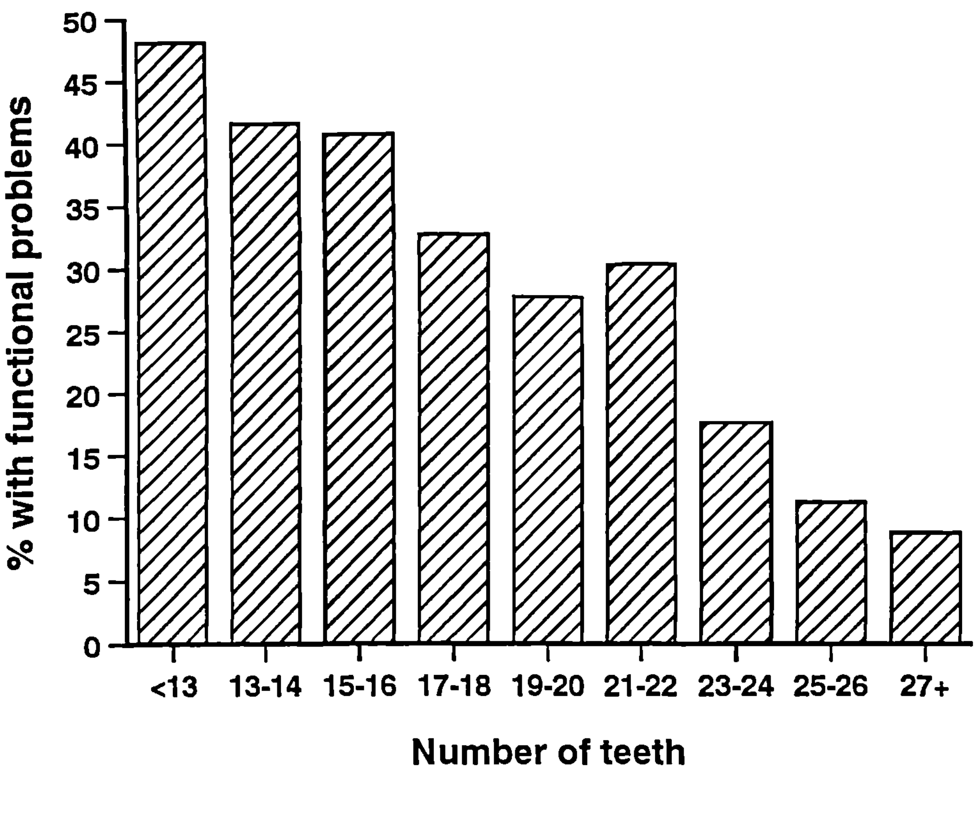


Figure 4.4.3. Contacts by % dissatisfied with function

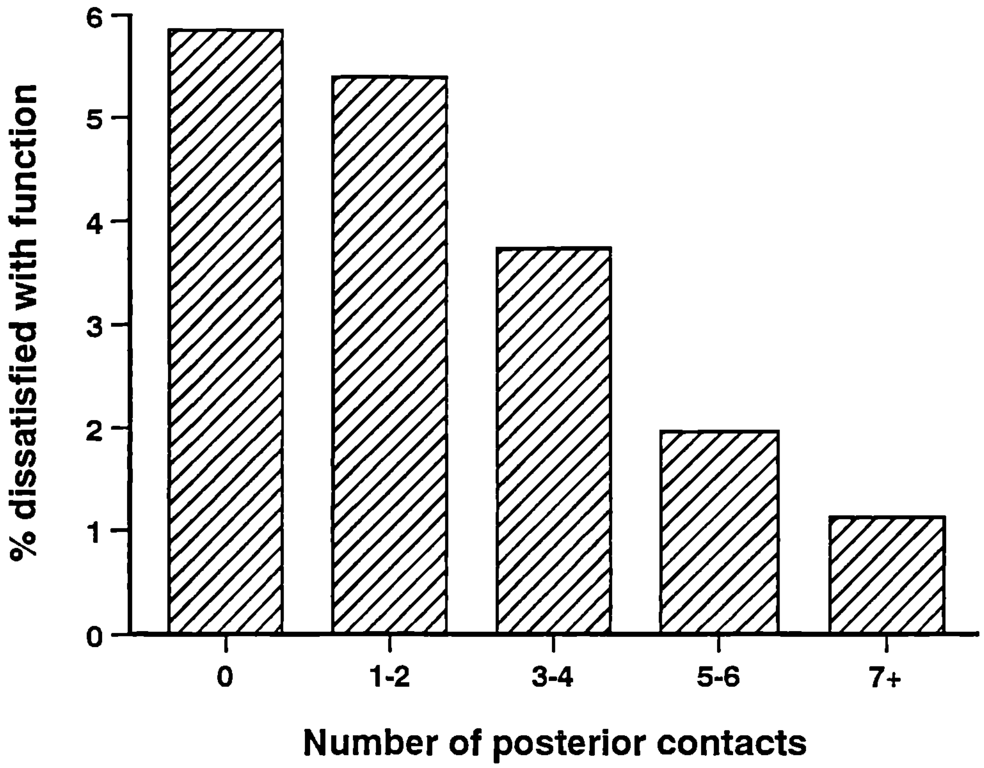
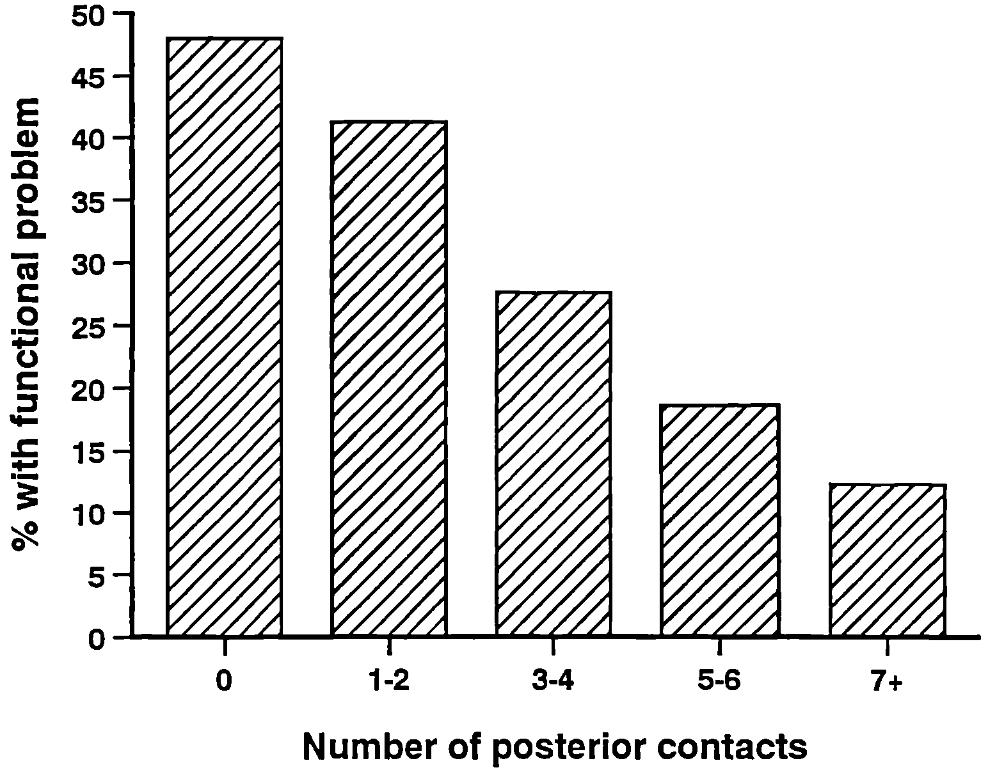


Figure 4.4.4. Contacts by % with functional problems



that are present, it does not appear to reach zero when there is an almost full arch of teeth. Among the dentate subjects with most teeth there appear still to be some with functional problems or who are dissatisfied with function, and many with very few teeth who do not report problems or dissatisfaction. Only 7% of those with 13 teeth or fewer were dissatisfied with their ability to bite and chew.

4.4.2. Partial denture wearing, and the role of partial dentures in dental disease.

Figure 4.4.5. illustrates the pattern of partial denture wearing according to number of teeth in those who are dentate in both arches. It shows a steep reduction from over 75% of the sample wearing partial dentures where there are less than 17 teeth down to below 5% where there are more than 24. Figure 4.4.6. illustrates the relationship between denture wearing and the number of natural posterior contacts. When there are 2 contacts or less, nearly two thirds of the sample wore a partial denture, when the number of contacts increases beyond this threshold the percentage with a partial denture diminishes sharply to well under 10% where there are 7 or more contacts. There does appear to be a critical size for the dentition (20 teeth + or - 4 teeth or 2-4 contacts) which marks the watershed for denture wearing. Clearly there are other factors which may determine whether or not a denture is worn, specifically the need to restore anterior spaces as well as a number of socio-demographic and clinical factors. In an attempt to untangle some of these a multiple logistic regression was undertaken, with partial denture wearing as a dependent variable and tooth number, filled and unfilled anterior spaces and a number of socio-demographic and clinical variables as the risk factors. This analysis was restricted to those who are dentate in both arches. The results of this analysis are shown in table 4.4.1. The -2 log likelihood indicated that the final statistical model created by the computer fitted the data well.

The single most important factor which determines whether or not a partial denture is worn is the presence of an anterior space. The odds of wearing a partial denture increase by a factor of 12.7 in those who have an anterior space. The other major factors were the number of missing teeth and the number of posterior contacts. Because the relationship between number of teeth (and number of contacts) and denture wearing is clearly non-linear, the number of missing teeth was split into three categories (<8, 8-15, 16 or more).

Figure 4.4.5. Number of teeth by % with partial denture

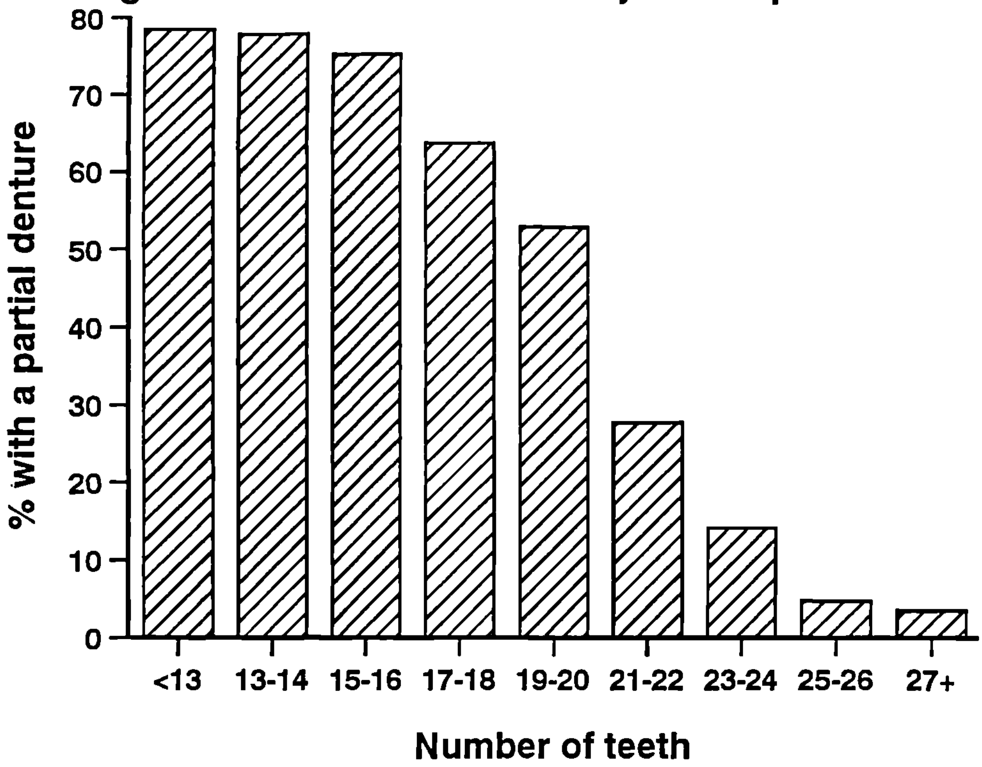


Figure 4.4.6. Contacts by % with partial denture

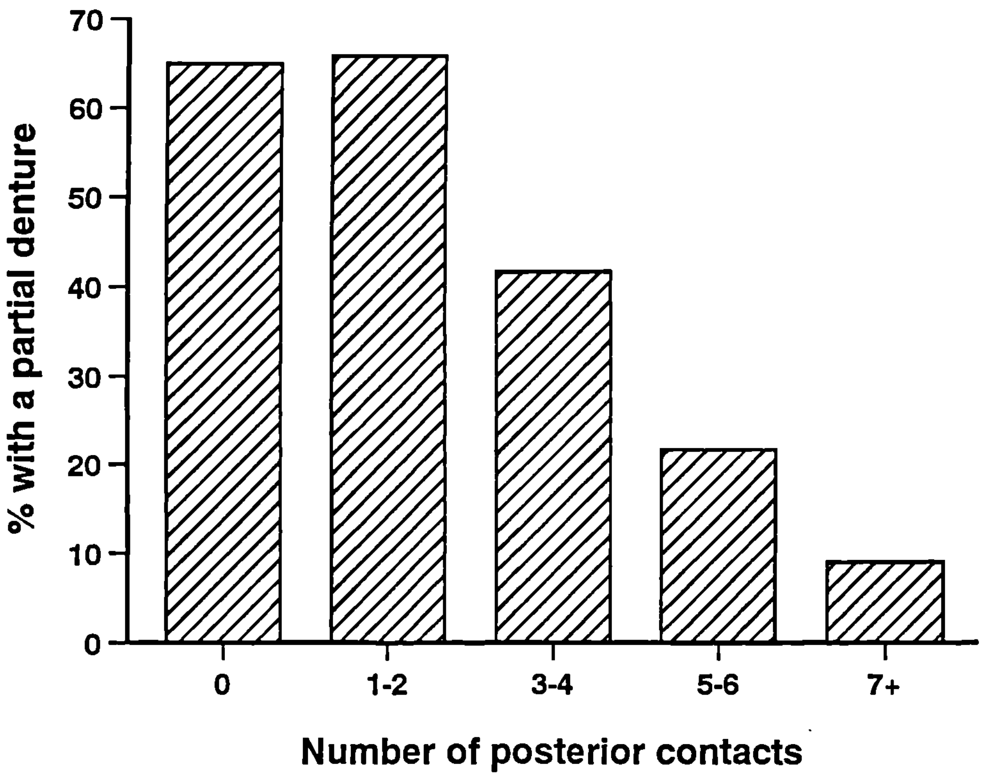


Table 4.4.1. Factors involved in wearing a partial denture

Dependent variable: **Wears a partial denture**
n=964 (only those dentate in both arches were included)

Independent variable	**Type**	**B**	**S.E.**	**sig**	**R**	**Odds ratio**
constant		-3.214	0.454	0.000		
1+ anterior spaces (filled or unfilled)	dichotomous	2.538	0.210	0.000	0.33	**12.65**
Being a dental non-attender	dichotomous	-1.163	0.243	0.000	-0.13	**0.31**
16+ missing teeth (compared to <8)	categorical	2.328	0.465	0.000	0.13	**10.26**
8 - 15 missing teeth (compared to <8)	categorical	1.540	0.404	0.000	0.09	**4.67**
Being female	dichotomous	0.501	0.183	0.006	0.07	**1.65**
Social class (manual)	dichotomous	0.204	0.204	0.014	0.06	**0.61**
5+ posterior contacts (compared to 0)	categorical	-0.567	0.254	0.026	0.05	**0.57**
1-2 posterior contacts (compared to 0)	categorical	0.497	0.225	0.027	0.05	**1.64**

Non-significant variables, not included the model above

Having had a higher education
Having 3-4 posterior contacts
Age
Being from the North of England

Table 4.4.4. Partial dentures as a risk factor for dental disease

n=1030

Statistics indicating relative risk of partial dentures

Disease variable (dependent)	**B**	**S.E.**	**sig**	**R**	**Odds ratio**
Presence of root caries	0.620	0.154	0.000	0.10	**1.86**
Presence of root caries/fillings	2.857	0.177	0.000	0.43	**17.42**
Presence of coronal caries		Partial dentures not significant			
Presence of tooth wear		Partial dentures not significant			
Presence of any LoA >6mm	0.539	0.139	0.000	0.10	**1.71**

Other independent variables tested for inclusion

Age
Being female
Being a dental non-attender
Social class (manual)
Education
Toothbrushing <once daily

Number of teeth with coronal fillings
Number of teeth with coronal decay/fillings
Number of root surface fillings ("Presence of root decay" only)
Number of missing teeth
Number of teeth with LoA of 6mm+
Number of posterior contacts("Presence of tooth wear "only)
Number of premolar contacts("Presence of tooth wear "only)
Number of molar contacts("Presence of tooth wear "only)

For tables 4.4.2. and 4.4.3. see page 231

Posterior contacts were split into 4 categories (0, 1-2, 3-4 and 5+). The number of missing teeth and the number of contacts are compared back to a reference category in order to calculate an odds ratio. For the former it was 0 to 8 missing teeth and for the latter it was 0 posterior contacts. The odds ratios in table 4.4.1. are the predicted change in the odds compared with these reference categories. So, where there are between 8 and 15 missing teeth the odds of wearing a partial denture increase by a factor of 4.7 compared to where there are 0-8 missing. Where there are 16 or more missing teeth the odds increase by 10.3. Number of posterior contacts also have an independent effect, over and above that of the number of teeth. Some socio-demographic and socio-dental factors had an influence on partial denture wearing. Being a manual worker and being a dental non-attender significantly reduced the odds of wearing a denture, whilst being female increased them.

The importance of anterior aesthetics as a factor are further emphasised by data on the pattern of denture wearing according to anterior spaces. Considering current denture wearers, in 83% of those with upper dentures their denture fills an anterior space, whilst this is the case in 50% of lower dentures. In the sample who do not wear a denture only 10% have upper spaces and 8% have lower spaces in the anterior region.

All dentate individuals were asked whether they had ever had a partial denture made which they could not or did not wear. Overall about a fifth to a quarter (19-25%) of the entire reweighted dentate sample said that they had. Non-wearers were divided fairly evenly between current partial denture wearers and current non-wearers. Salisbury had fewer (19%) who had a history of previously unsuccessful dentures than either of the Northern areas (25% and 23% respectively). These results are presented in table 4.4.2.. Further analysis of the pooled data for these subjects showed that 47% of them now wore a partial denture on a regular basis, whilst 53% wore no partial denture, or in some cases, had had an alternative type of prosthesis placed (i.e. a fixed bridge). Of those who had had a denture made which they could not wear in the past, but who now had an upper denture, (n=75), that denture filled an anterior space in 83% of cases, whilst of those who did not wear an upper denture (n=113), only 20% had an unfilled upper space. The equivalent figures in the lower jaw were 34.9% (n=43) and 17.2% (n=145).

Table 4.4.2. Percentage of the dentate sample who have had a partial denture made which could not be worn.

All dentate subjects were asked whether or not they had ever had a partial denture which they did not or could not wear.

	60-64	65-74	75+	60+ rwt
Richmondshire	30.8%	27.9%	21.4%	**25.3%**
Darlington	24.1%	23.2%	30.4%	**23.2%**
Salisbury	20.8%	25.2%	13.5%	**18.9%**

Table 4.4.3. Percentage of partial denture wearers expressing different reasons for wearing partial dentures by age and area.

All partial denture wearers were asked to choose the main reason for wearing their partial denture. The commonest two reasons are given here.

Richmondshire

	60-64	65-74	75+	60+ rwt
Wearers: main reason eating	36.5%	47.7%	50.0%	**44.3%**
Wearers: main reason aesthetics	38.1%	30.8%	30.0%	**33.0%**

Darlington

	60-64	65-74	75+	60+ rwt
Wearers: main reason eating	29.8%	41.9%	55.9%	**40.9%**
Wearers: main reason aesthetics	48.9%	39.5%	23.5%	**38.8%**

Salisbury

	60-64	65-74	75+	60+ rwt
Wearers: main reason eating	43.2%	56.6%	52.9%	**51.1%**
Wearers: main reason aesthetics	36.5%	31.3%	32.4%	**32.7%**

The data for both tables on this page are based on questions10 and 11 in Section 3 of the questionnaire.

Partial denture wearers were also asked to choose the most important reason that they wear a denture, from a list of four possibilities (to help eating, to improve appearance, because their dentist advised it and *other*). Eating and aesthetics accounted for about 80% or more of the reasons given, but the relative importance of the two reasons varied with age - aesthetics decreased and functional considerations increased with increasing age. In general, more people in Salisbury than in the Northern areas listed help with eating as the most important reason for denture wearing . All of these results are presented in table 4.4.3..

Multiple stepwise logistic regression was conducted for a number of dental disease variables to try to establish the relationship between the presence or absence of certain conditions and a variety of potential contributory factors, including partial denture wearing. The relationship between partial denture wearing and dental disease is not easy to test. Partial denture wearers may be more prone to disease, such as root caries, because of stagnation associated with the denture. However the people who wear partial dentures may be more prone to dental disease anyway (quite independent of the presence of dentures) and it may be this underlying predisposition which has caused them to lose teeth and need partial dentures. Logistic regression allows the past history of disease (as number of missing teeth and number of teeth with coronal restorations) to be taken into account as a risk factor, as well as the presence of a partial denture and a variety of confounding variables. Goodness of fit indicators suggested a well fitting statistical model had been created.

The results from this section are given in table 4.4.4. which only presents data for the effect of partial dentures. The other significant variables are not presented in order to keep the table relevant and simple. However, all potential confounding variables which reflect past disease (e.g. number of missing teeth, number of filled teeth, number of teeth with moderate or severe loss of attachment) were included where appropriate in the statistical models used in the analysis. Measures of caries (crown and root), tooth wear and periodontal disease were the dependent variables used. In the case of the presence of root surface caries and the presence of root surface caries or fillings, partial dentures were a significant and important factor. The odds of having *root surface decay or unsound restorations* were increased 1.9 times in those who wore partial dentures compared to non-wearers and the figure for *root decay or fillings* was 17.4.. This was after taking into account past vulnerability to dental disease (*number of teeth, number of periodontally involved* *teeth* and *number of missing teeth*). The presence of coronal decay was not influenced by partial denture wearing, however some loss of attachment was significantly more likely in the presence of dentures (odds ratio of 1.7).

4.5. THE FACTORS WHICH INFLUENCE ORAL HEALTH IN THE ELDERLY

Dental health has traditionally been measured by measuring the prevalence and severity of dental disease. In young age groups, where the priorities of dental care may be different from the elderly, this is a reasonable approach, however in the elderly there may be different considerations and this narrow approach is inappropriate.

