# Evaluation of dietary habits of Singaporean post-secondary students

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## Abstract

Adolescence is a period of transition in which the individual changes physically and psychologically from a child to an adult. Relative to other age groups, less is known about the diet of young Singaporeans. The aim of this work was to examine the eating habits of the mid and late adolescents, aged 17 to 21 years old, in Singapore. This age group was selected as they formed the post-secondary cohort in which, they have more autonomy in their food choices and are not bounded by school canteens. Dietary habits were compared between different genders, ethnicities, BMI classes and educational institutes. A particular focus of the study was on diet quality, breakfast intake, out-of-home eating and snacking habits.

Multiple pass 24-h recalls and focus groups were used to examine the dietary habits of participants from an ITE (Institute of Technical Education), JC (Junior College) and POLY (polytechnic). A healthy eating index (HEI-SG) and three models for snacking were developed as part of the work. A total of 507 participants (100 participants each from ITE and JC, 307 from POLY) were recruited for the multiple pass 24-h recalls and six focus groups (36 participants from POLY, of which there were 18 Chinese, 9 Malays and 9 Indians) were conducted.

Overall median HEI-SG scores were low at 47.2 (IQR 16) out of 100 due to an insufficient intake of total fruits, whole fruits, total vegetables, whole grains, dairy products and a high intake of sodium. More than 55% of the energy intake per day (56.58%, IQR 61.4% for female and 56.77%, IQR 52.7% for male) for both genders was contributed from food purchased out of home. It appeared that almost a third of Singaporean post-secondary students in this sample did not consume breakfast. Snacking behavior appeared frequent but estimation of this was hampered by the lack of a universally accepted definition. Three criteria and models for defining a snack were developed and tested. Divergent number of snacks/snackers were obtained, depending on the criterion used.

This is the first study to use the 24-h recall method to assess the dietary intake of late adolescents living in Singapore. Public health strategies to address the low intake of fruits, vegetables, whole grains and dairy products and the high intake of sodium and frequent skipping of breakfast in this population group are recommended.

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## LIST OF ABBREVIATIONS

| Abbreviation | Meaning |
|---|---|
| AHEI | Alternate Healthy Eating Index |
| AJC | Anderson Junior College |
| AMPM | Automated Multiple Pass Method |
| BMI | Body Mass Index |
| BMR | Basal Metabolic Rate |
| EAT | Eating Among Teens |
| EI | Energy Intake |
| FFQ | Food Frequency Questionnaire |
| HDI | Healthy Diet Indicator |
| HEI-SG | Healthy Eating Index for Singaporeans |
| HMSP | Healthy Meals in Schools Programme |
| HPB | Health Promotion Board |
| ID | Identity |
| IQR | Interquartile range |
| IRB | Internal Review Board |
| ITE | Institute of Technical Education |
| JC | Junior College |
| MAR | Mean Adequacy Ratio |
| NHANES | National Health and Nutrition Examination Survey |
| NNS | National Nutrition Study |
| NU | Newcastle University |
| OH | Out of Home |
| OPEN | Observing Protein and Energy Nutrition |
| POLY | Polytechnic |
| RTE | Ready-to-eat |
| S.D. | Standard Deviation |
| SES | Socio-economic status |
| SIT | Singapore Institute of Technology |
| TRAILS | Tracking Adolescents' Individual Lives |
| XENDOS | XENical in the prevention of Diabetes in Obese Subjects |

# Chapter 1 Introduction

## 1.1 Background

Adolescence is the transitional stage which lies between childhood and adulthood. The word adolescence comes from the Latin word *adolescere* which means "to grow" or "grow to maturity". Adolescence, which is usually defined as the time between 10-19 years old (World Health Organisation, 2016a), is a period of growth in which a child changes physically and psychologically into an adult. This rapid, yet complex, growth often requires a high intake of nutrients in order to accomplish the marked physiological and endocrinal changes. Any deficiency in intake of nutrients could possibly affect growth and hinder reproductive capacity (Story, 1992). At the same time, this is perhaps the period in which they want to exercise their personal autonomy most. The influences on the dietary habits of adolescents are multi-factorial – social, physical, environmental, macrosystem and individual (Neumark-Sztainer et al., 1999, Story et al., 2002) .

Adolescents' dietary intake is of concern as studies have suggested that their diet is often high in saturated fat and total fats but low in fruits, vegetables, fiber and calcium-rich foods (Munoz et al., 1997, French et al., 2001). An energy dense but nutrient poor diet will increase their potential of developing obesity and chronic diseases such as heart disease, hypertension, osteoporosis and various types of cancer (Story, 1992). Hence adolescence is a critical life phase in which dietary intake should be studied.

Singapore is made up of three main ethnicities: Chinese (74.3%), Malays (13.3%) and Indians (9.1%) and others (3.2%) (Government of Singapore, 2016). Historically, Chinese in Singapore were from China who migrated to the Southeast Asia countries, such as Singapore, for better job prospects. Singapore was part of Malaysia before gaining its independence in 1965. Malays are an Austronesian ethnic group that predominantly inhabit the Malay Peninsula, eastern Sumatra and coastal Borneo. Similar to the Chinese, the Indians were migrants from India. Cooking methods are influenced by the traditional cooking methods of their ancestors who originally migrated to Singapore. For instance, Chinese food originates from different regions of China each of which differ in their culinary practices, Malay food

from Malaysia and Indonesia, and Indian food from India. Northern Chinese cuisines are often described to be more salty, simple, less vegetables with wheat as the staple food, while the more southern Chinese cuisines are known to be spicier and their great variety of fruit, vegetable, and animal ingredients (Huiping Zuo, 2018). North Indian foods wheat based breads like roti, chapatti, naan, poori, kachori while South Indian foods have more rice based delicacies such as dosa, uttapam and puttu, which are made from fermented batter with rice. The cultural diversity of settlers in Singapore has resulted in the development of a diverse culinary scene in modern times (Sylvia Tan, 2016).

To date, there are limited studies conducted in Singapore examining the dietary habits of late adolescents. The Singapore Health Promotion Board (HPB) conducted the National Nutrition Study (NNS) in 1993, 1998, 2004 and 2010 for the adult population aged 18 to 69 years old using a food frequency questionnaire (Health Promotion Board Singapore, 2016b). Analysis was conducted on the following age groups of 18-29, 30-59 and 60-69 years old, which did not offer insights to the dietary intake, such as the healthy index, breakfast intake and snacking behaviour of the post-secondary school students.

### 1.2 Aim and objectives

The overall aim of this research was to examine the eating habits of the mid and late adolescents, aged 17 to 21 years old in Singapore. This is achieved through the following objectives:

1. To design a healthy eating index and evaluate their overall eating habit;
2. To evaluate their breakfast intake;
3. To evaluate the out of home food consumption;
4. To evaluate their snacking behavior.

The multiple pass 24-h recall was used to collect dietary data while focus groups were used to gather in-depth information on the late adolescents' views on breakfast, consumption of out of home foods and snacking. Weight and height were self-reported. Recruitment of the participants was conducted at an Institute of Technical Education (ITE), Junior College (JC) and polytechnic (POLY) which were all in close proximity to one another. A total of 100 participants were recruited each from the ITE

and JC. Three hundred participants were recruited from the POLY with equal numbers in terms of gender and ethnicity.

### 1.3 Organization of the thesis

Chapter 2 describes an overall literature review of adolescents and their associated dietary issues. Chapter 3 details the approach and methodology deployed in this study including recruitment of the participants, tools used for dietary assessment and handling of data.

Chapter 4 focuses on the development of a healthy eating index (HEI-SG) and its subsequent use to analyse to evaluate the eating habits of adolescents aged 17 to 21 years old. Chapter 5 describes the breakfast consumption which includes the types of food and beverages, the location and frequency of breakfast consumption. Focus groups were conducted to gain greater understanding of mid and late adolescents' perceptions of breakfast. Chapter 6 illustrates the contribution of out of home (OH) foods to the overall diet which includes the frequency of having OH foods, the reasons for having OH foods and how they decide which OH foods to purchase.

In Chapter 7, four models which comprised three commonly used criteria of snacking, were derived to evaluate the number of snacking occasions and the contribution of snacks to the overall energy intake. Chapter 8 concludes the thesis and provides the overall strengths and limitations of the research approach undertaken and also provides recommendations for future studies.

# Chapter 2 Literature Review

## 2.1 Adolescents

Adolescence is defined as the age ranged from 10 to 19 years old by the WHO (World Health Organisation, 2016a). Adolescence is the transitional stage from the onset of puberty to adulthood starting from the earliest signs of secondary sexual characteristics development and completes when a person has achieved adult status. During this crucial period, dramatic changes and development of the physical, emotional and cognitive functions occur and if there is any inadequacy in their diet, it could potentially affect an individual's growth and delay sexual maturation (Story, 1992). In spite of the accepted belief that eating healthily is especially important at this crucial stage of their lives, studies in the U.S. had also reported that adolescents generally have poor eating habits (Johnson et al., 1994). It is also during adolescence that individuals develop heightened autonomy and begin to make their own decisions about eating and physical activity and these acquired behavioral patterns are more likely to influence long-term behaviors (Kelder et al., 1994).

## 2.2 Why measure dietary intake?

"Dietary intake" is generally considered to represent all foods and beverages consumed. Dietary intake provides valuable insights for mounting intervention programs for prevention of chronic diseases. Doll and Peto (1981) found in a study conducted in U.S., that by making changes in the dietary habits, the incidence of cancer could be reduced by one-third. A systematic review on studies conducted by Schwingshackl and Hoffmann (2014) till 10 January 2014 reported that high adherence to a Mediterranean diet was associated with a significant reduction in risk of various cancer.

Researchers are often interested in the dietary intake of an individual or a population as it could be used to characterize dietary behavior and explain the correlation between diet and health outcomes. For instance, dietary information could be used to identify possible associations with cardiovascular diseases (Baik et al., 2013) while Streppel et al. (2014) found that consumption of nutrient-dense foods (which was defined using a nutrient rich food index, basing on nine beneficial nutrients - protein, fiber, vitamins and minerals and limiting three nutrients - saturated fat, sugar and

sodium) was associated with a low risk of all-cause mortality for people aged 55 and older in a Rotterdam study.

Research questions evaluated in dietary studies include, but are not limited to, the following:

- Does a particular population follow a specific dietary pattern?
- Is the individual or the population meeting the recommended daily intake?
- Does adherence to dietary recommendations lead to the desired health outcomes?
- Is there any dietary pattern that correlates to certain desirable or undesirable health outcomes?
- Is there any possible diet disease links?
- What are the possible interventions for healthy eating and evaluations of these interventions?

Measuring dietary intake allows researchers and national health authority to evaluate the health of the representative population and to gain insights into the possible nutrient deficiency or over-consumption. For instance, the Singapore Health Promotion Board conducted periodic National Nutrition Survey to gather the trend of the eating habit of Singaporeans and implement the appropriate health polices (Health Promotion Board Singapore, 2016b). The 2000 data, for example, it was noted that no information was available on the types of grains consumed (e.g. brown rice white rice and other rice types were only measured under a generalized heading of “rice”, while the 2010 data revealed a high consumption of salt consumption and excess calories intakes. Subsequent health policies were then implemented by the Singapore Health Promotion Board to tackle the identified issues and to prevent chronic illnesses which arise due to unhealthy eating habits. Incidentally the development of the 2015-2020 Dietary Guidelines for Americans was published with the intention to provide guidance for people to improve their overall eating patterns (U.S. Department of Health and Human Services, 2018).

## 2.3 Why measure dietary intake in adolescents?

Measuring dietary intake of adolescents is of paramount importance as this is the transition period into adulthood and understanding how their eating behavior is affected by social influences is critical for successful implementation of policies (Contento et al., 2006). Dietary change between adolescence and adulthood is the result of a complex interrelationship between social, cultural and biological factors. In the longitudinal TRAILS (Tracking Adolescents' Individual Lives Survey) study conducted in The Netherlands, dietary data were collected, and predictors of multiple health risk behaviors of adolescents were collated (Ormel et al., 2012). This allowed for suitable measures to be implemented. For instance, in one part of the study, the relationship between attentional biases towards general cues of reward or punishment and overweight/obesity was examined (Jonker et al., 2016). This study concluded that there is no correlation between attentional biases to cues and BMI. In addition, studies have proposed that eating habits formed during adolescence can continue into adulthood which may have long term health impacts (Birch, 1999, Craigie et al., 2011).

Adolescence is a period in which there is heightened awareness of one's body image, especially for females (Furnham et al., 2002). A review of studies conducted in the UK, USA and Australia gathered consistent evidence that exposure to thin 'body perfect' ideals in the media is strongly related to negative body image in girls and women, with female adolescents most vulnerable to its negative influence (Groesz et al., 2002). A recent study of 1,087 girls aged 10 to 15 years found that high exposure to social media such as Facebook was linked to a desire for thin body (Tiggemann and Slater, 2013). With the desire to fit into social norms, it may be difficult to cultivate heathy eating habits to meet the increased nutrient requirements in this period (Neumark-Sztainer et al., 1999). The lack of urgency of future health may also make ideal dietary habit/healthy eating a low concern among adolescents.

## 2.4 Factors influencing food choices of adolescents

As eating becomes a social activity, adolescents are more subjected to social norms and peer pressure, in which they may be influenced by how much or what their peers eat. The impact of their current food intake to their future health is likely to be of limited concern for the adolescents at this stage of their life (Bargiota et al., 2013).

Story and Resnick (1986) conducted a study in which 900 high school students in the state of Minnesota participated in small group discussions and qualitative surveys to gather their views on nutrition-related topics. This study highlighted that adolescents generally were aware of the nutrition practices and the health impact of their dietary behaviors. However, due to the lack of time, discipline and sense of urgency, they tend not to take action to change their dietary behavior.

Food choice itself is a complex process and we could broadly classify the factors that influence food choice in terms of personal, socio-environmental and behavioral factors. These factors could interplay with each other when an adolescent makes a food choice. Personal factors include hunger and food cravings, taste and food preference. Adolescents may eat because they are hungry or because they crave a particular food, even though they may not feel hungry at the point of time (Neumark-Sztainer et al., 1999). To satisfy their hunger, often they want to eat something fast and convenient. A study of 161 obese Austrian children and adolescents, suggested that obese adolescents with a high trait food craving were consuming higher calorie foods, in contrast to those with low trait food craving (Hofmann et al., 2016).

Adolescents' choice of food could also be influenced by the frame of mind that they were in. For instance, at high stress levels such as during examination period or during relationship issues, they could be eating much more or less (Deliens et al., 2014). In a study conducted by Biolcati et al. (2018) for Italian adolescents aged between 14 to 19, it was found that they consumed strong drinks and binge drank when they were bored while Cartwright et al. (2003) found that the more stressed adolescents tends to consume more fatty foods, fewer fruits and vegetables and had an unhealthy level of snacking and a lower tendency to consume breakfast.

Socio-environmental factors include the appeal of the food, convenience of food, food availability, cost, parental and peer influence. Adolescents' food choice is influenced by the sensory attributes of the food such as its taste, appearance and smell (Bissonnette and Contento, 2001). They may be more attracted to less ideal choices such as chocolate and ice cream. On the other hand, research has reported that adolescents tend to dislike healthy foods such as green vegetables, as they taste bland or unpalatable (Stevenson et al., 2007) and adolescents tend not to

consume the recommended amount of fruit and vegetables and consume increased amounts of high-fat foods (Silliman et al., 2004, Butler et al., 2004) . In a study conducted by Glanz et al. (1998), it was found that the most influential factor is taste followed by cost. As adolescents spend more time away from home as a result of social, school, and community activities and jobs; the amount of time an adolescent "has or wants to spend on food" is among the most important factors reported to influence adolescents' food choices. For instance, they may prefer to choose something convenient to eat in the morning or eat in fast-food restaurants during lunch time as they have limited time (Neumark-Sztainer et al., 1999).

Eating is a social act and hence family and social network can influence one's choice of food. Parental influence is one of the salient social factors that influences their adolescents' food choices, as parents are the ones who create the immediate food environment at home as well as when they are eating out together. In addition, parents serve as role models for eating behaviour and transmit dietary attitudes throughout the upbringing of the adolescents (Neumark-Sztainer et al., 2003). How parents encourage their children to eat when they are young also shapes the adolescents' food preferences, affecting their food choice (Kremers et al., 2003). With an increase in the number of dual-income families in Singapore, parents may opt for convenience food due to the limited time available. To prepare a meal for the family would entail planning the meal, purchase of ingredients, storage and preparation of the raw food materials, cooking and cleaning up after consumption, which may take up a substantiate amount of time. Hence, parents may instead dine out or purchase Ready-to-Eat (RTE) meals (Jabs and Devine, 2006). Neumark-Sztainer et al. (2000) conducted focus groups with adolescents from urban public junior and senior high schools in Minnesota on eating family meals. The adolescents identified parents as important influences on their consumption patterns. It was also found that there was an increase in consumption of fruits, vegetables and dairy foods when parents dined with the adolescents (Videon and Manning, 2003).

Although parents play an important role in shaping adolescents' food choice, peer influence plays a bigger role as acceptance and conformity within the group become more important as the adolescents consume a greater proportion of their meals with their friends (Brown et al., 2000). Yakusheva et al. (2011) conducted a natural

experiment assessing peer influence on weight. It was found that the amount of weight gained during the freshman year was strongly and negatively correlated to their roommate's initial weight, suggesting that peers are influenced by each other's eating behaviours. In addition, the food environment that the adolescents are being exposed to also influences their food choice. Brug et al. (2006) suggested that the food environment has changed during the last decades and opportunities to eat energy-dense foods are omnipresent. Story and Resnick (1986) found that adolescents were not eating healthily because there was a lack of availability of healthful food in their exposed environment. Another study propounded that students who were assigned to dormitories with on-site dining halls gained more weight during the freshman year as compared with students who were in self-catered accommodation not assigned to such dormitories (Kapinos and Yakusheva, 2011). Adolescents' food choice is also influenced by the media which is a good source of information about food and nutrition for many adolescents and has a certain degree of influence over individual's food choice (Levy and Stokes, 1987).

Another factor that influences adolescents' choice of food is the behavior factor (e.g. vegetarian lifestyle, meal patterns). In the study conducted by Alexy et al. (2010) on a group of 1081 participants aged 2–18 years, it was found that older children consumed breakfast less frequently than younger children. In the Goteborg adolescence study, it was found that irregularity in breakfast intake had resulted in a food choice which had a lower intake of protein, calcium, fibre and zinc (Sjoberg et al., 2003). It is important to note that these factors often interplayed with each other when an individual makes a food choice.

### 2.5 Dietary intake assessment

An array of dietary assessment methods has been developed to capture the dietary intake of a person or a population. The basis of the selection of a dietary assessment method depends on the following factors: the aims of the research; the attributes of the study participants (for example, age, literacy level and motivation level); whether absolute or relative intakes are of interest, the period of time for the study; and the availability of resources (for example, availability of funds, availability of databases for coding of the foods, availability of trained personnel) (Biro et al., 2002). There are four main types of dietary assessment methods: diet history, food

records, dietary recalls, and food frequency questionnaires (Freudenheim, 1993). There is no ideal method, each has advantages and disadvantages which are discussed in subsequent sections of this report. With the data obtained from dietary assessments, food intake could be translated into nutrient intake either by direct chemical analysis or more commonly using food composition databases (Biro et al., 2002). Data collected could also be analyzed in terms of the number of eating occasions, timing and locations of meal and snacks for dietary methods such as the 24-h recall and food diary, and yield contextual information such as snacking behavior, out of home food consumption and breakfast consumption (Chaplin and Smith, 2011, Gewa et al., 2007, Huang et al., 2010). The following figure summaries the process of dietary assessment for dietary records, recalls, diet history and food frequency questionnaire.

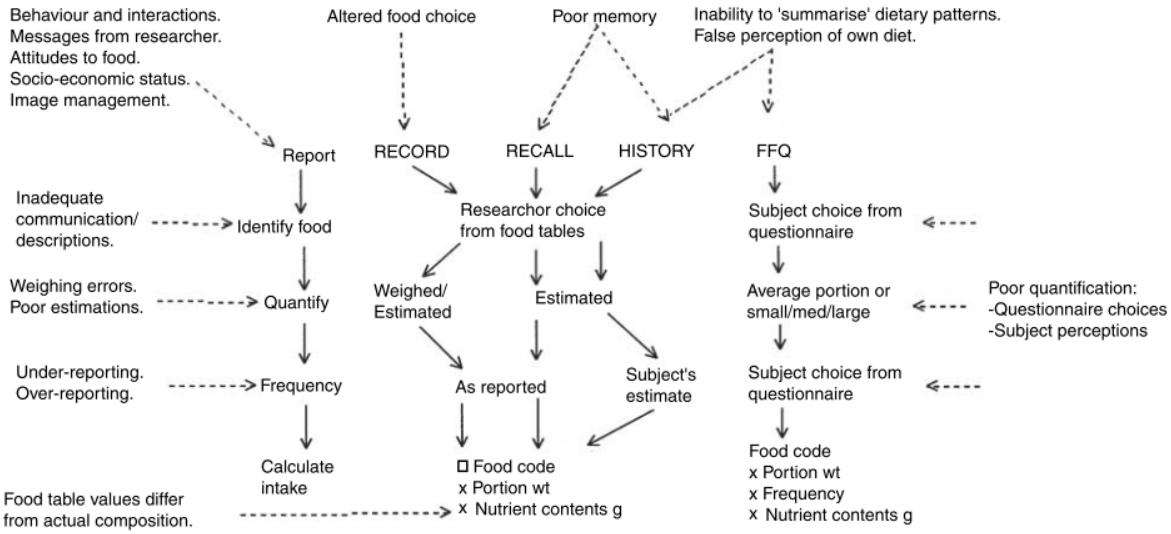



*Figure 1 - The process of dietary assessment (Goldberg et al., 1991)*

### *2.5.1 Diet history*

Diet history is a dietary method in which the respondent reports his/ her past diet. The Burke Diet History is a traditional version which comprises three components: 1) an interview with detailed questions on typical eating patterns, 2) a questionnaire on foods and beverages in which information on frequency and amount are gathered, 3) a 3-day dietary record. The questionnaire and the 3-day dietary record are used only to cross-check on the information gathered during the interview (Burke, 1947) .

Advantages

A major strength of the diet history is that it allows the collection of comprehensive information on habitual dietary patterns rather than food intake for a short period of time (as in food records or food recalls). Details of how food is prepared are included in a diet history and these details can significantly help in characterizing a diet (frying versus. steamed foods). In addition, the meal-based approach of this method may help the respondents in recalling the items consumed. For instance, it is easier to recall the amount of rice consumed at each meal than to recall the total amount of rice consumed over a period of time (Shim et al., 2014).

Disadvantages

Diet history is usually lengthy, and respondents must make decisions regarding the usual foods and amounts of foods eaten. This task may be challenging for many respondents. The meal-based approach could become a disadvantage if the respondent has no fixed eating patterns or grazes throughout the day (Thompson et al., 1994).

### *2.5.2 24-h food recall*

The dietary recall, typically requires a trained interviewer to interview the participants, either over the telephone or in person, on the foods and beverages consumed the previous day or 24 hours. The interview is usually conducted in a systematic manner with specific questions to probe and assist the participant in their recall (Blanton et al., 2006). Visual aids may be used during the interview which include three to six multiple passes, complete with standard prompts by the interviewer and portion tools, such as photographs, household measures (measuring cups, bowls and plates) to facilitate description of the portion size for the foods and beverages consumed (Subar et al., 2010). Details such as place of consumption, method of cooking, brand of food, time of consumption are collected as well (McPherson et al., 2000). A study has reported that there was no significant dissimilarity between single 24-h recalls compared to a weighed food record (Bingham et al., 1994).