The schematic model of oral health introduced in section 3.11. was used as the basis for testing a batch of potential contributory variables in a structured way, such that social, demographic, clinical dental and socio-dental variables (e.g. satisfaction, symptoms etc.) could be compared together. The results are presented in several forms. Table 4.5.1. shows the results of the logistic regressions where eating difficulties were used as the dependent variables. Table 4.5.2. give the results of the analysis where satisfaction variables were analysed. The calculations which test the goodness of fit of the statistical model created by the computer (the -2 Log likelihood, goodness of fit and % correct classifications) pointed to well fitting final (statistical) models for all of the dependent variables tested. These indicate that the final models did not differ significantly from a "perfect" model.

A considerable amount of data is presented in each table and the meaning of each statistic is described in section 3.11.7. However, for the purpose of straightforward interpretation the odds ratio (representing the change in the odds in the presence of that independent variable) is the most important. Where the odds ratio is greater than one it indicates a positive risk and where it is smaller than one it indicates a reduced risk in the presence of that independent variable. In the cases of discrete variables (e.g. age, number of missing teeth), the odds ratio is the change in the odds per one unit increase in the value of the independent variable, so even if the odds ratio seems small, its multiplicative effect could be large. Figures 4.5.1. and

Table 4.5.1. Risk factors for difficulty eating

Dependent variable: Diet limited by difficulty eating

n=1028

Independent variable	Type	B	S.E.	sig	R	Odds ratio
Constant		-3.669	0.2928	0.00		
Number of missing teeth	discrete	0.086	0.0135	0.000	0.21	1.09
Number of mobile teeth (dentist report)	discrete	0.173	0.053	0.001	0.10	1.19
Having had higher education	dichotomous	0.661	0.209	0.002	0.10	1.94
Presence of sensitive teeth	dichotomous	0.468	0.2162	0.031	0.06	1.60
Presence of mobile teeth (patient report)	dichotomous	0.456	0.2178	0.036	0.05	1.58

Dependent variable: Difficulty eating hard foods

n=1028

Independent variable	Type	B	S.E.	sig	R	Odds ratio
constant		-3.405	0.262	0.000		
Number of missing teeth	discrete	0.142	0.012	0.000	0.35	1.15
Number of decayed teeth	discrete	0.150	0.039	0.000	0.10	1.16
Being female	dichotomous	0.443	0.157	0.005	0.07	1.56
Living in the north	dichotomous	-0.401	0.156	0.010	-0.06	0.67

Dependent variable: Altered food preparation (eating problems)

n=1028

Independent variable	Type	B	S.E.	sig	R	Odds ratio
constant		-4.121	0.490	0.000		
Presence of sensitive teeth	dichotomous	1.778	0.438	0.000	0.25	5.92
Number of posterior contacts	discrete	-0.432	0.174	0.013	-0.13	0.65
Being edentulous in one arch	dichotomous	1.175	0.514	0.022	0.12	3.24

Dependent variable: Any difficulty eating

n=1028

Independent variable	Type	B	S.E.	sig	R	Odds ratio
constant		-3.044	0.246	0.000		
Number of missing teeth	discrete	0.134	0.011	0.000	0.33	1.14
Number of decayed teeth	discrete	0.127	0.038	0.001	0.08	1.14
Presence of sensitive teeth	dichotomous	0.481	0.171	0.007	0.06	1.62
Being female	dichotomous	0.392	0.151	0.009	0.06	1.48
Living in the north	dichotomous	-0.377	0.149	0.011	-0.06	0.69
Number of teeth with 6mm+ LoA	discrete	0.074	0.032	0.020	0.05	1.08

Non-significant variables, not included in any of the four models above

Age	Number of posterior contacts
Social class (manual)	Recent toothache
Being a dental non-attender	TMJ pain
Number of worn teeth	Difficulties with speech
Wearing partial dentures	

Table 4.5.2. Risk factors for dissatisfaction

Dependent variable: Dissatisfaction with ability to bite and chew
n=1028

Independent variable	Type	B	S.E.	sig	R	Odds ratio
constant		-0.568	1.929	0.768		
Difficulty eating hard foods	dichotomous	2.400	0.446	0.000	0.28	**11.02**
Interaction*	dichotomous	2.398	0.630	0.000	0.19	**11.01**
Diet limited by difficulty eating	dichotomous	0.682	0.270	0.012	0.11	**1.98**
Recent toothache	dichotomous	1.020	0.422	0.016	0.11	**2.77**
Age	discrete	-0.066	0.029	0.023	-0.10	**0.94**

* represents interaction between all three difficulty eating variables

Non-significant variables, not included in the model above

Altered food preparation (eating)
Any eating problems
Being a dental non-attender
Being female
Living in the North of England
Social class (manual)
Having had a higher education
Presence of sensitive teeth
Presence of mobile teeth
Difficulty with speech
TMJ pain
Number of missing teeth
Number of worn teeth
Number of decayed teeth
Number of teeth with LoA of 6mm+
Number of mobile teeth
Being edentulous in one arch
Having a partial denture

Dependent variable: Dissatisfaction with appearance of the teeth
n=1028

Independent variable	Type	B	S.E.	sig	R	Odds ratio
constant		-0.080	1.034	0.940		
Any unfilled anterior space	dichotomous	1.273	0.251	0.000	0.18	**3.57**
Number of teeth with 6mm+ LoA	discrete	0.121	0.038	0.002	0.10	**1.13**
Age	discrete	-0.046	0.016	0.004	-0.09	**0.96**
Having had higher education	dichotomous	0.611	0.230	0.008	0.08	**1.84**
Being a dental non-attender	dichotomous	0.582	0.228	0.011	0.08	**1.79**
Number of decayed teeth	discrete	0.112	0.049	0.021	0.07	**1.12**
Being female	dichotomous	0.408	0.207	0.049	0.05	**1.50**

Non-significant variables, not included the model above

Living in the North of England
Social Class (manual)
Difficulty with speech
Any filled anterior space
Number of missing teeth
Number of worn teeth

Dependent variable: Dissatisfaction with mouth generally
n=1030

Independent variable	Type	B	S.E.	sig	R	Odds ratio
constant		-4.534	0.347	0.000		
Dissatisfied with ability to bite/chew	dichotomous	2.996	0.407	0.000	0.34	**20.00**
Dissatisfied with appearance	dichotomous	1.449	0.344	0.000	0.19	**4.26**
Any problems eating	dichotomous	0.917	0.344	0.008	0.11	**2.50**
Recent toothache	dichotomous	0.923	0.357	0.010	0.10	**2.52**
Difficulty with speaking due to teeth	dichotomous	0.498	0.208	0.017	0.09	**1.65**
Wearing partial denture	dichotomous	0.716	0.326	0.028	0.08	**2.05**

Non-significant variables, not included the model above

Age
Being female
Social class (manual)
Having had a higher education
Being a dental non-attender
Presence of mobile teeth (patient)
Presence of sensitive teeth
TMJ pain
Being edentulous in one arch
Number of posterior contacts
Number of decayed teeth
Number of worn teeeth
Number of teeth with LoA of 6mm+
Number of mobile teeth

4.5.2. illustrate schematically two different parts of the final model and include all of the contributory variables where the relationships were found to be significant. Figure 4.5.3.. illustrates a simplified final model with known relationships indicated by solid black arrows.

All of the *difficulty eating* variables were affected by number of teeth or number of contacts, and when the three variables were combined into one (indicating **any** difficulty eating) the number of missing teeth increased the odds of problems by 1.14 per tooth. Decayed, periodontally involved and sensitive teeth all increased the odds of problems with eating, as did being female. Living in the North of England reduced them. Difficulties with eating were the major contributory factor towards dissatisfaction with the ability to eat, the only additional contributory factors were age, which reduced the odds of dissatisfaction, and recent toothache which increased them considerably (odds ratio of 2.8).

Risk of dissatisfaction with appearance was increased by the presence and number of unfilled anterior spaces, the number of teeth with 6mm or more loss of attachment, the number of decayed teeth, being female, having had a higher education, whilst they reduced with age.

The risk of overall dissatisfaction was increased considerably in the presence of either of the other aspects of dissatisfaction (with eating or appearance), as well as problems eating (a direct relationship over and above that for dissatisfaction eating), toothache, speech problems and wearing a partial denture.

Measurement of dental health has concentrated generally around the identification and measurement of disease. This model illustrates factors, including those related to disease, which impinge on a patient's ability to function and their satisfaction. Symptoms and functional impairment clearly play an important role in satisfaction in a much more direct way than clinical disease. This topic will be covered in more detail in the discussion.

Figure 4.5.1. Factors affecting ability to eat and satisfaction with function.

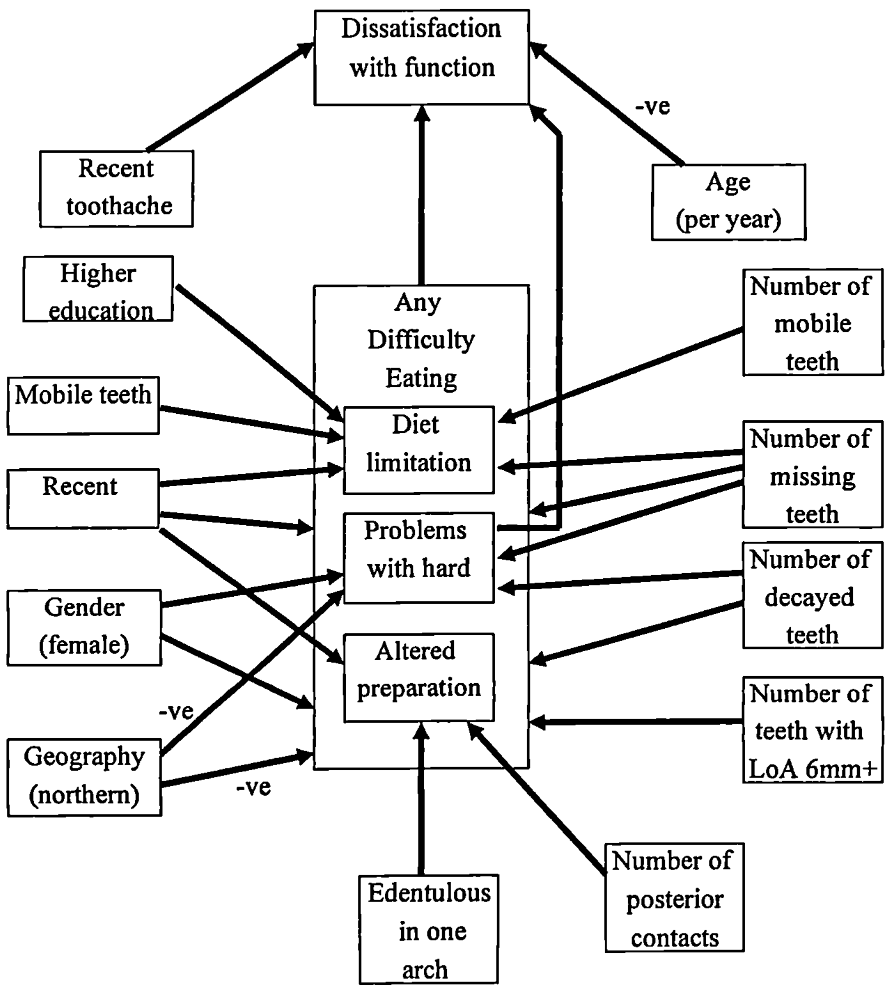


Figure 4.5.2.Factors affecting satisfaction with aesthetics.

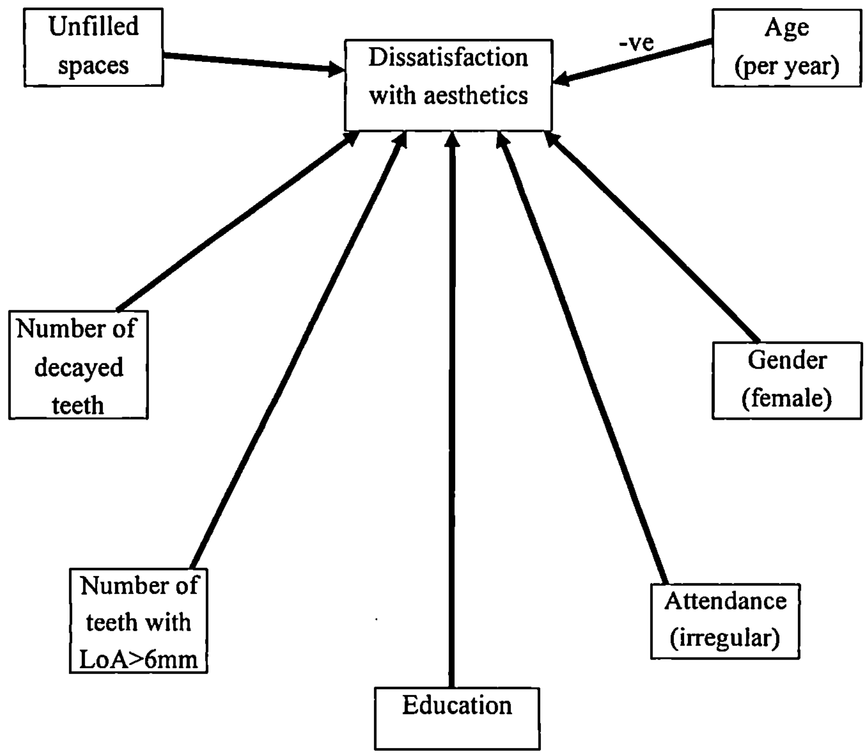
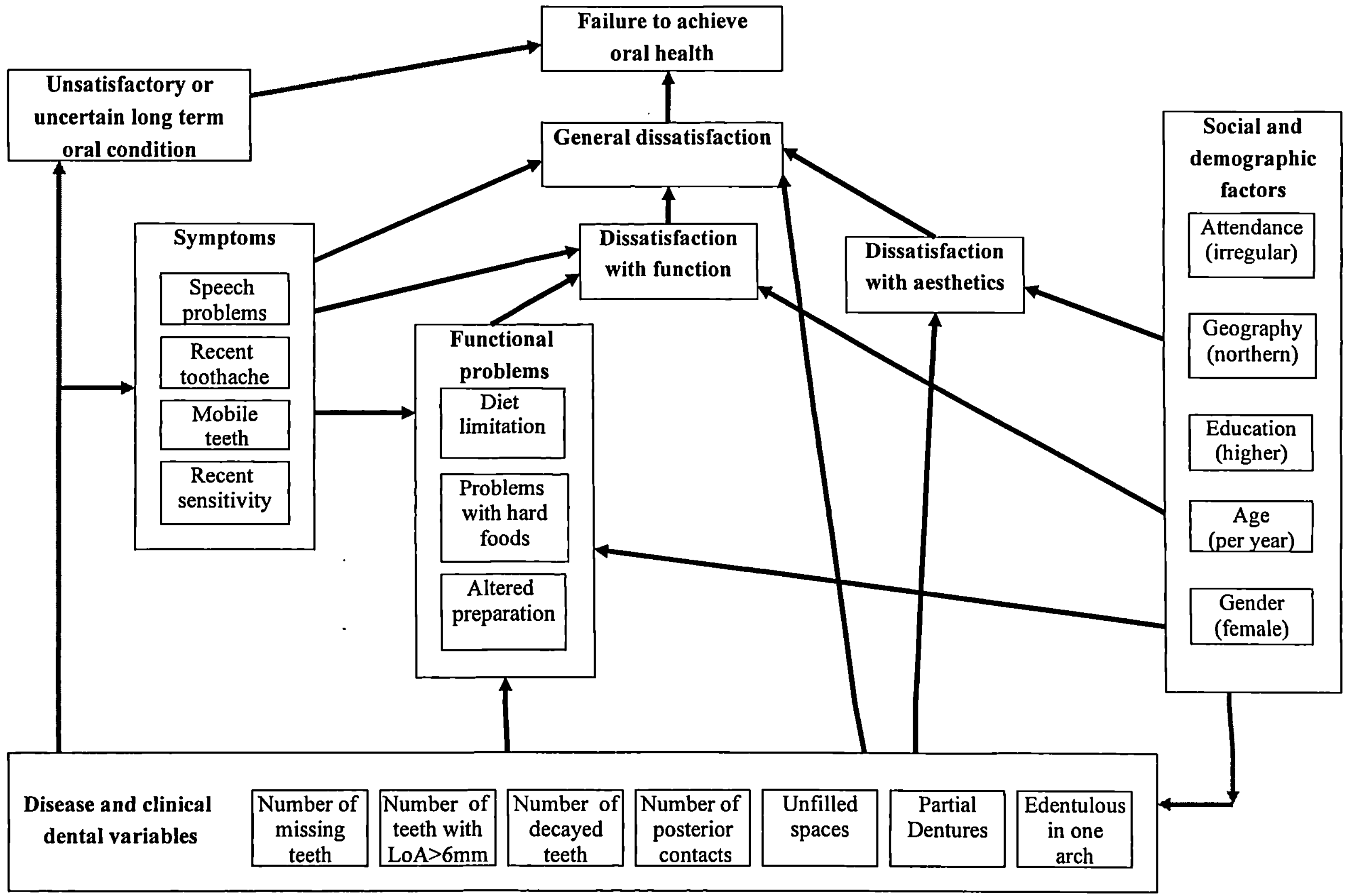


Figure 4.5.3. Final schematic model of the factors affecting oral health in the elderly



DISCUSSION

Section 5

DISCUSSION

The discussion comprises 5 sub-sections which follow the same structure as the 5 sub-sections in *Results* (section 4). These are the sample and methodological issues (5.1.), data from the clinical examination (5.2.), questionnaire data (5.3.), the partially dentate and the role of the number of teeth and partial dentures (5.4.) and the factors which influence oral health in the elderly.

5.1. THE SAMPLE AND METHODOLOGICAL ISSUES

5.1.1. Response rates

The acceptance rate for those contacted was fairly good for eight out of the nine area/age subgroups, but was poor for one. Given the nature of the study the 50% to 60% acceptance rate achieved for these eight groups would probably have been difficult to better, although small improvements could have been made by ensuring doctors letters for every subject (if this is possible) and perhaps by having the accompanying letter printed on Department of Health headed paper. The acceptance rate in Salisbury was generally a little lower than the two northern areas and this is probably a reflection of two things, firstly the large geographical distance involved, and secondly that there had been a recent, well publicised, spate of *bogus callers* in the Salisbury area. The one group where the response rate was poor was the Salisbury 75+. A number of factors conspired to keep the response rate for this group low. Due to early administrative and sampling problems there were no doctors letters available for a substantial proportion of these subjects. This, combined with the subject's age and perceived vulnerability and the factors noted above resulted in the response rate below 40%.

Comparison of the response rate between this and other large surveys is hampered by differences in sampling strategies and by an absence of other large studies specifically of the elderly. The response rates in this study were lowest in the oldest groups in all areas, but there is no indication from other large dental health surveys whether this trend is consistent. In the Finnish National Survey (Vehkalhati, M. et al., 1991), covering adults of all ages, 90.1% "participated", but there is no indication whether or not they all took a full part (i.e. had the examination and the full interview). In the Dutch national survey 68% were interviewed but only 53% of those contacted were actually examined, and all those taking part were given a small gift as an incentive to participate (Hof, M.A.van't. et al., 1991). In Ireland only 38% of the households sampled agreed to take part (O'Mullane, D. & Whelton, H., 1992). The United States National survey (NIH, 1987) only reported the number taking part, not the percentage of the total sample this represented. The 1988 UK National Survey (Todd, J.E. & Lader, D., 1991) obtained interviews from an estimated 84% of the adults in the sample (the figure could be no more than an estimate as it was households, not named adults which were sampled). In total around 68% both gave an interview and were examined. In the context of these surveys, the present study compares favourably, particularly with Ireland and the Netherlands. The luxury of a double visit (interview followed by examination at a second visit), a strategy employed by most of the other surveys, was one we could not afford, but this would probably have increased the number of interviews obtained, although it may not have affected the number of examinations.

In total 2280 subjects were examined, with a minimum of 715 in any of the three areas. This gave sufficient data to keep the margin of error within reasonable limits. The reweighted totals in each of the subgroups did not generally drop much below 100, even for the dentate sample, and this allowed comparisons between subgroups to be reasonably safe (95% confidence limits within 10 percentage points of the percentage given). Some of the minor subgroups (e.g. broken down by age **and** area **and** gender or social class or attendance) are much too small to draw firm conclusions, but to have ensured a sufficient number in each of these would have meant at least a four fold increase in the size of the total sample drawn.

In order to interpret the data to its maximum potential, reweighted 60+ totals (usually the column at the extreme right of the tables) were presented for comparing the effect of gender, social class and (where appropriate) attendance pattern, whilst the *all* totals for each age group (the bottom row of the table for each area) could be used to estimate the influence of age. The reweighted *all* figure given at the bottom right hand corner of most of the area tables allowed overall comparisons between areas to be made. In order to address some of the problems of inter-examiner variability which affected the clinical examination, data collected by the author alone were presented separately.

The method of sampling, utilising the FHSA lists, was unique for a dental survey, and reflected the difficulty in sampling any *age specific* adult group. Even with this methodology, there were some problems with follow-up of the selected subjects due to errors within the FHSA lists. It appeared to be the case that many of these errors had occurred during the initial setting-up of the lists rather than as a problem resulting from poor maintenance of the database, as many of the known errors related to individuals who had died or moved before the computer databases were established. Alternatives to this sampling frame are very limited due to the necessity of having some record of the age of the subjects. Post code address files and the electoral register, sampling frames which have been used in previous dental surveys were inappropriate because of the lack of any age information. The only realistic alternatives would have been to use the social security database, which would not have given the option of sending an accompanying doctor's letter, or the patient lists held in doctors' surgeries, which would have been much more cumbersome and less *random* than using the centralised FHSA database.

5.1.2. Sampling Bias

The gender ratio was roughly what would be expected for this age group. However there was under-sampling of women, particularly in the oldest age band in the two urban areas (see figure 4.1.1.). This probably reflects the personal vulnerability that these subjects perceive (for example to criminal offenses).

Only 9% - 20% of the samples were unskilled manual workers (social class IV/V), perhaps a little lower than may be predicted (although census data does not give a social class breakdown of retired adults). The reason for the apparent under-representation of these groups may be partly as a result of sampling bias (the proportion of non-attenders is generally highest in social class IV/V), but may also reflect the specific characteristics of the areas sampled.