Advantages

Firstly, as the dietary recall involves an interviewer recording the dietary intake, it does not require the participant to be literate or highly motivated. Hence this method

can be used for an extensive range of the population. A well-trained interviewer is also able to capture many details of the dietary intake and to minimise recall bias. Also, the participant burden is low as it only requires them to recall food consumed on the previous day and the interview is usually relatively short and can be done by a person with less training than that required for a person to conduct a diet history (Block, 1982). Lastly, as it does not require participants to record the food consumed concurrently, it is less likely that the participants will alter their eating habits.

Disadvantages

As the 24-h dietary recall captures only the dietary intake of a person on a particular day, it will not provide a good representation of the person's habitual diet due to high intra individual day to day variability intake. For instance, if the dietary recall was completed on a day in which the individual was unwell, the recall would not be a good representation of his diet. Heady (1961) conducted a study in which 116 English male bank employees recorded their intake for seven days. It was found that mean intake of the group was not significantly different from day to day. However, for individuals, there was large variations from day to day. Hence a single 24-h recall is usually used to capture the average dietary intake of a group, rather than an individual (McPherson et al., 2000). As the dietary recall requires participants to recollect foods and beverages consumed the previous day, there will be a certain degree of dependence on their memory. However, this disadvantage is usually overcome with suitable probes from the interviewers (Johnson et al., 1996). Similar to the food record, relatively large resource is required to perform coding of the data. In recent developments, automated software has been used to code the food consumed. For instance, the US National Health and Nutrition Examination Survey used the Automated Multiple Pass Method (AMPM) for the administering the 24h recall (Moshfegh et al., 2008) while the European Prospective Investigation into Cancer and Nutrition study deployed the menu-driven standardised 24-h program (EPIC-Soft) (Slimani et al., 2011). In addition, the requirement of a having trained interviewer will inevitably increase the cost of the research (Thompson et al., 1994).

### *2.5.3 Food frequency questionnaire*

For food frequency questionnaires, respondents are presented with a list of foods and are asked to state how often they consume certain food items in broad terms

such as number of times per day or per week or even per year. Participants only report on what they have consumed through a list of food. The food list can be prepared specially based on the culture and the food consumed in that region. Nutrient intakes can be estimated through summation of the foods that were reported and the frequency. Food frequency questionnaires can ask for food details to be reported in combined frequency for a specific food or reported in mixture. For instance, cabbage could be listed individually (as cabbage) or in mixed dishes (as cabbage soup). However, by listing the food as in mixed dishes could result in overestimation (Cade et al., 2002). Depending on the research questions, food frequency questionnaires could be formulated in a way to focus on specific nutrients (Son et al., 2005) or dietary exposures related to a certain disease (Park et al., 2011).

Advantages

The food frequency questionnaire provides an estimate of "habitual" intake and is a preferable method of measuring intake for foods or nutrients with very high day-to-day variability such as liver and salmon. The processing of the questionnaire is significantly less expensive than food records or diet recalls and it can be easy for literate subjects to complete as a self-administered form (Rockett et al., 1995, Kristal et al., 2005). Also, food frequency questionnaires can be administered over the telephone. This results in a higher response rate then when done through postal surveys (Cade et al., 2002). As it requires recall of food consumed, respondents will not alter their diet (McPherson et al., 2000).

Disadvantages

The validity of a food frequency questionnaire depends greatly on the comprehensiveness of the food list (McPherson et al., 2000). For instance, if fortified cereal is one of the frequently consumed foods in the study cohort but fortified cereal is omitted from the list, this could result in an underestimation in consumption. Details on the food preparation and the venue of consumption are not routinely gathered in FFQ (Thompson et al., 1994). Respondents have to make a judgement on the frequency of the consumption of the food and this is greatly dependent on the participants' memory which in turn may result in misreporting (Burrows et al., 2010). This disadvantage is similar for the diet history as well. The process itself is cognitively complex as it requires the participant to make a judgement of an average

intake over a period of long time. For instance, participants have to generalize the frequency of consuming milk in terms of per day/ per week/ month. Over-estimation of the dietary intake could sometimes occur because of the options given for portion size in the questionnaire (Bingham et al., 1994). Moreover, if fruits are individually listed out (watermelons, apples, oranges, etc, compared to just "fruits"), it is likely to be over-estimated. The food list developed for an FFQ is unique to the population as they are culturally specific. Hence FFQs need to be adapted and validated for the population under study.

The food list presented in the FFQs can be food-based (Hu et al., 1999) or dish-based (Park et al., 2011). Asian food contains many mixed dishes that are cooked with individual ingredients which could increase participants' burden if they are not aware of the ingredients or do not prepare and cook their own food. Food-based FFQs tend to underestimate dietary intake, compared to dish based FFQs (Ahn et al., 2004). Hence using a dish-based approached was recommended for an Asian diet in the dietary assessment (Kristal et al., 2005, Keshteli et al., 2014).

### *2.5.4 Food record*

For the food record approach, the participant records the foods and beverages consumed over a period of days, typically 3 to 4 consecutive days, with the inclusion of at least one weekend day. The quantity consumed can be reported by weighing (weighed food records) or by estimation with the use of household measures, food models, pictures or no special aid (estimated food records). Participants are asked to record as they consume the food or beverage. The food record is usually in an open-ended format, although close-ended formats have also been developed, and participants are usually trained in how to complete the food record (Bingham et al., 1994).

<u>Advantages</u>

A weighed food record is often regarded as a "gold standard" among the dietary assessment methods. Food and beverages are measured and recorded as they are being consumed and hence errors which could arise from participants' inability to recall accurately will be minimised (Thompson et al., 1994, Crawford et al., 1994).

Disadvantages

The food record method requires great cooperation from the participants and there is a high participant burden particularly for the weighed food records. Participants have to record the food and beverages as they are being consumed. However, participants may forget to do the recording or may not always be able to weigh food (for example when eating out) and may complete the record at the end of the day relying on memory. In the weighted food record method, studies have reported that participants may change their diet in order to reduce the hassle of weighing the food (Witschi, 1990). Hence in the food record method, participants must be highly driven to record their food intake which should be done at the time of consumption and without altering their eating patterns (Resnicow et al., 2000). Studies have suggested that as the number of days for the food records increases, the likelihood of incomplete records also increases (Gersovitz et al., 1978). Data must also be checked for erroneous entries. Huge resource is required to check and transfer the food records collected into electronic form and then perform de-coding of the data. In addition, a high level of literacy is required from the participants or participants' proxies. This could potentially limit the method's use in some population groups, for instance, the elderly or the lower social-economic status (Thompson et al., 1994).

### 2.5.1 Portion size

In order to convert the intakes of food into intakes of nutrients or other food constituents, a measure or estimate of the portion size of each food item consumed is required. The most accurate way to gauge the amount of food consumed is to weigh the food before and after eating. Although research studies can provide portable weighing scales for the participants' usage, it is cumbersome for participants to carry the scales around, especially when dinning out and requires great commitment and corporation from the participants as this method takes up a substantiate amount of time is disruptive and costly (Wolper et al., 1995).

The estimation of food portion sizes is crucial in dietary assessment. In many studies, portion size measurement aids have been used to assist participants to describe the amount of food that they consumed. Portion size measurement aids could be broadly classified into three-dimensional measurement and two-dimensional measurement aids. Examples of three-dimensional measurement aids include

household measures, real food samples, and models of real foods while two-dimensional measurement aids include food photographs, computer graphics or using food package labels to obtain the pack size.

Household measures such as measuring cups and spoons are useful aids in the portion size estimation, especially when describing a recipe. Models made of three-dimensional objects of known sizes such as wedges or tennis balls have also been used a portion size measurement aids (Godwin et al., 2006, Cypel et al., 1997). However in a study conducted by Foster et al. (2009), it was found that children, of all ages ((4–6 year old, 7–10 year old, 11–14 year old and 15–16 year old) were not able to estimate well using the food models. In the study, a total of 22 foods, which were typically consumed by children, were selected to include a variety of appearances, consistencies and textures. Care was taken to include single foods (for example, apples) and foods served as part of a meal (for example, sausages and baked beans). Photographs are useful aids as they are easy to use. In food photographs/ atlases, photographs of food portions in small, medium and large portion are usually presented. Participants then choose the appropriate photograph which depicts the portion size of the food that they consumed (Frobisher and Maxwell, 2003). Studies have reported that the use of food photographs assisted participants in estimation of portion size (Byers et al., 1985, Pietinen et al., 1988). Huybregts et al. (2008) validated adults estimates of food portion size of eight commonly consumed foods, namely stiff cereal porridge, rice, rice and beans, couscous, bean leaf balls, leafy sauce, liquid sauce and gruel, in four different portion sizes, using photographs. It was found that the mean differences between served and estimated portion sizes were between -8.4% and 6.3%. In another study, 448 Italian subjects of aged 6–60 years evaluated a colour food photograph atlas (Turconi et al., 2005) which consisted of foods (n = 434), such as pasta, rice, cheese, vegetables, sandwiches and pizzas, typically consumed by an Italians and presented in three portion sizes. Using the Bland–Altman's limits of agreement, it was concluded that for all the food groups other than for first courses (possibly attributed by the small amount) the photographs can be used in place of the weighed method.

Lucas et al. (1995) conducted a study in which photographs of three portion sizes (small, medium, large) of 45 common foods in the French diet were shown to the

participants. On average, they were within 25% accuracy the authors recommend ensuring that the range of portion sizes incorporates the range of amounts normally consumed in the population's diet. It is, however, important to use age-appropriate food pictures in order to improve the accuracy in the estimation of portion size (Foster et al., 2006)

With technology advancement, there are new ways of estimating portion size. For instance, Jia et al. (2014) carried a study in which participants wore a small, electronic device (eButton) which would take pictures of food consumed. Food portion size was then calculated using computer software based on the images captured. Out of the 100 images, of both western and Asian foods, captured, the mean relative error between the estimated volume and the actual volume was -22.8% with S.D. of 20.4%. Hence, although the image captured base methods are promising, much still has to be done as the error currently is quite large.

### 2.6 Challenges in measuring dietary intake

Dietary intake is difficult to measure, and any single method may not assess dietary intake perfectly. One of the main challenges is accuracy in reporting of the dietary intake. As discussed in the above sections, except for the food record method, most of the methods used in measuring dietary intake depend on certain degree of recall. As detailed by Dwyer et al. (1987), in the recall process, participants may fail to report the actual food consumed, report foods that were not consumed, report the wrong portion size or could confuse the current diet with diet in the past. All these reporting errors (either under reporting or over-reporting) would inevitably affect the conclusion made based on the dietary intake. Under-reporting was found to increase in higher intakes in the OPEN (Observing Protein and Energy Nutrition) study which was conducted in Montgomery County, Maryland, possibly as the participants who consume more would have difficulty recalling all the food consumed (Subar et al., 2003). It has also been observed in a study conducted in England that participants with lower socio-economic status and education tend to under-report (Price et al., 1997). The interviewer also affects how the participants report their dietary intake for methods such as 24-h recall, food frequency questionnaires and diet history. It is important that the interviewer uses the right language as the participants may be compelled to report what it is socially acceptable or desirable (Maurer et al., 2006).

Hence, training of the interviewers and having a protocol for the interview are very important to minimize mis-reporting.
There were also studies conducted to measure dietary assessments through the use of bio-markers. Commonly used makers include the energy expenditure as measured by doubly labelled water to compare with energy intake (EI) in weight stable individuals and the use of the ratio of EI to basal metabolic rate (BMR) to identify “plausible” consumption of food, urinary nitrogen as a marker of protein intake, urinary sodium and potassium, plasma levels of vitamins and tissue levels of minerals and fatty acids (Van Dam and Hunter, 2012). However, such methods could be costly and may not be feasible for use for large cohort studies (Rutishauser, 2005). Also, it was reported that the biomarkers were affected by disease and homeostatic regulation and hence their values may not be able to translate into individual’s absolute intake (Kaaks et al., 2002). In addition, dietary recommendation to modify an individual’s dietary habit is not possible if data are collected solely based on biomarkers.

Self-reporting of dietary intake could potentially be biased as participants tend to report what is socially desirable or approved (Hebert et al., 1995). Another challenge in measuring the dietary intake is the quantification of the portion size. Beside direct weighing of the food, other methods of estimating the portion size would involve a largely unknown percentage of error (Cypel et al., 1997). Estimating portion size itself is a complex cognitive task which even adults with nutritional knowledge may not find it easy (Chambers IV et al., 2000).

Quality control of the data management which includes coding and entering the dietary intake and the reference data, is a factor that could undermine the quality of dietary studies. This is especially so in large studies in which the data are handled by many researchers. There is a high possibility of human errors.

With advances in mobile technologies, there are developments of mobile phone applications in which participants record their diet by selecting corresponding items from a pre-defined list of foods and beverages, while quantity of food consumed can also be recorded by selecting from pre-defined portion sizes (Lieffers and Hanning, 2012). The mobile device provides a unique vehicle for collecting dietary information

that reduces the burden on respondents that are imposed using more classical approaches for dietary assessment. By using the mobile phone application to select the pre-defined portion size, it could also eliminate the challenge of quantifying the portion sizes. In Japan, participants captured dietary intake using a handheld personal digital assistant with camera and mobile phone card (Wellnavi) by sending images of food before and after consumption to study researchers (Kikunaga et al., 2007). The challenge then lies in having the appropriate list of food and portion sizes for the participants to select. In addition, participants would also have to be equipped with the appropriate mobile phone and data which could be used wherever they go.

The above highlights that selection of the dietary assessment tool should ideally be guided by the research objectives, design, literacy of population and available resources such as time, manpower and money.

## 2.7 Determining factors influencing dietary intake

The above-mentioned methods in Section 2.5 collect quantitative data on dietary intake. However, if there is a need to find out the reasons for observed trends, then focus group interviews will be a more appropriate methodology. A focus group interview is a method to collect qualitative data and it has gained popularity over the last few years. It allows researchers not only to gather the individuals' views but also how they processed their thoughts and the rationale for their views (Kitzinger, 1994, O Nyumba et al., 2018). Focus group discussion emphasizes interaction as a major source of data generation compared to other group interviews (Morgan, 1996).

A focus group usually consists of a group of individuals who share specific characteristics (e.g. age group, gender or ethnicity) set by the researchers, a facilitator and a scribe. Using their personal experience or knowledge, the focus group will discuss and comment on the topic of research. The role of the facilitator is vital in ensuring an interactional and purposeful discussion on the topic (Krueger and Casey, 2014).

There is no fixed number of participants required in a focus group discussion. Typically, it involves around 6 to 10 participants, but it can range from 4 to 12 participants as well (Powell and Single, 1996, Krueger and Casey, 2014). The number of participants should not be so large that it inhibits individuals sharing their views. There is a mixed view as to whether there should be a pre-existing relationship among individuals. Thomas et al. (1995) advocated having focus groups consisting of individuals who do not know each other as it will encourage more honest and spontaneous expression of their views and prevent patterns of leadership. However, depending on the purpose or topic of discussion of the focus group discussion, Kitzinger (1994) preferred to have focus groups discussions in which the participants already had a pre-existing relationship, such as friends, family or colleagues. He felt that pre-existing relationship would encourage more openness in the discussion as there was already a certain degree of trust.

The facilitator in a focus group discussion plays an imperative role. They must be proficient in handling the dynamic of participants, whether or not there is pre-existing relationship, and create an atmosphere to encourage interactions (Krueger and

Casey, 2014). In addition, there is usually a scribe to record the discussion, identity the participants and to record any non-verbal information, such as body language, in the absence of a video recording.

The focus group discussions should be conducted in a neutral ground and conducive environment to facilitate trust (White and Thomson, 1995). Provision of refreshment would help to relax the atmosphere and put the participants at ease. One of the potential pit-falls of a focus group is that the participants do not turn up or leave early during the discussion (Rabiee, 2004). Hence, it is advisable to over-recruit by 10 to 25% and inform the participants the expected duration of the focus group discussion.

Focus group discussions are usually audio-taped and transcribed. Data could be analysed manually or be done using data analysis package such as NVivo (QSR International Pty. Ltd., Doncaster, VA, Australia). The data is usually then categorized, tabulated and assessed thematically across questions to look for emergent themes (Yin, 1994).

One advantage of a focus group discussion is that they may be able to generate a substantial amount of information within a relatively short time, based on the synergy of the group interaction (Green et al., 2003, McLafferty, 2004). Morgan (1996) suggested that focus groups, either as a primary or secondary method, could be used together with surveys to provide greater insights to a topic and enhance the research study. A distinctive feature of a focus group is that it allows researchers to observe the agreements and disagreements among the participants and allows them to ask for clarification when necessary (Morgan, 1996).

In conclusion, a focus group discussion is a powerful tool which, if used appropriately, can generate insightful data to better understand respondents' attitudes, feelings, beliefs and reactions which may not be possible using other methods such as surveys or one-to-one interviews, in a shorter period of time.

# Chapter 3 Methodology

## 3.1 Overview of the Singaporean education system

Since 2000, it has been compulsory for Singaporean children to attend primary school from seven years old (Ministry of Education, 2016a). Children complete six years of primary education (from age 7-12 years) followed by four/ five years of secondary education. Typically, adolescents aged 17-21 years subsequently enter post-secondary education into one of three types of institute: an Institute of Technical Education (ITE), a polytechnic (POLY) or a junior college (JC). Appendix 1 illustrates the Singapore Education System. In 2015, the percentage of the Primary 1 cohort who eventually entered into the ITE, POLY and JC as their post-secondary education was 23.7%, 47.8% and 28% respectively (Ministry of Education, 2015a). Therefore, almost all young Singaporeans will attend one of these three types of educational institution. The difference in the educational institutes lies in their core mission. Institutes of Technical Education equip students with relevant technical knowledge and skills required for the industries while the polytechnics train students to be specialists in a particular field. Junior colleges include broad subject areas and have tended to be the main education route into subsequent university study (Ministry of Education, 2015b) .

## 3.2 Study design

This research work on the eating habits of adolescents aged 17-21 years old was conducted in three educational institutes located in the central part of Singapore. The age range of 17 to 21 was selected as this is the age range of the late adolescents and young adults (World Health Organisation, 2016a) and in Singapore, this is the age group in which the late adolescents can have the most autonomy in their selection of food. In Singapore, the school canteens at Primary, Secondary and Junior Colleges, have to subscribe to the Healthy Meals in Schools Programme (HMSP) and hence the foods sold are more controlled (Health Promotion Board Singapore, 2016a). External vendors, including national and international chains such as Koufu®, Subway, JR Hot Food Vending Machine, provide the food in ITEs and polytechnics. The aim of this work was to examine the eating habits of the late adolescents, aged 17 to 21 years old, in Singapore.

As illustrated in Figure 2, there are four main phases to this study. Although the validity and reliability of the multiple pass 24-h recall has been extensively researched (Blanton et al., 2006, Conway et al., 2003, Johnson et al., 1996), an initial pilot study in Phase 1 was conducted to compare the results obtained from the multiple pass 24-h recall with 3-day food records for late adolescents in Singapore.

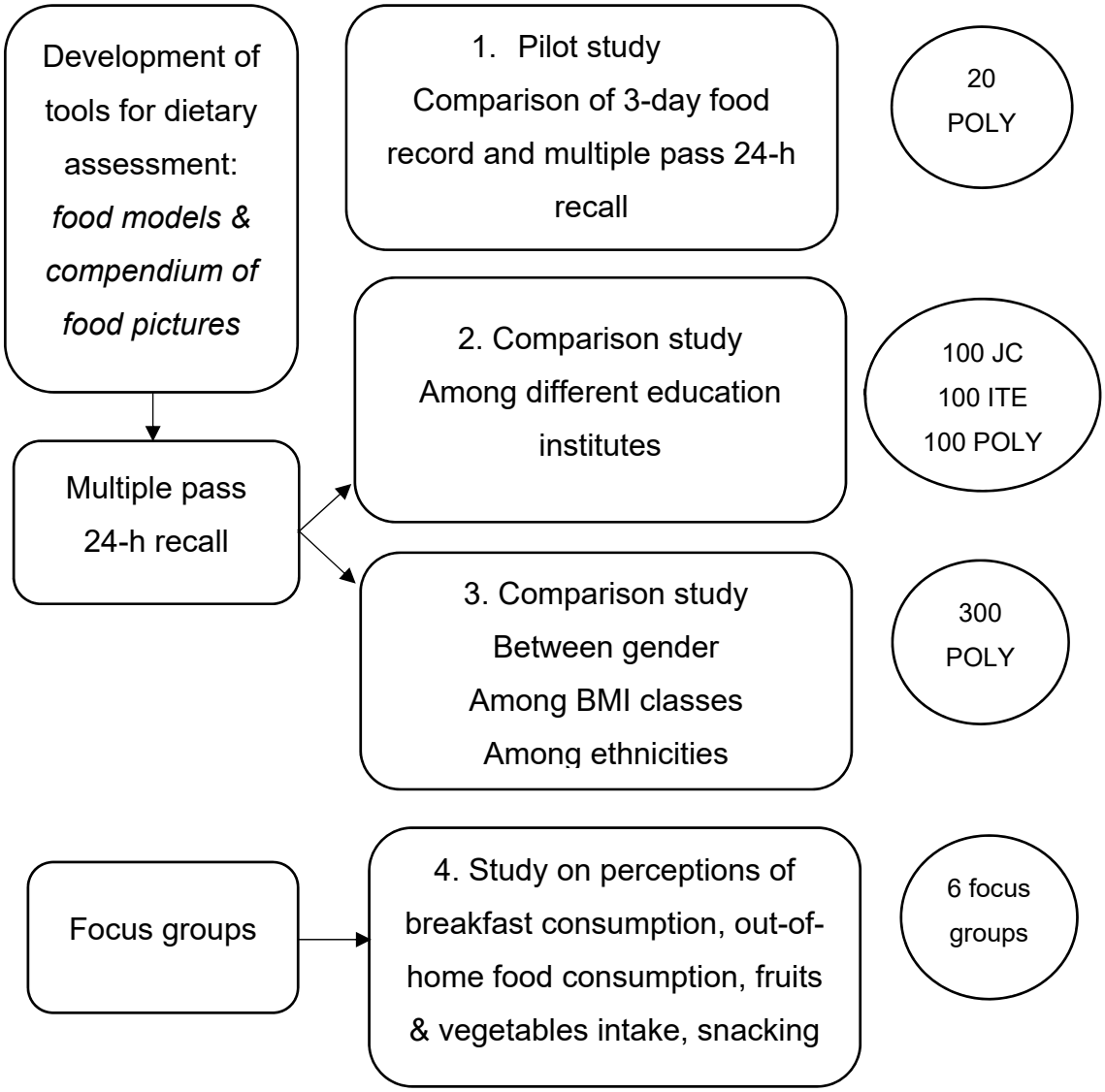



*Figure 2 - Overall view of the study design*

For Phases 2 and 3, the studies were based solely on the multiple pass 24-h recall. In Phase 2, 100 participants from each education institute (Anderson junior college - AJC, Institute of Technical Education College Central - ITE and Nanyang Polytechnic - NYP) were recruited. As illustrated in Figure 3, these three educational institutes are in close proximity to one another. This minimized any possible variation in eating habits due to difference in the exposed food environments. Participants were randomly recruited without any bias in terms of gender or ethnicity for Phases 1 and 2. Recruitment was conducted in the educational institutes in student thorough fares. Examples of the places were the canteens and study areas. Participants were recruited if they responded to the recruitment drive. In total 100 participants were selected to represent the typical population in each educational institute. It is noted that there is likely a recruitment bias as generally people who respond to studies on diet tend to be female, higher SES and more interested in health (Singer et al., 2000).