The ascertainment of sampling bias using a postal questionnaire of the refusers in both of the older age groups in all areas proved a worthwhile exercise and gave an invaluable insight into the make-up of the final sample. Although only data on attendance and edentulousness were collected, this key information was obtained from 60-70% of the refusers, so that when the information from those visited and those refusers who responded to the questionnaire were combined, data were available for 80-90% of the total number of individuals originally contacted and asked to take part in the study.

The postal survey revealed that edentulous subjects and dentate non-attenders were relatively under-represented in the sample who participated in the study. In the case of the edentulous, one major reason for this was probably a perception by many that the dental survey team would not be interested in someone with no teeth. However, under-representation of edentulous subjects was relatively small. Under-representation of non-attenders was variable, from only 2-3% in Richmondshire up to nearly 13% in Darlington. As attendance pattern appears to be a major influence on dental health, the detection of this bias was an important finding. Fortunately the sample sizes were large enough to separate out the statistics for attenders and non-attenders.

The Salisbury sample was generally more educated and financially better off than those in Darlington, with Richmondshire lying somewhere in between, at least when simple measures such as the proportions who have had higher education and who have no private income were used. These data are presented to further define the socio-economic make-up of the three samples, rather than to look for direct correlations with dental health. The impact of these on dental health and attitudes could be considerable, but trying to untangle all of the social, economic and demographic influences on dental health is an extremely difficult task.

The data on general health and mobility serve to illustrate two major points. First, that pathology, illness or disability of some sort is very common in older populations and may have a bearing on dental treatment. Second, that despite the abundance of illness and disability, the great majority of the elderly are ambulant, active, and largely self sufficient to a very advanced age. Many of the potentially debilitating conditions (e.g. heart problems, arthritis) from which they suffer are sufficiently well controlled to allow reasonable levels of activity. Looking to the future, there will be an increase in the potential medical complications of dental treatment as the need for more complex dental treatment itself increases, and a higher proportion of those in institutions will require maintenance of natural teeth. On the other hand most of the treatment need and demand will come from the ambulant and generally healthy elderly.

The finding that general health was poorer in Darlington than elsewhere was consistent for just about every measure used (mobility, frequency of disabling long term disease, medication usage etc.) and is unlikely to be a statistical artefact. It may be a reflection of the different socio-economic composition of the population, geographic inequalities in health or the relatively high number of institutionalised or dependent elderly in the town.

5.1.3. Examiner bias

Examiner variability is a complicating factor which can never be eliminated in any study of this sort, but it is possible to over-estimate its importance. In this survey it is a relevant factor in two situations:

1. When comparisons are being made between areas (as the second examiner was different in each area).
2. When considering the *accuracy* of individual statistics.

All examiners took part in a four day intensive training programme at the beginning of the survey to try to standardise scoring. As a part of this programme the examiners all examined the same patients and areas of disagreement were targeted and re-examined. The inter-examiner variability in the survey, as measured by both revisit data and by survey data calculated for separate examiners, was small for the condition of the crowns of the teeth, was moderate for root caries and wear and was rather high for periodontal disease. It is possible that if the training had been extended, levels of agreement would have improved, however it is doubtful whether this would have been maintained for the duration of the survey. In addition there would have been very serious logistic problems in increasing the training period and in finding willing and suitable training subjects. Problems of calibration, particularly of periodontal data, are well documented. The 1988

UK Adult Dental Health Survey did not produce periodontal data broken down by area because of the scale of inter-examiner variation. Examination of the periodontal data on the WHO global data bank (Miyazaki, H. et al., 1991; Pilot, T. & Miyazaki, H., 1991; Pilot, T. et al., 1992) demonstrates such variations in the prevalence of various conditions, between apparently similar populations, that inter-examiner variation must be an important factor. To complicate the issue further, some periodontal conditions are capable of rapidly changing between one examination and the next, for example improved hygiene in one area of the mouth could rapidly eliminate several bleeding sites and result in apparent disagreement between examiners.

Inter-examiner variability will have affected all areas of the clinical examination to a greater or lesser degree. Kappa scores are presented in table 4.1.11., however, kappa statistics do not tell the whole story. A high kappa means good agreement and there is no need for further discussion. A low kappa may reflect either of two situations, depending on the direction of the disagreement. If two examiners disagree, but the overall frequency of the variables recorded is much the same, then in a study of this sort it will make little difference to the overall statistics produced. If, however, one examiner is more sensitive and records, for example, more decay than the other then this will start to affect the final statistic substantially. For example two dentists may totally disagree about which roots are carious in nearly every subject examined, but if they both record 1.6 carious roots on average, the effect of their disagreements on the final statistics will be minimal, despite a very low kappa score. However, even if the two examiners agree frequently, but one records 1.6 carious roots and the other one records 3.0 on average, this can radically alter the final result. When looking for differences between areas even a difference in sensitivity between two examiners in one area may make little difference, it is only if the **combination** of examiners in one area is more sensitive than the **combination** of examiners in another that the difference between areas becomes difficult to interpret. In this study care was taken to ensure that the distribution of subjects to each examiner was as random as possible so that, if differences were apparent between the examiners, data for the one standard examiner (JGS) who covered half the subjects in each area could be used alone to compare between areas. As examination days in different areas were mixed together over the same time period there is no reason why the author should have been any more sensitive in one area than another.

Table 3.1.7. separates some of the key data by examiners, and shows that there were apparent differences in sensitivity between the *second* examiners in different areas. For example, when decayed or unsound roots were considered, the second examiner in Darlington recorded 50% more decayed or unsound roots in her sample than the standard (JGS), whilst in Richmondshire the second examiner recorded about 50% less. The pattern between examiners varied between the variables being recorded. Such variation will not affect the trends between social groups, genders and attenders/non-attenders within an area, these should be virtually unaffected, but they do make comparisons **between areas** more difficult. Table 3.1.7. presents the data for JGS alone. These data are consistent between areas, and the 95% confidence limits for the reweighted data are about 6-8% at most. It is recommended that for checks of differences between areas regarding root caries, wear and periodontal disease, that these data are used.

Intra-examiner variability was not measured in this study. The logistics of checking inter-examiner variability were difficult and it was felt that intra-examiner variation was a lower priority. Samples examined by all examiners were essentially the same throughout the period. Subject's names were drawn off the random list in unsorted batches, so those visited towards the end of the survey should have been no different, in terms of area of residence, gender, or social class than those visited at the beginning. Batches from the three age groups were drawn simultaneously.

Finally, consistency of questionnaire data, and some of the clinical data (where kappa scores were good or major errors were impossible) was not a problem. The questions in the questionnaire were identical for everybody and every effort was made to ensure a standard technique was used. The interviewers' techniques were kept under intermittent supervision by the author throughout the survey to ensure that standards of interviewing were maintained.

5.2. DATA FROM THE CLINICAL EXAMINATION

5.2.1. Edentulousness

Overall 33% of those examined in Salisbury and 57% of those examined in Darlington were edentulous. There is the suggestion of a ten year difference between the two areas: the Darlington 65-74 year olds have a similar level of edentulousness to the Salisbury 75+ group. This relationship holds true after taking into account the data obtained from the postal questionnaire from the refusers. Rural Richmondshire was broadly similar to nearby Darlington for the proportion edentulous, the small difference between the two could be explained by differences in the social class structure. This similarity probably reflects its position in the North of England, rather than the fact that it is rural.

Females were much more likely to be edentulous than males in all age groups, although in Salisbury the difference appeared to be smaller, even when the refusers were taken into account. This may reflect cultural attitudes to edentulousness. It is also interesting that more women than men were edentulous only in one arch in Salisbury, in contrast to the picture in the two northern areas where the situation was reversed. It may be that women in the South of England are more likely to hang on to their teeth come what may, whilst in the north the decision to have the remaining teeth extracted tends to come a little more easily.

The figures for edentulousness are substantially lower than the regional averages for the areas concerned which were published in the 1988 Adult Dental Health Survey (57% in the south of England and 68% in the North of England for the equivalent cohort). This is the case even taking into account the postal questionnaire although the discrepancy is reduced (Todd, J.E. & Lader, D., 1991). This difference probably reflects a number of factors. Firstly this data was recorded four years later, so cohorts of progressively more dentate individuals will have entered the over 60 population in this period. Secondly, the areas were chosen to be representative of their types, rather than as a microcosm of the North or South of England, so differences between the sample and the population of a region will occur. For example there were no sites of inner city deprivation in any of the three areas used. If it is the case that these areas are not the perfect representatives of their region, this does not necessarily present a problem as, with changing attitudes and a progressively more dentate population, the areas chosen are more likely to give a window into the future than would more *representative* but less dentate samples.

Only 15.2% of the Salisbury 60 - 64 year olds were edentulous, compared with 83% in 1962 (Bulman et al 1968). This is actually less than the same age group in the USA in 1985 (16.1%) and similar to the figures of 16% for the 55-64 year-olds in the South of England in the 1988 Adult Dental Health study in the UK. The figure for Salisbury in this study may be a little low due to sampling bias. However the scale of the reduction in edentulousness over the last 30 years has been enormous. The North of England has seen a smaller change. Edentulousness in the 60-64 year olds in Darlington was reduced from 75% in 1962 to 39% in this study, but even here the scale of the reduction has been considerable. In 1982 the FDI and the WHO called for a 25% reduction in the levels of edentulousness at age 65 by the year 2000 (FDI, 1982; WHO, 1986). The difference between the three age bands in this study suggest that the 25% reduction demanded will be, indeed probably already has been, comfortably achieved.

An additional 10% or so of the sample were edentulous in one arch and the figure was similar for all areas. Gender and social class differences follow no consistent pattern from one area to the next. In the north it is men who are more likely to be edentulous in one arch while in Salisbury it is women. In Salisbury and Richmondshire people from unskilled manual backgrounds have a far higher proportion edentulous in one arch (in Salisbury it is 18%), but in Darlington it is non-manual workers who have the highest proportion. In some of the sub-groups, particularly unskilled manual workers, the proportion with teeth in only one arch constitutes up to, and in one case exceeds, 50% of all **dentate** individuals.

The sum of the percentage edentulous and the percentage edentulous in one arch gives an indication of the proportion of the population who wear a full denture and hence have a need for maintenance of their complete prostheses. This could be an important measure of adult dental health in the future. At present 25% of the potential complete denture need in Salisbury would be ignored if those who are edentulous in only one arch were not considered.

A small but significant proportion of the edentulous sample were unable to wear their complete dentures either at all or for anything except appearance (up to 4% in the case of lower dentures). Those who did not wear the dentures provided were much more likely not to be able to wear the lower rather than the upper.

Data on denture faults has been kept to a minimum. The most important findings with respect to complete dentures were that fault free dentures (as assessed by a dentist) were a rarity, and the mean number of faults was around 3. Whilst some faults were apparently more common than others, the relative abundance of these will only be of significance if their impact on comfort, function and satisfaction are known. Many studies of the elderly report a high prosthetic treatment need (Floystrand, F. et al., 1982; MacEntee, M.I. & Scully, C., 1988; Merelie, D.L. & Heyman, B., 1992; Smith, J.M. & Sheiham, A., 1980a; Srisilapan, P. et al., 1985) but this need is invariably determined by the dentist, not by the patient. The relationship between professionally assessed need and satisfaction is covered in more detail in section 5.3.1..

5.2.2. Dentate subjects: The number of teeth and tooth replacement

In total 1211 dentate adults over the age of 60 were examined, with 300 to 500 in each area. This gave a sufficiently large sample size in all of the reweighted sub-groups and in each of the age groups to ensure statistics which are accurate and allow comparison. The rest of this section will discuss the percentage of the sample with 21 or more standing teeth, the mean number of teeth and partial denture data.

The proportion of the dentate population with 21 or more standing teeth was similar for the three areas (between 35% in Darlington and 42% in Salisbury), figures that are close to the statistics for the 55+ age group in the 1988 Adult Dental Health Survey (30% in the North and 40% in the South of England)(Todd, J.E. & Lader, D., 1991). This is a little lower than the figure for the US in 1985/6 (46%)(NIH, 1987). Attendance pattern was the most important correlate of whether or not someone has 21 or more standing teeth. Overall, two to three times as many attenders as non-attenders had 21 or more standing teeth (reweighted totals, all ages). Age and social class are also very important correlates with the proportion with 21 or more standing teeth. In two of the areas (Salisbury and Richmondshire) more than half of the youngest groups were at or above the 21 tooth threshold, whilst Darlington, which has only 14% of its oldest group in this category, shows signs of improvement in the youngest group. These statistics can be misleading as they refer only to the dentate part of the sample. Only 20.7% of the total sample, dentate and edentulous, had a natural dentition of 21 or more standing teeth. The mean number of teeth ranged between about 19 in all of the 60 - 64 year old groups, down to 12-15 in those aged 75 or older. The number of teeth and socio-demographic trends reflect those reported for *21 or more teeth.*

Around 40% of all of the dentate sample wore partial dentures. In the population this will account for several million individuals and dentures. This is consistent with the findings from the 1988 UK Adult Dental Health Survey which found 41% of over 55 year olds with partial dentures. In the North of England samples, far more women than men wore partial dentures, but in Salisbury the position was reversed. This difference between the north and the south in terms of gender variation was unexpected and quite marked. It may well illustrate an important difference in attitude to dental health between northern and southern men (or women), and it reflects the findings for edentulousness, coronal restorations and crowned teeth, where the gender difference was pronounced in the north and minimal (or even reversed) in the south. There is an age related increase in partial denture wearing and this may be related to number of teeth and it could also account for the unexpectedly high prevalence of partial dentures found among non-attenders compared to attenders. There appears to be a preponderance of upper dentures. This is probably mostly a reflection of aesthetic concerns, and possibly the difficulty of wearing lower partial dentures.

The quality of design of partial dentures was poor by the standards taught in British dental schools. Nevertheless, the subjects were able to wear their dentures. Although the 1988 Adult Dental Health Survey provides data on the material and design of partial dentures, this is a little difficult to interpret as partial dentures and complete dentures for dentate adults are lumped together (Todd, J.E. & Lader, D., 1991). Nevertheless the data shows a similarly small proportion of cases where dentures are tooth supported and made of anything other than acrylic. Further data on partial dentures and the factors which influence their provision and acceptance, their influence on comfort and satisfaction and the relationship between wearing partial dentures and current dental disease are discussed in section 5.4..

5.2.3. Dentate subjects: Data on the condition of the crowns of the teeth

The number of teeth decreases with age and various social and socio-dental factors. The fact that there is an age related decrease is no surprise, but in interpreting the rest of the mean figures it is important to take this into account. If there are fewer decayed teeth in any particular group it does not necessarily mean that that group is less prone to decay, it may just be that there are fewer teeth to get decayed. In order to interpret the data properly the CCI and CCI(d) are given, these should give some idea of the rate of attack and the risk of treatment need in different groups (see section 3.11.5. for details on the calculation of these indices). The CCI is an index of the percentage of all teeth which are decayed or filled. For the reweighted data the CCI is just under 50% for all areas, and shows a slight tendency to reduce with age. The percentage which are decayed or have unsound fillings is generally around 5% for the group as a whole, but is doubled in the case of the non-attenders.

Of all of the factors presented in the tables, attendance pattern is the single most important correlate with the condition of the crowns of the teeth. Attenders and non-attenders have similar numbers of sound teeth, but non-attenders have far fewer filled teeth and more decayed ones. As a general rule the number of teeth present in the non-attenders is 4-7 fewer than those in attenders. However the attenders have about 4-7 more filled teeth. The suggestion from these data is that the rate of decay may not be very different, but the attenders retain their teeth by having them filled, whilst the non-attenders have them removed. Attendance pattern appears to be a very important factor in terms of current, and probably also future, normative treatment need as well as demand. Much of the variation according to age and social class may be associated with attendance patterns, but this will require further analysis to clarify. Gender differences were evident in the north with women having a higher proportion of restored teeth and a lower proportion of decayed ones. This trend was not evident in Salisbury.

If the decayed component is used as an indication of treatment need, a relatively small proportion of the treatment need of the crowns of the teeth is as a result of new decay, whilst around half (42-56%) is concerned with the failure of existing restorations. Furthermore, a consistent 21% of the decay in the reweighted 60+ samples is accounted for by gross caries with obvious pulp involvement or little chance of successful restoration. The relative size of this category shows a steep rise with age in both of the urban areas. This may reflect an increasing tendency to self-neglect with age, in which case the need for extractions in the very old is liable to increase markedly as more of them retain some teeth. Alternatively, it could be a *cohort effect*, and successive cohorts who are more dentally aware and demanding may have fewer such teeth. At this stage it is impossible to establish which is the case but it is clearly a statistic to keep under observation. These findings reflect those of the 1988 Adult Dental Health Survey (Todd, J.E. & Lader, D., 1991), which reported on the percentage of subjects with various types of decay. In the over 65 year olds, 15% of their sample had grossly decayed teeth: this was considerably more than was the case for younger subjects.

Approximately one third of the dentate sample had one or more crowned teeth, with greater proportions in females and attenders. The gender difference was much more pronounced in the northern areas than in Salisbury as the difference between the reweighted totals for females and males in Darlington was 19 percentage points, compared to 3 percentage points in Salisbury. This is evidence once again (see also data above on filled/decayed teeth and edentulousness) of a polarisation of attitude according to gender in the northern areas, with women being much more likely to have crowns than men. Todd and Lader (Todd, J.E. & Lader, D., 1991) also found a considerable gender difference (6%), but the data was broken down by area **or** gender, not by both simultaneously. Those who had crowns tend to have more than one, the mean being between 2 and 3 for the reweighted totals. An exception to the general trend for dental decay and restoration was that far more manual workers, and fewer non-manual workers in Darlington had crowns than in the other areas. This may reflect differences in treatment patterns, which may in turn be influenced by the social make up of the samples, the ability to pay and the availability of treatment free of charge to some patients (for example those on very low income) on the National Health Service. The incoming dentate generation (represented by the 60-64 year olds) are much more likely to have crowns than their dentate predecessors, this is particularly evident in the north of England and among manual workers. The Salisbury elderly appear to have a longer history of advanced restorative work with a significant proportion of multiple crowns and bridges at all ages. The wave of advanced restorations presently found in the 60-64 year olds has considerable treatment implications. There are about a third more people with crowns in this generation than there are in the cohort just ahead of them. Around 9-15% of the crowns examined in this survey were deemed to be unsound.

Fixed bridges are relatively uncommon, being worn by 3-6% of all subjects (reweighted totals), with most in Salisbury, 30% of the 50 or so bridge wearers seen in the survey were in Salisbury.

5.2.4. Dentate subjects: Data on decay and fillings of the roots

Between 28% and 36% of the reweighted sample showed no history of root surface decay and only a minority of the sample had any active treatment need for their exposed root surfaces. However, even including those who had no history of root surface caries, between 20% and 24% of all vulnerable teeth had been affected, whilst 7-9% of vulnerable teeth actually had a current treatment need (decay or an unsound restoration), and about 65% of teeth were vulnerable. The treatment need increased markedly with age.

The pattern of disease according to demographic factors was similar to that for coronal decay and restoration, with men and non-attenders having more decayed roots and generally higher RCI and RCI(d). Unlike coronal disease however, women generally had no more fillings than men, and they tended to have a similar or smaller number of *at risk* teeth. The differences between areas appear to be substantial, however, when data from JGS is considered alone these disappear, suggesting that much of the observed geographical difference was due to inter-examiner variability.

The RCI(d) for non-attenders was nearly double the score for attenders, however the RCI was substantially higher in the attenders. There are a number of possibilities why this should be so. The attenders may have had restorations placed in their root surfaces which are not strictly necessary, as root caries lesions can remineralise if the conditions are correct. Non-attenders may have had affected teeth extracted, which would increase the proportion of healthy teeth in their mouths. Alternatively some of the attenders may have had some restorations placed for reasons other than root surface caries, typically for cervical wear. This last explanation probably accounts for a proportion of the discrepancy, but its relative importance is unknown.

The RCI and pattern of root caries found in this survey are rather similar to that reported elsewhere. The mean number of decayed and filled teeth is generally a little higher than was reported in the 1988 Adult Dental Health Survey (Todd, J.E. & Lader, D., 1991). The RCI in the present study is also similar to, or a fraction higher than, that which can be calculated for data from the 1988 UK national survey, although RCI as such was not presented in the survey report. The prevalence, RCI and mean number of teeth affected in the present study are very similar to samples of older Canadians (Locker, D. et al., 1989) and a sample of older adults in Sweden (Fure, S. & Zickert, I., 1990)

A number of the factors reported here are significant when the prospects for root surface decay in the future are considered. Both the actual number of decayed teeth and the proportion of vulnerable teeth which are decayed or have an unsound filling increase markedly with age and in the case of the latter the proportion nearly doubles in all areas between the youngest and the oldest group. In other words, even when the number of vulnerable teeth is controlled for, the risk of having decayed roots is an age related phenomenon, as is the treatment need itself. At present, the number of teeth in the over 75 year old population is relatively small: a high proportion are edentulous whilst the dentate have relatively few teeth. The proportion of this population with teeth will rise sharply in the next few years, and the number of teeth per person may also rise. In terms of gross treatment need there could be a several fold rise in the treatment need for root surfaces. There is the possibility of limiting the increase if the disease is amenable to prevention.

Decayed roots, or roots with an unsound filling, were about as common as teeth with decayed or unsound crowns in the sample studied. However the constitution of the decayed component was substantially different in the case of root surfaces, 76-80% of all decayed roots were accounted for by new decay. This difference in the relative proportions of different categories of decay between crown and root is important as it highlights root decay as a disease process of specific relevance to the elderly. Furthermore, new decay should be easier to prevent than the failure of an existing restoration as, in the case of the latter, the quality of the restoration is a complicating factor. Root caries may be more amenable than coronal caries (most of which occurs around existing restorations) to prevention in the elderly population.

A further factor which may have implications for the control of this disease in the future is its distribution in the population. Figures 4.2.3 and 4.2.4. illustrate the concentration of most of the teeth with lesions needing treatment (those scored as active caries or restorations in need of replacement) and most of the teeth with lesions and sound fillings in a minority of the population. This concentration of the disease, such that the most severely affected 20% of the sample accounted for well over 70% of all treatment need suggests that any preventive programme would be best targeted at these individuals, if they could be identified.

In summary, root surface caries will increase sharply as a specific problem of the elderly. Furthermore, most root surface decay is new decay, rather than unsound existing restorations, and most of the decayed lesions are concentrated in a minority of the population. If that minority can be targeted for preventive action the impact and cost of the disease could be reduced.

5.2.5. Dentate subjects: Periodontal disease

Periodontal data, particularly that on pocket depth was prone to inter-examiner variability. For inter-area differences the reader is referred to the data for JGS alone.