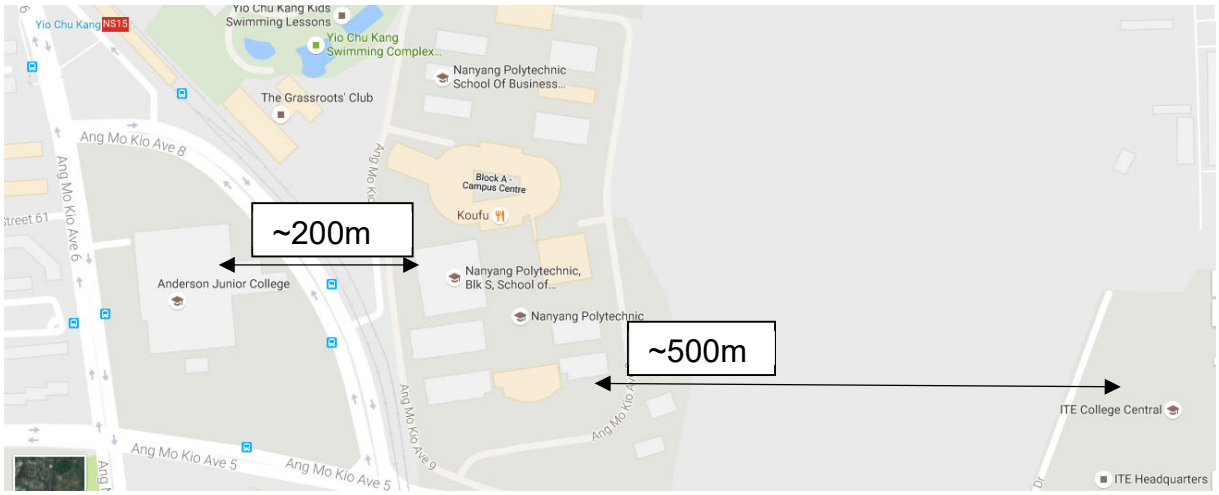



*Figure 3 - Location of AJC, NYP and ITE*

In Phase 3, another 200 participants from Nanyang Polytechnic were recruited. Together with the 100 NYP participants recruited in Phase 2, a total of 100 participants of each major ethnicity (Chinese, Malays and Indians) were recruited with an equal number of males and females within each ethnic group (that is, 50 males and 50 females). Ethnicity is the term for the culture of people in a given geographic region, including their language, heritage, religion and customs. The ethnicities examined in this study are the Chinese (74.3%), Malays (13.3%) and

Indian (9.1%), which make up the majority of the population of Singapore (Government of Singapore, 2016).

In Phase 4, focus groups were held to discuss specific topics, breakfast, fruits and vegetable intake, snacking and out of home food consumption. The participants for the focus groups were either recruited from Phase 3 or they could be recruited for focus group sessions only. Breakfast and out of home consumption were grouped as a set for focus group discussion while snacking and fruits & vegetable consumption were grouped as another set. There was a total of six focus group sessions for these topics. Care was taken to ensure that the three ethnicities were represented in each of the six focus group sessions.

### 3.3 Funding and ethical approval

This research was funded by NU-POLY-SIT scholarship. The study method was approved by the Ethics Committee (Faculty of Science, Agriculture and Engineering), Newcastle University on the 24 October 2014 and Institutional Review Board and Nanyang Polytechnic on the 18 September 2014. As the participants included students from a junior college additional approval from the Ministry of Education, Singapore was obtained on the 23 February 2015. Email approval was obtained from the principal of ITE College Central on 19 March 2015.

### 3.4 Recruitment, consent and incentive

#### *3.4.1 Recruitment*

The following recruitment criteria were set for the study:

- Healthy individuals
- Age 17 to 21 years old
- Ethnicity: Chinese, Malays and Indian

Participants were recruited between November 2014 and August 2015. Recruitment was conducted via school portals and posters (see Appendix 2). Posters were displayed in students' notice boards for the attention of students and to encourage word of mouth recruitment through friends. On-site recruitment was also performed where response from school portal or posters was low. Contact details (email address of primary researcher and office phone number: m.e.tay@newcastle.ac.uk

and 6550 1543) were included on the recruitment poster, information sheet and consent form.

### *3.4.2 Consent*

A consent form (see Appendix 3 and Appendix 4 for examples) which also served as a participant information sheet was developed. Ethical approval for the study was granted by the NYP Internal Review Board (IRB) requirement for study to be conducted in NYP. The consent form included details such as the aim of the study, what would be involved, the targeted number of participants for whole study, the risks, benefits of taking part of the study and reimbursement. Interested participants were also verbally briefed on the purpose of the study and informed consent was obtained for participation. For participants aged 17 years, parental consent was obtained. Participants were informed of their right to refuse to participate and they could withdraw from the study at any point without giving a reason to the research team. As required by NYP IRB, a contact number of NYP IRB Analyst at 6550-1566, was provided in the consent form so that if the participant wanted to have an independent opinion of his/her rights as a research participant, he/ she has an independent party to clarify with. A separate participant data form was developed to collect details of their name, contact, address, ethnicity, gender, date of birth, education institute, self-declared weight and height. The participant was then assigned an identification number which was used to record on the 3-day food record.

### *3.4.3 Reimbursement*

Participants received a $20 shopping voucher following completion of the study. This reimbursement was used to encourage participation in the study and to compensate participants for their time.

## 3.5 Dietary intake assessment

### *3.5.1 3-day food record*

A small pilot study was done to compare the results obtained from the 3-day food record and the multiple pass 24-h recall. A questionnaire was used to evaluate whether the food record was relatively easy and unambiguous to fill in. A total of 50 participants took part in the survey. From the results obtained, 87% indicated that

the dietary record was not easy to understand and 89% indicated that they did not understand the meaning of portion. With the results obtained from the initial questionnaire, more instructions were provided on the food record and a briefing tailored to address the concerns of the participants was included. Participants were given a 30-minute, individual briefing on recording of the food intake. Participants were given the opportunity to ask questions during the briefing session and doubts were clarified.

The front cover of the diaries contained the Newcastle University logo, participants ID, and the dates for which the dietary information was to be collected. Contact information of the primary researcher was also provided. Each diary consisted of an example page, see Appendix 5, and eight pages on which to record intakes of food and beverages. Each page included: an area to record the date, the time at which items were consumed, details of the items consumed, quantity, the amount of leftovers and whether the food was home-cooked, out of home food or purchased food. For estimation of quantity, participants were shown the physical food models (see Figure 4 to Figure 7) and were provided with portion size photos. Out of home food is defined based on the place of preparation of the food. For instance, if the food is bought from the canteen but taken away and consumed at home, the food is considered as OH food. Conversely, if home-made food is brought to school for consumption, it is considered as home-cooked food.

Guidelines on recording of dietary intake were provided on the second page of the food diary. Participants were encouraged to provide as much detail as possible, such as the brand, method of cooking and the types of food (e.g. home cooked or out of home or processed foods).

Upon participants returning their 3-day food records, a debriefing was conducted for each participant, face to face. Clarification on the entries (such as portion or how the food was prepared) was made to improve the accuracy of the data collected. Participants were assured that the data would be kept confidential.

### *3.5.2 Multiple pass 24-h recall*

The 24-h recall form was adapted for use from The UK Low Income Diet and Nutrition Study Survey (LIDNS) (Holmes et al., 2008). A multiple-pass approach was taken to collecting dietary data from participants. This approach was adapted from the USDA 5-step multiple-pass method (Moshfegh et al., 1999, Moshfegh et al., 2001). Previous studies had highlighted that the 5-step multiple-pass method improved the accuracy of the dietary recall (Conway et al., 2003).

An interview was arranged with the participant, at their educational institute. Upon arrival, the trained interviewer conducted the 24-h recall. The full interviewer's script is attached in Appendix A3-3. The five steps involved were as follows:

- Quick List: Participants reported an uninterrupted listing of all foods and beverages consumed in the last 24 hours.
- Forgotten Foods List: Participants answered a series of food category questions to help identify additional foods.
- Time and Occasion: Participants answered the time they consumed foods or indicate eating occasions.
- Detail Cycle: Participants provided descriptions and amounts of each food reported. Participants reviewed each eating occasion and times between eating occasions.
- Final Review Probe: A final probe for any other foods consumed was conducted by the interviewer.

(a) Quick List

*Quick List* was the first column of the multiple pass 24-h recall form. The participant was asked to recall all the food and drink items consumed during the last 24 hours. At this juncture, they did not have to indicate the portion size. Instructions were given, to the interviewer, on how to fill out the form.

(b) Forgotten List

When the participant indicated he/she had completed the quick list, a set of typical "forgotten food items" was presented to them. Participants were asked to review the

list and identify any forgotten food items. The forgotten list comprised local snacks, desserts & cakes, beverages and sauces.

(c) Time

Participants answer the time they consumed foods. For each eating occasion, participants were asked to recall the time that they consumed the food or beverage.

(d) Detail Cycle:

Participants reviewed each eating occasion and the times between eating occasions. Then the interviewer collected further details on each item including the brand, the type (e.g. white or brown rice), preparation method (e.g. grilled or fried). Information on the portion size consumed was collected using the food models and compendium of food pictures (see section 3.6).

(e) Final Review Probe

In the final review probe each participant was asked to review what they had written and a few more questions were posed to them to ensure there were no food or drink items missed out. This gave the participants a chance to rectify any incorrect information given or to add in any missing information (Jonnalagadda et al., 2000).

## 3.6 Tools used in dietary intake assessment

An important element in the accuracy and precision of dietary assessment is the portion size estimation. There is a body of evidence suggesting a variety of visual aids could enhance the recall of the participants, as well as the improve the accuracy of the portion size estimation (Morgan et al., 1982, Pietinen et al., 1988, Faggiano et al., 1992). In this research work, food models and a compendium of local food pictures were developed to enhance the portion size estimation by the participants.

### *3.6.1 Food models*

As part of the tools in the multiple pass 24-h recall, food models were used to aid in gauging the portion size consumed. The food models consisted of typical bowls, a plate, measuring cups and spoons, tea cups and mugs. The food models were selected in consultation with Health Promotion Board, Singapore as the database of

food composition used the same set of food models.  Figure 4, Figure 5, Figure 6 and Figure 7 illustrate the food models used during the 24-h recall.


*Figure 4 - Food models (Bowls)*

Bowl 1 is a typical serving for rice dishes in Singapore.  A brief observation study was carried out to observe the typical serving portion for rice in the three educational institutes as well as the cooked food center within 1km of the institutes. Bowl 2 was selected as a typical bowl for soup while Bowl 3 is a typical serving bowl for noodle with soup.  The weight of rice, *Beehoon*, macaroni, *Laksa* Noodles, *Ban Mian* (handmade noodles), water (to mimic clear soup) in ½ Bowl 1, Bowl 1, ½ Bowl 2, ¾ Bowl 2, 1 Bowl 2, ½ Bowl 3, ¾ Bowl 3 were then measured.  Participants were presented with the above food models to indicate the amount that they consumed.


*Figure 5 - Food model (Typical plate, serving spoon, dessert spoon)*

A 23-cm diameter plate was selected as a typical plate for dishes such as fried rice, stirred fried noodles and ethnic dishes. HPB Energy & nutrient composition of food are illustrated in household measures such as the bowls and plates illustrated in Figure 4 and Figure 5. HPB Energy & nutrient composition of food showed the value of the food using a 23-cm diameter plate (Health Promotion Board Singapore, 2011). For instance, the HPB Energy & nutrient composition food gave a weight of 418g for a plate of *char siew* fried rice in a 23-cm plate. Hence, if a participant said that he had consumed half of a plate of *char siew* fried rice, the amount of fried rice would be 208g (418g divided by 2). A serving spoon of 50ml was selected as a typical serving spoon used by the food stall owners. A dessert spoon of 10ml was selected as a typical spoon.


*Figure 6 - Food models (glasses, cup and mug)*

There are several glasses and mugs commonly used in Singapore. Hot drink mug of 230ml was observed to be the typical mug used in cooked food centers while cold drink glass of 260ml was observed to the typical glass used. Two additional glass, G1 and G2 were included as well. The traditional coffee cup is typical cup used in coffeeshop to serve hot drinks such as coffee and tea. Participants can use the mugs or cup as a reference and indicate whether their actual cups/ mugs used is bigger or smaller.

*Figure 7 - Food model (Measuring spoons and cups)*

Measuring spoons and cups were also included in the food model. These were useful when it came to description of recipes.

### *3.6.2 Compendium of local food pictures*

One of the main challenges in dietary assessment is the quantification of the food consumed. Ideally, weighing foods before and after eating would be the most accurate way (Bingham et al., 1994). However, this method of gauging portion size is not possible for retrospective dietary assessment methods such as the food recalls and food frequency questionnaires. Also, the actual process of recording food intake can lead participants to change their food intake patterns due to the burden of weighing foods (Block and Hartman, 1989). Studies have reported that the use of a photographic food atlas improved accuracy during dietary assessment (Harris-Fry et al., 2016).

In this study, a compendium of local food was developed and used as a tool during the dietary intake assessment. The development of a compendium of local food pictures was developed together with the Singapore Health Promotion Board. There were six sections in this compendium of local food pictures. The six sections were as follows: food portion, noodles, vegetables, fish, *kueh* (a typical bite-sized snack which is made from rice or glutinous rice and typically found in Southeast Asia) and Indian snacks.

A list of commonly eaten food was selected for the food portion section. As there are variations in the serving size for different food retails, food was bought from popular food outlets such as *Kopitiam* (a coffee-shop chain in Singapore) and food courts. The weight of the dishes was then measured, and the average weight was taken as a typical serving size (standard). For items 1-15, see Table 1, three serving sizes of the food were weighed and photographed.

*Table 1 - Categories for food portion section in the Compendium of Food Pictures*

| **Noodles** | **Meat** | **Vegetable & other dishes** | **Side dishes** | **Fruits & dessert** |
|---|---|---|---|---|
| 1.Bee Hoon, *stir fried* | 3.Chicken Chop | 9.Leafy vegetable, *stir fried* | 14.Tofu | 16.Banana |
| 2.Spaghetti, *boiled* | 4.Chicken Cutlet | 10. Long beans, *stir fried* | 15.Egg, *steamed* | 17.Apple |
| | 5a. Beef Steak (thin) | 11. Cauliflower and broccoli, *stir fried* | | 18.Watermelon, *sliced* |
| | 5b. Beef Steak (thick) | 12. Peas, *boiled* | | 19.Papaya, *sliced* |
| | 6.Salmon, *grilled* | | | 20.Pear |
| | 7.Beef, stir fried | | | 21. Cake, *sliced (50g, 100g)* |
| | 8.Curry chicken | | | |

The serving sizes are standard, small (half of standard) and large (1.5 times of standard). The food items were placed on a 23cm plate, as illustrated in Figure 5. For the fruits, except for watermelon, they were taken as a whole. For watermelons, they were cut into three typical slices, which were commonly sold in fruit stalls. A total of 65 items (21 different foods with variation in portions) were photographed for this section (see Table 1).

The commonly consumed noodles, vegetables, fish, *kuehs* and Indian snacks were selected for the subsequent sections. Vegetables were classified as pale green leafy vegetables and dark green leafy vegetables. Fish were classified as white fish and oily fish. *Kuehs* were classified as with coconut/ coconut milk and without coconut/ coconut milk. A total of 185 food items were photographed for these sections. Example pages of the compendium of food pictures can be found in Appendix 7 and Appendix 8. The compendium was printed in an A4 format and used during the multiple pass 24-h recall to aid participants in estimating the portion size of foods consumed. The compendium of food pictures (ISBN 978-981-11-7005-8) was published in April 2018 and was made available for public use by the National Library of Singapore (Health Promotion Board and Nanyang Polytechnic, 2018).

### 3.7 Data handling

All anonymized data obtained from the dietary assessment were compiled in Microsoft Excel. Participants' personal particulars (names, contact details, educational institutes, gender, and date of birth, height and weight) were keyed into a separate, password–protected file to help ensure anonymity. In the dietary records, only participants' code was used to identify the records. This was to ensure that the participants remain anonymous during data entry.

The portion size of the food was then translated into weight in terms of grams either using the HPB Energy and Nutrient Composition Database (Health Promotion Board Singapore, 2011) or by actual weighing of the food items if required. For example, a participant reported eating a slice of bread with 1 tablespoon of tuna. The weight of one slice of bread can be obtained from HPB Energy and Nutrient Composition Database. One 1 tablespoon of tuna was weighed as the data is not available in the database. The portion sizes stated in the HPB Energy and Nutrient Composition

Database were typical portion sizes served in the Singapore eating establishments. As rice and noodles are typical food consumed, the amount of rice or noodles were weighed using Bowl 1, 2 and 3 (Figure 4). Average weight of rice and noodles were calculated based on triplicate measurements. Table 2 illustrates the average weight measured in different typical serving bowls.

*Table 2 - Average weight of rice, bee hoon, macaroni, laksa noodles in typical bowls*

| Bowl | Weight (g) | | | |
|---|---|---|---|---|
| | Rice | Bee Hoon | Macaroni | Laksa noodles |
| ½ Bowl 1 | 68 | 40 | 56 | 61 |
| Bowl 1 | 179 | 136 | 127 | 145 |
| ½ Bowl 2 | 144 | 100 | 112 | 114 |
| Bowl 2 | 319 | 254 | 247 | 294 |
| ½ Bowl 3 | 168 | 126 | 145 | 143 |
| ¾ Bowl 3 | 234 | 162 | 207 | 222 |

The food items were then translated into nutrients using the HPB Energy and Nutrient Composition Database, WinDiets™ or from the nutrient information panel on the product. WinDiets™ is a dietary analysis program which includes a system that allows users to calculate the nutrition value of recipes. The food composition databases were originally from data collected in the UK and US. Database in the WinDiet had also been updated to reflect Singapore's food database due to the projects that were carried out by Newcastle University Singapore. In cases where the food items could not be found in Windiets™, the HPB Energy and Nutrient Composition Database was used. For packaged products, if the specific brand of the products was provided by the participants, the nutrient composition was established by referring to the Nutrition Information found on the packaging of the product.

Hard copies of multiple pass 24-h recall form were initially used to record the entry. Data checks were performed to ensure there was no transposition error when transferring the data from hard copy to electronic copy (e.g. "saba fish" was keyed in as "sambal fish"). However, after the pilot study, it was decided that subsequent entries would be directly keyed into EXCEL while conducting the 24-h recall in order to reduce the potential for transcription errors. A subsequent data check searched

for the maximum and minimum intake from the cohort of participants for each food to further eliminate erroneous entries. Where there were discrepancies, reference was then made to the original record (hard/ electronic copy) and the data was amended accordingly.

### 3.8 Focus group

The data from the multiple pass 24-h recall gave a quantitative value, in which trends could be analysed. However, participants' attitudes, feelings and experiences were not gathered using the 24-h recall. Focus groups allow researchers to have the chance to clarify any observed trends (Harrell and Bradley, 2009). Hence, focus groups were conducted in order to gather detailed information about personal and group feelings, perceptions and opinions on the following:

- Views on breakfast consumption;
- Views on out-of-home food consumption;
- Views on fruit and vegetable intake;
- Views on snacking

There are two proposed approaches in determining the optimum number of focus groups to be conducted. Krueger and Casey (2014) viewed that the focus groups should be conducted until there was a clear pattern and by conducting further focus groups no new information would be gathered. Nonetheless, Burrows and Kendall (1997) and even Krueger and Casey (2014) viewed that for a simple research theme, having three or four focus groups would suffice. In this study, it was planned to conduct the focus groups until there was a saturation of themes and ideas. The next consideration was the number of participants required for each focus group. There was a range of the "optimum" number of participants. Howard et al. (1989) suggested to have a group of six to ten participants while Kitzinger (1996) recommended four to eight participants per group. Having a focus group of six to ten was more manageable and allowed for potential drop-out on the actual day (Krueger and Casey, 2014). Hence in the planning of the recruitment of the participants, six to eight participants were planned for each session.

Consideration of the participants' school timetable was given to ensure that there would be a good turnout for the focus group sessions. A convenient venue to the

participants was selected for the focus groups to take place. One of the frequently cited pitfalls of focus groups is low attendance (Rabiee, 2004). Hence to ensure that they would turn up, two reminders were sent to the participants: one day prior to the focus group session and another one hour before the session.

Before the start of the discussion, participants were told to switch their mobile devices to silent mode. Participants were required to write their names on the tent cards prepared beforehand so that the facilitator was able to identify the participants by their names.

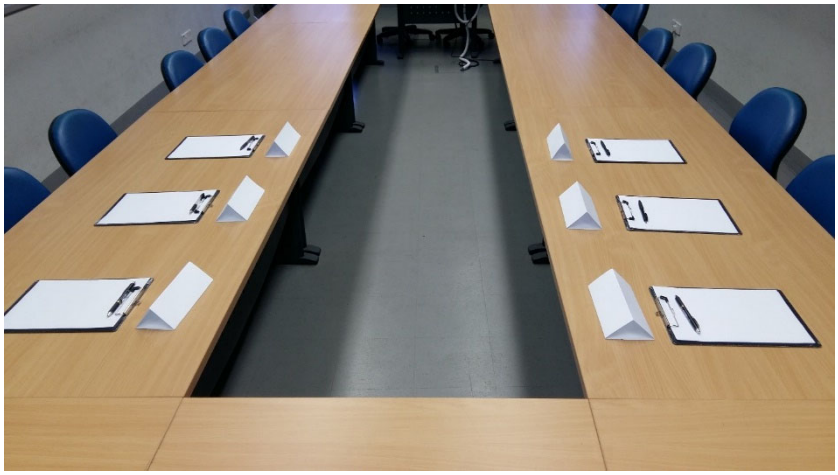


*Figure 8 - Focus group setting*

Participants were told that the discussion would be about the mid and late adolescence in general. They were encouraged to state their own views or what they had observed from their peers. In addition, the participants were also informed of the following ground rules:

- If there is any question that you feel uncomfortable with, you do not have to answer.
- Please do not disclose any personal or sensitive information.
- In the event of personal or sensitive information being disclosed, please keep the discussion confidential once the focus group discussion is completed.
- All points of view should be shared even if there are differences of opinions among the group. There is no “right or wrong” opinion.
- All opinions are valued by the research team.

- As the session will be audio-taped, please speak individually and do not use non-verbal communication (e.g. nodding or shaking of heads) as this will not be captured by the recording.

A SONY Stereo IC Recorder ICD-PX440 was placed in the middle of the discussion table to audio record the sessions. Besides audio recording, a scribe was present during the focus group sessions to note down the discussion and help to identify the participants. Participants were first offered light refreshments and asked to introduce themselves by saying their name and an interesting fact about themselves. This served as an ice-breaking session for the participants which was important as it would set the participants at ease and encourage more interactions during the discussions (Powell and Single, 1996). In addition, this helped the transcriber to identify their voices during the process of transcribing.

The focus groups were conducted in a semi-structured manner, with multiple choice questions as well as open-ended questions for group discussion. Details of the questions can be found in Appendix 9 to Appendix 12. Papers were provided for the participants to write down their thoughts before discussion. The flow of the questions posed depended on the responses from the participants. After each focus group session, the script and discussion were transcribed and examined thematically using the qualitative data management package NVivo 11 (QSR International Pty. Ltd, Doncaster, VA, Australia). Coding of common nodes were identified using NVivo 11 and subsequently themes were identified from the nodes. Following this another session was then arranged and focus groups were held until data saturation was reached, that is no more new ideas emerged (Morgan et al., 1998).

In total, three focus groups were conducted with a total of 19 participants (8 Chinese, 6 Malays and 5 Indians) to explore views on breakfast consumption (findings are presented in Chapter 5) and out-of-home food consumption (findings are presented in Chapter 6). Three further focus groups were conducted with a total of 17 participants (10 Chinese, 3 Malays and 4 Indians) to explore views on fruits & vegetables intake (findings are presented in Chapter 4) and snacking (findings are presented in Chapter 7).

# Chapter 4 Overall Healthy Eating Index

## 4.1 Introduction

Development of chronic conditions such as diabetes, hypertension and cancer is often a result of multi-dimensional factors such as environment, behavior and diet, with poor diet often being cited as the paramount avoidable cause (McCullough et al., 2000). Nutritional epidemiological studies have conventionally linked disease risk to specific foods or nutrients such as saturated fat or low intake of fruits or vegetables (van't Veer et al., 2000, Mozaffarian et al., 2010). However, an individual's diet is not comprised of only single foods or isolated nutrients, but rather a mix of different foods consumed together (Mertz, 1984). The physiological or pathophysiological effects of components in food appears complex and it would be difficult to evaluate the associations between a single dietary factor and challenging to study the effects of a single dietary component in isolation (Schulze and Hoffmann, 2006, Newby and Tucker, 2004, Hu, 2002). In addition, it was also suggested that a high quality diet is associated directly with other healthy lifestyles such as non-smoking and greater physical activity (Haveman-Nies et al., 2001).

## 4.2 Literature Review

### *4.2.1 Types of indices*

Recently developments in the evaluation of diet have moved towards evaluating the quality of the whole diet rather than individual food groups, with growing interest in identifying dietary patterns linked to health (Kant, 1996, Coulston, 2001). The term "diet quality" has existed for a long time and traditionally a high quality or healthy diet was seen as one which could provide energy for work (Elmadfa and Meyer, 2012). With industrialization and economic development over the past decades, "diet quality" has since then evolved to the current notion that a healthy diet, which is adapted to individual needs, supplies optimal levels of nutrients required to maintain one in a healthy state for physical growth and mental performance (Wu et al., 2012). The general purpose of such an index is to combine a large amount of information into a single useful indicator.

There are different examples of diet quality indices used in various studies (Fransen and Ocké, 2008), which are broadly stratified into three approaches. The first approach is to give a score to the studied population's overall diet, usually based on

meeting the national dietary guidelines. This is considered as *a priori* approach or hypothesis-oriented approach as the indices are derived based on knowledge of a healthy diet. For instance, in Luxembourg, a recommendation compliance index (RCI), consisting of 13 quantified components according to their national dietary guidelines was used to evaluate the diet quality of the adult population (Alkerwi et al., 2012), while a diet quality index which consisted of 10-components based on adherence to the Mediterranean diet template, was used to evaluate the relationship between total mortality and this notional ideal for a Greek adult population (Trichopoulou et al., 2003). Some indices included lifestyle behavior in the evaluation of the diet quality indices. In a study conducted that developed a dietary index to assess the diet quality of Chinese school-aged children in South China, behavioral components of having breakfast and dinner, and energy balance, were included in the proposed Chinese Children Dietary Index (Cheng et al., 2016).

The second approach is using cluster analysis or principal component analysis (PCA), which is considered as *a posteriori* approach as the results were obtained using statistical modelling of the dietary data (Trichopoulos and Lagiou, 2001). In the cluster analysis, the studied population is placed into subgroups based on their dietary intake (Millen et al., 1996). For instance, cluster analysis was used to analyze the dietary patterns and identify four diet groups among the UK males and females (Pryer et al., 2001). PCA is a dimension-reduction approach in which dietary intake information is reduced into a smaller number of factors which examine specific patterns of dietary behavior. McCann et al. (2001) used the PCA approach to examine the effects of different categorizations of food and its association with cancer risk. A recent study proposed a new statistical tool, the Treelet transform (TT) which incorporated the quantitative approach of PCA with the interpretational advantages of cluster analysis (Gorst-Rasmussen et al., 2011).

The third approach is essentially a hybrid of the above two approaches, with the reduced rank regression as the most commonly used method for dietary pattern analysis (Hoffmann et al., 2004). This approach is especially applicable for studies which attempt to determine the dietary components linked to given health outcomes (Schulze and Hoffmann, 2006, Nettleton et al., 2007). Each of the approaches has its

strengths and weaknesses, depending on the type of data collected as well as the objectives of the study.

Kant (1996) reviewed these indices of overall diet quality and conducted another review of dietary patterns, both empirically derived and theoretically defined, and health outcomes eight years later (Kant, 2004). It was suggested that using food-based indices as an indication of diet quality in relation to health outcomes was propitious as the indices encompassed the review of the overall diet.

There were four commonly referred to indices The Healthy Eating Index(T Kennedy et al., 1995), the Diet Quality Index (Patterson et al., 1994), the Healthy Diet indicator (Huijbregts et al., 1997) and the Mediterranean Diet Score (Trichopoulou et al., 1995). These four indices are discussed in detail in the subsequent paragraphs.

### *4.2.2 Healthy Eating Indices and adapted scores*

T Kennedy et al. (1995) developed the Healthy Eating Index (HEI) to measure the adherence of one's dietary intake to the USDA (United States Department of Agriculture) Food Guide Pyramid. The HEI has a maximum score of 100, with a 10-component system of five food groups – grains, vegetables, fruits, milk and meat, four nutrients – total fat, saturated fat, cholesterol and sodium, and a component for variety. Each of the 10-components has a criterion for a minimum score of 0 and a maximum score of 10. A person who fulfills part of the criterion will be accorded the scores proportionately. The HEI was subsequently updated using the revised 2005 dietary guidelines (HEI-2005) (Guenther et al., 2008). The HEI-2005 has 12 components: total fruit (0 - 5 points); whole fruit (0 - 5 points); total vegetables (0 - 5 points); dark green and orange vegetables and legumes (0 - 5 points); total grains (0 - 5 points); whole grains (0 - 5 points); milk (0 - 10points); meat and beans (0 - 10 points); oils (0 - 10 points); saturated fat (0 - 10points); sodium (0 - 10 points) and calories from solid fats, alcoholic beverages and added sugars (0 - 20 points). It has an overall score ranging from 0 to 100. The scores were based on amounts of foods and nutrients consumed per 1,000 kcal energy intake rather than on absolute amounts. The HEI was again revised and validated to reflect the 2010 dietary guidelines (HEI-2010) (Guenther et al., 2013a, Guenther et al., 2013b). HEI-2010 includes 12 components in which nine components are to reflect the adequacy in the

diet while the other three components were to assess dietary components that should be consumed in moderation. The 12 components are: total fruit (0 - 5 points); whole fruit (0 - 5 points); total vegetables (0 - 5 points); greens and beans (0 - 5 points); whole grains (0 - 10 points); dairy (0 - 10 points); total protein foods (0 - 5 points); seafood and plant proteins (0 - 5 points); fatty acids (polyunsaturated fatty acid + monounsaturated fatty acid-to-saturated fatty acid ratio) (0 - 10 points); refined grains (0 - 10 points); sodium (0 - 10 points); and empty calories from solid fats, alcoholic beverages and added sugars (0 - 20 points). The overall score therefore ranges from 0 to 100.

The Canadian HEI was developed to evaluate the diet quality using the Canada's Food Guide for Healthy Eating and Nutritional Recommendations. It has nine components and also a maximum score of 100 points, stratified in terms of gender and age (Shatenstein et al., 2005). The nine components are grain products (0 -10 points), vegetable and fruits (0 -20 points), milk products (0 -10 points), meat and meat alternative (0 -10 points), total fat intake (0 -10 points), saturated fat intake (0 - 10 points), cholesterol intake (0 -10 points), sodium intake (0 -10 points), dietary variety (0 -10 points). Vegetables and fruits component was allocated a maximum of 20 points to reflect the combination of the two food groups). The Canadian HEI illustrated that the concept of HEI could be applied for data collected using FFQ instead of 24-h recall.

Using similar approach as HEI, Roy et al. (2016) developed and validated a Healthy Eating Index for Australian adults (HEIFA-2013) in accordance to the 2013 Dietary Guidelines for Australians. HEIFA-2013 comprised an 11-component system core food groups, discretionary foods and negative nutrients such as saturated fat, added sugar and sodium, water intake and alcohol. The HEIFA-2013 has a score range from 0 to 100. It was evaluated to be a useful measure for public health surveillance.

Feskanich et al. (2004) modified the HEI and created a YHEI (HEI for youths) in a study conducted in 50 US states. The YHEI consisted of 13 components but was calculated based on food choices instead of direct calculation of nutrient intakes. The 13 components were consumption of: whole grains, vegetables, fruits, dairy, meat ratio, snack foods, soda and drinks, multivitamin use, margarine and butter,

fried foods outside home, visible animal fats, and breakfast and dinner with family. The first seven components had a maximum score of 10 points while the subsequent five components had a maximum score of 5 points. Total score remained at 100 points.

An Alternate Healthy Eating Index (AHEI) was developed by McCullough et al. (2002) to evaluate the chronic disease risk associated with diet. The AHEI adopted an absolute approach instead of a percentage of overall diet. Another version (AHEI-2010) was subsequently developed by Chiuve et al. (2012). The findings suggested that AHEI-2010 could be used to predict risk for coronary heart disease and diabetes associated with diet. Akbaraly et al. (2011) evaluated the AHEI in a British working population and the findings suggested that the risk of premature death from cardio-vascular disease could be lessened with better adherence to the AHEI dietary recommendations.

### *4.2.3 Diet quality indices*

With the exception of AHEI, the other HEIs developed could not find the association of dietary intake to risk of chronic diseases. To address this problem, Patterson et al. (1994) developed the diet quality index (DQI) which measures the overall diet quality that reflects a risk gradient for major, diet-related diseases in the United States. It used eight criteria (total fat, saturated fat, cholesterol, fruits and vegetables, grains and legumes, protein, sodium and calcium) to evaluate the diet quality. The points ranged from 0 (highest quality diet) to 16 (lowest quality diet). It was noted that instead of using diary products as a component in the score, calcium was used. The rationale for adopting calcium as a component was to reflect that people may use non-diary sources for calcium. Dubois et al. (2000) subsequently adapted this index to evaluate the diet quality of the Canadian Rainbow Food Guide. In the same study, the HEI and DQI were evaluated for the mean adequacy ratio (MAR). HEI was evaluated to be a better indicator for MAR.

The index was subsequently revised (DQI-R) to reflect the changes in the Dietary Guidelines for Americans (5$^{th}$ edition) (Haines et al., 1999). The DQI-R had 10 components, with scores ranging from 0 to 10 for each component and a maximum diet quality score of 100. Dietary diversity and moderation were included in the DQI-R

to reflect the principles of the Food Guide Pyramid. Also, the protein component was replaced with iron, as an attempt to review the status of undernutrition. Haines et al. (1999) subsequently validated the DQI-R for data collected from food frequency questionnaires. In a study conducted by Newby et al. (2003), it was found that DQI-R correlated significantly with several plasma biomarkers representing micronutrient intake. However, there was no significant correlation with markers of inflammation and endothelial dysfunction (Fung et al., 2005). This probably could be attributed to the non-specificity of fat and carbohydrate components used in the scoring.

Kim et al. (2003) designed the Diet Quality Index- International (DQI-I) in an attempt to compare the dietary quality among countries. DQI-I concentrates on four crucial characteristics of a high-quality diet: variety, adequacy, moderation and overall balance and has a total score of 100, with 0 indicating the poorest diet and 100 being the best diet quality. DQI-I was applied to dietary data collected from China and United States. Although average overall DQI-I (approximately 60 points) was similar for both countries, there were major differences in the three of the characteristics. The United States scored higher in variety, while China scored higher in moderation and overall balance. Similar scores were obtained for the adequacy characteristics. It was concluded that the DQI-I had successfully compared the diet quality between the two countries.

In a meta-review of diet quality indices, it was observed that in most studies in which DQI was used to predict health outcomes, the associations were generally moderate (Waijers et al., 2007). Seymour et al. (2003) evaluated the DQI in associations with cancer mortality using the data from the American Cancer Society Cancer Prevention Study II Nutrition Cohort. It was concluded that the ability of DQI to predict cancer mortality was modest.

### *4.2.4 Healthy Diet Indicator*

The Healthy Diet Indicator, HDI is based on the WHO dietary guidelines for the prevention of chronic diseases and is useful in a cross-cultural setting (Huijbregts et al., 1997). HDI was evaluated for its association with mortality using diet history records from Finland, Italy and the Netherlands. HDI consists of nine components (saturated fatty acids, polyunsaturated fatty acids, protein, complex carbohydrates,

dietary fibre, fruit and vegetables, pulses, nuts and seeds, monosaccharides and disaccharides, and cholesterol). A binary system was used to score these components. If one's dietary intake fulfils the criteria, one point will be awarded. Zero points will be awarded if one does not fulfill it. Hence HDI has a score ranging from 0 to 9. It was found that HDI was inversely related to mortality for men in the three countries, that is for someone whose diet complied most to the WHO guideline (higher HDI), he would live the longest. Huijbregts et al. (1998) subsequently conducted another study and suggested that HDI was inversely associated with cognitive impairment. HDI was found to be minimally associated with MAR (Mean Adequacy Ratio) (Dubois et al., 2000) but no association with hemoglobin, serum albumin or waist circumference (Haveman-Nies et al., 2001).

### *4.2.5 Mediterranean Diet Score*

The Mediterranean diet is a pattern based on the purported dietary habit of people living near the Mediterranean sea and has been popular as adherence to it has been reported to give one a favorable health status, such as lower occurrence of cardiovascular diseases and chronic degenerative diseases and a better quality of life (Willett et al., 1995, Serra-Majem et al., 2006). It is characterized especially by a high consumption of vegetables and olive oil and moderate consumption of protein. The Mediterranean diet score (MDS) consisted of the following eight components: monounsaturated: saturated fat ratio; ethanol; legumes; cereals; fruit and nuts; vegetables; meat and meat products; and dairy products (range 0 – 8) (Trichopoulou et al., 1995). It was found that there was a 17% reduction in mortality for every 1 unit increase in the 8-point score. In another study which involved 202 Danish older adults, it was found that there was a 21% reduction in mortality for 1 unit increase in the 7-point score of the MDS, in which it was modified to contain the following seven components instead of the original eight: high monounsaturated: saturated fat ratio, moderate ethanol consumption, cereals, fruits, vegetables and legumes, meat, and milk & daily products. However, no significant association of mortality to diet only was found in another study conducted which involved European elderly adults (Haveman-Nies et al., 2002). Cherfan et al. (2018) modified the MDS to LMDS (Lebanese Mediterranean Diet Score) to investigate the relationship of diet with hypertension. LMDS has nine components (raw vegetables, cooked vegetables, fruits, olive oil, food grains and beans, fish, rice and pasta, whole grain, and white

bread), in which each component has a score of 0 to 4, depending on the frequency of consumption. It was found that there is no significant association between LMDS and the development of hypertension.

## 4.3 Aim

To the best of this author's knowledge, there is no healthy eating index customized for the context of Singaporeans. As such, the aim of this work was to develop a healthy eating index for Singaporeans to evaluate the late adolescents' overall diet.

## 4.4 Method

### *4.4.1 Healthy Eating Index for Singaporeans*

In this study, the proposed overall healthy eating index of Singaporeans (HEI-SG) was calculated based on the Healthy Eating Index 2010 (Guenther et al., 2008, Guenther et al., 2013a) and Healthy Eating Index for pregnant women in Singapore, HEI-SGP (Han et al., 2015) but modified accordingly to Singapore food-based dietary guidelines for adults (Health Promotion Board, 2012a). There were 11 components in the HEI-SG as illustrated in Table 3. A comparison of the components in the HEI-SG and the HEI-2010 is illustrated subsequently in Table 13.

*Table 13 - Comparison between HEI-2010 and HEI-SG*

*Table 3 - Proposed HEI-SG*

| No. | Component | Standards for *minimum* score of zero | Standards for *maximum* score | Maximum score |
|---|---|---|---|---|
| 1 | Total fruit | No fruit | ≥ 0.87 serves/ 1000kcal | 5 |
| 2 | Whole fruit | No whole fruit | ≥ 0.43 serves/ 1000kcal | 5 |
| 3 | Total vegetables | No vegetables | ≥ 0.87 serves/ 1000kcal | 5 |
| 4 | Dark green leafy & orange vegetables | No dark green leafy and orange vegetables | ≥ 0.43 serves/ 1000kcal | 5 |
| 5 | Whole grains | No whole grains | ≥ 3.04 serves/ 1000kcal | 10 |
| 6 | Dairy | No dairy | ≥ 0.43 serves/ 1000kcal | 10 |
| 7 | Total protein foods | No protein food | ≥ 1.08 serves/ 1000 kcal | 10 |
| 8 | Total rice & alternatives | No rice and alternatives | ≥ 1.30 serves/ 1000kcal | 10 |
| 9 | Total fat | ≥ 40% of energy | ≤ 30% of energy | 10 |
| 10 | Saturated fat | ≥ 20% of energy | ≤ 10% of energy | 10 |
| 11 | Sodium | ≥ 870mg/ 1000 kcal | ≤ 435mg/1000kcal | 10 |
| **Totals** | | | | **90** |

1. *Total fruit*

Singapore *My Healthy Plate* and dietary guidelines (Health Hub Ministry of Health Singapore, 2017, Health Promotion Board, 2017a) recommend each individual to consume 2 servings of fruits/ 2300 kcal diet/ day. Therefore, maximum standard for **Total fruit** (i.e. all forms including juice) component was calculated as ≥0.87 servings/1000 kcal diet. Zero points were allocated if no fruit in any form was consumed while maximum of 5 points were allocated if 0.87 or more servings of fruit

per 1000 kcal were consumed. Total fruit includes all forms of fruits and 100% juices. Detailed calculated is illustrated in Section 4.3.3.

*2. Whole fruit*

For whole fruit, at least half of fruit servings were encouraged to be consumed in fresh, canned, frozen and/or dried forms (as per *My Healthy Plate* recommendations). Hence, a maximum score for the **Whole fruit** component was calculated as half of Total Fruit component, which is ≥0.43 servings/1000 kcal diet. Zero points were allocated if no whole fruit is consumed while maximum of 5 points were allocated if 0.43 or more servings/ 1000 kcal of fruits is consumed. Whole fruits include all forms of fruits, except juices.

*3. Total vegetables*

Singapore *My Healthy Plate* recommends each individual to consume 2 servings of vegetables/ 2300 kcal diet/ day. Taking 2 servings as the optimal serving size of vegetables/ 2300 kcal diet, maximum standard for **Total vegetable** component was calculated as ≥0.87 servings/1000 kcal diet. Zero points were allocated if no whole vegetable is consumed while a maximum of 5 points were allocated if 0.87 or more servings of vegetables / 1000 kcal were consumed. Total vegetables includes all vegetables, except most starchy tuber vegetables such as yams and potatoes.

*4. Dark green leafy and orange vegetables*

Dietary guidelines also recommend a variety of vegetables to be consumed, especially in forms of dark-green and orange vegetables. Hence, maximum score for **Dark green leafy and orange vegetables** component was calculated as half of Total vegetable component, which is ≥0.43 servings/1000 kcal diet. Zero points were allocated if no dark green leafy and orange vegetables is consumed while maximum of 5 points were allocated if 0.43 or more servings of vegetables per 1000 kcal were consumed. Dark green leafy and orange vegetables include vegetables such as *Xiao Bai Cai, Kale, spinach, and carrots.*

*5. Whole grains and Total rice & alternatives*

Singapore *My Healthy Plate* recommends each individual to consume 5 to 7 servings of brown rice and wholemeal bread. Taking 7 servings as the optimal serving size of

whole grains/ 2300 kcal diet, maximum standard for **Whole grains** component was calculated as ≥3.04 servings/1000 kcal diet. Taking 3 servings as the optimal serving size of Total rice & alternatives /2300 kcal diet, maximum standard for ***Total rice & alternatives*** component was calculated as ≥1.30 servings/1000 kcal diet. Zero point is allocated if no total rice & alternatives or whole grains is consumed while maximum of 10 points were allocated if 1.30 or more servings of total rice & alternatives or whole grains per 1000 kcal were consumed. Total rice & alternatives include plain rice, noodles, pasta, plain roti prata and bread. Whole grains include food made from the entire grain kernel (bran, germ and endosperm), oat, wholegrain biscuits or baked products.

*6. Dairy, Total Protein Foods*

My Healthy Plate recommends each individual to consume 3 servings of meat and alternatives, where dairy consumption should be 0.5 to 1 serving. Taking 1 serving as the optimal serving size of dairy/ 2300 kcal diet, maximum standard for the **Dairy** component was calculated as ≥0.43 servings/1000 kcal diet. Since the Dairy component was separated from the **Total Protein Foods** Component in HEI-2010, the same approach was taken for HEI-SG. The maximum standard for **Total Protein Foods** was calculated by subtracting minimum dairy serving (0.5 servings/ 2300) from the meat and alternative serving (3 servings/2300 kcal diet) giving a serving size of ≥1.08 servings/1000 kcal diet. Dairy products include milk, cheese, yoghurt and milk powder.

*7. Total fat and Saturated fat*

The Singapore dietary guidelines recommend the **Total fat** intake to be 25-30% of total calorie intake, of which less than 10% is contributed from **Saturated fat**. There is no upper limit recommended for both total fat and saturated fat. Hence the same guidelines of less than 40% and 20% of total calorie intake from HEI-SGP for total fat and saturated fat respectively were adopted.

*8. Sodium:*

Dietary guidelines in Singapore recommend salt intake to be ≤ 5g/day, which is equivalent to 2g/day /2300 kcal of sodium. Hence minimum score for **Sodium**

component was calculated as ≥ 870mg Na/1000 kcal diet while the maximum standard was ≤1g salt /2300 kcal diet = 435mg Na/1000 kcal).

### *4.4.2 Calculation of serving size*

Prior to the calculation of the HEI-SG, the serving size of the food consumed for each dietary component has to be calculated. For single food items, it was straight-forward as illustrated in Figure 9. For example, milk is a single food item where the entire mass/weight was allocated to the **Dairy** scoring category, and nutrient composition somewhat impacting on the nutrient intake categories (i.e. **Total fat**, **Saturated fat** and **Sodium** components using the nutritional information. For mixed food items, it is more complicated as the dietary information was based on the single entry of that mixed food item. There were three approaches to analyze the mixed food entries. It could be done by (1) back calculations (for example, to estimate the amount of calcium in cereal drink with milk, the amount of calcium in cereal drink with milk was compared with the calcium value in the database. This was then used to estimate the portion size of dairy component in the drink), (2) use of the HPB database (This was used to identify the types of ingredients used e.g. for fried rice) or (3) through estimation based on the proportion of ingredients suggested in online recipes For instance, the online recipe for Subway Cold Cut Trio was used to estimate the content of different ingredients into its individual food components (e.g. g of **Total protein foods**, g of **Total rice and alternatives**) as illustrated in Figure 9.