Around 10% of the reweighted samples suffered from periodontal disease which had resulted in advanced attachment loss (6mm or greater) in three or more teeth, **and** mobility of at least one tooth (two or more on average). This probably represents the most severely affected 10% of the population. A further 10% had signs of widespread disease (3 or more teeth affected by attachment loss of 6mm or greater), whilst another 10% had at least one mobile tooth. These two groups represent those with some signs of threatening disease. In total nearly half of the subjects examined had some loss of attachment, but in around half of them it only affected one or two teeth. So moderate or severe periodontal destruction (or strictly speaking, evidence of past periodontal destruction) was really rather common, whilst severe and/or widespread disease affected up to 30% of the sample. The US national survey is the only one to report loss of attachment data on a large sample of elderly people, and the statistics found in the present study seem to indicate rather more severe disease than was reported in a similar age group in the US. 34% of older Americans had some loss of attachment of 6mm or greater, compared to around 40-50% in this study (NIH, 1987).

The distribution of loss of attachment according to socio-demographic variables reflects the findings for coronal and root caries. Males, manual workers and non-attenders tend to be more severely affected by loss of attachment. The proportion with deep pocketing reduces with age, whilst the proportion with advanced attachment loss, if anything, tends to increase. This may be a reflection of recession catching up with pocketing in the oldest age group, altered treatment patterns in old age or a genuine reduction of risk.

Involvement of molar furcations can seriously complicate periodontal treatment. In this study it was found that a majority of those with molars and, in some areas, nearly a third of all molar teeth, had furcations involved by loss of periodontal attachment, albeit not severely in most cases.

The temptation, when examining this data, is to identify a huge unmet treatment need, millions of people with moderate or advanced attachment loss and up to a third of all remaining molars with some furcation involvement. However these findings must be placed in the context of the age of the subjects, their expectations of their teeth, and the likely impact of any treatment on the longevity of the dentition and the quality of life of the individual. In order to translate data of this sort into a real assessment of treatment need, much more needs to be understood about the factors which govern risk of disease progression (for example age, tooth and site, see Grbic, J.T., et al 1991), the natural history of the disease in the elderly, and the impact of periodontal disease and tooth loss on oral comfort and the quality of life. As more British adults retain natural teeth into old age these issues will become increasingly important.

Indices of clinical disease - CPITN

The best index for the measurement of periodontal disease is a vexed question. The Community Periodontal Index of Treatment Need (CPITN) is probably the most widely used, but its validity has been questioned (Baelum, V. et al., 1993b) and it may be particularly inappropriate for use in an elderly population for several reasons. These include:

1. It has no component of loss of attachment measurement. In any group, but in particular in the elderly, a tooth can have extensive loss of attachment which threatens its integrity and longevity without necessarily having a deep pocket (the worst level of disease recorded by CPITN). In other words the index may not actually detect the most advanced disease.
2. CPITN relies on a sextant scoring method. As sextants are rendered toothless the count of the number of sextants affected by disease (one of the standard WHO analyses) becomes increasingly difficult to interpret and compare, as the number of affected sextants will be limited by the number of dentate sextants left.
3. Components of the CPITN are subject to severe problems of inter-examiner variability. This has already been discussed elsewhere (see section 4.1.3.).
4. The priorities and needs of the elderly are likely to be different from those of younger generations. The maintenance of a full arch of perfect teeth may well cease to become a realistic goal, the maintenance of a functional comfortable dentition, even if there are a couple of deep pockets, may be a sufficient goal in itself for some. Against this background, the treatment need (TN) component of CPITN may well be irrelevant, and may not reflect the true concerns of an individual, their satisfaction and ability to function

When CPITN was applied to the data from this sample, the worst score (pockets of 6mm or greater) failed to detect a disturbingly large number of people who undoubtedly had severe periodontal disease, or who had at least had experienced substantial periodontal damage, when other straightforward measures were used. The sites used in this study were a mid-buccal/lingual and an interproximal site. This may have favoured the detection of loss of attachment over pocketing (there is often extensive buccal recession in the absence of a pocket). Nevertheless, the failure to detect affected subjects was large and consistent for several different measures. When the position was reversed, and those with 6mm loss of attachments were cross-tabulated against those with pockets and those with mobile teeth, a much smaller proportion of those with the second measure (i.e. deep pockets or mobile teeth) were missed. Part of the discrepancy in these cases will have arisen from unscorable codes being recorded for teeth where the amelocemental junction was not present or not detectable (e.g., deep fillings, crowns and gross calculus), and most of the rest will have been cases where the gingival margin lay above the amelocemental junction. The former could be addressed in the design of diagnostic criteria as it should not be necessary to record as *unscorable* all sites where there are crowns or gross calculus.

The detection rates of severe disease which are reported here are based around individual subjects, not sites. In other words they are reporting differences in the prevalence, not the extent, of periodontal disease using alternative measures. However, in terms of studies of the population the first priority must be to identify the subjects who have some severe disease. In this respect CPITN fails.

5.2.6. Dentate subjects: Tooth Wear

Cervical wear

The threshold used for describing the pattern of cervical wear was a score of three which represents a cervical defect 1-2mm in depth and is consistent with the possibility of early treatment need. However the treatment implications for cervical wear are not major. If these lesions are deemed to need operative treatment at all, the treatment required is quick and inexpensive (usually placement of a glass ionomer cement filling). In many cases, even with quite deep lesions, treatment may not be necessary. Cervical wear was one of the areas with a significant inter-examiner variability problem, but using data for the author alone there appears to be no difference between areas; 42-46% of the population were affected. Cervical wear is therefore rather widespread. Not surprisingly, in cases where wear was present, a number of teeth were affected, with the mean number affected lying between 2.3 and 2.7. Filled cervical root surfaces were coded as unscorable so there is no wear data from these, in some cases the fillings may have been placed because of wear. Consequently, the prevalence of cervical wear is almost certainly underestimated.

Coronal Wear

Grade 3 (or worse) was also the threshold used to analyse coronal wear data. This represents considerable exposure of dentine (or worse) but unlike cervical wear there is no direct relationship between the wear score for an individual tooth and its treatment need. Wear of grade 3 or worse occurred in a substantial minority (around 40%) of mouths (see data for JGS alone in table 4.1.10.), but where wear was found an average of over three teeth were affected. The finding that men are more likely to have wear, and have more worn teeth when wear is present, is consistent with previously published research in this area (Robb, N.D., 1992). That wear is slightly more common in non-attenders and manual workers may be related to a smaller number of teeth in these individuals and consequently a reduced occlusal support. Such a relationship between number of teeth and occlusal wear has been reported by some authors and refuted by others (Robb, N.D. & Smith, B.G.N., 1992). There was a clear age related increase in prevalence of wear. As wear of the teeth is an irreversible process this is only to be expected, however tooth number could also be a factor in these cases.

Wear of the crowns of the teeth is frequently quoted as a particular problem of the elderly, but the scale of the problem will depend on a number of factors. Unless the rate of wear has shown signs of a rapid increase, coronal wear will only be of concern in the elderly if:

1. It threatens the long term integrity of the dentition
2. It causes aesthetic or functional problems which are of concern to the patient.

Analysis of data from this study, using a simple chi-squared test of the presence of wear against the presence of dissatisfaction, showed that the presence of grade three wear was not correlated with any aspects of dissatisfaction or functional impairment. Grade 4 wear (only 13% of the sample had any grade 4 teeth) is only correlated to general dissatisfaction and dissatisfaction with chewing, and even here the association was only marginally significant and a reflection of the large sample size. Over 90% of those with grade four wear were still satisfied. There is no evidence, even from this rather simplistic statistical analysis, that tooth wear, even severe wear, causes a particular problem to the elderly at the population level at the moment.

5.2.7. All subjects: Other oral disorders.

The prevalence of uncommon oral mucosal lesions is not a statistic which is readily estimated in a study of this sort, a much larger sample and a completely different survey design would be required. Although pathology was recorded where it was found, the reporting in this survey is confined to dry mouth, denture related pathology and temporo-mandibular symptoms, all of which are reasonably common and were familiar to all of the examiners.

Dry mouth was reported commonly, but the relationship between reported dry mouth and the rate of salivary flow is not perfect and neither is the relationship between the rate of flow and the condition of the gland. Reported dry mouth is as valid as any of the other measurements of dry mouth - indeed it may be more relevant as it is directly tied to the subjects perception of the problem. The prevalence of reported dry mouth, at around a fifth of the sample, was in line with the findings of Österberg (Österberg, T. et al., 1984) in a study of older adults in Sweden. The Swedish study also reported a correlation between dental status, as recorded by the Eichner index, and reported dry mouth, a finding which is interesting in the context of the higher prevalence of reported dry mouth which was found in the edentulous in this study. There was an age related increase in the prevalence of reported dry mouth, but the relationship between edentulousness and dry mouth appeared to be maintained, even within individual age bands, and in the Swedish study all of the patients were the same age. It may be that the presence of dentures alters the oral environment sufficiently to increase the awareness of dryness, or that dentures actually reduce salivary flow, or that other denture related problems, such as candidal infections, manifest as a feeling of oral dryness.

The causes of the reported dry mouth are not clear cut. Around a quarter of the subjects who reported dry mouth also reported dry eyes, a combination suggesting (although obviously not always confirming) Sjögren's syndrome. Between 18% and 30% of those with dry mouth were on a medication strongly implicated in causing dry mouth whilst nearly half (47%) of individuals who took such a medication reported a dry mouth. These figures are similar to those reported recently for older Floridans (Gilbert, G.H. et al., 1993). The sum of subjects with suspected Sjögrens syndrome or known potent xerostomic drugs can only account for, at most, about a half of all cases of reported dry mouth. Over 80% of all dry mouth sufferers took **some form** of medication. Many of the cases of reported dry mouth where there was no obvious cause (e.g. a drug known to cause xerostomia or a history suggesting Sjögrens syndrome) may be accounted for by drugs which are less potent xerostomic agents but may nevertheless be capable of causing a problem where the functional capacity of the gland may be reduced already, or where the interaction with another medication potentiates the effect of a drug which normally only causes a minor reduction in salivary flow.

Denture related lesions were fairly common, affecting 16-20% of all denture wearers. However the denture related pathology which was found was generally minor and of little significance. The majority was accounted for by cases of denture stomatitis.

Pathological lesions unrelated to the presence of dentures were also quite common, occurring in between 10% and 15% of subjects, but were thought to be benign in all cases and were rarely a source of any discomfort. The sorts of lesions encountered most frequently included small epulides and papillomatous lesions, geographic tongue, black hairy tongue and lichen planus/lichenoid reactions. No cases of suspected malignancy were found and, bearing in mind the incidence of oral carcinoma in this age group (around 1 per 10,000 per year in over 60 year olds), in a sample of this size this is not surprising.

Signs of TMJ dysfunction (clicks and crepitus) were relatively common, but tenderness and pain were rather rare, occurring in less than 5% of the population. TMJ problems appear not to be a severe problem at a population level in the elderly.

5.3. QUESTIONNAIRE DATA

5.3.1. Edentulous subjects

Only a tiny minority of the edentulous sample attend regularly (or even occasionally) for check-ups. The mean age of dentures for any given area/age group combination was between 9 and 18 years, and for the over 75 year olds it was 16-18 years, as there was a general increase in the age of the dentures according to the age of the individual. It is fair to assume that a large proportion of these edentulous older adults have not visited a dentist since they had their dentures made, and although the **mean** age of the dentures varied between 9 and 18 years (depending on the area and age group), in some individuals the dentures were over fifty years old. The high prevalence of soft tissue disorders, particularly denture stomatitis, may be related to this, but it should be noted that, in spite of the age of the dentures and the lack of regular dental care, levels of subjective satisfaction were high.

Many of the current generation of elderly people were rendered edentulous at a young age (40 or less). Up to 40% of the Darlington 75+ group fell into this category, although Salisbury stood out as having fewer (14% in the over 75 year olds). The statistics clearly show a changing pattern, a much smaller proportion of the younger groups in all areas were rendered edentulous at a young age, but Salisbury still stands out from the northern areas in having fewer who were rendered edentulous under the age of 40.

The vast majority of the dentures worn by the edentulous were manufactured under the National Health Service, a maximum of 14% (reweighted totals) were private, and in Darlington the figure was only 4%. Although only a minority said they found dentistry expensive, the infrequent exposure to dental services of most of these individuals must limit the significance of this finding. Younger edentulous subjects were more likely to find dentistry expensive than older subjects. This is mirrored by the findings for the dentate and may be a result of more widespread recent contact with the dentist among the younger group.

A fairly low percentage of the edentulous sample said they were dissatisfied with their overall oral condition. Inadequate function was a more important source of dissatisfaction than aesthetic concerns. The edentulous in Salisbury were more dissatisfied (with all aspects of their oral health) than those in Darlington and Richmondshire. In Richmondshire, the proportion who were dissatisfied with function was half that in Salisbury. The reasons for this regional difference are no doubt complex, but it may be that there are higher expectations in Salisbury, or that they have been edentulous for less time, or that they are dissatisfied with being edentulous in the first place. However it is important to keep this in perspective, as only 8-16% of the edentulous reported being dissatisfied with function and 10-12% overall.

Restriction of diet (when there are some things which people would like to eat but cannot due to problems biting or chewing) was reported by between 22% and 37% of the reweighted sample. Ulceration and discomfort from dentures during eating were reported with similar, or greater, frequency. This is considerably more than the percentage who reported being dissatisfied with any aspect of their dentures. This may be a reflection of lowered expectations among many of the denture wearers; discomfort and eating difficulties appear not necessarily to result in dissatisfaction in many cases, and may be regarded as inevitable hazards by many. Restriction of diet due to dental problems in the elderly has been reported before and the findings of previous work are described in detail in section 2.3.. This suggests that there is no evidence that dietary restriction leads to any significant nutritional impairment.

Although there are many possible reasons for dissatisfaction among the edentulous, there is only really one which can easily be treated by the dental profession - poor quality dentures and problems related to these. The analysis of dissatisfaction according to the number of denture faults was intended to try to identify the relative impact of these factors on dissatisfaction. The percentage dissatisfied increased with the number of denture faults. There was greater dissatisfaction where there were more faults. However only 10% more of those with the worst dentures were dissatisfied compared with those with the best. Even where no faults could be found with the dentures 13% of their wearers were dissatisfied with some aspect of oral function. Various specific faults were cross-tabulated with satisfaction/dissatisfaction and tested using a simple chi-squared test. Although a number of significant relationships were found, the relationships were generally weak and the fact that they were significant was probably related to the large sample size being used. The implications of this are that much patient dissatisfaction appears to be connected with factors over which the dentist has little control (for example age, length of time edentulous, expectations), at least once the patient has been rendered edentulous. Considerable further analysis would be necessary to quantify the relative importance of these factors. It should also be noted that even the wearers of what were judged to be poor dentures were satisfied with what they were wearing in a majority of cases.

4.3.2. Dentate subjects: Demands

Overall, 54-62% of the reweighted sample felt that they needed no dental treatment. Those who had decay or unsound restorations were not much more likely to think they needed treatment compared with the sample as a whole. The conclusion from this is that patients are not very good at knowing whether they have a treatment need or not. Further analysis according to attendance pattern and treatment need showed that those who attend the dentist only when they have pain were more likely to think that they were in need of treatment than those who had a genuine treatment need (according to the findings of the examination). The design of the diagnostic criteria were such that, where decay or unsound restorations were detected, this probably translates fairly well into treatment need. This seems to indicate that non-attenders feel less secure about their dental state (and this is probably justified), whilst regular attenders may feel a potentially unjustified sense of security that there is no treatment required.

The data on choice of treatment options exposed large regional differences in attitudes and demands between Salisbury and the two northern samples. On the whole, the Salisbury sample had a more restorative ethos, not only choosing restoration as an option more frequently, but also were less likely to pick and choose between restoration and extraction depending on the circumstances. The two northern samples showed evidence for a swing away from extractions in the younger age groups with only 9-12% opting for extraction in all cases. In the over 75 year olds the percentage opting for extractions in the North of England increased to 19%, but in Salisbury there were only 10%, and 75% of over 75 year olds in Salisbury opted for restoration in all cases compared to only 41-49% in the two northern samples. Differences in gender attitudes between north and south have already been discussed, but such differences are once again apparent here. Men in all areas were more likely to opt for extraction than women. Women in Richmondshire and Darlington were more likely to choose restoration **in all circumstances** than men, but in Salisbury the position was reversed such that more men would choose restoration **in all circumstances**. Seen in the context of the figures for edentulousness (more women are edentulous than men) this may seem surprising, but it may be that women tend to be more interventionist than men in terms of treatment and are more likely to seek active treatment, even the provision of full dentures, if that is what is required.

Manual workers and non-attenders were more likely to opt for extraction or to pick and choose according to circumstance. Although the results were presented differently, the 1988 Adult Dental Health Survey similar age related trends were seen (Todd, J.E. & Lader, D., 1991). The data were not broken down by area so there was no indication of these geographical trends.

Symptoms experienced will be an important determinant of demand across the whole population, including *non-attenders*. Up to a quarter of the dentate samples reported sensitivity of their teeth to hot or cold in the last four weeks, whilst up to 10% reported toothache over the same period and 10-16% reported other oral discomfort (dominated by that related to dry mouth). This adds up to a considerable amount of discomfort among the elderly, even if it was not enough to make the sufferers seek professional advice in many cases. Toothache showed no age related increase or reduction. However, sensitivity reduced in the older age groups, despite the similar number of teeth with gingival recession seen in all age groups. Mobile teeth were also reported frequently by 13-16% of subjects although patients reported mobile teeth rather less frequently than they were detected during the periodontal examination: 17-30% of subjects were found to have mobile teeth in the examination, perhaps suggesting that dentists can detect problems of this nature before their patients. The frequency of all of these dental symptoms is rather high. Other authors have reported high levels of symptoms in the elderly (Smith, J.M. & Sheiham, A., 1980a) although there is little data on the dentate elderly. The results from this study indicate the potential for discomfort in an elderly population who increasingly will be dentate.

4.3.3. Dentate subjects: Attitudes

Attendance pattern has been found throughout this survey to be an important indicator of dental health and attitudes to dental health in the dentate sample. The needs and demands of the edentulous are different and regular dental attendance was a rarity in this group. However, amongst the dentate, irregular attendance was much more common in manual workers, particularly unskilled manual workers, than in the non-manual part of the sample, and was also more common in men than in women. This may account for much of the difference in clinical dental disease between men and women and between manual and non-manual workers.

workers. A higher proportion of the Salisbury sample were regular attenders than those in either of the northern areas. This may also be linked to some of the (usually minor) regional differences in disease levels and treatment patterns. Similar geographical and social differences were noted in the Adult Dental Health Survey (Todd, J.E. & Lader, D., 1991), but the percentage of non attenders which they reported for their older subjects (around 45-50%) was higher than in this survey (19-28%). There are three reasons for this discrepancy. First, the three samples used in this survey may not be a true representation of the national picture (for example no large areas of urban deprivation were included). Second, there was a known selection bias away from non-attenders in this study which has already been discussed in some detail. Finally, the sample size for this age group in the national survey was smaller, so the confidence limits will be wider.

Toothbrushing frequency is a behavioural manifestation of peoples attitude to dental health. The geographical differences in toothbrushing frequency were not between north and south (although there was an element of difference here), but between rural and urban. In both of the urban areas brushing twice a day was the norm (61-70%), and only 5-6% brushed less than once a day. In rural Richmondshire only 42% brushed twice daily and 11% brushed less than once a day. This is one of the few variables for which Richmondshire stood out as quite different from the other two areas. There was no suggestion though that the periodontal health of the Richmondshire sample had suffered adversely, but there are so many confounding variables that this is difficult to say with certainty. Todd and Lader found a similar age related increase in non-brushers, and the percentages of the samples who brushed their teeth less than once a day was similar (7-11% , increasing with age) (Todd, J.E. & Lader, D., 1991).

The amount of upset at the prospect of edentulousness may give a good indication of differences in cultural attitudes between the north and the south. The proportion of the dentate sample who would be "not at all upset" about losing their teeth was highest in Darlington (27.7%) and lowest in Salisbury (23.1%) but the difference between them is surprisingly small and this is also the case for data from the 75+ group alone. However the 60-64 age band in Darlington stood out as having a much larger proportion who would not be concerned at losing their teeth than either of the other areas (31% compared to 17-19%). Darlington was also the area where the highest percentage of the reweighted dentate sample *expected* to be edentulous at some stage. There is a discrepancy, greatest in the oldest age groups but also substantial in the youngest group in Darlington, between those who would not be upset at the prospect of edentulousness and those who do not expect to become edentulous. There are substantial numbers of people who, although they do not expect to lose all of their teeth, would not be upset if they did. It appears that there may still be a cultural acceptance of edentulousness, not only in the oldest adults (75+), but also perhaps in the late middle aged groups (60-74 year olds) in the north of England. The same question about how upset people would be with the prospect of total tooth loss was asked in the Adult Dental Health Survey, and a higher proportion said that they would not be upset than was the case in this survey, but once again the difference is likely to be related to the selection bias against non-attenders. Non-attenders in all areas were the least likely sub-group to be upset about tooth loss, and had the highest percentage who expected to lose all of their teeth at some stage. Although they are an obstacle to universal good dental health in the population, the people in this category do not present as large a problem as it may seem. Their demands are low (they do not seek care unless they have to), their expectations are low (fewer are likely to be upset about tooth loss), and consequently when (if) they do lose their teeth they are less likely to be upset and are probably less likely to make unrealistic demands of their prostheses than regular attenders who visited the dentist with the aim of preserving oral health.

As with the edentulous, the vast majority of the dentate in all areas usually received dental care under the NHS. The pattern of private care usage was also similar to that for the edentulous, with a far smaller percentage in Darlington using private dentistry, although the uptake of private care was small in all areas (3-7%). These findings are in line with those for the Adult Dental Health Survey (Todd, J.E. & Lader, D., 1991). Nearly half of the total dentate sample (41-51%) said that they thought dentistry was expensive or very expensive. Fewer attenders thought that it was expensive than non-attenders in Darlington and Salisbury, although this was not the case in Richmondshire. The oldest group (75+) were the subjects who were least likely to say that they found dentistry expensive in all areas, but the difference between young and old was much less in Salisbury than in the northern areas. This finding could be a reflection of variation in dental attendance pattern with those who had attended most recently having had a clearer memory of cost. The fieldwork for this study was just finishing as proposed cuts in the fees paid to dental practitioners for NHS work were leading to threats to the availability of NHS dentistry in some areas. Consequently this data may be out of date already, but it gives an insight into the experience and possible expectations of older adults.