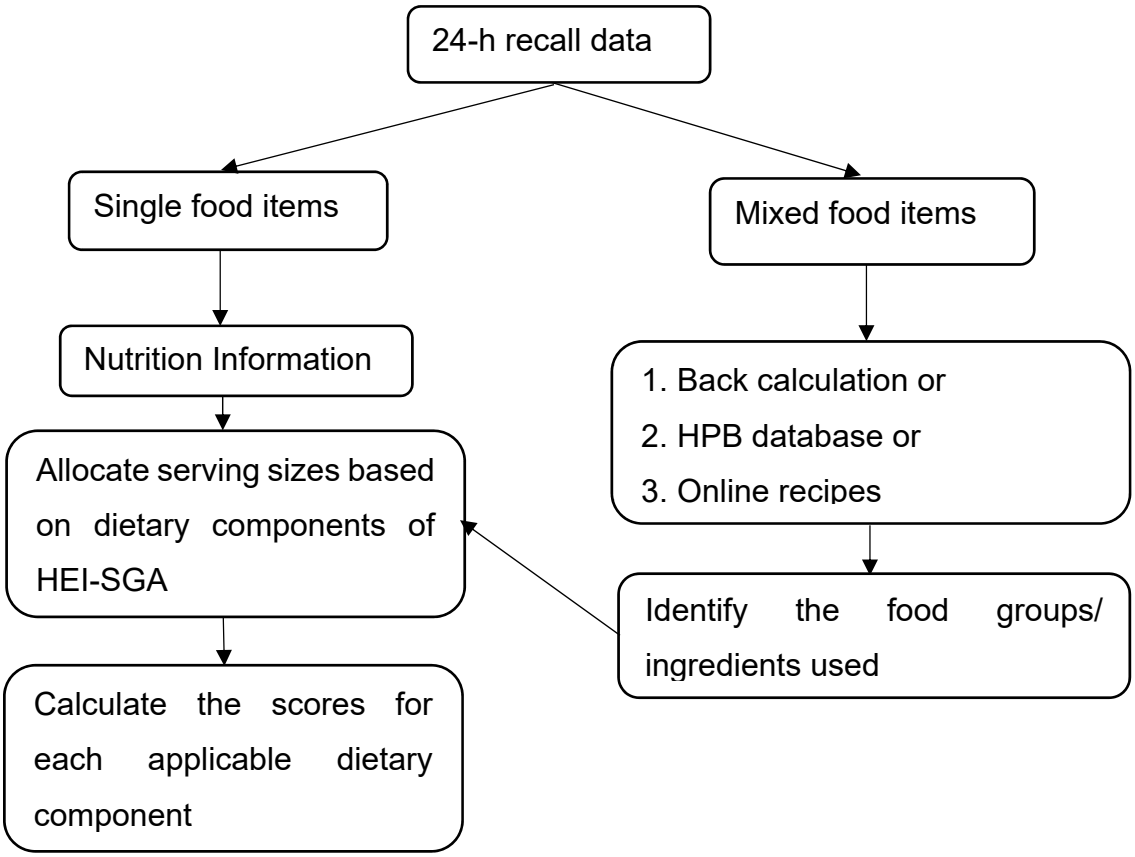



*Figure 9 - Calculation of serving size for HEI-SG*

*4.4.3Calculation of the HEI-SG*

The calculation of HEI-SG was performed as following:

1. Based on the components stated in Table 3, convert all food items from the 24-h recall data into the corresponding serving based on Table 4.
2. Sum up the total servings consumed per day for each component.
3. Calculate the divide factor:

   Divide factor =

   $$\frac{Total\ calories\ consumed\ in\ a\ day\ (kcal)}{1000kcal}$$
4. For each component, calculate the total servings consumed per day per 1000kcal.

   Total servings consumed per day per 1000kcal =

   $$\frac{Total\ serving\ per\ day}{Divide\ factor}$$
5. To calculate the score for the adequacy components (total fruit, whole fruit, total vegetables, dark green leafy and orange vegetables, total rice and alternatives, whole grains). Total recommendation servings per 1000kcal and maximum score of components were stated in Table 3.

   Score for each adequacy component =

   $$\frac{total\ servings\ per\ 1000\ kcal}{total\ recommendation\ servings\ per\ 1000kcal}\ x\ maximum\ score\ of\ component\ *$$

   **if the calculation results in a value greater than the maximum score of the component, then the maximum score is allocated.*
6. To calculate the score for moderation components: total fat, saturated fat and sodium:

   Score for each moderation component =

   $$\frac{[Upper\ limit\ (g) - amount\ consumed\ (g)]\ per\ 1000\ kcal}{[Upper\ limit\ (g) - Lower\ limit\ (g)]\ per\ 1000kcal}\ x\ maximum\ score\ of\ component$$

Since total fat had an upper limit of 40% and a lower limit of 30% of total energy intake, it would correspond to 44.4g per 1000kcal (40/100 x 1000/9) and 33.3g per 1000kcal respectively. For saturated fat, which had an upper limit of 20% and a lower limit of 10% of total energy intake, it would correspond to 22.2g per 1000kcal and 11.1g per 1000kcal respectively.

7. Total score of HEI-SG = (∑ score from each component /90) x 100

The following is an example of how HEI was calculated.

Scenario:

An adolescent consumed 2 pieces of wholemeal bread with one egg for whole day.

Total energy = 193.5 kcal, Total fat = 3.5g, Saturate fat = 1.1g, Sodium = 236.5mg

Serving for rice & alternatives = 1

Serving for whole grains = 1

Serving for protein = 1/3 (as one serving of protein is equal to three eggs)

Divide factor

$$= \frac{193.5\ (kcal)}{1000kcal}$$

= 0.1935

<u>For adequacy components</u>

Serving for rice & alternatives = 1/ 0.1935 = 5.168 serving/per day/1000kcal

Serving for whole grains = 1/0.1935 = 5.168 serving/per day/1000kcal

Serving for protein = 1/3/ (0.1935) = 1.723 serving/per day/1000kcal

Score for adequacy components:

Score for whole grains

$$= \frac{5.168}{3.04}\ x\ 10$$

= 10 (maximum score of 10)

Score for protein

$$= \frac{1.723}{1.08}\ x\ 10$$

= 10 (maximum score of 10)

<u>For moderation components</u>

Score for moderation components:

Score for Rice & alternatives

$$= \frac{5.168}{1.30}\ x\ 10$$

= 10 (maximum score of 10)

Score of total fat

$$= \frac{44.4 - 3.5/0.1935}{44.4 - 33.3}\ x\ 10$$

= 10 (maximum score of 10)

Score of saturated fat =

$$= \frac{[22.2\ -\ 1.1/0.1935]}{[22.2\ -11.1\ ]} x\ 10$$

= 10 (maximum score of 10)

Score for sodium

$$= \frac{\left[0.870\ -(\frac{0.2365}{0.1935})\right]}{[0.870 - 0.435]} x\ 10$$

= 0 (minimum score of 0)

Total score of HEI-SG

$$= \frac{[10 + 10 + 10 + 10 + 10 + 0]}{90} x\ 100$$

= 55.6 (moderate overall diet quality)

*Table 4 - Portion Size using for HEI-SG*

| Food | *One serving |
|---|---|
| Fruits | 1 small apple, orange, pear or mango (130g) |
| | 1 wedge papaya, pineapple or watermelon (130g) |
| | 10 grapes or longans (50g) |
| | 1 medium banana |
| | cup dried fruits (40g) |
| | 1 cup pure fruit juice (250ml) |
| Vegetables | 100g raw non-leafy vegetables |
| | mug cooked vegetables (100g) |
| | plate* cooked vegetables (100g) |
| | *plate = 25cm |
| Total rice and alternatives | 2 slices bread (60g) |
| | ½ bowl** rice (100g) |
| | 2 bowls rice porridge (500g) |
| | ½ bowl noodles, beehoon or spaghetti (100g) |
| | 4 plain biscuits (40g) |
| | 1 thosai (60g) |
| | 2 chapatis (60g) |
| | 1 large potato (180g) |
| | 1½ cups plain cornflakes (40g) |
| | 2/3 bowl uncooked oatmeal (50g) |
| Dairy | 2 glasses milk (500ml) |
| | 2 small blocks soft bean curd (170g) |
| Total protein foods | 1 palm-size piece meat, fish or poultry (90g) |
| | ¾cup*** cooked pulses (peas, beans, lentils) |
| | 3 eggs (150g) |
| | ***250ml |

*(Health Promotion Board, 2012a)

## 4.5 Results

### *4.5.1 Profile of respondents*

In phase 2, 100 respondents were recruited from each educational institute (details given in Chapter 3). Table 5 illustrates the profile of the respondents from each educational institute. In phase 3, further participants were recruited from the POLY in order to have an equal number of respondents: 100 Chinese, 100 Indian and 100 Malay. For of each ethnic group the aim was to recruit 50 females and 50 males. The number of Chinese POLY female respondents was eventually slightly over-sampled at 57 instead of the planned 50.

*Table 5 - Profile of respondents recruited in phases 2 and 3*

| Education Institutes | Phase | Chinese | Indian | Malay | Total |
|---|---|---|---|---|---|
| ITE | 2 | 45 | 15 | 40 | 100 |
| POLY | 2 | 60 | 18 | 22 | 100 |
| | 3 | 47 | 82 | 78 | 207 |
| JC | 2 | 90 | 10 | 0 | 100 |
| TOTAL | - | 242 | 125 | 140 | 507 |

### *4.5.2 HEI-SG results*

Overall median HEI-SG score was low at 47.2 (IQR 16) out of 100 (see Table 6). This was found to be due primarily to an insufficient intake of total fruits, whole fruits, total vegetables, dark green leafy & orange vegetables, whole grains, dairy products and a high intake of sodium in this population. Component scores for **Total rice and alternatives**, **Total protein foods**, **Total Fat** and **Saturated fat** were generally high.

Table 6 - HEI for the 17-21 years old adolescents

| Components | Median | IQR |
|---|---|---|
| Total fruits | 0.00 | 3.1 |
| Whole fruit | 0.00 | 3.5 |
| Total veg | 0.00 | 1.5 |
| Dark green leafy & orange veg | 0.00 | 0.0 |
| Total rice & alternatives | 10.0 | 2.0 |
| Whole grains | 0.00 | 0.0 |
| Dairy | 1.40 | 7.0 |
| Total protein foods | 10.0 | 3.7 |
| Total Fat | 10.0 | 2.9 |
| Saturated fat | 9.70 | 3.4 |
| Sodium | 0.00 | 0.0 |
| Overall HEI | 47.2 | 16 |

**based on independent samples, Kruskal-Wallis*

Table 7, Table 8, Table 9 and Table 10 illustrate the score of each individual component and healthy eating index (HEI) calculated for gender, BMI, ethnicity and education institute.

The overall median HEI-SG score was similar for both gender (see Table 7). There was a significant difference for the components: **Whole fruits**, **Total vegetables**, **Dark green leafy & orange vegetables** and **Total protein foods.**

There was no significant difference among the different categories of BMI (see Table 8). In terms of overall score for HEI, participants with high risk BMI had the lowest score. The **Whole grains** component score for the BMI Classes - risk of nutrient deficiency, healthy and high risk are most skewed.

*Table 7 - Evaluation of HEI-SG based on gender*

| Components | Female | | Male | | Gender |
|---|---|---|---|---|---|
| | Median | IQR | Median | IQR | **p*-value |
| Total fruit | 0.00 | 3.6 | 0.00 | 2.0 | 0.062 |
| Whole fruit | 0.00 | 5.0 | 0.00 | 0.0 | **<0.001** |
| Total veg | 0.50 | 1.9 | 0.00 | 1.2 | **0.008** |
| Dark green leafy & orange veg | 0.00 | 0.0 | 0.00 | 0.0 | **0.007** |
| Total rice & alternatives | 10.00 | 1.8 | 10.00 | 2.1 | 0.936 |
| Whole grains | 0.00 | 0.0 | 0.00 | 0.0 | 0.799 |
| Dairy | 0.90 | 7.0 | 2.10 | 7.1 | 0.678 |
| Total protein foods | 10.00 | 4.8 | 10.00 | 1.4 | **0.004** |
| Total Fat | 10.00 | 3.3 | 10.00 | 2.2 | 0.621 |
| Saturated fat | 9.50 | 3.9 | 10.00 | 3.1 | 0.173 |
| Sodium | 0.00 | 0.0 | 0.00 | 0.0 | 0.929 |
| Overall HEI | 47.20 | 16.2 | 47.50 | 16.4 | 0.740 |

**Based on independent samples - Mann-Whitney U Test*

Table 8 - Evaluation of HEI-SG based on BMI

| Components | Risk of nutrients deficiency | | Healthy | | Moderate risk | | High risk | | BMI Classes |
|---|---|---|---|---|---|---|---|---|---|
| | Median | IQR | Median | IQR | Median | IQR | Median | IQR | *p-values |
| Total fruit | 0.00 | 2.8 | 0.00 | 2.5 | 0.00 | 3.4 | 0.00 | 4.1 | 0.437 |
| Whole fruit | 0.00 | 0.2 | 0.00 | 2.1 | 0.00 | 0.4 | 0.00 | 5.0 | 0.190 |
| Total veg | 0.00 | 1.3 | 0.00 | 1.4 | 0.60 | 1.7 | 0.80 | 2.2 | 0.152 |
| Dark green leafy & orange veg | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.877 |
| Total rice & alternatives | 10.00 | 2.2 | 10.00 | 1.7 | 10.00 | 1.6 | 9.00 | 2.1 | 0.330 |
| Whole grains | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.246 |
| Dairy | 2.65 | 6.8 | 1.20 | 6.5 | 3.05 | 10.0 | 0.00 | 3.1 | **0.024** |
| Total protein foods | 10.00 | 1.9 | 10.00 | 3.6 | 10.00 | 4.7 | 10.00 | 3.9 | 0.620 |
| Total Fat | 10.00 | 2.2 | 10.00 | 3.4 | 10.00 | 0.4 | 10.00 | 2.8 | 0.272 |
| Saturated fat | 9.70 | 3.7 | 9.40 | 3.4 | 10.00 | 3.1 | 9.85 | 3.8 | 0.589 |
| Sodium | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.437 |
| Overall HEI | 45.90 | 16.2 | 47.20 | 15.6 | 49.05 | 17.7 | 45.65 | 16.0 | 0.272 |

**based on independent samples, Kruskal-Wallis*

Table 9 - Evaluation of HEI-SG based on ethnicity

| Components | Chinese | | Indian | | Malay | | Ethnicity |
|---|---|---|---|---|---|---|---|
| | Median | IQR | Median | IQR | Median | IQR | *p-values |
| Total fruit | 0.00 | 5.0 | 0.00 | 3.5 | 0.00 | 0.9 | **0.018** |
| Whole fruit | 0.00 | 5.0 | 0.00 | 3.2 | 0.00 | 0.0 | **0.005** |
| Total veg | 0.90 | 2.3 | 0.05 | 1.5 | 0.00 | 0.6 | **<0.001** |
| Dark green leafy & orange veg | 0.00 | 5.0 | 0.00 | 0.0 | 0.00 | 0.0 | **<0.001** |
| Total rice & alternatives | 10.00 | 2.2 | 10.00 | 1.9 | 10.00 | 1.6 | 0.523 |
| Whole grains | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | **0.005** |
| Dairy | 2.20 | 7.2 | 2.45 | 6.4 | 0.00 | 6.5 | 0.239 |
| Total protein foods | 10.00 | 5.2 | 10.00 | 3.5 | 10.00 | 2.7 | 0.511 |
| Total Fat | 10.00 | 0.2 | 10.00 | 3.4 | 10.00 | 4.4 | **0.016** |
| Saturated fat | 10.00 | 2.0 | 9.35 | 4.4 | 9.10 | 4.0 | **0.006** |
| Sodium | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.180 |
| Overall HEI | 49.40 | 16.8 | 47.60 | 15.4 | 44.40 | 13.7 | **<0.001** |

**based on independent samples, Kruskal-Wallis*

*Table 10 - Evaluation of HEI-SG based on education institute*

| Components | ITE | | JC | | POLY | | Education Institute |
|---|---|---|---|---|---|---|---|
| | Median | IQR | Median | IQR | Median | IQR | *p-values |
| Total fruit | 0.00 | 3.5 | 4.60 | 5.0 | 0.00 | 3.6 | **<0.001** |
| Whole fruit | 0.00 | 1.1 | 4.15 | 5.0 | 0.00 | 5.0 | **<0.001** |
| Total veg | 0.70 | 2.7 | 2.70 | 5.0 | 0.50 | 2.2 | **<0.001** |
| Dark green leafy & orange veg | 0.00 | 0.0 | 0.00 | 3.7 | 0.00 | 3.7 | **<0.001** |
| Total rice & alternatives | 10.00 | 3.8 | 10.00 | 1.3 | 9.75 | 2.9 | **0.005** |
| Whole grains | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | **0.015** |
| Dairy | 0.00 | 4.1 | 3.35 | 8.4 | 2.70 | 8.2 | **0.001** |
| Total protein foods | 10.00 | 3.5 | 10.00 | 2.5 | 10.00 | 4.5 | 0.385 |
| Total Fat | 10.00 | 0.4 | 10.00 | 0.8 | 10.00 | 4.0 | 0.052 |
| Saturated fat | 10.00 | 1.4 | 10.00 | 2.4 | 9.80 | 4.7 | 0.100 |
| Sodium | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.629 |
| Overall HEI | 47.45 | 12.5 | 56.56 | 17.1 | 48.35 | 18.0 | **<0.001** |

**based on independent samples, Kruskal-Wallis*

The healthy eating index for the Malays was significantly lower among the three ethnicities, while the Chinese scored the highest for the overall HEI (see Table 10). The Malays were consistently scoring the lowest for the components of **Total fruit**, **Whole fruit**, **Total vegetables**, **Dark green leafy & orange vegetables, Whole grains, Dairy, Total fat** and **Saturated fat.** There was significant difference between the HEI-SG of the Malay and Chinese, but not for Malay – Indian or Indian – Chinese (see Table 11). A test of between subject effect (gender*ethnicity) yielded a *p*-value of 0.269, indicating that the only significant factor is ethnicity ($p<0.001$).

*Table 11 - Pairwise comparisons of ethnicity (HEI-SG)*

| Sample 1 -2 Sample 2 | *Adjusted Significant |
|---|---|
| Malay – Indian | 0.110 |
| Malay – Chinese | **<0.001** |
| Indian - Chinese | 0.198 |

*Significance values have been adjusted by the Bonferroni correction for multiple tests

Out of the three educational institutes, JC participants scored 56.56 (IQR 17.1) (reference to Table 10) for the overall HEI and this was significantly higher ($p <0.001$) than the other two educational institutes (reference to Table 12). The contributing factor for the higher score was due the fact that higher scores were obtained for the **Total fruit**, **Whole fruit**, **Total vegetables**, and **Dairy components**.

*Table 12 - Pairwise comparisons of education institute (HEI-SG)*

| Sample 1 -2 Sample 2 | *Adjusted *P*-values |
|---|---|
| ITE – POLY | 1.000 |
| ITE – JC | **<0.001** |
| POLY – JC | **<0.001** |

*Significance values have been adjusted by the Bonferroni correction for multiple tests. *Based on Kruskal-Wallis multiple comparisons.*

## 4.6 Discussion

With accelerated economic development and urbanization over the past decades, the challenge is no longer focusing on undernutrition, but rather on how to eat healthily in Singapore. Researchers are often interested in the overall quality of diets, leading to several indices being developed, with different degrees of complexity (Kant, 1996). The use of diet quality indices has allowed researchers to consider overall dietary habit in relation to measures of a population's health using a single useful indicator, derived from an array of data. Public health agencies could also use these indices to evaluate compliance to the country's dietary guidelines. Growth and development of adolescents are often associated to their meal patterns and dietary intake. Hence, this section of the study developed a tool (HEI-SG) to evaluate the compliance of the late adolescents' eating habits to the HPB dietary guidelines.

In 1995, the US Department of Agriculture (USDA) Center for Nutrition Policy and Promotion introduced a Healthy Eating Index (HEI) which evaluated the overall diet quality based on the Federal dietary guidelines (T Kennedy et al., 1995). The HEI developed comprised 10 food components which were adapted from the Dietary Guidelines for Americans (DGA) (Health and Services, 1995) and the Food Guide Pyramid (Pyramid, 1992). The index had an overall score of 100 and USDA used it as a tool to promote healthy eating among consumers. The Dietary Guidelines for America was published in 2010 and subsequently the HEI was revised to HEI-2010 to reflect the changes and to adopt an approach that corrects for total energy intake (Guenther et al., 2013a).

In this study, the HEI-2010, which is an *a priori* approach, was adapted to analyze the diet quality of the 17-21 years old adolescents. This approach was selected so that the diet quality of late adolescents can be evaluated against the Singapore Health Promotion Board (HPB) dietary guidelines. HPB launched *My Healthy Plate* in 2014 in order to better communicate the stipulated dietary guidelines (Health Promotion Board Singapore, 2017b). *My Healthy Plate* was suggested to be more discernible and practical to use compared to the *Healthy Diet Pyramid*. Thus, it will be useful to evaluate how the late adolescents have complied with the dietary guidelines. The AHEI was not adopted as the focus group discussions were adopted to explore how they eat. HDI was not used in this study as it is based on WHO dietary guidelines.

Table 13 illustrates the difference between the proposed HEI-SG and the HEI-2010. Milk and dairy were considered as one component while meat (and beans), total protein foods, seafood and plant proteins were also considered as one component (Total Protein) in the HEI-SG. This was because in the *My Healthy Plate,* these foods were considered as total protein foods. **Dark green leafy and orange vegetables** was considered as a separate component as *My Healthy Plate* encourages people to take a variety of vegetables. **Total fats and saturated fats** were included instead of "empty calories".

*Table 13 - Comparison between HEI-2010 and HEI-SG*

| No. | HEI-SG | HEI-2010 |
|---|---|---|
| | **Adequacy components** | |
| 1 | Total fruit | Total fruit |
| 2 | Whole fruit | Whole fruit |
| 3 | Total vegetables | Total vegetables |
| 4 | Dark green leafy and orange vegetables | Greens and beans |
| 5 | Whole grains | Whole grains |
| 6 | Dairy | Dairy |
| 7 | Total protein foods | Meat (and beans) |
| | - | Total protein foods |
| | - | Seafood and Plant Proteins |
| | **Moderation components** | |
| 8 | Total rice and alternatives | Refined grains |
| 9 | Total fat | Empty calories |
| 10 | Saturated fat | - |
| 11 | Sodium | Sodium |

One advantage of the HEI-2010 approach is that it is an energy density-based method in which the recommended minimum and maximum serving size for each dietary component was expressed in terms of per 1000 kcal diet. This allowed each individual's reported energy intake to be adjusted for enabling a fairer comparison between each individual (Guenther et al., 2013a, Han et al., 2015).

In this study, a recommended diet intake of 2300 kcal/ day instead of activity level, which can be age-specific / gender-specific, or activity, was used. This is because activity level was not captured during the data collection.

With the proposed HEI-SG, the late adolescents' diet quality was evaluated. Overall mean HEI for the late adolescents was at a low median score of 47.20 (IQR 16) 100 (reference to Table 6). The late adolescents were complying well for the components **Total rice & alternatives, Total protein foods, Total fat and Saturated fat**. However, the late adolescents were having insufficient intake of total fruits, whole fruits, total vegetables, whole grains, dairy products and a high intake of sodium. There was a significant difference in the overall HEI among the education institutes and ethnicities (reference to Table 10). The participants from the JC had a significantly higher HEI compared to the ITE and POLY, with ITE having the lowest HEI (reference to Table 12). Based on the Kruskal Wallis test, the Malays had a significantly lower HEI compared to the Chinese and Indian late adolescents (reference to Table 9). In this study, the portion of Malay participants was higher in the ITE as well.

As illustrated in Table 9, the Malays also scored significantly lower compared to the Chinese and Indians for the components total fruit, whole fruit, total vegetable, dark green leafy & orange vegetable, whole grains, total fat and saturated fat. The National Nutrition Study (NNS) 2010 also reported that the adult Singapore Malays had a higher total fat and saturated fat intake than Indians and Chinese (Health Promotion Board Singapore, 2016b). The study also revealed that the adult Singaporean Malays had a lower intake of wholegrains, fruits and vegetables than Indians and Chinese. This implied that the eating behavior of the late adolescents is likely to be carried into adulthood.

The scores for the components of total rice & alternatives and total protein foods were high across all three educational institutes, with a median score of 10 (reference to Table 10). The same trend was also observed for both female and male participants of all ethnicities and BMI classes. This would suggest that the majority of adolescents aged 17 to 21 years were consuming adequate amounts based on the food-based dietary guidelines for total rice & alternatives and the total protein foods

components. This result was similar to a USA study conducted by Fulgoni (2008), in which it was found that less than 3% of the males aged 14 to 30 years old and females aged 14 to 18 years old were not meeting the EAR (estimated average requirements) for protein, while 8.6% of the females aged 19 to 30 were not meeting the EAR. Rolland-Cachera et al. (2000) conducted a study on adolescents living in Western Europe and concluded that there was adequate intake of proteins. A high intake of carbohydrate and protein was probably attributed to the increase in appetite experienced during this rapid growth period.

Although the intake of the **Total rice & alternatives** complied with the dietary guidelines of Singapore, the median score for the **Whole grains** component was very low at less than or equal to 1.0 for the females and males of all BMI classes, all ethnicities and from all education institutes (reference to Table 7, Table 8, Table 9 and Table 10 . In the Singapore National Nutrition Survey (NNS) conducted in 2010, only 27% of Singaporeans, aged 18 to 60, consumed one serving or more of wholegrain products per day (Health Promotion Board Singapore, 2017e). Hence, it is not surprising that the late adolescents did not meet the guideline of having 5 to 7 servings of brown rice and wholemeal bread per day or the maximum score 10 which was equivalent to ≥1.30 servings/1000 kcal diet. O'Neil et al. (2011) reviewed the consumption of whole grains in USA children and adolescents using the National Health and Nutrition Examination Survey (NHANES) 1999–2004. It was concluded that the consumption of whole grains was low, with a mean serving of 0.63 servings of whole grains/ day for adolescents, aged 13- 18 years. Grains are important sources of many nutrients, including fiber, B vitamins (thiamin, riboflavin, niacin and folate) and minerals (iron, magnesium and selenium) (McKeown et al., 2013). Kamar et al. (2016) proposed the following possible reasons for low consumption of whole grains: palatability, difficult to purchase, and consumers' inability to identify the wholegrain products. Although the NNS reported a low percentage of consumption of wholegrain products in 2010, it was an increase from a mere 8.4% in 2004 (Health Promotion Board Singapore, 2017e) to 27% in 2010. In Singapore, HPB has increased its efforts in promoting the consumption of whole grains through increasing availability of whole grains by working with the food manufacturers to produce more whole grain products and actively broadcasting the benefits of whole grains through initiatives such as the supermarket tours and school talks (Health Hub, 2017). In

2016, a major shift was made in the Heathy Meals in Schools Programme to incorporate at least 20% of the rice/ alternative as wholegrains and only wholemeal or wholegrain bread can be used to prepare the sandwiches (Health Promotion Board Singapore, 2017d). However, this programme is not mandatory for tertiary education. There is no requirement for ITEs and polytechnics to comply to the guidelines. As the JCs are under the purview of the Ministry of Education, the canteens of JCs have to comply with the guidelines. Hence, Health policy makers could consider making the programme mandatory for tertiary education and explore other methods to further increase the consumption of whole grains in Singaporean late adolescents.

The scores for the **Total fruit**, **Whole fruit**, **Total vegetable**, **Dark green leafy & orange vegetable** components were also very low, with a median score of <2, for the females and males from all BMI classes, all ethnicities and all education institutes (reference to Table 7, Table 8, Table 9 and Table 10). The scores for the **Total vegetable, Dark green leafy & orange vegetable** components were consistently lower than that of the **Total fruit** and **Whole fruit** components. This suboptimal level of consumption of fruit and vegetables is perhaps not unique to Singapore. National nutrition surveys in different regions of the world indicate that children and adults may not be meeting the minimum suggested consumption goals of 400g/day (Pomerleau et al., 2004, WHO and Organization, 2003). In a recent study conducted in India, it was found that adolescent girls' consumption of the vegetables and fruits was way below the Recommended Dietary Intake (RDI – suggested by the India National Institute of Nutrition (Sharma and Singh, 2017). It has been proposed that diets rich in fruits and vegetables have health-protective effects as fruit and vegetables are important sources of a wide range of vital micronutrients (World Health Organization, 2002). There is also a strong body of evidence that suggests the consumption of fruit and vegetables can prevent many chronic non-communicable diseases including cardiovascular disease and some cancers (Klerk et al., 1998, Robertson et al., 2004, WHO and Organization, 2003). Studies have also suggested that with increased availability of fruits and vegetables at home, fruit and vegetable consumption increases (Neumark-Sztainer et al., 2003, Pearson et al., 2017).

The lowest scoring nutrient-based category in the HEI-SG is sodium (reference to Table 6). From the raw data, most individuals scored less than 1.5 out of 10. In Singapore, the recommended daily intake of salt is 5g/day which is equivalent to 2g of Na/day (Health Promotion Board, 2017a). As discussed in Chapter 6, the average consumption of sodium per day is approximately 2.7g Na/day (reference to Table 20), suggesting that majority of Singaporean late adolescents exceeded the guideline. Studies have reported that there is a positive association of sodium intake and blood pressure in children (He and MacGregor, 2010, Arvaniti and Panagiotakos, 2008, Sugiyama et al., 2007). High sodium intake and overweight/ obesity are often identified as risk factors for hypertension in both adults and children. The high sodium intake could possibly be attributed to the frequent consumption of out-of-home food consumption and fast food (Brown et al., 2009).

Dairy consumption also appeared to be on the low side with a median score of 1.40 (IQR 7.0) out of a possible 10 (reference to Table 6). Attainment of an optimal bone mass during adolescence is vital for the prevention of osteoporosis later in life. Dairy food consumption is important as it provides the majority of calcium in the diets of children and adolescents (Gerrior et al., 1998, Albertson et al., 1997) but dairy consumption has been low for children and adolescents in Asia (Lee et al., 1993, Lee et al., 2005, Wu et al., 2007). A possible reason for this observed trend is that Asian's diet is usually non-milk based (Auld et al., 2002). It is important to note that other non-dairy foods, such as broccoli, kale and tofu are also important sources of calcium. Nonetheless, it is also noted that the participants have also scored low for dark leafy vegetables, indicating that calcium intake from these food sources are likely to be low too.

### 4.7 Strengths, limitations and future works

The HEI-SG allows one to systematically evaluate the Singaporean late adolescents' diet quality against the Health Promotion board's recommendations using a density approach. The energy density approach is useful as it normalizes the energy intake of individuals to a base of 1000kcal and allows for comparison. Whole fruit was created as a separated component as My Healthy Plate encourages to consume whole fruits. The index is food based and recognizes the complexity of dietary

patterns (Kant and Graubard, 2005). This index would be useful in monitoring public health of the late adolescents (McNaughton et al., 2008).

One challenge in this study was establishing portion size as there is a variety of food consumed by the participants but there were not many references available to evaluate the portion size of different foods. Another limitation was that most of the food consumed in Singapore falls into the category of mixed food items. Examples of mixed food items include fried rice, stirred fried noodles and curry chicken. It was resolved using online recipes but may not truly depict the actual food consumed. It is also recognized that while the HEI-SG is a useful tool, it is also limited by the data collection method, 24-h recall (which is further discussed in Chapter 8). Another limitation of this study is that total protein is evaluated as one component. Other micronutrients such as iron, zinc and vitamin B12, which are often present in protein rich foods were not evaluated. Also, in this study, empty calories contributed from alcohol, were not considered. It was also argued that although a high HEI score likely indicates a good and balanced diet, the association with health outcomes could not be determined because of a lack of specificity (Arvaniti and Panagiotakos, 2008).

For future works, it would be recommended to propose interventions (for instance, to encourage fruits and vegetables consumption) at this targeted group of post-secondary school students over a period of time and then to review the impact of the intervention by calculating and comparing the HEI-SG before and after the interventions.

## 4.8 Conclusion

A healthy eating index was established and the eating habits of the late adolescents were evaluated. Public health strategies should be customized to address the low intake of total fruits, whole fruits, total vegetables, whole grains, dairy products and a high intake of sodium for this group of adolescents. This is the stage of life in which there is a higher demand of nutrients due to the rapid growth at this stage of their life (Story, 1992). Adolescents' eating habits formed in this phase of their life are also crucial as it is likely that they will continue the same eating habits into their adulthood(Must et al., 1992). With such a poor diet quality, more efforts are needed to address the eating habits for the late adolescents. The HEI-SG revealed the food

groups that required more attention in order to improve diet quality and hence provides valuable information for health policy-makers.

# Chapter 5 Breakfast Intake

## 5.1 Introduction

Breakfast is often regarded as the most important meal of the day as it is the first meal taken after an overnight fast. Studies have reported that regular breakfast intake is associated with many positive health benefits such as lower body weight, lower blood cholesterol (Ruxton and Kirk, 1997), improved overall diet quality (Chitra and Reddy, 2007), improved cognitive function and improvement in alertness (Kleinman et al., 2002, Murphy et al., 1998). Other studies suggested that having a breakfast which has a low glycemic index on a regular basis may be useful for people who are overweight and daily consumption of breakfast could help to reduce the risk of type 2 diabetes mellitus (Tolfrey and Zakrzewski, 2012). However, despite the plethora of benefits that breakfast may offer, studies have concluded that as children approach or enter adolescence, the likelihood of them skipping breakfast increases.

## 5.2 Literature review

### *5.2.1 Frequency of breakfast consumption*

Studies observed that skipping breakfast or irregular breakfast consumption is most frequently seen in adolescents and young adults. For instance, in the Goteborg Adolescence Study, it was reported that 12 % of male and 24% of female Swedish adolescents did not have breakfast on a regular basis (Sjoberg et al., 2003). In a study of Australian adolescents 12% of children aged 13 years skipped breakfast (Shaw, 1998) while the figure for American adolescents was at 19% (Nicklas et al., 2004).

A study on 742 Spanish students aged 9 to 13 years old found that 95% had regular breakfast (Ortega et al., 1996) while another study conducted on 136 Scottish students aged 7 to 8 years old reported a similar value for breakfast consumption (Ruxton et al., 1996). Nonetheless the DONALD (Dortmund Nutritional and Anthropometric Longitudinally Designed) study, which analyzed of 7800 3d dietary records of 1081 participants aged 2–18 years collected between 1986 and 2007 observed that there is a significant reduction in regular consumption of breakfast between the ages of 6 – 12 years and 13 – 18 years old (Alexy et al., 2010).

Recent studies in Asia revealed trends of adolescents skipping breakfast. For instance, approximately 15% of Japanese adolescents, aged 15 to 19 years old (Murata, 2000) and a high percentage of Taiwanese adolescents (23.6%), aged 12 to 20 years old did not consume breakfast regularly (Yang et al., 2006). However, there do not appear to be any data available on breakfast consumption of Singaporean late adolescents at the point of study.

### *5.2.2 Impacts of skipping breakfast*

Early studies in England found that skipping breakfast had no effect on performance in arithmetic or short-term memory and attention-demanding tasks (Dickie and Bender, 1982) or mental performance (Craig, 1986). However, subsequent studies conducted in South Wales suggested that regular breakfast consumption appeared to improve mental health status for adults (Smith, 1998) and young adults (Smith, 2003). Breakfast may be more impactful for children and adolescents who are not fully developed as they have a larger brain to liver ratio than adults and do not have the same adults' ability to store required nutrients for fasting, which resulted from skipping breakfast as found in a study conducted in the United States (Pollitt et al., 1981).

In a large sample of adolescents aged 15–16 years recruited in Oslo, Norway, Lien (2007) reported that skipping breakfast had an impact on mental distress and affected academic performance negatively, with a greater impact seen in boys than girls. The quality of breakfast consumed is equally as important as the frequency of breakfast consumption. Having a poor quality breakfast is equally undesirable as skipping breakfast as it affects the overall nutrient intake (Timlin et al., 2008). In a study conducted in public secondary schools in South Africa, quality of breakfast was evaluated based on the Australian Guide to Healthy Eating (AGHE). The mean breakfast quality was found to be moderate with a marginal association with improved calcium intake and phosphorous intake (Tee et al., 2015). A systematic review of journals from 1950–2013 suggested that regular intake of good quality breakfast has a positive association with the children and adolescents' academic performance (Adolphus et al., 2013).

In more recent studies, Glycaemic Load (GL), Glycaemic Index (GI) or both of the breakfast were examined in relation to their impact on children's cognitive performance. The studies suggested that a lower postprandial glycaemic response has a positive association with children's cognitive performance (Cooper et al., 2012, Micha et al., 2011). However, in a study conducted by Brindal et al. (2012), there was no clear association between GL or GI of breakfast and cognitive performance. Rampersaud et al. (2005) reviewed 47 studies in children and adolescents. It was concluded that a good quality breakfast with a variety of foods from different food groups can have a positive impact on cognitive functions.

The importance of breakfast consumption to dietary adequacy has also received much attention. Morgan et al. (1986) evaluated the breakfast consumption of US children and adolescents using the US Nationwide Food Consumption Survey data. It was concluded that having ready-to-eat (RTE) cereal as breakfast improved the overall diet quality of the children and adolescents. Similar results were also observed in a subsequent study conducted (Deshmukh-Taskar et al., 2010) using the US National Health and Nutrition Examination Survey 1999-2006. It was concluded that children aged 9 to 13 years and adolescents aged 14 to 18 years who had RTE cereal for breakfast had a better nutrient intake compared to those who did not. This could be in part attributed to the fact that RTE cereal is usually fortified with vitamins and minerals. Some studies have observed that skipping breakfast has resulted in a poorer intake of various vitamins and minerals (Nicklas et al., 1993, Morgan et al., 1986). Nicklas et al. (1998) evaluated the breakfast intake of young adults and found that breakfast skippers were less likely to meet their recommended dietary allowances compared to those who ate breakfast. Similarly, in a study of low-income African-American children of grades two through five attending four elementary schools in the United States, Sampson et al. (1995) found that for those who skipped breakfast, more than one third consumed less than halfof the recommended dietary allowance of various vitamins.

Skipping breakfast was found to be positively associated with BMI, and more prevalent among the US children and adolescents in 1991 compared to 1965 (Siega-Riz et al., 1998). Using data from the Third National Health and Nutrition Examination Survey (NHANES III) conducted in United States, Cho et al. (2003)

found that breakfast consumers who had RTE cereal or quick breads for breakfast had a significantly lower BMI compared to breakfast skippers. In a five-year longitudinal study which reviewed the eating habits of adolescents, there was a significant inverse relationship between breakfast frequency and BMI. In the EAT (Eating Among Teens) study conducted in Minnesota, US, this relationship remained unchanged or slightly lower after being adjusted for other factors such as dietary behaviors and weight-related concerns (Timlin et al., 2008). However, the evidence is equivocal. Ostachowska-Gasior et al. (2016) evaluated the association of BMI and breakfast consumption of 3009 adolescents from Southern Poland and did not find any association between breakfast frequency and BMI. Reeves et al. (2015) tried to propose a metabolic-based mechanism to explain the lower BMIs seen in breakfast consumers in a cross-over experiment conducted in England but did not find any significant result to explain the process. Hence the impact of breakfast on weight management or BMI remains controversial due to insufficient casual evidence (Leidy et al., 2016)

In a small sample of 13 young and healthy adults (age:23.5±0.9y), Gwin and Leidy (2018) attempted to evaluate the impact of a high-protein (30g of protein) breakfast on appetite, satiety and quality of sleep. It was concluded that daily consumption of high protein breakfast aids in one's appetite and diet quality. Impact on sleep quality was not conclusive. Melve and Baerheim (1994) conducted a study which includes girls aged 15 to 19 years in Bergen, Norway and suggested that skipping breakfast and other meals could be used a possible indicator of subclinical eating disorders.

*5.2.3 Why do adolescents skip breakfast?*

Bidgood and Cameron (1992) found that children from low income families in southern Ontario, Canada, skipped breakfast twice often as others, although less than 1% cited that they skipped breakfast because of finance difficulty. Yeoh et al. (2008) conducted a study among the 1,600 children aged 7 to 18 years and concluded that the students from low-income families in Korea were more likely to skip breakfast compared to those who were more affluent. However, in a study of approximately 1000 low-income African-American elementary school children in East Orange, New Jersey, only 22% to 26% reported not having breakfast (Sampson et

al., 1995). Hence it is not conclusive that being in a financial difficult situation is a main reason for skipping breakfast.

Another commonly cited reason for skipping breakfast was due to a lack of time. Singleton and Rhoads (1982) conducted a survey with a sample size of 3,309 students aged 8 to 17 years in 135 Louisiana schools and found that 43% cited that the lack of time was the reason for skipping breakfast while 42% cited not being hungry as another reason for skipping breakfast.

Knowing the reasons why adolescents skip breakfast would be beneficial to formulate an intervention programme to encourage them to eat breakfast.

## 5.3 Aim

The aim of this part of the study is to determine the proportion of late adolescents in this study regularly consuming breakfast. The work includes examining the effects of educational institution, ethnicity, gender and BMI on breakfast consumption. The location of breakfast consumption and types of breakfast were also examined. Focus groups were conducted to determine how the late adolescents define breakfast and the perception of having/ skipping breakfast.

## 5.4 Method

### *5.4.1 Definition of breakfast*

To date, there is no universal definition of “breakfast”. Some studies define it simply as a person’s first meal before or after the start of their daily routine (Arora et al., 2012, Schusdziarra et al., 2011) while there are more complex definitions which include the time, ranging from 5am to 9 or 10am (Dubois et al., 2009, Siega-Riz et al., 1998), or energy intake, such as meeting a certain percentage of the daily energy intake (Pereira et al., 2011, Monteagudo et al., 2013). In this study, breakfast was defined as a consumption of at least 100kcal of food and/or beverage within 2-3 hours after waking. However this definition excludes consumption of plain coffee, tea or water only (Howden et al., 1993). Plain coffee, tea, without milk and sugar or water have minimum nutrient values and hence were not considered as breakfast if it is consumed on its own. The criterion of no later than 10 a.m. was disregarded for

this study as late adolescents have erratic sleeping patterns (Dahl and Lewin, 2002) and students at different institutions have different structures to their day.

### *5.4.2 Focus group*

Focus groups were conducted to explore the participants' views on breakfast. The setting up of the focus group was described in Chapter 3. In brief, three focus groups of 6-7 people were conducted using semi-structured interviews to explore participants' views on the definition and importance of breakfast. There was a total of 8 Chinese, 6 Malay and 5 Indian participants.

### *5.4.3 Data analysis*

Breakfast intake data were collected using the multiple-pass 24-h recall and this information was processed and collated in Excel 2013. All statistical analysis was performed using the Statistical Package for Social Sciences, SPSS, version 23 for Windows and statistical significance for all the tests was defined at p-value <0.05. The Pearson chi-squared test was performed to determine the likelihood of an association between breakfast consumption and location of consumption of breakfast with educational institute, ethnicity, gender and BMI. The impact of educational institutes was reviewed based on the data collected from an Institute of Technical Education (ITE), junior college (JC) and polytechnic (POLY) during phase 2. Impact of ethnicity, gender and BMI was reviewed based on the data collected solely from the POLY during phases 2 and 3. Additionally, to assess to what extent breakfast intake was associated with the above factors, coefficient measures such as Phi and Cramer's V values were calculated. The value of the two measures was between −1 and +1, with a value close to 1 indicating a very strong relationship between the variables Statistical significance was set at the level of $p < 0.05$. All the statistical analyses were assessed using SPSS Version 23. The analysis on the types of breakfast and location of breakfast consumption was based on the data collected from the POLY only. Part of the data was examined thematically using the qualitative data management package NVivo Pro 11 (QSR International Pty. Ltd, Doncaster, VA, Australia).

*5.4.4 Data processing*

The dietary intake of 507 participants were reviewed by assigning a “Yes” if all the criteria of breakfast (consumption of at least 100kcal of food and/ or beverages, excluding plain coffee/ tea/ water, within 2-3 hours after waking up) were met. A “No” is assigned if one of the criteria is not met.

The place of consumption was grouped into “home” and “elsewhere”. “Home” refers to the respondents consuming breakfast at their house or student accommodation. The food could be bought from a supermarket, eating outlet or cooked by their parents or themselves. “Elsewhere” refers to school, coffee shops, food courts or eating along the way to school or other eating outlets. If the food was brought from home but eaten in school, it would be classified as “elsewhere” for the place of consumption.

If the criteria were met the foods and beverages consumed were coded as breakfast and grouped into the following categories.

*Table 14 - Food and beverages classification for breakfast intake*

| **Food** | **Beverage** |
|---|---|
| Bread/ Pastry | Malted beverages |
| Asian Food | Coffee/ tea |
| Cereal products | Milk |
| Protein source only | Sweetened drink |
| Others | Soymilk |
| - | Juice |
| - | Water |
| - | Cereal drink |
| - | Others |

## 5.5 Results

### *5.5.1 Breakfast consumption results*

Table 15 and Figure 10 summarize the breakfast consumption data obtained from phases 2 and 3. Breakfast consumption is lowest for the ITE respondents. Breakfast consumption was found to be the similar in the junior college and polytechnic students, with 79% and 78% of the respondents from the junior college and the polytechnic students consuming breakfast respectively. Using the Pearson Chi squared test, breakfast consumption was found to be dependent on educational institute ($p = 0.001$) with a medium effect size (Cramer value = 0.224), which meant that it was a moderately strong relationship. Using the Bonferroni Adjustment for a post-hoc analysis and an adjusted p-value of 0.00833 (=0.05/6), ITE students were less likely to consume breakfast and it is significantly less than the junior college and polytechnic students. There is little difference in breakfast consumption between the genders.