Only around 5% of the total dentate sample were dissatisfied with their overall oral condition. A larger proportion were dissatisfied with various aspects of their mouth, particularly aesthetics (11-14%). More of the dentate were dissatisfied with the appearance of their teeth than the edentulous. However, only 3-5% of the dentate sample were dissatisfied with their ability to bite and chew their food (much less than the edentulous). Despite the nearly universal satisfaction with being able to bite and chew, a much higher percentage of the reweighted dentate samples (13-17%) said that there were some foods which they would like to eat but could not due to difficulties biting and chewing (for example tough meat and apples were often quoted), so that they had some restriction of their diet due to their teeth (or the combination of food and dentures). The relationship between dissatisfaction with eating and actual dietary restriction is similar for dentate and edentulous people and suggests that, in the present generation of elderly at least, many people modify their expectations and are not dissatisfied as a result. In both the urban areas there was the suggestion of a strong age related increase in dietary restriction. A fuller discussion of the factors which contribute to satisfaction is given in section 5.5..

5.3.5. Dentate subjects: Barriers and reasons for non-attendance (non-attenders only)

Data on barriers was collected only for those who attended the dentist when they have pain or not at all, as this is clearly the group in which the presence of barriers is most important. However, as a consequence the sample sizes are fairly small and it is the reweighted totals which will give the most reliable data. Of all of the barriers covered in the survey it was "don't need to go" which was the one chosen most often in all areas; it was also the one most frequently given as the single most important barrier in any individual case. It is difficult to know whether the widespread feeling that a dental visit is unnecessary is the result of a genuine belief that there is no treatment requirement or a convenient cover for another reason for non-attendance. This was also frequently reported as a barrier by the predominantly dentate over sixty five year olds interviewed in one study (Schou, L. & Eadie, D., 1991). In many cases more than one reason was given for not attending. The subjects in Darlington tended to find the most reasons, and those in Richmondshire the fewest. Expense (22-33%) and fear (24-39%) were the other two barriers most often listed and between them accounted for nearly a quarter of the *single most important barriers.* Quite a substantial percentage (13-25%) listed "cannot be bothered" as a reason for non-attendance although few (2-5%) listed it as a most important reason. Difficulty with travel was rarely given as a reason for non-attendance. Even in rural Richmondshire where the distance to the nearest dentist can be large, and public transport may be limited, only a few of individuals reported it as a problem. It is difficult to compare directly from one study on this subject to another as the questions, samples and techniques used are so variable, but the general scope and direction of the findings are in line with other published findings (Kandelman, D. & Lepage, Y., 1982; Schou, L. & Eadie, D., 1991; Todd, J.E. & Lader, D., 1991; Wilson, M.C., 1991).

4.3.5. Access to care and knowledge of services

Only a tiny proportion of the sample in any area reported any problems obtaining dental treatment, getting an appointment or travelling to the surgery. Despite the fact that a much higher proportion in Richmondshire had to travel a substantial distance to the surgery, they were no more likely to report a problem. Domiciliary care was felt to be a possibility by 51-63% of the reweighted samples. Those in Darlington were more aware of this possibility than either of the other areas. There appears to be a different perception of the value of domiciliary care between the north and the south. Half of the Salisbury 75+ groups thought that it would be helpful for them if domiciliary care was available, this is twice the proportion in either of the other areas. Few people had had any direct experience of domiciliary care; 3-5% for reweighted data, but increasing with age to a maximum of 8% in the Darlington 75+ group.

5.4. THE PARTIALLY DENTATE: MASTICATORY FUNCTION, THE NUMBER OF TEETH AND THE ROLE OF PARTIAL DENTURES.

Even as more and more people retain natural teeth it will be impractical, at least in the medium term, to aim for a complete and healthy dentition of 32 (or even 28) natural teeth. Few of the current middle aged have a complete set of teeth in both arches, and some tooth loss is likely to continue. The results which are discussed in this section were the outcome of investigations which aimed to identify the factors which contribute to function so that realistic targets for oral health in the elderly can be set. The positive and negative roles of partial dentures, still the most commonly used means of restoring function and aesthetics, are also discussed.

5.4.1.Number of teeth and function

It is clear from the results of the logistic regression that the number of teeth, or the number of missing teeth, is an important factor in determining the presence of problems with eating. Although the odds ratios are fairly small (mostly around 1.1 to 1.2) these are the change in odds for every missing tooth, where there are a lot of missing teeth the overall effect will be large. It does not indicate the nature of the relationship, whether there is a steady decline with every missing tooth, or whether there is a critical number of teeth, below which masticatory function is greatly impaired, and above which it is generally satisfactory. A number of authors have suggested a minimum number of teeth for satisfactory function, and these have been in the region of 20 teeth (Agerberg, G. & Carlsson, G.E., 1981). Some authors (Käyser, A., 1981; Witter, D.J. et al., 1990) suggested that the number of teeth required may diminish with age, whilst they and others have put requirements on the distribution of teeth a well as the number (Aukes, J.N.S.C. et al., 1988; Battistuzzi, P.G.F.C.M. et al., 1987; Käyser, A., 1981).

The purpose of the plots of number of teeth against eating problems, and against dissatisfaction with the ability to eat (figs.4.4.1. to 4.4.4.), are not to try to fit an exact formula to the line, but to give a visual representation of the nature of the relationship. These graphs exclude subjects who are edentulous in one arch. Such individuals can, in many ways, be regarded as a separate sub-group of the dentate and it was felt reasonable to exclude them from this analysis. The plots indicate a linear relationship with both the percentage of the sample reporting functional problems and the percentage of the sample who are dissatisfied. Data for subjects with fewer than 13 teeth and more than 27 teeth were pooled due to relatively small sample sizes in these areas. This could have concealed flattening off of the graphs at either end, but the data is fairly normally distributed, with respect to the number of teeth and contacts, and for the large majority of the sample (those with 14 - 26 teeth), the relationship is linear. Posterior contacts show a similar linear relationship.

Two important points arise from this. First, there appears to be no critical number of natural teeth at which problems or dissatisfaction become suddenly more common. Second, the relationship between tooth number and eating problems is not perfect. There are significant proportions of the sample who have few teeth and report no problems eating and are satisfied (over 90% of subjects with less than 13 teeth are still satisfied) and some who have almost a full dentition and still report eating problems or are not satisfied. Even amongst those with only a few teeth the majority are quite satisfied, despite reporting some problems with eating.

In identifying no critical number, one further factor must be taken into account. The data here is not split into partial denture wearers and those without partial dentures. Partial dentures will be a major confounding variable. There is evidence that well fitting partial dentures replacing relatively few teeth make a significant contribution to masticatory ability (Chauncey, H.H. et al., 1984), and if this is the case there may be evidence of a critical number of teeth, but it may have been masked by the presence of dentures. Unfortunately, even with a multivariate model it is impossible to resolve this problem satisfactorily, as the dependent variables being tested (eating problems) may actually be made less likely by wearing a denture, and those who do not have a problem are less likely to wear a partial denture. However, the relationship between number of teeth and partial denture wearing may give an indication of the minimum desirable number of teeth.

5.4.2. Partial denture wearing and the role of partial dentures in dental disease

It is very difficult to asses how successful partial dentures are at their job; those for whom partial dentures are not successful will probably not wear them or wear them selectively. In addition, some factors may provide a greater incentive to persist with an otherwise unsatisfactory denture than others, for example a denture which replaces unsightly missing central incisors may be more likely to be worn than an otherwise similar denture which replaces only posterior teeth. The data on partial denture wearing which is discussed here attempts to untangle some of the major stimuli for denture wearing. The graphs of number of teeth and number of posterior contacts against partial denture wearing (shown in figures 4.4.5. and 4.4.6.) do not show the same sort of linear relationship described above for functional problems and satisfaction. Instead the plot shows a steeper portion where there are between 17 and 24 teeth after which it flattens out again. Where there are 16 teeth or less a fairly constant 75% or so wear a partial denture, over 24 teeth and there are less than 5%, and many of these will be replacing only one or two anterior teeth. The same sort of relationship is evident according to the number of posterior contacts with 2-4 contacts being the critical number.

The results of the multiple logistic regression (Table 4.4.1.) which tested the factors contributing to partial denture wearing indicated the importance of the presence of anterior spaces in determining whether or not a person wore a partial denture. This was the single most significant factor and increased the odds of wearing a partial denture by 12.7 in subjects who were dentate in both arches. Furthermore, the importance of this factor is, probably, underestimated as it was impossible to separate out those who had an anterior space restored with a bridge from those where it was restored with a denture. With bridge wearers removed from the equation the importance of anterior spaces in determining partial denture wearing would have probably been increased. The other major explanatory variables were the number of missing teeth (an odds ratio of 10.3 where there are 16 or more teeth missing compared to a reference of less than 8 missing teeth), and the number of posterior contacts. The latter showed a significant contribution to the model which already included the number of teeth and the presence of anterior space(s), in other words the number of contacts mattered even when number of missing teeth and anterior spacing are taken into account. However the effect of the number of contacts did not indicate the straightforward increase in the odds of partial denture wearing with fewer contacts that one might expect. Subjects with one or two posterior contacts were more likely to wear a denture than those with none (odds ratio of 1.6), and those with more than 5 contacts were much less likely (odds ratio of 0.57). This relationship is also suggested by the graph (in figure 4.4.6.). Those with 3 or 4 contacts were no more or less likely to wear a partial denture than those with none. This slightly unusual pattern may illustrate the problems of wearing a denture where there is relatively little to aid support and retention. Where everything else is equal, a partial denture with just one or two posterior teeth to support it may be easier to tolerate than one where there are none. This is interesting in the context of other findings (Chauncey, H.H. et al., 1984) which showed that food appreciation and mastication improved where there was a partial denture replacing just a few teeth (compared to no partial denture), but showed no improvement where there was a more extensive prosthesis. The other factors which influenced whether a denture was worn or not included being female (which increased the odds) and being a dental non-attender or being from a manual background, both of which decreased the odds.

Other data served to underline the importance of anterior spaces in continued denture wearing. Subjects who had had a partial denture made in the past which they could not or did not wear regularly are a particularly interesting group. Those who now wore a denture were much more likely to be the ones who had a space to fill, the ones who wore no denture were less likely to have an anterior space. In many cases those in the latter group presumably felt that, in the absence of an important aesthetic role, the masticatory benefit (if any) of wearing a denture did not outweigh any discomfort or inconvenience.

Between 19% and 25% of all dentate individuals had had a partial denture made which they did not or could not wear. This represents hundreds of thousands of unworn dentures and a large waste of effort and money. This may be a reflection of the quality of partial denture design and manufacture, discomfort and difficulty wearing any partial dentures or the provision of partial dentures which the patients feel are unnecessary. It is probably a combination of these, but one way or another it probably says quite a lot about the success of partial dentures as prostheses. It is worth considering briefly the reasons given for denture wearing by those who persist with them. Although eating and aesthetics were the most important reasons given there was a small minority (about 10%) who chose as the most important reason "because my dentist advised it". The percentage who quoted help with eating as the most important reason for denture wearing increased with age to over half (50-56%) of the 75+ samples. This may have some implications in terms of prosthesis design for older adults as it may be reasonable to aim to improve function even at the cost of some impairment to aesthetics in the oldest subjects.

The role of partial dentures in causing dental disease has not been fully established. In the presence of perfect oral hygiene and intensive maintenance, Bergman (Bergman, B. et al., 1982) found no increased risk of periodontal disease or dental caries amongst partial denture wearers. However, in the UK at present, near perfect oral hygiene is an unrealistic aim. Other authors have shown increased disease in partial denture wearers in large population samples, but the differences have not been great (Carlsson, G.E. et al., 1962; Chandler, J.A. & Brudvik, J.S., 1984; Derry, A. & Bertram, U., 1970; El Ghamrawy, E., 1976; Lappalainen, R. et al., 1987; Rissin, L. et al., 1979; Tuominen, R. et al., 1988; Drake, C.W. & Beck, J.D., 1993). One major difficulty with the relationship, at least when it is to be tested on a cross-sectional basis, is in trying to control for the factors which may have led to the wearing of partial dentures in the first place. A higher rate of disease may be expected in those with partial dentures as they are likely to have had greater disease experience, in some cases as a result of greater disease vulnerability, which has resulted in tooth loss. One possibility is to include measures of past disease history in a multivariate model. In a case of this sort a logistic regression model is appropriate, but only the presence or absence of disease, not its extent, can be tested using this procedure. However, in the case of active caries and advanced periodontal disease, where less than half of the sample are affected, this is a reasonable approach.

In this study root caries and coronal caries were considered separately, as well as loss of attachment. In the model to test the relationship between the presence of root caries lesions and partial dentures, the presence of a partial denture was the most significant independent risk factor and the first to be included in the model. Whilst the significance and the odds increase were reduced as variables reflecting previous disease (number of teeth, number of fillings) were included in the model, there was still a significant relationship between the presence of partial dentures and the presence of active root surface caries when the model was complete with an odds ratio of 1.9. In other words the odds of having a root caries lesion were doubled where there was a partial denture, even taking into account the other contributory variables reflecting susceptibility to disease. The odds of having some root caries lesions or fillings were increased 17-fold where a denture was present. Interpretation of this is a little less easy as the root restorations were not necessarily placed after the denture, and root surface fillings and partial dentures may be associated for many reasons, other than just a cause and effect relationship. Most of these were included in the statistical model and an increase in the odds of this scale cannot be disregarded.

Coronal caries was not affected by the presence of a partial denture, but the presence of loss of attachment was. The interpretation of this is a little more difficult as much loss of attachment may have already occurred prior to denture placement, and unlike caries history where the number of fillings can be included in the model as a reflection of past disease susceptibility, there is no easy way of differentiating between active and past periodontal disease.

Most previous studies relating partial denture wearing to disease have not separated root caries from coronal caries. In the elderly there are a number of important reasons why this is desirable. Teeth with unsound roots are at least as common as teeth with unsound coronal surfaces in older adults (as has been shown in this study), but unsound roots conform to a different pattern with more new decay compared to the failed restorations which account for much of the *unsound* component in tooth crowns. Furthermore, the exposed roots would appear to particularly vulnerable to the sort of stagnation areas and plaque accumulation often found in association with partial dentures. From the results of this study, and some other recent work (Wright, P.S. et al., 1992; Drake, C.W. & Beck, J.D., 1993), concern about an increased prevalence of root caries in partial denture wearers appears to be well placed. It seems paradoxical that a prosthesis constructed and worn for the purpose of improving oral function, may increase the risk of further oral breakdown significantly.

5.4.5. The minimum requirements for the partial dentition

In this sub-section the data discussed in the previous four sub-sections (5.4.1. to 5.4.4.) has been drawn together to try to establish what the minimum goal should be for the partial dentition. Given the potential for damaging effects of partial dentures it would seem preferable to avoid them where possible. In order to do this at a population level, two conditions need to be met. The first is that enough teeth are retained to ensure that partial dentures are not required for the provision of adequate function. The second is to ensure that any anterior spaces are restored by something other than partial dentures. In practical terms this means either conventional or adhesive fixed bridges. The latter is an attractive option in terms of the preservation of natural tooth tissue, and possibly also on economic grounds.

The relationship between tooth number and partial dentures may not be as clear as the graph (figure 4.4.8) suggests. The rapid reduction in the need for partial dentures where there are 17 teeth or more may be, in large part, a reflection of the reduction in the odds of there being an anterior space where there are more teeth. Data from the stepwise logistic regression, with partial denture wearing as the dependent variable, indicate that this may well be the case. The effect of tooth number is relatively small when it is included in a model with anterior spaces. A measure of the number of posterior contacts is relatively free from this complication and number of contacts is a significant influence on denture wearing.

Tooth loss is likely to continue through life, so in order for a sustainable, denture free, condition to be achieved, more than the minimum number of teeth or contacts (which are required for satisfactory function) will be required, at least for the under 70 year olds. The rate of tooth loss in the elderly is unknown, so an accurate assessment of the minimum is impossible. In this context 20 teeth would seem too low, unless the number of natural posterior contacts can be maximised. Somewhere around 24 teeth or 4 posterior contacts may be appropriate at age 60. In this study, only 472 of 2280 (20.7%) over 60 year olds had 20 or more standing teeth. Käyser has suggested that the number of teeth required for comfortable function reduces with age (Käyser, A.F. et al., 1990), however there is no hard evidence to support this assertion. If this was the case *reserve* teeth may not be necessary, and 20 teeth at age 60 may be appropriate.

Much of this accords with the principles of the shortened dental arch proposed by Käyser (Käyser, A., 1981; Käyser, A.D. & Witter, D.J., 1985). The shortened dental arch would seem to be a worthwhile goal as it embraces the concept of posterior tooth contacts, the need to restore anterior teeth and the undesirability of partial dentures. However the shortened dental arch, in its pure form of two dental arches unbroken by spaces from premolar or first molar to premolar or first molar, is uncommon in the UK: only 10% of the people aged over 55 years and 2% of those aged over 65 years examined in the 1988 Adult Dental Health Survey had the potential for a *classic* shortened arches from second premolar to second premolar in upper and lower. It is not achievable widely as a public health goal in the short term, although with sufficient planning and education it may be a possibility in the longer term. For individual older patients it remains an appropriate and useful treatment strategy, particularly where resources are limited or the capacity to undergo advanced treatment is impaired as a result of chronic illness, and where a natural dentition for the rest of the subjects life is a realistic prospect.

5.5. THE FACTORS WHICH INFLUENCE ORAL HEALTH IN THE ELDERLY

The theoretical model (figure 3.11.2.), which was used as the basis for testing the relationships between aspects of function and satisfaction and various explanatory variables, is based on four assumptions. Working down from the top of the model the first assumption is that, in the elderly, it is inappropriate to measure oral health solely by measuring disease. In order to achieve oral health the subject has to be satisfied with their oral condition and with their ability to perform normal oral functions (e.g. eating, looking good) as well as being free of disease. A disease free population would be a failure in terms of public health if widespread dissatisfaction with appearance or inability to eat remained. The second assumption is that a good natural dentition is always preferable to a completely artificial one. The evidence from studies of masticatory performance support this view (Gunne, H.J., 1985a; Helkimo, E. et al., 1978; Mahmood, W.A. et al., 1992; Wayler, A.H. et al., 1984). More dentate than edentulous subjects in this study were satisfied with their ability to bite and chew their food, in line with the findings of Bergman and Carlsson (Bergman, B. & Carlsson, G., 1972). The superiority of a natural dentition is not necessarily supported in terms of aesthetic satisfaction, which in this study was higher among complete denture wearers.

However, for the purposes of the analysis this assumption regarding the superiority of a natural dentition will be upheld. The third assumption is that a healthy set of natural teeth is only of value if it is sustainable in a reasonable condition for the rest of a persons life. In other words, oral health is of little value if it is a transient state. The final assumption is that overall satisfaction is likely to depend in large part on satisfaction with two of the major roles of the dentition; to enable eating and to provide sufficient aesthetics to be socially acceptable.

An analysis of the factors contributing to problems with eating was the first to be undertaken (table 4.4.1). The importance of the number of teeth in relation to problems with eating was only to be expected and has already been discussed. Whilst the impact looks relatively small (odds ratio of 1.12) this is the effect for each missing tooth, so the multiplicative effect for a large number of missing teeth would be considerable. The other factors which were contributory to the four variables indicating difficulty with eating, included a variety of social, demographic, symptom related and clinical variables. Being female appeared to make problems with eating hard foods more likely, as did living in the South of England, this is over and above the differences in the number of teeth and dental state related to these variables. It may be that women and people living in the South of England expected more from their teeth. Although dental health in both cases was a little better, the expectations may be higher in these groups and, in the case of the geographical variation, it could also be that southern diets are more demanding. Those who had been through some form of higher education were also more likely to report dietary limitations than those who had not. Once again it is difficult to be sure what underlies this finding, whether it is a result of higher expectation, a more demanding diet, or both.

The other variables which contributed to the model related to symptoms and disease. Tooth mobility (both when reported by the subject and when found by the dentist) was a factor in dietary limitation due to problems eating. Although the ability to bite and chew without difficulty was greater where there were more teeth, if teeth are preserved without consideration of the potential for symptoms, the overall effect may be to reduce the ability to function, not increase it. It is interesting that subject-detected mobility and dentist detected mobility were both included in the model separately, suggesting that even where the subject did not notice any mobile teeth, they may still have been the source of problems with eating. The other symptom which seemed to play a role was sensitivity. The questionnaire asked specifically about temperature sensitivity, but it is possible that some subjects who had discomfort on biting may have reported this as sensitivity, so care over the interpretation of this point is advisable. The number of decayed teeth and the number of teeth with loss of attachment over 6mm were found to contribute to the odds of suffering from any of the three eating problems, but mobile teeth were not included in the final model in this case, and loss of attachment may just be another indication of the same sort of thing (advanced periodontal disease causing problems).

Dissatisfaction with the ability to bite and chew food was heavily influenced by all of the three variables indicating problems with masticatory function (diet limitation, difficulty with hard foods and altered food preparation), including an interaction between the three of them. The only other contributory factors were *age*, which decreased the odds of dissatisfaction as it increased, and *recent toothache*, which increased the likelihood of problems by a factor of 2.8. The former may be a reflection of diminished expectations with increasing age. Alternatively, it may indicate that future generations of the elderly may be more demanding and that the present age related reduction in the percentage dissatisfied may not be sustained. None of the other potential contributory variables had a significant effect on the model in their own right, and were not significant once the three *eating problem* variables (diet limitation, difficulty with hard foods and altered food preparation), *age* and *recent toothache* were included.

Dissatisfaction with appearance is apparently much more open to influence from social, socio-dental and demographic variables than dissatisfaction with masticatory function. Age reduced the odds of being dissatisfied, whilst being female, having had a higher education and being a dental non-attender all increased the odds of being dissatisfied. The single most potent factor was the number of unfilled spaces which saw a 3.6 fold increase in the odds of being dissatisfied for every anterior space, although the number of decayed teeth and the number of teeth with loss of attachment of over 6mm were also significant factors. The implications of this are that improved dental health will only go some of the way to improving the levels of satisfaction with aesthetics. Much of the variation is due to socio-demographic factors, and in years to come these may act in favour of increased dissatisfaction as more demanding, educated and dentally aware generations grow old.