By ethnicity, Chinese respondents were found to be the most frequent breakfast consumers (79.4%) while the lowest percentage of breakfast intake was seen in the Malays respondents at 57.0% (reference to Table 15). Using the Pearson Chi-squared test, breakfast consumption was found to be associated to ethnicity ($p =0.001$) with a medium effect size (Cramer value = 0.216), which indicated a moderately strong relationship only. Using the Bonferroni Adjustment for a post-hoc analysis and an adjusted p-value of 0.00833 (=0.05/6), the number of Chinese who consumed breakfast was significantly higher among the other three ethnicities.

Using the Pearson Chi-squared test, breakfast consumption was found to be independent of gender and BMI ($p > 0.05$). Almost a third of the male and female participants do not regularly consume breakfast.

*Table 15 - An overview of breakfast consumption*

| Breakfast Consumption | | Phase | No. of respondents who consumed (%) | No. of respondents who did not consume (%) | Total |
|---|---|---|---|---|---|
| Educational Institutes | ITE | 2 | 57 (57.0%) | 43 (43.0%) | 100 |
| | JC | | 79 (79.0%) | 21 (21.0%) | 100 |
| | POLY | | 78 (78.0%) | 22 (22.0%) | 100 |
| Ethnicity | Chinese | 3 | 85 (79.4%) | 22 (20.6%) | 107 |
| | Indian | | 59 (59.0%) | 41 (41.0%) | 100 |
| | Malay | | 57 (57.0%) | 43 (43.0%) | 100 |
| Gender | Female | 3 | 105 (66.9%) | 52 (33.1%) | 157 |
| | Male | | 96 (64.0%) | 54 (36.0%) | 150 |

Approximately 65% of the respondents who had a healthy BMI consume breakfast and 73.4% of those at risk of nutrient deficiency consume breakfast. However, for respondents with a high-risk BMI, only around 50% of the respondents consumed breakfast.

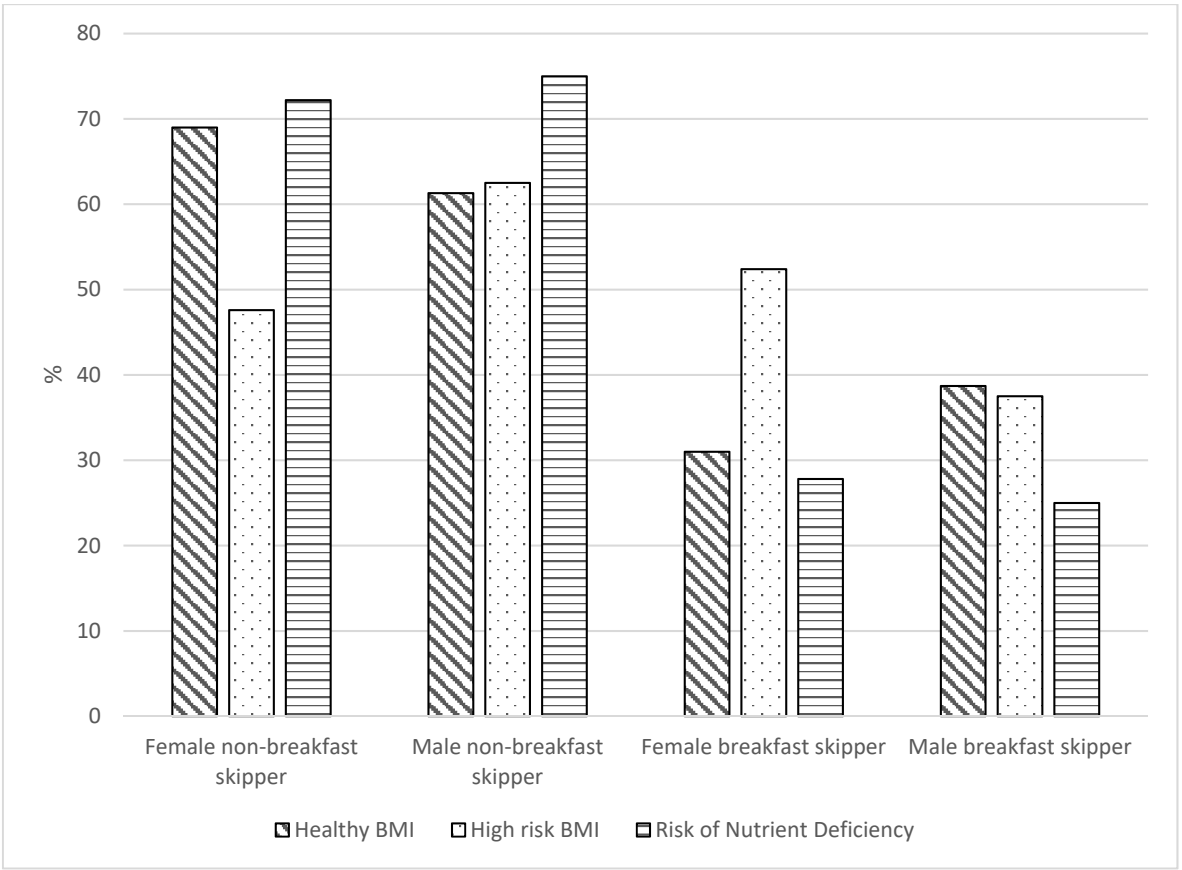



*Figure 10 - Breakfast consumption in relation to BMI*

*5.5.2 Types of breakfast*

Figure 11 and Figure 12 illustrate the proportion of different types of food and beverages consumed by the late adolescents while Table 16 and Table 17 illustrate examples of common foods and beverages consumed respectively. A large percentage of the late adolescents consumed bread/ pastries (58.8%) and Asian food (23.5%) for their breakfast. Malted beverages (42.1%) such as Milo and Horlicks were favored by the late adolescents.

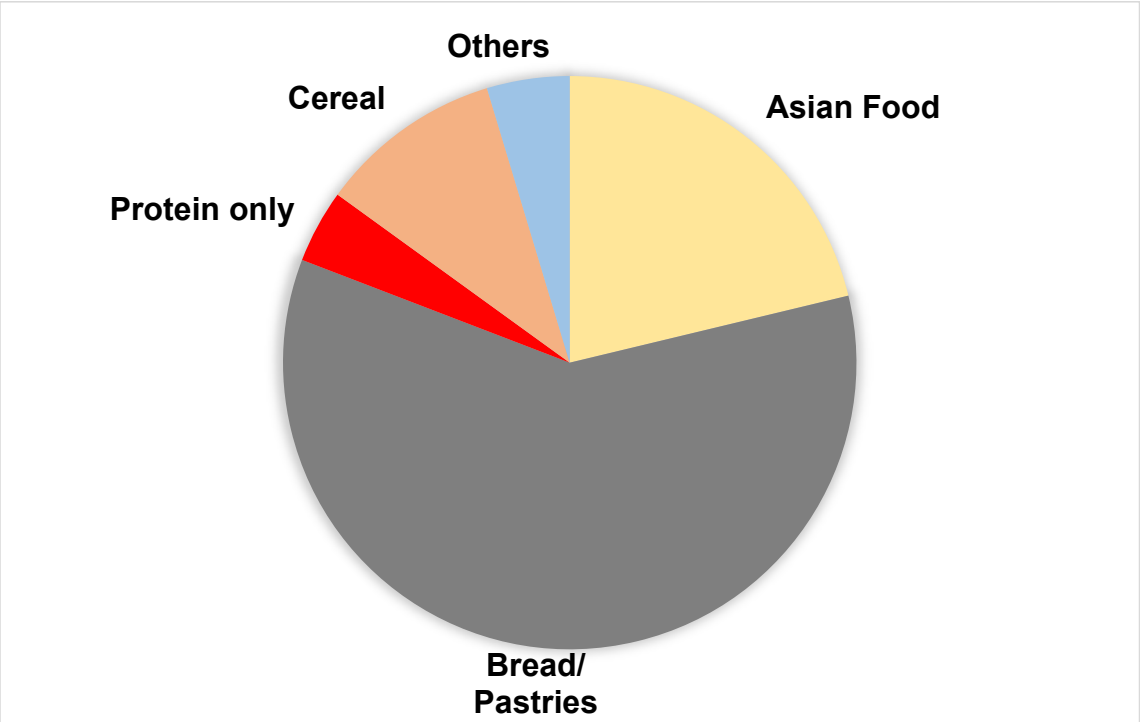



*Figure 11 - Proportion of types of breakfast (food) consumed*

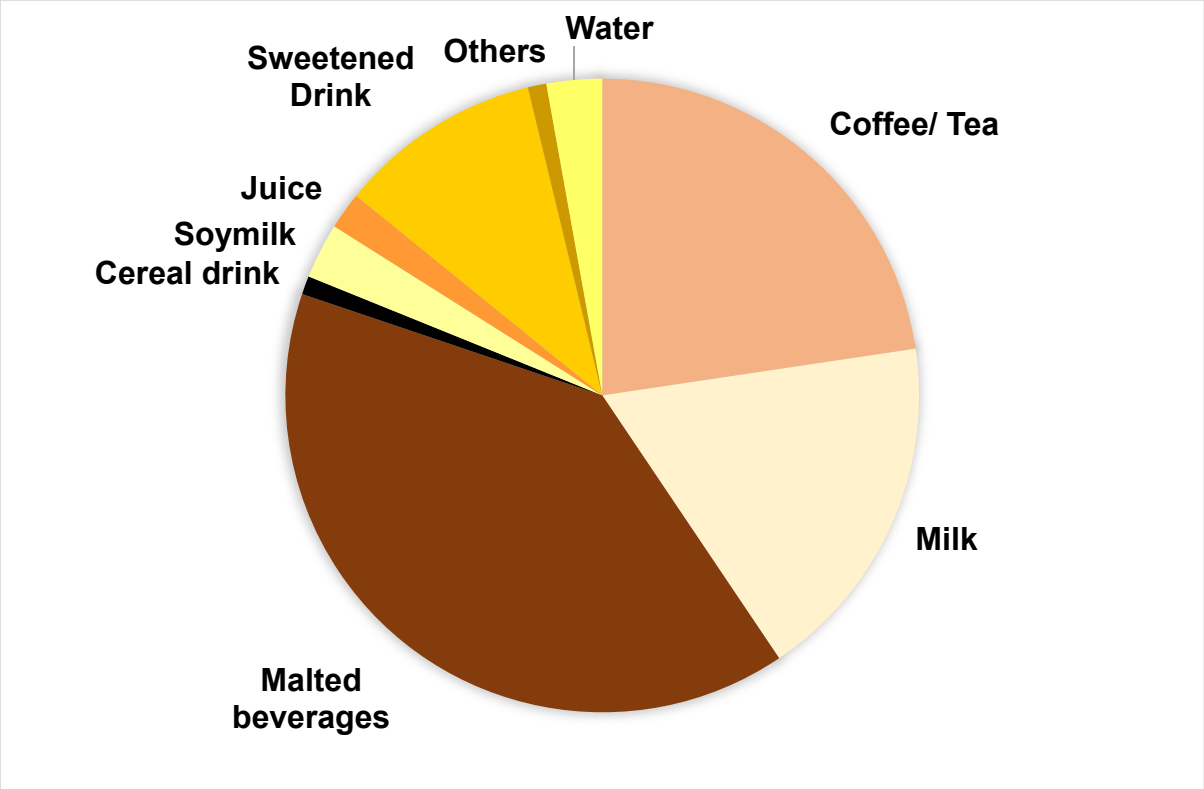



*Figure 12 - Distribution of types of breakfast (beverages) consumed*

Table 16 and Table 17 illustrate some of the most frequently consumed food and beverages in each category.

*Table 16 - Examples of breakfast (Food)*

| Type of Breakfast | Examples |
|---|---|
| Asian Food | Rice or noodles with/ without side dishes such as chicken, fish, vegetables |
| | Sushi, Porridge, Dumplings, Yam Cakes, Fried carrot cake |
| | Prata, *Lor Mai Kia,* Beancurd with *youtiao,* White carrot cake |
| | Lontong, Rice |
| Bread/ Pastries | Bread with or without spread |
| | Bread from bakery shops |
| | Burger, Sandwiches, Cake |
| Protein only | Meat |
| | Egg |
| Cereal | *Nestle's* Koko Krunch, |
| | *Kellogg's* Crunchy nut cereal |
| Others | Yoghurt |
| | Fruits |
| | Biscuits & cookies |

*Table 17 - Examples of breakfast (Beverages)*

| Type of Beverages | Examples |
|---|---|
| Coffee/ Tea | Black coffee with/ without sugar/ milk, tea with or without sugar/ milk, ice coffee, white coffee, 3-in-1 coffee/ tea |
| Milk | Chocolate milk, vanilla milk |
| Malted beverages | Milo/ Horlick |
| Cereal drink | *NutreMilk*'s 3in1 cereal drink, *Kinohimitsu's* multigrain beverage |
| Soymilk | - |
| Juice | Mango juice, lime juice |
| Sweetened Drink | Sweetened green tea, flavoured orange juice, lemon tea |
| Others | Red Bull, Yakult |
| Water | - |

*5.5.3 Location of breakfast consumption*

From the respondents who consumed breakfast, the location of breakfast was evaluated. Table 18 illustrates the results obtained.

Table 18 - Location of breakfast consumption

| Places of Breakfast Consumption | | No. of respondents (Home/Hostel) (%) | No. of respondents (Elsewhere) (%) | Total |
|---|---|---|---|---|
| Educational Institutes | ITE | 25.0 (43.9%) | 32.0 (56.1%) | 57.0 |
| | JC | 61.0 (77.2%) | 18.0 (22.8%) | 79.0 |
| | POLY | 56.0 (71.8%) | 22.0 (28.2%) | 78.0 |
| Ethnicity | Chinese | 63 (74.1%) | 22 (25.9%) | 85 |
| | Indian | 46 (78.0%) | 13 (22.0%) | 59 |
| | Malays | 43 (75.4%) | 14 (24.6%) | 57 |
| Gender | Female | 78 (74.3%) | 27 (25.7%) | 105 |
| | Male | 74 (77.1%) | 22 (22.9%) | 96 |

Using the Pearson Chi-squared test, the location of breakfast consumption was found to be associated with educational institute, ethnicity and gender ($P < 0.005$). However, using the Bonferroni Adjustment for a post-hoc analysis and an adjusted p-value of 0.00833 (=0.05/6) 0.0125 (=0.05/4) for ethnicity and gender respectively, there was no significant difference.

JC respondents had the highest percentage consuming breakfast at home/ hostel, and within the ethnic groups, Indians have the highest percentage consuming breakfast at home/ hostel. More males than females consumed breakfast at home/ hostel.

*5.5.4 Focus results – Qualitative data on late adolescents' perception of breakfast*

There is a number of suggested definitions that are slightly different as discussed in the earlier section 5.4.1. Hence, in the focus groups, the participants were asked to give their own definition of what they think breakfast is. The majority felt that

breakfast is the first meal of the day and breakfast provides energy. However, there were different views on the timing of breakfast. Some defined it as the first meal after they woke up regardless of the time, while others felt breakfast had to be taken before noon.

> "…Usually must consume within 1 hour of waking up because it is a good start of the day…", FG1, P4
> "…Breakfast is something to give us energy to start the day. They can eat it anytime, after they wake up…", FG2, P2
> "…Breakfast is something that you eat right after you wake up. Usually in the morning but, for people with extremely screwed body clock, it can be anytime of the day…" FG2, P3
> "…First meal of the day, before noon…", FG3, P3 and P6

A few described breakfast as a meal that gives them energy or large in portion.

> "…Breakfast is something to give us energy to start the day…", FG2, P2
> "…Something that must be eaten before noon…and must be able to make me full, so I have energy for later work….", FG3, P1

When asked whether they think breakfast is important to them, majority replied it was very important, even though they may not themselves have breakfast regularly.

> "…Because the food you take during breakfast is the food that give you energy throughout the day…" FG1, P1
> "…very important, else attention span also decreases…" FG2, P1
> "…will have a tendency to become overweight if skip breakfast…" FG2, P7

However, some of them had been skipping breakfast and did not see the need to have breakfast.

> "…I don't really know if breakfast is truly important or not… I survived for so long without breakfast…" FG2, P3

Participants were asked their reasons for skipping breakfast. Insufficient time in the morning, no appetite or it was not their habit to consume breakfast were the major

reasons for skipping breakfast. It was evident from the focus group discussion that although the late adolescents knew that taking breakfast is important, they were not always eating it due to the lack of time. Students even reported that lack of time had resulted in them sacrificing their breakfast so that they could have more time to sleep.

> "…no appetite in the morning… can only eat after a few hours (from waking up)…" FG1, P3
>
> "…better to sleep more than to wake up for breakfast…" FG2, P6
>
> "…no time, not a breakfast person…" FG2, P3
>
> "…no time for breakfast…" FG2, P3

The participants were also asked whether they and their parents consumed breakfast. Majority falls in the category of having breakfast a few times per week. The frequency of parents taking breakfast was daily.

*Table 19 - Frequency of having breakfast (participants and their parents) noted by focus groups*

| **Frequency** | **FG1** | **FG2** | **FG3** |
|---|---|---|---|
| Never | - | | |
| Daily | P1 (Y)[1], P2 (Y) | P1 (Y), P2 (Y), P5 (Y), P6 (Y) | |
| Sometimes (a few times a week) | P3 (Y), P4 (Y), P5 (Y), P6 (Y) | P3 (N), P4 (Y), P7 (Y) | P1 (Y), P4 (Y), P5 (Y), P6 (Y) |
| Only weekends | - | | P2 (N) |
| Seldom | | P3 (N) | P3 (Y) |
| No. of participants | 6 | 7 | 6 |

[1]indicates whether participants' parents take breakfast. N – No, Y – Yes

Participants were also asked about the types of food they have for breakfast and the usual location of breakfast intake. Their typical breakfast, if they had breakfast, consisted of toast and coffee/ tea/ milo or the Asian type of breakfast (fried noodles). Also, they usually consumed breakfast out-of-home, such as schools, instead of at home. Their responses were similar to that collated from the 24-h recall.

## 5.6 Discussion

### *5.6.1 Prevalence of Breakfast intake associated with educational institution, ethnicity, gender and BMI*

When compared to studies conducted in other countries, the prevalence of Singaporean post-secondary students skipping breakfast, which ranged from 21% for the JC to 43% for the ITE participants, can be considered moderate (reference to Table 15). For instance, 59.7% of the 8$^{th}$ grade children who were white and 71.7% of the 8$^{th}$ grade children who were black in a USA study skipped breakfast (Delva et al., 2006), while 41.3% of adolescents in another US study skipped breakfast (Merten et al., 2009). Delva et al. (2006) suggested that breakfast intake has a direct relationship with SES level in which low SES was defined in the study to neither (or the only) parent having no more than a high school degree, high SES corresponded to both parents having a college degree and the remaining were coded as middle SES. Adolescents with lower SES level tend to skip breakfast compared to those of higher SES level. Merten et al. (2009) also suggested that a lower SES level could result in a lower breakfast consumption. However, in this study, SES level was not collected and hence the comparison could not be made. Skipping breakfast is a phenomenon commonly observed among adolescents in other parts of the world (Shaw, 1998, Ruxton and Kirk, 1997, Hoyland et al., 2009, Rampersaud et al., 2005). Skipping breakfast has attracted much attention as there are many studies that suggest it could led to many health issues as well as a decrease in academic performance (Keski-Rahkonen et al., 2003). In a study conducted in Australia, non-breakfast consumers had a higher likelihood of having insufficient intake of micronutrients such as thiamin, riboflavin, calcium, magnesium and iron (Williams, 2007). Based on the US Department of Agriculture's Healthy Eating Index scores, breakfast consumers have been found to have a better diet quality than non-consumers (Basiotis et al., 1999). In another review of breakfast quality correlation to diet quality using the 2001-2008 NHANES data, it was found that breakfast consumers had a higher mean HEI-2005 scores than breakfast skippers O'Neil et al. (2014b).

One finding from this study was that breakfast intake was associated with educational institution (with the lowest breakfast intake at the institute of technical education), and ethnicity (with the lowest breakfast intake by the Malay respondents) (reference to

Table 15). Incidentally, 40% of the ITE respondents were Malays, while the percentage of Malays in the JC and POLY respondents were lower (22% of the POLY respondents were Malay while there was no Malay respondent from JC). However, data on the socioeconomic status (SES) was not obtained in this study, which preclude the potential for further analyses. Entry to junior colleges, polytechnics and Institutes of Technical Education in Singapore is mainly based on their Singapore-Cambridge General Certificate of Education Ordinary Level ("O" level). Usually students with better academic performance will enter the junior colleges or polytechnic while those with lower academic performance will enter the ITE (Ministry of Education, 2016b). A literature review on the importance of breakfast has also suggested that the academic performance is positively associated with breakfast consumption (Rampersaud et al., 2005). The sample in this study was a convenience sample of late adolescents from the three educational institutes. There was no information in the public domain on the distribution of ethnicities among the three educational institutes, which impedes a representative sampling for each educational institute. The only main criteria for participation was healthy individuals of age 17 to 21 years. Although this limitation encumbers the generalizability of the data, the results are unique in that they target an at-risk age group which has not been sufficiently researched. For longer-term prospective studies, the sample size could be increased.

To my knowledge, no studies in Singapore have been conducted to examine the association of ethnicity and breakfast consumption. The results of this study proposed that breakfast consumption is significantly associated with ethnicity, with the Malay respondents having the lowest breakfast intake (57% consuming breakfast), followed closely by the Indians (59% consuming breakfast). In this study, the effect of ethnicity was analyzed using the data from phase 3 of the study in which the impact from the different educational institutes was removed. This result is similar to a study conducted in Pahang, Malaysia, which reported that Malay female adolescents had a higher tendency to skip meals, with breakfast being the most frequently skipped meal Chin and Mohd Nasir (2009). However, there are not many studies that examine the difference in the dietary intake between people of Chinese, Malay and Indian background, limiting the possibility for comparison.

In this study, there is no significant difference in the breakfast consumption between the genders (P = 0.596). Approximately 35% of male and female late adolescents skipped breakfast. This finding agrees with some studies but does not align with others. For instance, in a study conducted in South Africa, no significant difference was found between the genders (Tee et al., 2015) while a study conducted in Australia observed that girls were three times more likely to skip breakfast than boys (Shaw, 1998). The present data indicate that of the breakfast skippers, girls were more likely to be overweight than boys, while for non-breakfast skippers, boys were more likely to be overweight than girls.

An analysis of the self-reported BMI (Body Mass Index) of the POLY respondents was conducted. The lower Asian BMI cut-off points for adults were used for analysis in this study (World Health Organisation, 2016b). A BMI of 18.5 – 22.9 is defined as heathy range and low risk of developing cardiovascular diseases (such as heart attack) and diabetes in Singapore. A BMI of less than 18.5 indicates a risk of nutrient deficiency. A BMI of 23-27 indicates moderate risk while >27 indicates high risk of developing cardiovascular disease (Health Promotion Board, 2012b). Although breakfast consumption was found to be independent of BMI, obesity was observed to be more common in those who skipped breakfast. 16.0% of non-breakfast consumers had a high-risk BMI compared to only 10.0% of breakfast consumers. This finding is congruent with many studies in which skipping breakfast is likely to result in obesity (Merten et al., 2009, Croezen et al., 2009, Keski-Rahkonen et al., 2003). Non-breakfast consumers have a tendency to over-eat at their first meal, if it is more than 3 hours after they have woken up, and in the long run, this may lead to an increase in weight and thus a higher BMI (Odegaard et al., 2013). In a study conducted in the USA using data from the National Health and Nutrition Examination Survey, 1999-2000, it was found that female breakfast consumers were significantly less likely to have a BMI ≥ 25 although the trend was not observed for male breakfast consumers (Song et al., 2005). The prevalence of obesity in children in Singapore has increased at an alarming rate, from a mere 0.9% overall obesity prevalence from 1998 to 2004 to 11% in 2010 (Ministry of Health, 2017)! The rising prevalence of obesity is a global concern as obesity is a major contributing factor to several health problems such as diabetes, heart disease and hypertension (Bray and Bellanger, 2006). An increase in breakfast consumption frequency was found to have a positive

association with reduced occurrence of overweight and obesity in a cross-sectional study conducted which includes 1814 students from grade 8th and 10th from eight schools in India (Arora et al., 2012). With considerable evidence of association between breakfast consumption and obesity found in various countries (Jääskeläinen et al., 2013, Veltsista et al., 2010, Schlundt et al., 1992, Horikawa et al., 2011) , policy makers could explore the impact of breakfast consumption as one of the measures to combat the increase in obesity in Singapore.