Figure 4.5.1. shows the final tested model of the factors contributing to oral health, function and satisfaction, given that the assumptions made above are accepted. Significant factors are marked with bold arrows. The final dependent variable in the model was overall dissatisfaction (reporting being not very satisfied or completely unsatisfied to the question "overall, how satisfied are you with your mouth and teeth"). The original model of oral health was upheld, in that the two major satisfaction variables (appearance and ability to eat) were both major determinants of overall satisfaction. However, two further factors played a significant role, both of them included under the general heading of *symptoms*. These were a recent history of toothache, and difficulties with speech. Neither affected peoples' ability to eat or impaired their appearance, but both increased significantly the odds of being dissatisfied. The model is by no means complete, and is only a part of a wider and more complex interaction. A variety of motivational and vulnerability factors, including aspects of dental health behaviour, diet and predisposing factors related to systemic or local disease will contribute to the model at various points, but these have not been quantified and lie outside the scope of this study.

The variables which had an impact on satisfaction were in line with those described by Cushing (Cushing, A.M. et al., 1986) for younger subjects, particularly the importance of discomfort. Davis (Davis, P., 1976) argued that dental disease has little impact on daily life, and other authors (Heyinck, J.W. & Schaub, R.M.H., 1986; Reisine, S.T. et al., 1989) have indicated that the impact of dental problems on social functioning is small. This may be so, but the factors which contribute to the *oral dissatisfaction* which is reported by a significant proportion of subjects must be of relevance to the dental profession. Dissatisfaction with aesthetics or function is in large part a failure of the profession. The service which is provided cannot be improved if the factors which contributed to the dissatisfaction are unknown.

With the final tested model of oral health and data from other parts of the survey it is possible to make some comments about the factors which should be included when measuring the oral health in the elderly.

This is done by defining a series of criteria or goals for oral health in elderly subjects. The criteria for oral health are in accord with the definitions of oral health which are presented in section 2.4., but present more detailed goals with a specific population, older adults, in mind. These goals are applicable both at an individual level and in terms of the public health, and incorporate the principles of shortened dental arch philosophy (Käyser, A., 1981; Käyser, A.D. & Witter, D.J., 1985). Although relatively few of the elderly subjects interviewed as part of this survey were dissatisfied or reported difficulties with oral function, the criteria described below are based on the factors which have been identified as responsible for the dissatisfaction or problems which were reported. They have also been constructed with a long term view in mind, so that being dentate continues to be an advantage and does not become a burden with advancing age.

The goals are:

1. A dentate population, with the prospect of remaining dentate for life.
2. A minimum number of teeth, with the prospect of maintaining that minimum number for life. This was discussed at length in section 5.4.4.. 20-24 teeth would be an appropriate minimum to aim for. Below this level the odds of requiring a partial denture are increased considerably. Furthermore, any loss of teeth implies a further increase in the probability of eating difficulties and dissatisfaction.
3. A minimum number of posterior contacts, and the prospect of maintaining these for life. This is desirable in addition to the data on the number of teeth as it sets a requirement for the distribution of the teeth. Number of posterior contacts are a factor in determining whether or not partial dentures are worn.
4. No unrestored anterior spaces; where spaces are restored this should be by fixed prostheses, not dentures if possible.
5. An absence of partial dentures. This should be implicit if goals 2 to 4 are fulfilled.
6. Clinical disease should be under control and there should be a reasonable expectation of retaining a natural dentition for life.
7. An absence of recent symptoms including toothache and speech problems (which impair overall

satisfaction directly) and mobility and sensitivity (which impair the ability to function).

8. Subjects should be satisfied with their appearance and ability to eat. This will be much more likely if all of the above criteria are met.

The three samples reported here fall well short when measured against these criteria. The 60-64 year old samples are the groups with the best oral health, and the best chance of achieving a functioning natural dentition for life. However, even amongst this group only 61-85% were dentate and a further 11-18% of them were dentate only in one arch. Only just over half (at most) of these dentate subjects have 21 or more teeth and a third wear partial dentures. So, whilst a majority may be dentate and have the prospect of remaining dentate for life, relatively few of them can be expected to have the potential to approach the minimum criteria set out above (in terms of tooth number and distribution, and lack of partial dentures.). Furthermore, there is a risk that many of those who are partially dentate will continue to lose teeth in an unplanned manner, leading to a need for partial dentures, further dental disease and yet further unplanned tooth loss. The result of this, in individual cases, could be the combination of factors most likely to lead to dissatisfaction, such as eating difficulties, discomfort, anterior spaces and so on. There is little that can be done to improve this situation in the current over 60 year olds, except aiming for the criteria above (where they are achievable), controlling tooth loss and disease by prevention and treatment (where they are not), and restoring function as effectively as possible.

The findings of this survey should also be looked at in the context of the study conducted by Bulman in Salisbury and Darlington 30 years earlier. At that time 80% or more of the subjects aged 60 or over were edentulous and the author wrote that "hardly anyone over the age of 65 can be expected to have more than a few of their own teeth". This should be compared to 50% or less who are dentate and 20% of all subjects aged over 60 who have 21 or more standing teeth. Considerable progress has been made, but the oral health goals which are set out above will take a longer time to achieve, and are more appropriate for the present 30-60 year olds, rather than the current population of older adults. The 30-60 year olds are a generation with a large number of teeth, a high proportion of which are restored, and for whom the goals above are still achievable for many. However, in order to accomplish these goals, long term treatment strategies will to be employed by dental practitioners to ensure that retaining a natural dentition into old age is an advantage and not a burden.

Clinical Photographs

There follow a series of clinical photographs of five subjects who took part in this project. The photographs were taken during the fieldwork, often in less than ideal conditions. They have been selected to illustrate various points raised in section 5.5.

Figure 5.5.1. Case 1

These show the teeth of an 80 year old male who is dentate in both arches, but has only 8 teeth, and no contacts at all between upper and lower teeth (anterior and posterior). He relies entirely on partial dentures to provide function. However, function is poor, the dentures are inadequate and there is widespread disease (caries, root caries and periodontal disease), in the development of which the dentures may have played a contributory role. On the anterior teeth there is advanced attachment loss and mobility, but with only moderate pocketing. CPITN used alone may not have detected this as a severe case of periodontal disease, despite these findings. The subject has experienced slow and uncontrolled tooth loss, and the final result is a person who is dentate, but where the dentition has become a burden rather than an asset. The oral health in this case falls well short of almost all of the goals set out in this section. It illustrates well that being dentate is in itself not necessarily desirable if function is poor, disease is uncontrolled and the subject cannot eat comfortably.

Figure 5.5.2. Case 2

These photographs show the teeth of a sixty five year old woman where the only contacting teeth are in the anterior region. Partial dentures had been supplied, but with further tooth loss these had become increasingly difficult to tolerate and were no longer worn by the subject. There is no upper anterior space at present and both function and aesthetics were felt to be satisfactory. Whilst the situation described is reasonable, any further tooth loss could lead to considerable problems. This illustrates a state of oral health in a person at the younger end of the elderly spectrum where there may not be enough teeth in reserve to accommodate further loss without a considerable reduction in function or aesthetics.

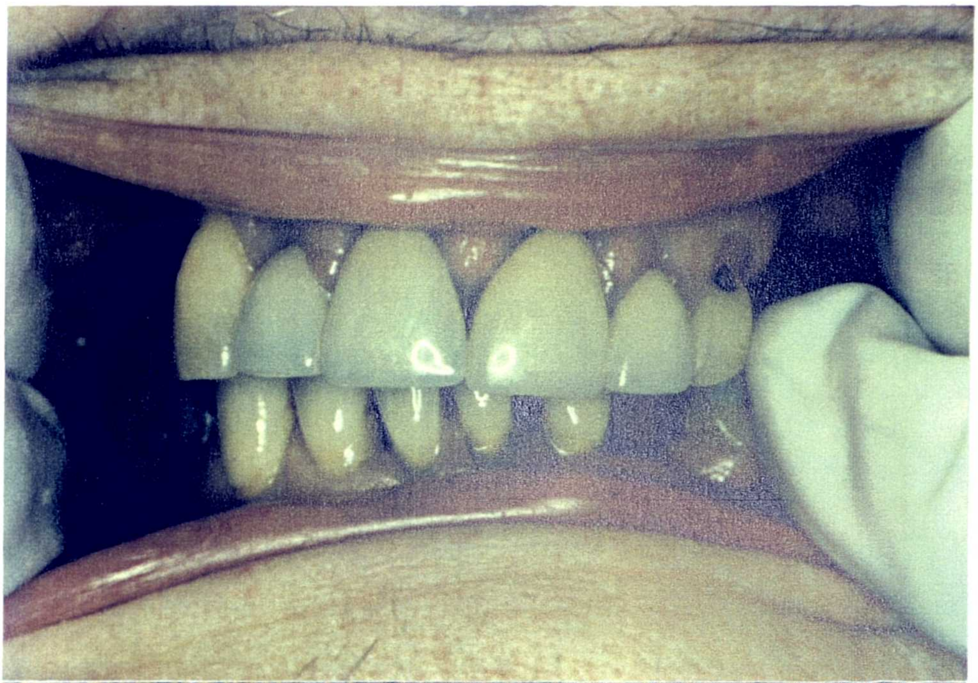


Figure 5.5.3. Case 3

A sixty five year old male with some tooth loss (first molars), a fairly heavily filled dentition and severe wear of the functional surfaces of the anterior teeth (grade 4 on the incisors). Despite the wear, there is no reason why he should not keep a useful natural dentition for the rest of his life, even if he lives to an advanced age. He was satisfied with all aspects of his teeth. This subject would fulfil all of the oral health goals set out in section 5.4..

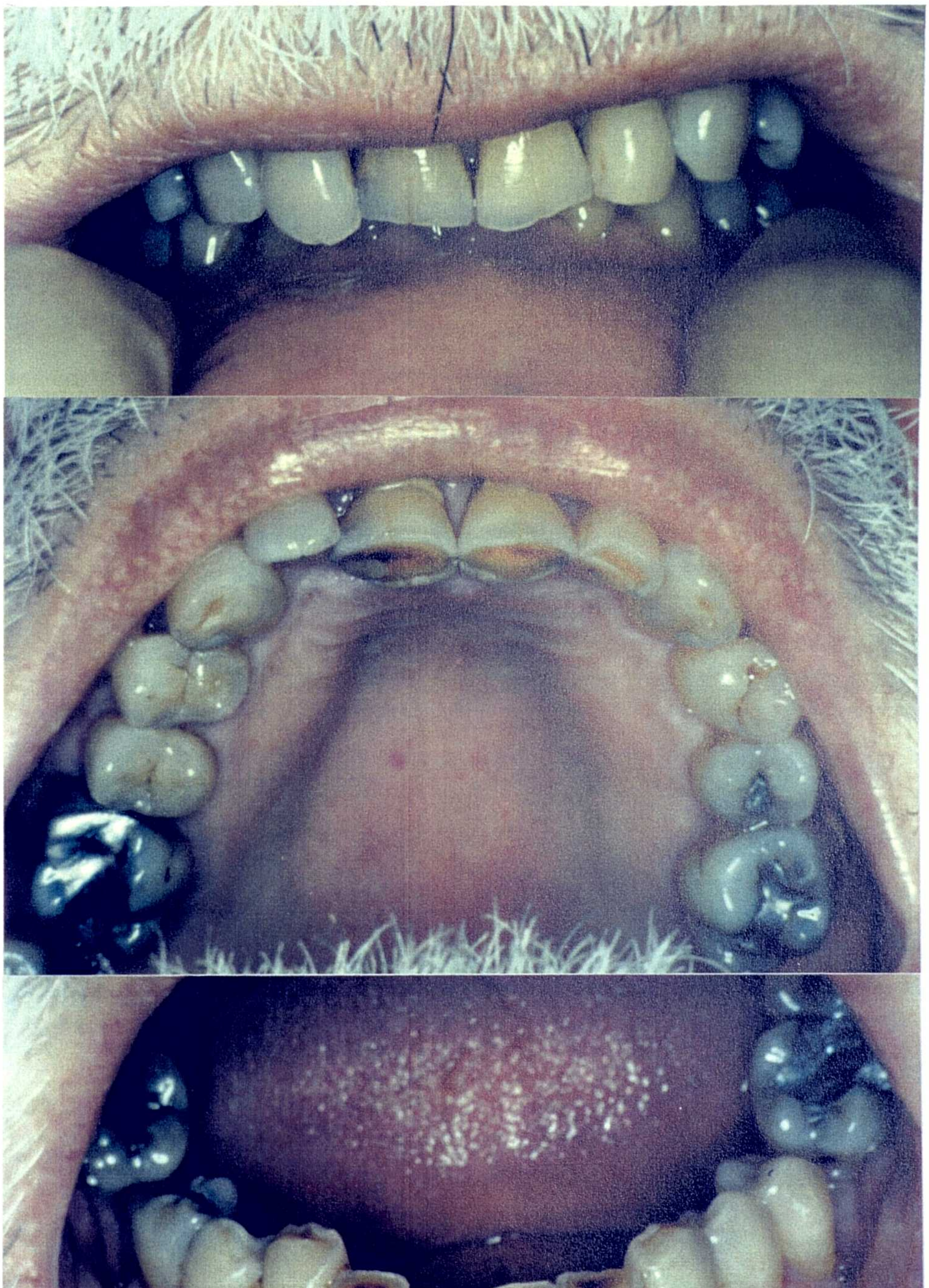
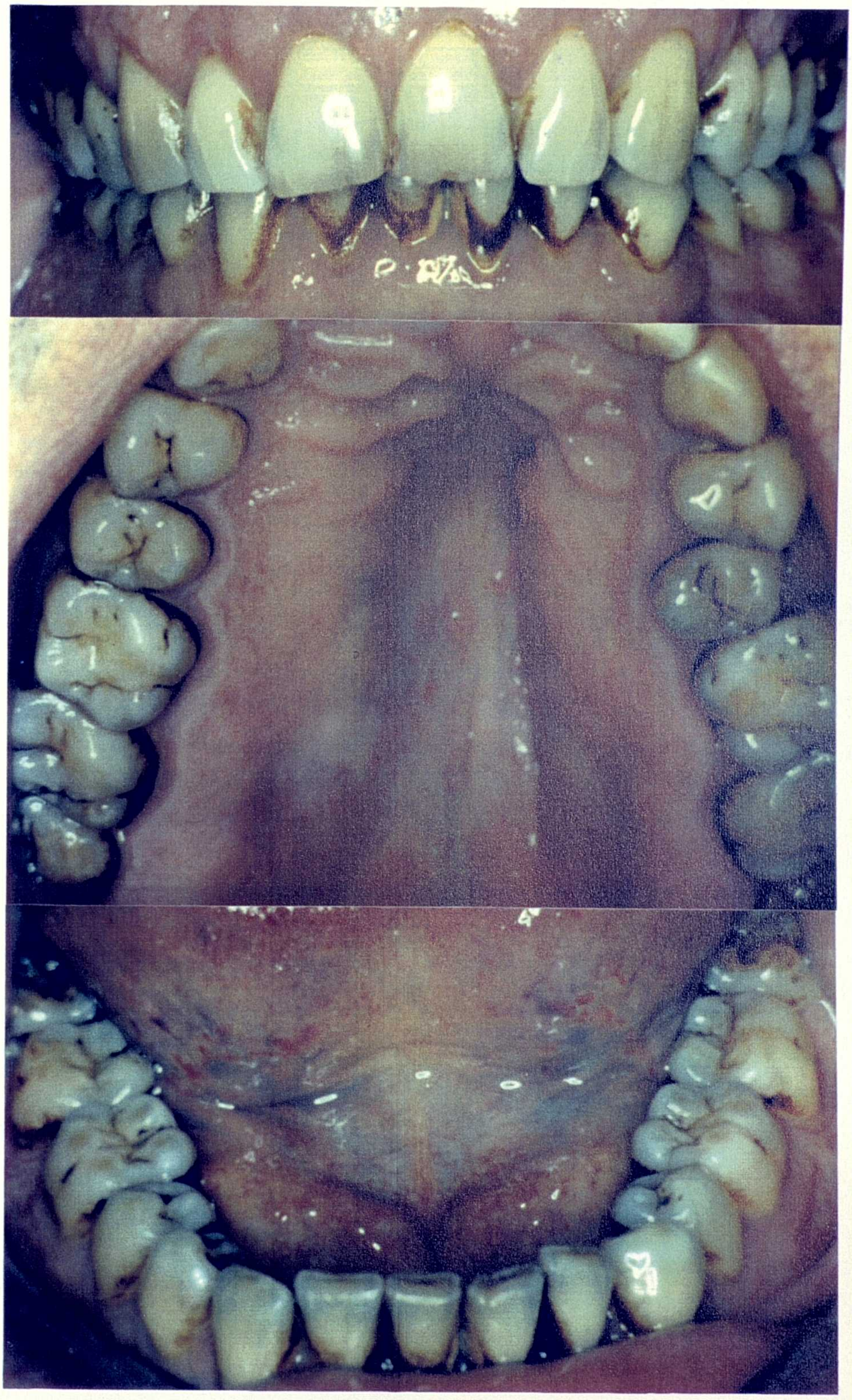


Figure 5.5.4. Case 4

A 71 year old former actress with 28 well aligned teeth. There are some restorations, which are in good condition, and the periodontal tissues are generally healthy. This subject has every prospect of retaining a healthy, functional dentition for life. She met all of the oral health goals except one, and that was that she was *not very satisfied* with her appearance due to the slight rotation of one upper central incisor. This illustrates that clinical problems which are obvious and easily soluble do not account for all dissatisfaction, particularly with aesthetics.

Figure 5.5.5. Case 5

A 61 year old male with 31 standing teeth (the lower left canine is unerupted but palpable in the mandible), no restorations, 10 good posterior contacts and no anterior spaces. There was no caries, and although there was some marginal gingivitis, widespread staining and localised mild attachment loss, these posed no threat to the longevity of any of the teeth in the short term. This subject had not visited a dentist for 40 years and future treatment need should be low unless there is some change in the oral environment (e.g. development of dry mouth). Even if disease leading to loss of several teeth were to occur there are sufficient teeth in reserve to provide adequate function, and support for fixed prosthodontics (if necessary) without recourse to partial dentures. This illustrates that a complete, sound and unrestored dentition can be consistent with advanced age.



CONCLUSIONS

Section 5.

CONCLUSIONS

Four objectives were set for this research (see Section 1). In this concluding section each of these will be examined in turn and a synopsis of the findings most relevant to each is given.

Objective1.

To collect information about the oral health of subjects over the age of 60 years living in three areas of England, and to review the effect of geographic and social factors on oral health

- A random sample of the population aged 60 years and over was drawn in each of three areas of England. 2280 subjects from Richmondshire, Darlington and Salisbury were examined and interviewed in their own homes. Four dentists were involved. The author examined approximately half the sample in each area; three other dentists examined in their home location.
- The sampling process was successful, despite the fact that the sampling frame (FHSA lists) had not been used before in a study of this type. The resultant sample was fairly representative of the areas studied although, as a result of differences between the refusers and those who agreed to take part, there was some bias away from the edentulous and non-attenders in the samples. The scale of this bias varied between areas. Response rates were generally around 55%.
- 48% of the reweighted 60+ age group was edentulous and there were large geographical differences. There were far fewer edentulous people in the younger age groups than in the older ones. The lowest rates of edentulousness were found in the 60-64 year olds in Salisbury.
- Around 10% of the sample in all areas were edentulous in one arch only. These people were accounted for in the dentate sample but may represent an increasingly important component of the need for complete dentures.
- Complete dentures had on average 3 faults when assessed by a dentist. Less than 15% were

fault free.

- In the dentate sample the mean number of standing teeth declined from about 19 in the 60-64 year age group to 14 in the 75+ year age group.
- About 40% of the sample wore partial dentures. 55% of these were made entirely from acrylic and were completely tissue supported (*gum strippers*).
- Overall, the 60+ sample had around 17 standing teeth, of which 9 were sound, 7 were filled and 1 was decayed.
- Around half of the coronal decay was accounted for by unsound restorations, and a further 21% was accounted for by grossly decayed or broken down teeth.
- One third of the population had one or more crowned teeth and 18-22% had multiple crowns. The youngest age group (60-64 year olds) were much more likely to have crowns than the 75+ age group.
- Almost the whole of the dentate sample in all 3 areas had at least one root surface vulnerable to decay.
- 30-40% of the dentate samples have no root caries experience. A mean of 2-3 root surfaces were decayed or filled. The mean number of decayed, and the mean number of decayed and filled roots increased with age. 20-24% of all vulnerable teeth had roots which were decayed or filled, 7-9% of vulnerable teeth had roots which were decayed/unsound.
- The treatment need for root caries is concentrated, such that a small proportion of the population account for a large proportion of the lesions which may need treatment. Most of the decayed component is accounted for by new decay rather than unsound restorations.
- 40-45% of the samples exhibit marked cervical wear. Those who have cervical wear have, on average, about 2-3 teeth affected.
- The proportion with significant coronal wear increased with age.
- Most worn teeth are concentrated in a minority of mouths; about 40% of the dentate samples exhibit marked coronal wear (grade three or worse) and those with this marked wear have on average 3-4 affected teeth.
- Tooth wear was not associated significantly with dissatisfaction with oral function. Cases of

very severe wear show a weak association with functional problems and dissatisfaction with aesthetics.

- Deep pocketing (>6mm) affected around 20-25% of the samples.
- About 45% of the sample had one or more teeth with loss of attachment of 6mm or greater and severe loss of attachment (9mm or greater) affected around 12%. About 20% of the sample had one or more mobile teeth. Up to a third of all molars had furcations which were exposed by loss of periodontal attachment.
- Dry mouth was reported by around 20% of the sample
- Denture related soft tissue lesions were found in 16-20% of the sample, with denture stomatitis by far the most common finding.

The effect of geography

- The biggest difference found between the south and the north of England was in the percentage edentulous. 33% of those in Salisbury were edentulous compared to 57% of those in Darlington, with rural Richmondshire broadly similar to Darlington, its northern neighbour. Only 15% of the 60-64 year olds in Salisbury were edentulous, in contrast to 39% in Darlington.
- There is a suggestion of a ten year difference between north and south in terms of the proportion edentulous.
- The geographical differences among the dentate are less clear. However Salisbury generally had a higher percentage with 21 or more teeth, a slightly higher mean number of teeth (17.5 compared to 17.2 in Darlington and 16.8 in Richmondshire). Numbers of sound, decayed and filled teeth are similar though with a tendency to more filled and fewer decayed in Salisbury. The sample from Salisbury also had more crowns and more bridges than those in the northern areas, although the numbers of bridges overall were small.
- Geographical variation in much of the rest of the dental data must be interpreted with caution, but when the findings from the author (who examined in all areas) are considered alone, the geographical differences are small. Salisbury had slightly more individuals with some root

decay or fillings, but fewer decayed or filled roots on average. The Salisbury sample also had slightly more cervical wear and mobile teeth, a higher proportion with some advanced loss of periodontal attachment and a higher proportion who wear partial dentures. However the differences were subtle.

- In terms of dental health, the difference between rural and urban was small. Rural Richmondshire tended to be similar to Darlington which is geographically very close. Levels of edentulousness were a little lower in Richmondshire than in Darlington, particularly in the youngest age group, while decay and restorations of both crowns and roots occurred at a similar frequency. For many variables Richmondshire lay somewhere between Darlington and Salisbury.
- The study by Bulman et al (1968), which was conducted in 1962, reported that 83% of the Salisbury 60-64 year olds and 80% of the Darlington 60-64 year olds were edentulous. What appears to have happened since then is that the proportion edentulous has reduced enormously in both areas, although the reduction has been less in Darlington (now 39%) than in Salisbury (now 15%). The differences between the areas in the state of teeth of the dentate population may have been diminished.

<u>The effect of gender on dental health</u>

- The effect of gender on dental health differed between north and south. In both of the northern samples men tended to have fewer teeth, fewer fillings, fewer crowns, more coronal wear, a little more periodontal disease and fewer partial dentures, but more of them were dentate. All this suggests that they have less professional intervention in their oral health. In Salisbury almost all of these differences were much reduced, and in some cases eliminated or reversed. It is probably not a co-incidence that far more women than men are regular or occasional attenders in the northern areas, whilst in Salisbury there is little difference.

<u>The effect of social class on dental health</u>

- Generally the oral health of manual workers and their families was poorer than that of non-manual workers.

- Far more manual workers than non-manual workers were edentulous in all areas, and unskilled manual workers (social classes IV and V) had a far higher proportion edentulous than skilled manual workers (social class IIIm).
- Among the dentate samples, manual workers tended to have more decayed and fewer filled teeth, and fewer crowns although often more sound teeth as well. There was also a slight tendency to more coronal wear in this group, slightly more advanced periodontal attachment loss and (except in Salisbury) fewer partial dentures. The finding that there were fewer fillings and more sound teeth in spite of higher levels of decay indicate that some of the difference may be related to dental attitudes and behaviour, specifically dental attendance patterns.

<u>The effect of dental attendance pattern on dental health</u>

- Only a few of the edentulous attend the dentist for check-ups.
- Where there are social class differences in the dental health of the dentate, these are amplified when the sample is split into those who attend the dentist for check-ups and those who attend only when they have trouble. In all areas far more manual than non-manual workers and more men than women attend the dentist only when they have trouble. In addition more of the Darlington and Richmondshire samples attended only when they have trouble than those in Salisbury. It is attendance pattern and related attitudes and behaviours, which probably underpin many of the gender, social class and even geographical differences seen in the dentate.

Objective 2.

To collect data on the attitudes, demands and barriers to dental care among older adults and to review the effect of geographic and social factors on these.

- The edentulous in this study had, on average, been in this state for about 30 years. The mean age of their present dentures was about 14 years, which suggests a high degree of acceptance of their dentures. The mean age of dentures increased markedly in the oldest age-band.

- Discomfort and functional problems were common in the edentulous. 63-72% of the reweighted samples had some oral discomfort or ulceration.
- Despite the discomfort and functional problems only about 10% of the edentulous were dissatisfied with their dentures. The main problems were diet restriction and difficulty with hard foods. Very few subjects complained about aesthetics. There were no marked inter-area differences.
- The proportion of the edentulous who were dissatisfied varied with number of denture faults, but the relationship was weak. The difference in the proportion of those dissatisfied between the subjects with the best dentures and the worst dentures (as assessed by a dentist) was small. The majority of those with the poorest dentures were satisfied.
- 33-40% of the edentulous samples said they found dentistry expensive or very expensive. This proportion fell in the oldest age-band, but this may simply reflect their infrequent attendance and hence a lack of knowledge of fees.
- The dentate were generally poor at assessing whether or not they needed treatment.
- The proportion of the dentate who had suffered toothache or sensitivity of their teeth in the previous four weeks was as high as 10% for toothache and nearly 25% for sensitivity.
- There were few changes in frequency of tooth brushing with increasing age, suggesting that the habit of tooth brushing does not alter much with age.
- The proportion of the dentate population who would not be upset at losing all of their teeth was similar in all three areas, particularly for the older age groups, and there was an indication of an increase in this proportion with age. Only 11-19% of the dentate samples expected to become edentulous.
- Almost 9 out of 10 dentate people obtained their treatment on the NHS with a patient's contribution.
- 40-50% of the dentate samples said that they found dental treatment expensive or very expensive.
- A fifth to a quarter of the total dentate sample had experience of a partial denture which could

not be or was not worn, representing a considerable waste of dentists' effort.

- Only 5% of the dentate sample were dissatisfied with the function of their teeth - there were no large differences among age groups or areas.
- For those dentate people who were dissatisfied the two major problems were diet restriction and aesthetics; very few expressed dissatisfaction with masticatory function. The edentulous on the other hand were more likely than the dentate to be satisfied with aesthetics, but less likely to be satisfied with masticatory function.
- The most frequent barrier amongst non-attenders was that they "didn't need to" attend. This attitude increased markedly with age in all 3 areas. The other frequently reported barriers were "fear", "too expensive" and "can't be bothered".
- The single most important reason for non-attendance - accounting for about 60% of the non-attenders - was that they considered they didn't need to go to the dentist.

The effect of geography

- Around a third of the edentulous subjects in Darlington and Richmondshire became edentulous under the age of 40 years. In Salisbury the figure was only 14% overall.
- There were regional differences in treatment preferences, such that even non-attenders in Salisbury were more likely to choose restoration than their northern counterparts.
- There was little geographic variation in the frequency of various symptoms. However, the proportion reporting loose teeth was highest in Richmondshire, lowest in Salisbury, reflecting the examination findings.
- The proportion of the dentate sample who attend only when having trouble increased with age in both Richmond and Salisbury, but not in Darlington. Overall there were more non-attenders in the northern areas than in Salisbury, this was mostly accounted for by differences in the proportions of non-manual workers who were non-attenders.
- There were inter-area differences in the reported frequency of tooth brushing. 12% said they brushed less than once and 42% said they brushed twice (or more) daily in Richmondshire, compared with 5-6% for less than once and 60-70% for twice or more in Salisbury and

Darlington.

- There was little geographical variation in the percentage who said that they would be upset at the thought of becoming edentulous, although the figure for 60-64 year olds in Darlington (31%) stood out as being unexpectedly high. More subjects in Darlington expect to become edentulous than in the other areas (fewest in Richmondshire). There may still be a cultural acceptance of edentulousness amongst some groups in the north of England.
- 7% in Salisbury and Richmondshire paid for dental treatment privately or by means of insurance, compared with 3% in Darlington.
- The non-attenders in Darlington reported the most barriers to care and reasons for non-attendance, Richmondshire the least. Even in rural Richmondshire where travel can be difficult, only a tiny percentage reported difficulty with travel as a major barrier.

The effect of gender, social class and dental attendance pattern

- The variation in attitudes, demands and barriers according to gender and social class were probably closely linked to attendance pattern. More males and manual workers were dental *non-attenders* than females and non-manual workers. Males, manual workers and non-attenders were all more likely to opt for extraction rather than restoration, not be upset at the prospect of edentulousness and to expect to become edentulous. The gender differences were generally smaller in Salisbury

Objective 3.

To investigate the relationship between the presence, number and distribution of teeth and partial dentures, and levels of satisfaction and function.

- All of the variables relating to problems with eating were significantly associated with number of missing teeth or posterior tooth contacts.
- The relationships between number of teeth or posterior contacts and variables measuring ability to eat and dissatisfaction with the ability to eat appear to be linear. However the presence of

partial dentures confounds the relationship.

- The relationship between the number of teeth and the presence of partial dentures is non-linear. Where there are less than 17 teeth nearly 80% of subjects wear dentures, where there are over 24 teeth there are only 5%.
- Anterior spaces, the number of teeth and the number of posterior contacts were the key correlates with partial denture wearing when tested using a logistic regression model.
- 19-25% of all dentate subjects had had a partial denture made at one time which they could not, or did not, wear. Those with anterior spaces were much more likely to be the ones who now wore a denture, those with no anterior space generally did not.
- Partial dentures appear to increase the risk of dental disease, specifically root surface caries. The odds of having root surface caries are nearly doubled where partial dentures are worn, even when measures of disease history are taken into account.
- If partial dentures are to be avoided and a functional and aesthetic dentition are to be maintained for life, a minimum of 20-24 teeth and 4 posterior contacts would seem a reasonable goal.

Objective 4.

To identify goals for oral health in the elderly and to identify the factors, clinical and sociological, which may need to be addressed in order to achieve these goals.

- Oral health can only be achieved if the population are generally satisfied with their oral condition.
- A long term view of oral health is required such that a satisfactory natural dentition must be sustainable throughout life.
- Using a logistic regression model, satisfaction with the ability to eat and with the appearance of the teeth were found to be the principal influences on overall satisfaction with the oral condition. Satisfaction with the ability to eat and the presence of difficulties eating are, in turn, influenced by the number of teeth or contacts, various symptoms (mobile teeth, sensitivity), periodontal disease and untreated dental caries as well as a number of socio-demographic

variables. The risk factors for dissatisfaction with aesthetics include the presence of anterior spaces, a variety of socio-demographic variables and the presence of decayed or periodontally involved teeth.

- A population which is completely satisfied with its oral condition is probably an impossible objective, but by identifying the factors which contribute to dissatisfaction, appropriate goals and criteria for oral health can be identified.
- The list of oral health goals for the elderly which are given include requirements for number of teeth, contacts, anterior spaces, clinical disease, symptoms and satisfaction.
- The goals identified are already out of reach for the majority of the current over 60 year olds, even those in the 60-64 year old group, but would be an appropriate target for the present 30-60 year olds in the UK as they age.

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APPENDICES

Appendix 1

Letter sent to all General Medical Practitioners from whose lists the sample was drawn

UNIVERSITY OF
NEWCASTLE UPON TYNE

Appendix 1

The Dental School

Framlington Place
The University
Newcastle upon Tyne NE2 4BW

Dean of Dentistry
Professor Roy Storer

G.P. name
Address

Dear (name)

The Dental Status, Needs and Demands of the Elderly in Three Different Communities

I am writing to you as a medical practitioner in Salisbury to inform you of this important study. The study has been funded by the Department of Health as part of its Primary Health Care Initiative. It is being conducted by a team of investigators from the University of Newcastle upon Tyne assisted by dental officers from the community dental service in each area. Salisbury has been chosen as one of the areas to be studied. It is likely that up to 20% of the patients aged 60 years and over on your list will be selected during the sampling procedure.The study has received ethical approval from the ethical committees of the University and each of the districts concerned, and the LMC and LDC have been informed.

With the consent of the individual concerned, each subject will be visited at home where a straightforward interview and dental examination will be conducted. The data collected will be used to identify areas of dental need so that resources can be planned appropriately for the future.

Our reasons for contacting you are two-fold:

1. To ensure that all general practitioners whose patients are likely to be involved in the study are fully informed about the study and the reasons for it. To this end a short summary is enclosed
2. A high response rate is critical in an epidemiological study of this kind, and the support of the subjects' general practitioners can increase the response rate by up to 10%. The study organisers would greatly appreciate your co-operation in the form of a standard letter of support which we could copy and enclose with our introductory letter to those individuals who are your patients.

Telephone · 091 222 6000 Ext 8347
Fax · 091 222 6137
Telex · 53654 (UNINEW G)

One of the study team will be in contact in the near future to discuss the matter further and to answer any questions that you may have.

Yours sincerely,

A.W.G.Walls PhD BDS FDSRCS(Eng)
Senior Lecturer and Honorary Consultant

Appendix 2

Letter sent to secretaries of Local Medical Committees

UNIVERSITY OF
NEWCASTLE UPON TYNE

Appendix 2

The Dental School
Framlington Place
The University
Newcastle upon Tyne NE2 4BW
Dean of Dentistry
Professor Roy Storer

Secretary, L.M.C.
Address

Date

Dear Dr (name)

I am writing to you regarding a proposed epidemiological study of the dental status, needs and demands of the elderly in three areas of England. The research has been funded by the Department of Health as part of their Primary Health Care Initiative, and the work will be carried out by a team from Newcastle University with help from appropriately qualified community dental officers from the regions involved.

The study will look at around 800 subjects over the age of 60 years in each of three areas, one of these areas will be Richmondshire, North Yorkshire. The sample will be drawn from the computerised patient register of the local FHSAs.

I enclose a brief description of the study and would be most grateful if you would draw the attention of the LMC to this research. We would be very happy to answer any questions that the committee may have.

I look forward to hearing from you.

Yours sincerely

J.G.Steele
Lecturer in Operative Dentistry.

Telephone · 091 222 6000 Ext 8347
Fax · 091 222 6137
Telex · 53654 (UNINEW G)

Appendix 3

Letter sent to secretaries of Local Dental Committees

UNIVERSITY OF
NEWCASTLE UPON TYNE

Appendix 3

The Dental School
Framlington Place
The University
Newcastle upon Tyne NE2 4BW
Dean of Dentistry
Professor Roy Storer

Secretary, L.D.C.
Address

Date

Dear (name)

As you may already know, a team from the dental school at Newcastle upon Tyne is planning to undertake a large epidemiological study of the dental status of the elderly in three areas of England. One of the areas in which we will be collecting data is (name as appropriate).

Clearly, the co-operation of the L.D.C. would be most helpful. and I enclose a brief description of the study. A full protocol could be sent if you wish , but it is becoming an increasingly bulky document.

I would be most grateful if you could draw the attention of the L.D.C. to this study. We would be very happy to answer any questions the committee may have. I look forward to hearing from you.

Best wishes,

Yours sincerely,

J.G.Steele
Lecturer in Operative Dentistry.

Telephone · 091 222 6000 Ext 8347
Fax · 091 222 6137
Telex · 53654 (UNINEW G)

Appendix 4

Information sheet sent with letters (Appendices 1 to 3)

Appendix 4

THE DENTAL STATUS, NEEDS AND DEMANDS
OF THE ELDERLY IN THREE DIFFERENT COMMUNITIES

OUTLINE

The Dental School at the University of Newcastle upon Tyne has been awarded a research grant by the Department of Health to look at the dental status, needs and demands of the elderly in three different communities, Darlington (to represent an urban area in the north of England), Richmondshire (to represent a rural area), and Salisbury (to represent an urban area in the south of England).

The objectives of this study are to provide data to help to plan for the dental needs of an ageing population, and to investigate the influence of social, geographic and demographic factors on dental health. In addition we will investigate a number of specific concepts of clinical significance, particularly the concept of the "shortened dental arch" as it applies to the elderly.

The study will collect data from 800 randomly selected subjects in each area who will be visited in their homes for the purpose. The visit will comprise a clinical examination and a questionnaire led interview. The clinical data will cover coronal- and root-surface caries, periodontal disease, tooth wear, dentures and soft tissue pathology. The questionnaire will attempt to establish the subjects own assessment of their dentition, their dental attendance pattern and the sort of things that influence this, as well as some relevant aspects of general health, mobility and disability which may influence dental health. The examinations will be carried out either by a dentist from the Newcastle Dental School (Mr J.G.Steele), or a Senior Community Dental Officer calibrated for the purpose.

A report of the study will be prepared for the DoH. The study is purely epidemiological and involved with data collection, no advice or treatment will be offered by the examiners. Subject confidentiality will be maintained at all times, and for the purposes of computer analysis and storage, each subject will be represented by a code number.

Copies of a full protocol may be obtained from:

Mr J.G.Steele
Department of Operative Dentistry,
Dental School,
Framlington Place,
Newcastle upon Tyne,
NE2 4BW.

Principal Investigators: Mr J.G.Steele
Dr A.W.G.Walls
Professor J.J.Murray
Professor A.Rugg-Gunn
Professor I.E.Barnes

Appendix 5

Letter sent to subjects whose names were drawn in the original sample

UNIVERSITY OF
NEWCASTLE UPON TYNE

Appendix 5

The Dental School
Framlington Place
The University
Newcastle upon Tyne NE2 4BW
Dean of Dentistry
Professor Roy Storer

Subject's name
Address

Date as postmark

Dear (subject's name),

I am writing to you to ask for your help. The Department of Health has asked the Dental School of the University of Newcastle upon Tyne to look at the dental health of people over 60 years of age in several areas of the country. This will provide very useful information which will help to plan dentistry over the next few years.

As part of this survey we would like a dentist and dental nurse to visit you at home. They will carry out a simple examination of your mouth and then ask you some questions relevant to your teeth or dentures. There is no treatment involved at all.

A member of the research team will contact you in the next few weeks to ask you if you are willing to take part in this study and to try to arrange a mutually acceptable time for this visit. There is, of course, no obligation for you to help in this way, but we really would be most grateful for your assistance.

Yours sincerely,

Dr AWG Walls
Professor JJ Murray

Telephone · 091 222 6000 Ext 8347
Fax · 091 222 6137
Telex · 53654 (UNINEW G)

Appendix 6

Questionnaire sent to subjects who refused to be visited.

Appendix 6

Please <u>**TICK THE APPROPRIATE BOX**</u> in answer to each of the two questions below and return it in the stamped envelope provided.

1. **Do you have any of your own NATURAL teeth left (even if it is only one) or not? (tick the appropriate box)**

	- One or more natural teeth	☐
or	**- Complete dentures and NO NATURAL teeth**	☐

2. **In general, do you the visit the dentist for ....**

	- Regular/occasional check-ups?	☐
or	**- Only when you have trouble/never?**	☐

Other comments/complaints:

Thank you very much for your help.

From J.G.Steele, Dental School, University of Newcastle upon Tyne.

Appendix 7

Covering letter to go with questionnnaire to refusers.

UNIVERSITY OF
NEWCASTLE UPON TYNE

Appendix 7

The Dental School
Framlington Place
The University
Newcastle upon Tyne NE2 4BW
Dean of Dentistry
Professor Roy Storer

Name of refuser,
Address

Date as postmark

Dear (name),

Some months ago we wrote to you to ask for your help with a Government survey of dental health. You felt unable to take part, and we appreciate your reasons for this.

As this is a study of the population, it is important that we know **two simple facts about the people who did not agree to be seen,** specifically whether you have any teeth or not and whether or not you are a regular dental attender. Without this information the results from the rest of the survey will be much less useful to the community and the health care services.

The sheet enclosed is completely anonymous, we do not need to know who you are at all. The 4 digits at the top of your sheet are the first four digits of your postcode to identify roughly which area you are from. We would urge you to please answer the two simple questions on the form and return it to us in the stamped envelope provided. Please feel free to add any further comments you wish in the space provided. **No further contact will be made.**

Many thanks for your help.

Yours sincerely

Dr A.W.G.Walls

Telephone · 091 222 6000 Ext 8347
Fax · 091 222 6137
Telex · 53654 (UNINEW G)

Appendix 8

Consent form for the examination and interview (completed by all subjects)

Appendix 8

THE DENTAL STATUS NEEDS AND DEMANDS OF THE ELDERLY IN THREE COMMUNITIES

I, ...,

of...
..
..

consent to have my mouth examined by a dentist and be interviewed as part of the above study which has been explained to me by Mr/Mrs/Miss ....

I understand that I am free to withdraw from the survey at any stage, should I so wish. I also understand that the examiner cannot reveal the findings of the examination to me, or anybody not involved in the study except in exceptional circumstances.

Date / / signed ....subject

Date / / signed ....dentist

Appendix 9

Instruments and equipment used for the examination

Appendix 9

List of equipment used in the survey.

For each examination:

Sickle probe with size 54 removable tip*
Size 4 plane mouth mirror
CPITN Type C
Alma Gauge
Willis Gauge
Petzel Head Torch plus batteries
Rubber gloves
Paper towels
Tissues
Alcohol wipes

* The removable tips had their points standardised to 0.2 mm diameter.

Appendix 10

Form used for all visits.
Note that this includes questionnaire followed by examination form

Appendix 10

This is a confidential document concerning the dental status and attitudes of individuals taking part in a study of a sample of people in three areas of England.

PERSONAL DETAILS

(To be answered by all patients)

Name:

Date of Birth: / /

Address:

Postcode (MUST COMPLETE) | | | | | | | |

Area: Darlington / Richmondshire / Salisbury

I.D.No.

Date of Examination: / /

This top sheet should be removed and stored in a locked cupboard.

Section 1: General Details and Medical Health

(This section should be answered by all patients, dentist to interview)

I.D.Number		4
Record Number		6
Age * ON 1/1/92 *		8
Sex		9
Postcode		16

This section concerns your general medical health. I am asking you these questions because some medical conditions influence your mouth and teeth.

1. **Do you have anything wrong with your heart that you know of ?**

   Yes - 1
   No - 0 — 17

   If YES, what is the problem (keep brief) ?

2. **Have you ever had rheumatic fever or St Vitus dance that you know of**

   Yes - 1
   No - 0 — 18

3. **Have you ever had Hepatitis that you know of ?**

   Yes - 1
   No - 0 — 19

(If YES, probe to establish type if possible)

4. **Have you ever had arthritis or rheumatism that you know of ?**

   Yes - 1
   No - 0 — 20

5. **Do you have a replacement hip or knee joint?**

   Yes - 1
   No - 0 — 21

6. **Have you ever had swelling of any joint that you know of ?**

   Yes - 1
   No - 0 — 22

7. **Do you wake up with stiffnes or aching in your joints or muscles ?**

   Yes - 1
   No - 0 — 23

8. **Are you troubled by a dry mouth at all ?**

   Yes - 1
   No - 0 — 24

   If Yes, what do you do to relieve it?

9. **Are you troubled by dry or gritty eyes at all ?**

Yes - 1
No - 0 ☐ 25

10. **Do you take any tablets or medicines which you have been on for more than a month ?**

Yes - 1
No - 0 ☐ 26

If YES, What are they (list and <u>mark box</u>)?

no drugs with known xerostomic effect - 0
one or more drugs with a known xerostomic effect - 1 ☐ 27

I would now like to ask you some questions about your overall health and how well you manage.

11. **Would you say that your general health is excellent for your age, good for your age, fair for your age or poor for your age?**

Excellent - 1
Good - 2 ☐ 28
Fair - 3
Poor - 4

12. **Do you have any long standing illness, disability or infirmity. By long standing I mean anything that has troubled you over a period of time.**

Yes - 1
No - 0 ☐ 29
Other (specify) - 9

If YES, What is the matter with you? (record verbatim)

Does this illness or disability limit your activities in any way?

Yes - 1
No - 0 ☐ 30
Other (specify) - 9

14. Here are a few things that some people have difficulty with. Do you have any difficulty with.........(if no difficulty - code 1)

If YES, can you do it on your own (code 2)or are you not able to do it at all alone (code 3)?

Tying a good knot in a piece of string	☐	31
Getting on a bus	☐	32
Reaching an overhead shelf	☐	33
Doing heavy housework	☐	34
Going shopping and carrying heavy bags	☐	35
Preparing and cooking a hot meal	☐	36
Cutting own toenails	☐	37
Washing all over	☐	38

15. Are you able to leave the house unassisted, only with assistance, or do you never leave the house?

Unassisted - 1
Only with assistance - 2 ☐ 39
Never leave home - 3

I would now like to have a look in your mouth. The examination should be comfortable for you, please let me know if you are in any discomfort.

Before I look in your mouth with rubber gloves on, can I just check that you are not allergic to rubber?

EXAMINATION (see sheets at end)

Thank you very much for letting me examine your mouth. I am now going to hand over to ... who will ask you some questions about your teeth. I have some paperwork to sort out now so I shall go back to the car. Thank you again.

INTERVIEWER CHECK WITH EXAMINER

Does the patient have any natural teeth?

Both jaws - 1
upper jaw only - 2
lower jaw only - 3
neither jaw (completely edentulous) - 4

40

Does the patient have a full denture (plate) to replace all the teeth in one or both jaws (even if not regularly worn)?

both jaws (complete set) - 1
upper only - 2
lower only - 3
neither jaw (no dentures) - 4

41

Section 2. (For subjects who are edentulous in at least one arch)

For subjects who have complete dentures:

I would now like to ask you some questions about your (complete) dentures (teeth).

1. **How old were you when you first had some false teeth ?**

age in years

43

2. **How long ago did you get your present top/bottom plate ?**

Insert age in years uing two digits
can't remember, don't know - 99

Upper Lower 47

3. **How many top/bottom dentures have you ever had?**

1denture - 1
2-3 dentures - 2
4-5 dentures - 3
6+ dentures - 4

Upper Lower 49

About your present dentures:

4. **Overall, how satisfied have you been with the comfort of your dentures over the last three months?**

Very satisfied - 1
Reasonably satisfied - 2
Not very satisfied - 3
Completely unsatisfied - 4

50

5. **Do you have any discomfort or trouble with your dentures when you are eating?**

Always - 1
Sometimes - 2 ☐ 51
Never - 3

6. **Do you ever get ulcers or painful spots under your dentures?**

Always - 1
Sometimes - 2 ☐ 52
Never - 3

7. **How satisfied are you with your ability to speak with your dentures in?**

Very satisfied - 1
Reasonably satisfied - 2 ☐ 53
Not very satisfied - 3
Completely unsatisfied - 4

8. **Do you use denture fixative?**

Always - 1
Sometimes - 2 ☐ 54
Never - 3

If sometimes

for eating only - 1
socially - 2 ☐ 55
both - 3

9. **When do you wear your upper/lower denture?**

For eating only - 1
Socially only - 2 **Upper** **Lower**
Both of the above - 3 ☐ ☐ 57
All day - 4
All night - 5
All day and all night - 6
Never - 7
Other - 8

If NEVER, Have you ever had a denture which you could wear in the upper jaw? ....the lower jaw? **Upper** **Lower** 59
Yes - 1 ☐ ☐
No - 0

Only for subjects who have NO remaining natural teeth

10. How many years ago did you lose the last of your natural teeth?

Insert number of years in double digits
Don't know / Can't remember - 99 [ ][ ] 61

How old were you then?

age in years [ ][ ] 63

11. Did you expect to lose them around then or were you surprised to lose them at that age ?

expected - 1
surprised - 2 [ ] 64
don't know - 9

12. Did you find losing the last of your natural teeth and having full dentures ...

very upsetting? - 1
a little upsetting? - 2 [ ] 65
not at all upsetting? - 3
or did you never have full dentures? - 4

Section 3.(Dentate subjects)

(To be answered by subjects with some natural teeth, interview after clinical examination)

1. How well do you manage with the teeth that you have got ?

Very well - 1
Satisfactory - 2 [ ] 66
Not very well - 3

2. Have your gums bled at all in the last 4 weeks, for example when you brush them ?

Always - 1
Often - 2 [ ] 67
Sometimes - 3
Never - 4

3. Are any of your teeth loose at all, or not ?

Loose - 1 [ ] 68
Not - 0

4. **Have you had any sensitivity to hot or cold things from your teeth in the last four weeks, or not ?**

A lot - 1
Some - 2
None - 3 ☐ 69

5. **Have you had any other pain or toothache from your teeth or gums in the last four weeks, or not ?**

Yes - 1
No - 0 ☐ 70

6. **Do you put sugar in tea ?**

Yes - 1
No - 0 ☐ 71

7. **Do you put sugar in coffee ?**

Yes - 1
No - 0 ☐ 72

I would like to ask you some questions about the way that you clean your teeth:

8. **How often do you clean your teeth nowadays ?**

Never - 1
less than x1 daily - 2
x1 daily - 3
x2 daily - 4
more than x2 daily - 5
Other (specify) - 6 ☐ 73

9. **Nowadays there are more things available in chemists shops to help with dental hygiene. Do you use anything, other than an ordinary toothbrush and toothpaste for dental hygiene purposes?**

Yes - 1
No - 0 ☐ 74

If YES, what? ☐

10. **Do you have a partial denture which you usually wear ?**

Yes - 1
No - 0 ☐ 75

If YES, is it

Upper - 1
Lower - 2
Both - 3 ☐ 76

How long ago did you get your present partial denture (plate)

years [ ][ ] — 08

New record

Do you usually wear your partial denture to eat ?

Yes - 1
No - 0 [ ] — 09

Why do you wear your partial denture ?

Because your dentist advised it - 1
Because it improves your appearance -2 [ ] — 10
Because it helps you eat - 3
Other - 4

If subject is dentate in both arches (i.e. section 3 has NOT been completed)...

How old were you when you first had a denture ?

years [ ][ ] — 12

11. Have you ever had a partial denture made which you could not or did not wear regularly ?

Yes - 1 [ ] — 13
No - 0

Section 4.(All subjects)

(The questions in this section should be answered by all subjects).

1. Talking about both your natural teeth and/or your dentures, on the whole, how satisfied are you with your teeth ?

Very satisfied - 1
Reasonably satisfied - 2 [ ] — 14
Not very satisfied - 3
Completely unsatisfied - 4

2. How satisfied are you with the appearance of your teeth ?

Very satisfied - 1
Reasonably satisfied - 2 [ ] — 15
Not very satisfied - 3
Completely unsatisfied - 4

If unsatisfied or not very satisfied, **What is it that makes you not satisfied?**

3. How satisfied are you with your ability to bite and chew your food?

Very satisfied - 1
Reasonably satisfied - 2 [ ] — 16
Not very satisfied - 3
Completely unsatisfied - 4

4. **Is there any food which you would like to eat but which you cannot eat because of difficulty biting or chewing it ?**

Yes - 1
No - 0 ☐ 17

If YES, is this because of pain or discomfort with your natural teeth, loose or painful dentures or something else ?

Pain/discomfort of natural teeth - 1
Loose/painful dentures - 2 ☐ 18
Other (specify) - 3

If YES, what sort of food are you unable to eat ?

5. **How easy do you find it to bite and chew hard foods, such as toast or apples ?**

Very easy - 1
Minor difficulties - 2 ☐ 19
Not very easy, but possible - 3
Impossible - 4

6. **Have problems with your teeth made you change the way you prepare your food recently ?**

Yes - 1 ☐ 20
No - 0

7. **Do problems with your teeth affect the way that you speak ?**

Yes - 1 ☐ 21
No - 0

8. **Do you have any discomfort or dryness in your mouth, other than toothache or sensitivity, these days ?**

Yes - 1 ☐ 22
No - 0

If YES, is it:

Dryness	☐	Yes = 1	23
Burning	☐		24
Pain/aching	☐	No = 0	25
Other (specify)	☐		26

Does it affect;

Tongue	☐	Yes = 1	27
Lips/cheeks	☐		28
Jaw(s)	☐	No =0	29

9. **Do you have any pain in your jaw joint (indicates) these days ?**

Yes - 1 ☐ 30
No - 0

10. Do you suffer from regular headaches ? (including migraine)

Yes - 1
No - 0 ☐ 31

Section 5. (Dentate subjects only)

(The next six questions should be answered by dentate patients only).

I would like to ask you some questions about the sorts of things you would like a dentist to do to your teeth.

1. If you went to the dentist tomorrow, do you think that you would need any treatment or not?

Yes - 1
No - 0 ☐ 32

2. If you went to a dentist with an aching back tooth, would you prefer the dentist to take it out or fill it?

Take it out - 1
Fill it - 2 ☐ 33

3. If the dentist said a front tooth would have to be taken out or crowned, what would you prefer?

Taken out - 1
Crowned - 2 ☐ 34

4. If the dentist said a back tooth would have to be taken out or crowned, what would you prefer?

Taken out - 1
crowned - 2 ☐ 35

5. If you had several missing teeth at the back would you prefer to have a partial denture or manage without?

Partial denture - 1
Manage without - 2 ☐ 36

6. Do you find the thought of losing all your own teeth and having full dentures...

... very upsetting ? - 1
a little upsetting ? - 2
not at all upsetting ? - 3 ☐ 37

7. Do you think that at some time you will have full dentures, or do you think that you will always have some natural teeth ?

Full dentures - 1
Always dentate - 2
Dont know - 3 ☐ 38

Section 6. (All subjects)

(The next section should be answered by ALL patients).

The next two sections ask some questions about visiting the dentist.

1. Thinking about the dental practice you went to last time, had you been there before or was that your first time at that practice.

been before - 1 ☐ 39
first time - 2

If "been before", please answer the next four questions

For about how many years have you been going to that dental practice

< 1year - 1
1 to <2 years - 2
2 to <5 years - 3 ☐ 40
5+ years - 4
Don't know, can't remember - 9

How easy is it to get an appointment with your dentist ?

Very easy - 1
Reasonably easy - 2 ☐ 41
Not very easy - 3
Difficult - 4

How far do you travel to see your dentist ? (n.b. one way)

< $^1/_2$ mile - 1
1/2 - 1 mile - 2
1 - 2 miles - 3
2+ - 5 miles - 4 ☐ 42
5+ - 10 miles - 5
10+ - 20 miles - 6
20+ - 30 miles - 7
30+ miles - 8
Other - 9

Do you have any problems getting to your dentists surgery?

Yes - 1 ☐ 43
No - 0

If YES, would you like to tell me what they are ?

2. How did you choose this particular dental practice

convenience/nearest - 1
recommended - 2
family dentist -3 ☐ 44
Other - 4
Dont know - 9

3. **The last time you went to the dentist what made you go? Was it because you had some trouble with your teeth, for a check up or for some other reason?**

Trouble - 1
Check-up - 2
Other - 3

45

4. **In general, do you go to the dentist for...**

... regular check-ups - 1
occasional check-ups - 2
or only when you are having trouble with your teeth - 3

46

For IRREGULAR ATTENDERS (those who go to the dentist only with trouble)

Why is it that you only visit the dentist when you have trouble / never visit the dentist (more than one answer is acceptable)

1) dont need to	Yes = 1	47
2) too expensive		48
3) dislike or fear of the treatment		49
4) too far to travel	No = 0	50
5) Can't be bothered		51
6) other (specify)		52

Which of the above is the MOST important reason (1 - 6, as above). 53

Section 7. (All subjects)

(This section should be answered by all subjects).

1. **When you have dental treatment, do you usually receive all treatment free of charge under the NHS, do you pay a part of the cost under the NHS, do you pay for all the treatment yourself (privately) or is it under insurance or some other arrangement.**

NHS free - 1
NHS + contribution - 2
Private - 3
Insurance - 4
Other - 5
Dont Know - 9

54

If treatment normally PRIVATE

Why do you normally seek private treatment ? (record the most important reason)

Is it because you feel that the treatment is better? - 1
or because you feel that it is easier to get an appointment? - 2
or because your dentist does not offer NHS treatment? - 3
or something else? (specify) - 4

55

2. About how long ago was your last visit to the dentist?

<1 year - 1
over 1, up to 2 years - 2
over 2, up to 3 years - 3
over 3, up to 5 years - 4
over 5, up to 10 years - 5
over 10, up to 20 years - 6
over 20 years - 7
Don't know, can't remember - 9

56

3. At your last visit, did you have your treatment carried out free of charge under the NHS, did you pay part of the cost under the NHS, did you pay for all the treatment yourself (privately) or was it under insurance or some other arrangement.

NHS free - 1
NHS contribution - 2
Private - 3
Insurance - 4
Other (specify) - 5
DK - 6

57

4. Did the treatment at your last visit cost...

...more than you expected ? - 1
about what you expected ? - 2
less than you expected ? - 3
Other ? - 4
Don't know ? - 5

58

5. In general do you think that dental treatment is ...

...very expensive ? - 1
expensive ? - 2
value for money ? - 3
or inexpensive ? - 4
Dont know ? - 5

59

Section 8.(All subjects)

(This section should be answered by all subjects).

The next section asks some questions about your dentist and yourself ?

1. **Have you ever had problems getting dental treatment when you needed it?**

Yes - 1
No - 0 60

if YES, what were these problems ?

2. **Do you think it is possible for a dentist to visit people in their homes to carry out treatment ?**

Yes - 1
No - 0 61
Don't Know - 9

3. **Have you ever tried to get a dentist to see you at home ?**

Yes - 1 62
No - 0

If YES, what treatment did you receive ?

If No, do you think that it would be helpful for a dentist to see you at home ?

Yes - 1
No - 0 63
Don't know - 9

4. **Is there anything else you would like to say about dentistry or your own dentist that has not already been covered ?**

Section 9. (All subjects)

I would now like to ask you a couple of general questions.

1. **Thinking of your full time education: What type of school or college did you last attend full time ?**

Elementary/secondary school - 1
College/University - 2 ☐ 64

2. **Do you rely entirely on the state pension/state benefits or do you have any private income (e.g.company pension, shares) over and above your state pension and other state benefits?**

Yes - 1
No - 0 ☐ 65

Finally I would like to ask you three of questions about your marital status and past employment.

3. **Are you ...**

Married - 1
Widowed - 2 ☐ 66
Divorced - 3
Single - 4

4. **Are you retired from regular paid work?**

Yes - 1 ☐ 67
No - 2

5. **What was your (if male or single female)/ your husbands last full time job?**

If the respondent is a woman who was widowed or divorced at an early age and it is felt that husbands last main job is inappropriate, then record the respondents last full time job. If the respondent has always been single and lived with relatives for most of their life, without employment, then record occupation of head of household over that period.

Social Class

I - 1
II - 2
IIInm - 3 ☐ 68
IIIm - 4
IV - 5
V - 6

DECAYED, MISSING AND FILLED SURFACES

UPPER

	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
03 D																	
04 O/I																	
05 M																	Crown
06 B																	
07 L																	
08 D																	
09 M																	Root
10 B																	
11 L																	

LOWER

	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
12 D																	
13 O/I																	
14 M																	Crn
15 B																	
16 L																	
17 D																	
18 M																	
19 B																	Rt
20 L																	

TOOTH WEAR

UPPER

	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
21 C																
22 B																
23 O/I																
24 L																

LOWER

	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
25 C																
26 B																
27 O/I																
28 L																

CODES - Decayed, missing and filled

CROWN		ROOT
Tooth missing	—	Tooth missing
Sound	0	no recession
	1	Recession, sound
Caries, restorable	2	Recession + caries
Carious, unrest/exp.	3	Rcsn + caries, exp.
Restored, needs repl.	4	Restored, nds repl.
Restored, satisfactory.	5	Restored , satis.
Crown,satisfactory	6	Arrested caries
Crown, unsatisfactory	7	
Bridge pontic	8	
Unscorable surface	*	Unscorable

CODES - Tooth Wear

All	- Tooth missing	—
All	- No dentine exposed or minimal cervical loss	0
B/L/O	- Loss of enamel exp. dentine <1/3rd surface	
I	- Loss of enamel just exposing dentine	2
C	- *Definite defect <1mm*	
B/L/O	- exp. dentine > 1/3rd surface	
I	- extensive dentine loss, not to 2^{o} dentine/pulp	3
C	- *Defect 1 - 2mm deep*	
B/L/O	- Complete enamel loss/ exp. 2^{o} dentine/pulp	
I	- 2^{o} dentine/pulp exposure	4
C	- >2mm or exposure of 2^{o} dentine/pulp	
	Cannot be scored due to restoration/disease	*

PERIODONTAL DISEASE

UPPER

	8		7		6		5		4		3		2		1		1		2		3		4		5		6		7		8	
	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M	M	B	M	B	M	B	M	B	M	B	M	B	M	B	M	B
29P																																
30I																																
31C																																
32F																																
33B																																
34M																																

LOWER

	8		7		6		5		4		3		2		1		1		2		3		4		5		6		7		8	
	L	M	L	M	L	M	L	M	L	M	L	M	L	M	L	M	M	L	M	L	M	L	M	L	M	L	M	L	M	L	M	L
35P																																
36L																																
37C																																
38F																																
39B																																
40M																																

CODES - Poc/loa
In mm unless:
10mm W
11mm X
12mm Y

CODES-Calculus
Absent 0
Present 1

CODES-Furcation
None 0
Present, not t & t 1
Through and through 2

CODES-Bleeding
None 0
Present 1

CODES-Mobility
< 1mm horiz. 1
> 1mm horiz. 2
Horizontal & vertical 3

In all cases, where tooth is missing, score – and where a surface is unscorable score *

POSTERIOR CONTACT 41

8	7	6	5	4	4	5	6	7	8

CODES
None = 0
contact = 1

Anterior contact only ? Yes = 1 None = 0

ANTERIOR SPACING

CODES
none = 0
unrestd. = 1
restored = 2

TMJ

Click
Crepitus
Tenderness

CODES
None 0
Unilateral Lt. 1
Unilateral Rt. 2
Both 3

SOFT TISSUES

Angular Cheilitis
Denture Stomatitis I
Denture Stomatitis II
Denture Stomatitis III
Denture Hyperplasia
Ulcer assoc. with Denture
Other

CODES
Unaffected 0
Affected 1
Unrecordable *

Other Lesions

Site: Clinical Diagnosis:

Description:

Follow up Y/N

PARTIAL DENTURES 42

Does the subject have a partial denture which he/she normally wears?

- Upper
- Lower

Yes 1
No 0

Does the Partial Denture replace all missing teeth?

- Upper
- Lower

Yes 1
No 0

Are the tissues affected?

- Upper
- Lower

Yes 1
No 0

Kennedy Class (1 - 4)

- Upper
- Lower

Class I 1
Class II 2
Class III 3
Class IV 4

Are any natural anterior teeth missing which are replaced by the denture?

- Upper
- Lower

Yes 1
No 0

Material	- Upper	Acrylic only 1
	- Lower	Acrylic+clasps 2
		Metal based 3
Support	- Upper	Tissue 1
	- Lower	Tooth only 2
		Both 3
Retention	- Upper	Tissue/friction 1
	- Lower	Clasps 2
		Other 3

COMPLETE DENTURES

Does the patient have a complete denture which he/she normally wears?

- Upper
- Lower

Yes 1
No 0

Ridge form

- Upper
- Lower

Adequate 1
Poor 2

Material - Base

- Upper
- Lower

Acrylic 1
Metal 2
Vulcanite 3
Other 4

Material - Teeth

- Upper
- Lower

Acrylic 1
Porcelain 2

Matching Set

Yes 1
No 0

Occlusal Wear

- Upper
- Lower

Satisfactory 1
Excessive 2
Unrecordable *

Defects

- Upper
- Lower

None 1
Missing anterior teeth 2
Rectifiable (repair/rebase) 3
Requires remake 4

Tooth Position

Upper anterior

Adequate 1
Too anterior 2
Too posterior 3
Unrecordable *

Lower Posterior

Adequate 1
Lingual 2
Unrecordable *

(If lingual is there any cross bite?)

Yes 1
No 0

Adaptation

- Upper
- Lower

Adequate 1
Inadequate 2
Unrecordable *

Retention

- Upper
- Lower

Adequate 1
Inadequate 2
Unrecordable *

Extension

- Upper
- Lower

Adequate/under 1
Overextended 2
Unrecordable *

Occlusal relationship

Adequate 1
Inadequate 2
Unrecordable *

Free way space

Satisfactory 1
Excessive 2
Too little 3
Unrecordable *

Appendix 11

Notes for examiners on drugs regarded as contributing to xerostomia

Appendix 11

List of Drugs Causing Dry Mouth

It is extremely difficult to form a perfect list, as many drugs have been reported as causing a dry mouth, if I was to include every possibility the list would be so long that it would be almost meaningless. Consequently I have attempted to lay down some rules so that only those drugs for which dry mouth is a reasonably frequently recorded side effect are noted.

Drugs which are implicated in dry mouth according to the following sources are included:

1. Sreenby LM and Schwartz SS. A Reference Guide to Drugs and Dry Mouth. Gerodontology 5;2:75-99 (1986). **PLEASE NOTE THAT ONLY DRUGS WHICH ARE ASTERISKED AS FREQUENT CAUSES OF DRY MOUTH ARE INCLUDED.**
2. Lamey P-J and Scully C. Clinical Dentistry in Health and Disease. Volume 2: The Mouth and Perioral Tissues. Ed. Scully C. pp 305-316, Heinemann, Oxford (1989)
3. DPF/BNF (1988-90).

The final Drugs are as follows:

Morphine based analgesics
Anticholinergics (Atropine based drugs)
Tricyclic Antidepressants
MAOIs
Antihistamines
Anti-emetics (Hyoscine, Prochlorperazine, Cyclizine, NOT Metaclopramide)
Anti-Parkinson's Drugs (e.g. Benzhexol)
Anti-psychotics (including Lithium Carbonate)
Centrally acting Hypertensives (Clonidine, L-dopa etc.)
Syympathomimetics (Ephedrine decongestants, Amphetamines and appatite suppressors, systemic bronchodilators - e.g. Theophylline)
Oxprenalol, Pindolol and Acebutolol (Sectral, Betadren). These drugs all have intrinsic agonist activity and therefore are sympathomimetic.

NOTE - THE FOLLOWING ARE NOT INCLUDED

Diuretics
Beta-blockers (except Oxprenalol etc. as above)
Digoxin and related drugs
Benzodiazepines

These drugs and many others have been implicated but their role in dry mouth seems to be sufficiently uncertain or infrequent to exclude them.