### *5.6.2 Types of breakfast & location of breakfast*

The type of food consumed at breakfast is suggested to be important for metabolic health (Timlin and Pereira, 2007). The types of breakfast consumed by the participants in this study revealed a move towards westernized eating practices. More than half of the late adolescents consumed bread or pastries while only a fifth of the respondents consumed traditional Asian foods such as rice or noodles. More than 40% of the respondents consumed Milo and Horlicks for breakfast.

Consumer trends have also reported a similar trend of increased consumption of baked products. It was postulated that the consumption of baked products in the Asia-Pacific region will overtake that of North America by the year 2019 (Euromonitor International, 2017). Traditional Asian food such as porridge and rice would require one to sit down and eat the meal. On the other hand, foods such as bread or pastries are convenient for the busy adolescents who could eat it on their way to school. Another possible reason for late adolescents choosing bread/ pastries as breakfast is that many mothers in Singapore are working and hence they may not have the time to cook a hot meal for the late adolescents as their breakfast (Howden et al., 1993).

In some studies, attempts have been made to examine the quality of breakfast consumed. In Australia, breakfast quality was defined based on the Australian Guide to Healthy Eating food groups (Radcliffe et al., 2004) while in Italy, breakfast was qualified using the Italian recommended daily dietary intake (Giovannini et al., 2008). The models used are similar in nature to an ideal breakfast. Ideal breakfast typically includes an energy intake of 15% to 25% of the recommended daily intake of energy, with food contributed from three food groups - energy giving food, protein-based

food, dairy products (such as milk or yoghurt), fruits and vegetables (O'Neil et al., 2014a). Examining the data collected and based on the definition of the above as an ideal breakfast, breakfast quality is low for late adolescents in Singapore. The two major food types consumed are bread/ pastry and Asian food which made up 82.3% of the total breakfast items consumed (reference to Figure 11). From the food type of bread/ pastry, only a small percentage (10%) of bread consumed was wholemeal or multigrain. For the Asian food, the rice/ noodles consumed are all white rice or noodles. The drinks, which accounted for 72.6% of drinks consumed during breakfast, that the late adolescents have are usually energy dense or sweetened drinks or nutrient poor (e.g. coffee/ tea).

The respondents from the Institute of Technical Education tended to consume their breakfast in the school more frequently. Hence one possible measure to encourage breakfast eating for this group of respondents could be having more affordable and healthy breakfast sold in the school canteens. Parents could also make breakfast available at home to encourage breakfast consumption. Among the ethnicities, Indians have the highest percentage of respondents consuming breakfast at home/ hostel.

### *5.6.3 Reasons for not having breakfast (focus group)*

Skipping of breakfast may be attributed to the lack of time or nobody to prepare breakfast for them (Sweeney and Horishita, 2005) and this was reflected in the discussion at the focus groups. However, weight concerns, which was usually seen among the female adolescents (Malinauskas et al., 2006) was not highlighted as a reason for skipping breakfast during the focus group discussions.

Among the three focus group discussions, the majority of the late adolescents reported that their parents had breakfast daily while they themselves often skipped breakfast. The result differed from a systematic review conducted by Pearson et al. (2009) who suggested that parental eating behavior has a positive association with that of the adolescents. A possible reasons attributing to this observed phenomenon is that in Singapore, both parents are frequently working, a trend that was observed to have increased from 45.9% in 2010 to 65.5% in 2015 (Ministry of Social and Family Development Singapore, 2017). The main reason cited for not eating

breakfast are not having time to do so and they choose sleep over breakfast. Food manufacturers could consider having healthy, convenience meals for breakfast to combat the time-tight adolescents. Jackson (2013) suggested to serve meals at table and eat together as a family to improve the frequency of breakfast intake.

### 5.7 Strengths, limitation and future directions

One of the strengths of this study is that the analysis of the quantitative data was reviewed with the inputs of qualitative data from the focus groups. For instance, definition of breakfast was defined using the inputs from the focus group participants. It gave an insight of how the respondents of this age range define breakfast in their own views. With focus groups data, it helped to explain the quantitative data collected from the 24-h recall. For instance, as reviewed from the 24-h recall data, breakfast consumption is low among this age group. From the focus group sessions, the reasons for not consuming breakfast was solicited. The information gathered provides insights to the trend observed.

One limitation of the study is that it does not examine the socio-economic status (SES) of the participants. Some studies have reported that breakfast consumption is related to the SES (Alexy et al., 2010). Also, in this study, it was decided not to evaluate the breakfast quality as an overall heathy eating index was established in the early chapter (Chapter 4) and it was suggested that the overall diet quality was not ideal. More works could be done to establish whether there was an association of parent's influence, such as parents themselves not taking breakfast, on the late adolescents' intake of breakfast. And since this group of participants are still schooling, data such as their school performance could be obtained to evaluate how their breakfast quality affects their academic achievements. Again, it is noted that this could be confounded by other factors such as SES. In this study, the time of waking up was obtained. Data on the sleeping patterns could also be obtained to have a better understanding of how their daily pattern is affected by their sleeping pattern.

Future studies could consider investigating the causes of this age group skipping breakfast. Although it was revealed in this study that not having sufficient time is a cause of skipping breakfast, more work needs to be done to determine the cause(s)

of this. For instance, was it the school work load that resulted in deprival of sleep and hence they would rather sacrifice their breakfast for sleep, or was it a case of addictive to online games or social media that resulted in poor time management? It is speculated that there may not be a single root cause for skipping breakfast but rather a series of external factors that may mean that breakfast consumption is not prioritized in Singaporean late adolescents. In addition, future studies could consider specifically examining the causes of skipping breakfast among the Malays. The limited availability of food choices (Halal food) could be a possible reason for them to skip breakfast or other meals.

## 5.8 Conclusion

Researchers have suggested that habits formed early in life are likely to continue into adulthood (Perry et al., 1985, Craigie et al., 2011). With evidence from various studies attesting to the benefits of breakfast consumption, establishing good habits such as breakfast consumption becomes crucial. The Singapore Health Promotion Board has already made it mandatory to sell only wholemeal bread in Primary, Secondary schools and junior colleges under the Healthy Meals in Schools Programme (Health Promotion Board Singapore, 2017a). With bread being the most popular choice of breakfast, Singapore government could consider making it mandatory to fortify all bread with more micronutrients as a measure to improve breakfast quality. It is noted however, the implementation may not be that straightforward. For instance, it was highlighted in a report that having mandatory folate fortification in flour may result in high intake of folate in children and adolescents who tends to eat more bread and therefore may result in them exceeding the recommended daily intake of folate (Swedish Council on Technology Assessment in Health Care, 2007). Promotion of healthy eating programs are in place for the Primary and Secondary schools. However, more efforts could be done for the post-secondary school students in which they have more autonomy in their choice of food. Post-secondary schools could consider starting a later time to allow the time-tight late adolescents to take their breakfast.

# Chapter 6 Out of home food consumption

## 6.1 Introduction

The popularity of having out of home food (OH) or food away from home has increased over the years in the developed countries (Guilkey et al., 1990). Studies have reported that an increase in consumption of OH food has led to a decline in micronutrient intakes (Guenther and Ricart, 1989, Le Francois et al., 1996). Kant and Graubard (2004) reviewed three surveys, namely the National Health Interview Survey (NHIS) 1987 and 1992 and National Health & Nutritional Examination Survey (NHANES) 1999-2000 and concluded that more Americans consumed OH food in 1999 -2000 compared to 1987, with 41% having 3 or more commercially prepared meals weekly versus 36%. In a recent systematic review about the nutritional significance of eating OH foods, in which peer-reviewed studies of eight databases (up to 10 March 2011) were conducted, all age groups consumed a considerable part of their daily energy from eating OH food (Lachat et al., 2011). The studies reviewed were conducted across Europe, USA, China, Philippines and Vietnam. The percentage contribution of energy from OH food ranged from 6-21% for the elderly in Mediterranean Europe, to a high of 83% for school-aged children in the United States. The total daily energy contribution from OH school food was around 9-16% for adolescents and for the American children who were enrolled in school lunch programme, the energy contribution from school food was as high as 39%. For Vietnam adolescents, the contribution of OH food was estimated to be 25% of total energy. In terms of nutritional characteristics, the review concluded that OH foods were higher in fat, saturated fat, sodium and energy, particularly in studies conducted in Ireland, UK and USA (Lachat et al., 2012).

Increased intake of out of home foods has also been linked to increasing obesity rates. Young and Nestle (2002) found that the portion size of commonly consumed out of home foods had increased since 1970s and exceeded the USDA and FDA standard portions. In another study in US, it was reported that the contribution of OH foods to the total energy per day had increased from 18% (1977 – 78) to 32% (1994 – 96) (Guthrie et al., 2002). During this time an increase in the proportion of the population classified as overweight also occurred, suggesting a possible link between excess energy intake due to larger portion size and an increase in body weight.

Singapore has a food culture that is markedly different from the Western countries in which the aforementioned studies have been carried out. Singapore is a multi-racial country and there are many eating outlets around the island, some of which operate 24-hours a day. Having meals at 'hawker centres' forms part of the food culture in Singapore. A hawker centre is a unique feature of the food landscape in Singapore. The hawker centre is a conglomerate of many cooked food stalls, owned by individuals, ranging from the Chinese, Malays and international (such as Thai, Japanese and Korean food) cuisines, typically in an open air setting and which may form part of a market in which fresh produce is being sold(National Environment Agency, 2013). Such hawker centres are located all over the island. These centres are managed by agencies such as the National Environment Agency (NEA) and the Housing Development Board (HDB). A meal at these hawker centres can cost as little as S$2. With the median gross monthly income for Singaporeans at S$3480(Ministry of Manpower, 2013), the cost of per meal at a hawker centre per day is approximately 0.06% of income, making it a very affordable option to many Singaporeans.

In the recent Singapore National Health Survey 2010, it was concluded that the percentage of people consuming foods OH (at least four times per week) for adult Singaporeans has increased from 47.8% (year 2004 data) to 60.1% (an increase of 12.3%) (Health Promotion Board Singapore, 2017e). The figure obtained was based on consumption of foods at hawker centres/ coffee shops/ restaurants and food courts. Coffee shops and food courts are similar in concept to the hawker centres. The individual cooked food stalls are usually managed by private owners who lease the stalls to individuals. Thus, the trend of increasing consumption of OH foods in Singapore seems to be similar to the global trend as countries become more developed. Possible explanations for this trend could be limited time available for cooking healthy meals at home, a decline in cooking skills or a shift towards grazing and snacking practices (Lindsey et al., 2013).

In addition, Singapore is a cosmopolitan city with increasing rates of dual household income (Ministry of Social and Family Development Singapore, 2017). The proportion of dual income in Singapore has increased from 45.9% in 2000 to 65.5% in 2015. Studies suggested that dual income could possibly affect the percentage of

out of home food consumption. For instance, in a study conducted by Yen (1993), it was suggested that households with dual incomes have a higher propensity to consume out of home food than those with a single income as they have more money to afford out of home food but have limited time for food preparation and cooking.

A body of evidence suggests that with an increase intake of OH foods there is a decline in micronutrient intakes or diet quality (Le Francois et al., 1996, Clemens et al., 1999, Mancino et al., 2009). Hence, it would be useful to examine the contribution of OH foods to the diet of Singaporean late adolescents in this study.

## 6.2 Aim

To date, there is very little information on the out-of-home food consumption of late adolescents in Singapore. Most of the studies conducted in Singapore have focused on adults. The present work aims to; generate knowledge about the contribution of out-of-home foods to the diet of adolescents, aged 17-21 in Singapore and, to examine differences in out of home food behavior, among the educational institutes, gender, classes of BMI and ethnicities.

## 6.3 Method

### *6.3.1 Processing the data for out-of-home food consumption*

Data (24-h recalls) collected from phase 2 and 3 were analysed for the out-of home food consumption. Each individual food within the 24 h recall data was coded either “H” (home) or “OH” (out of home) in the Microsoft EXCEL 2013 spreadsheet. Information in the raw data “Homemade/ retail” column indicated information such as school canteen, coffeeshop, homemade. The place of preparation was used as the criterion to define out-of-home foods. If the food was purchased from outside but consumed at home, it would still be considered as “OH”. For instance, a participant had chicken rice and coffee for lunch at home. The chicken rice was bought from the school canteen while the coffee was made at home. Hence the chicken rice would be coded as “OH” while the coffee would be coded as “H”. Any food taken from the home would also be considered as “H”. For instance, a biscuit taken from home but consumed at school would be considered as “H”. The data was then summarized using the PIVOT function and data were processed using the Statistical Package for

Social Sciences, SPSS, version 23 for Windows. Statistical significance for all the tests was defined at p-value <0.05. The skewness and Kurtosis suggested that the data were not of normal distribution, therefore non-parametric analyses were performed.

### *6.3.2 Focus group*

Focus groups were conducted to gather late adolescents' perception of having out of home food. Full details of the methodology for focus groups is discussed in Chapter 3. Three sessions of focus groups of 6-7 people, using semi-structured interview, were held to with the aim of exploring the frequency that participants had OH food for lunch and dinner and the reasons for having OH food. There was a total of 8 Chinese, 6 Malay and 5 Indian participants in the three focus groups. Participants were also asked for their usual meal venues, how they chose where and what to eat and whether they would opt for healthier choice options.

## 6.4 Results

The following table depicts the overall energy and nutrient components for the late adolescents. Subsequent tables illustrate how out-of-home food contributed to their dietary intake.

*Table 20 – Overall energy and nutrient components (based on data collected from POLY students only)*

| **Energy and Nutrient components** | **Median** | **IQR** |
|---|---|---|
| Total Energy (kcal) | 1711 | 855 |
| Total Total Fat (g) | 60.4 | 38 |
| Total Protein (g) | 65.1 | 41 |
| Total Ca (mg) | 422 | 380 |
| Total Na (mg) | 2427 | 1810 |
| Total Dietary Fibre (g) | 11.6 | 8.7 |
| Total Saturated fat (g) | 23.4 | 17 |
| Total Cholesterol (mg) | 244 | 280 |
| Total Carbohydrate (g) | 218 | 130 |

The following sections illustrate the results obtained from the 24-h recall and focus groups with regards to the OH intake.

### *6.4.1 Percentage of OH foods to the total food consumed in a day*

Table 21, Table 22, Table 24 and Table 26 illustrate the contribution of out-of-home food to the energy and nutrient intakes in terms of gender, education institutes, BMI classes and ethnicity. No significant difference was observed between gender or BMI classes (reference to Table 21 and Table 26).

*Table 21 - Percentage of out-of-home food contribution (gender)*

| **Energy & different nutrients** | **Female n = 157** | | **Male n = 150** | | **Gender** |
|---|---|---|---|---|---|
| | Median | IQR | Median | IQR | **P*-value |
| Energy | 61.35 | 54.7 | 58.46 | 43.22 | 0.353 |
| Carbohydrate | 59.54 | 58.9 | 55.47 | 44.2 | 0.284 |
| Protein | 61.25 | 58.9 | 62.87 | 50.5 | 0.482 |
| Fat | 66.33 | 59.3 | 64.33 | 47.8 | 0.476 |
| Saturated fat | 69.01 | 60.9 | 62.52 | 51.8 | 0.298 |
| Calcium | 59.56 | 71.4 | 50.66 | 60.2 | 0.225 |
| Cholesterol | 78.75 | 70.6 | 67.36 | 72.8 | 0.260 |
| Sodium | 61.47 | 64.2 | 63.61 | 57.8 | 0.995 |
| Dietary fiber | 56.68 | 61.4 | 56.77 | 52.7 | 0.604 |

**Based on Mann-Witney U Test*

*Table 22 - Percentage of out of home food consumption (educational institution)*

| Energy & Nutrients | ITE (n=100) | | JC (n=100) | | POLY (n=100) | | Education Institute |
|---|---|---|---|---|---|---|---|
| | Median | IQR | Median | IQR | Median | IQR | *p-value |
| Energy | 77.74 | 44.01 | 66.56 | 45.9 | 72.24 | 61.1 | **0.028** |
| Carbohydrates | 76.64 | 41.7 | 62.25 | 42.6 | 67.05 | 58.9 | 0.013 |
| Protein | 82.03 | 45.2 | 58.46 | 50.0 | 80.17 | 62.1 | **<0.001** |
| Fat | 81.41 | 47.4 | 73.96 | 42.8 | 82.21 | 59.6 | 0.105 |
| Saturated fat | 82.47 | 42.2 | 75.09 | 42.7 | 76.42 | 56.2 | 0.074 |
| Calcium | 77.72 | 49.5 | 66.17 | 45.2 | 68.50 | 67.0 | 0.061 |
| Cholesterol | 86.66 | 52.4 | 65.55 | 64.1 | 50.50 | 50.5 | **<0.001** |
| Sodium | 78.71 | 47.3 | 73.56 | 47.9 | 78.61 | 56.5 | 0.114 |
| Dietary Fiber | 77.29 | 47.2 | 59.07 | 51.8 | 67.20 | 64.8 | **0.002** |

**based on Kruskal-Wallis Test*

*Table 23 - Pairwise comparisons of education institute (% of OH foods)*

| Sample 1 – Sample 2 | *Adjusted *P*-value | | | |
|---|---|---|---|---|
| | Energy | Protein | Cholesterol | Dietary fiber |
| JC – POLY | 1.000 | **0.024** | 0.055 | 0.281 |
| JC – ITE | **0.045** | **<0.001** | **<0.001** | **0.002** |
| POLY – ITE | 1.000 | 1.000 | **0.035** | 0.675 |

**Significant values have been adjusted by the Bonferroni correction for multiple tests.*

**Based on Kruskal-Wallis multiple comparisons.*

*Table 24 - Percentage of out-of-home food contribution (ethnicity)*

| Energy & nutrients | Chinese n = 107 | | Indian n = 100 | | Malays n = 100 | | Ethnicity |
|---|---|---|---|---|---|---|---|
| | Median | IQR | Median | IQR | Median | IQR | *P-value |
| Energy | 67.75 | 57.5 | 54.35 | 42.0 | 55.26 | 56.5 | **0.049** |
| Carbohydrates | 66.19 | 53.4 | 53.12 | 45.5 | 56.18 | 55.6 | 0.066 |
| Protein | 72.98 | 59.0 | 51.91 | 51.2 | 59.05 | 57.8 | **0.036** |
| Fat | 70.67 | 59.6 | 62.00 | 40.7 | 63.37 | 57.5 | 0.091 |
| Saturated fat | 70.42 | 55.9 | 60.19 | 49.4 | 66.89 | 61.8 | 0.063 |
| Calcium | 61.10 | 69.2 | 43.56 | 64.1 | 51.80 | 70.0 | **0.015** |
| Cholesterol | 82.76 | 61.5 | 72.25 | 76.5 | 63.83 | 83.6 | 0.061 |
| Sodium | 78.90 | 59.7 | 55.40 | 57.2 | 60.60 | 67.1 | **0.01** |
| Dietary Fiber | 60.48 | 59.4 | 52.12 | 44.2 | 62.43 | 64.5 | 0.088 |

**Based on Kruskal-Wallis Test*

*Table 25 - Pairwise comparisons of ethnicity*

| Sample 1 – Sample 2 | *Adjusted *P*-value | | | |
|---|---|---|---|---|
| | Energy | Protein | Calcium | Sodium |
| Indian – Malay | 1.000 | 1.000 | 0.325 | 1.000 |
| Indian – Chinese | 0.061 | **0.041** | **0.011** | **0.014** |
| Malay - Chinese | 0.205 | 0.189 | 0.622 | 0.069 |

**Significant values have been adjusted by the Bonferroni correction for multiple tests.*

**Based on Kruskal-Wallis multiple comparisons.*

Out-of-home food contribution to energy and protein was highest in the ITE participants. ITE participants' energy intake contributed from OH food was significantly higher compared to JC, but no significant difference was observed between JC-POLY or POLY-ITE. For protein contribution from OH food, it was observed that it was significantly higher in the POLY participants compared to the JC, and ITE participants compared to JC (reference to Table 22 and Table 23). ITE's participants had significantly higher contribution of cholesterol contribution from OH food (reference to Table 22 and Table 23).

*Table 26 - Percentage of out of home food consumption (BMI classes)*

| Energy & nutrients | Risk of nutrient deficiency n = 62 | | Healthy n = 147 | | Moderate risk n = 62 | | High risk n = 36 | | BMI class |
|---|---|---|---|---|---|---|---|---|---|
| | Median | IQR | Median | IQR | Median | IQR | Median | IQR | *P-value |
| Energy | 61.85 | 46.2 | 61.00 | 52.1 | 58.62 | 46.5 | 55.03 | 66.9 | 0.67 |
| Carbohydrates | 60.57 | 46.2 | 55.92 | 49.5 | 54.57 | 48.0 | 53.23 | 71.4 | 0.67 |
| Protein | 61.69 | 44.6 | 63.63 | 55.1 | 58.05 | 54.1 | 61.73 | 68.3 | 0.75 |
| Fat | 68.32 | 45.9 | 65.84 | 54.1 | 60.87 | 46.2 | 56.54 | 79.4 | 0.658 |
| Saturated fat | 74.85 | 45.9 | 65.25 | 53.4 | 63.55 | 51.3 | 48.80 | 81.1 | 0.529 |
| Calcium | 52.71 | 61.0 | 50.31 | 65.4 | 52.60 | 72.5 | 66.82 | 70.1 | 0.691 |
| Cholesterol | 80.07 | 49.1 | 68.69 | 74.6 | 74.22 | 72.3 | 69.80 | 83.3 | 0.455 |
| Sodium | 68.80 | 53.1 | 62.04 | 56.0 | 52.95 | 66.4 | 54.84 | 73.6 | 0.619 |
| Dietary Fiber | 58.79 | 52.1 | 60.48 | 59.1 | 55.72 | 58.5 | 52.77 | 63.4 | 0.869 |

**Based on Kruskal-Wallis Test*

### *6.4.2 Focus group results*

Table 27 illustrates the distribution of the participants noted out of home food consumption habits for lunch and dinner. The number indicates the number of participants who voted for the frequency.

*Table 27 - Frequency of eating out for lunch and dinner*

| **Meals** | **Lunch** | | | **Dinner** | | |
|---|---|---|---|---|---|---|
| **Frequency** | **FG1** | **FG2** | **FG3** | **FG1** | **FG2** | **FG3** |
| Every weekday | 0 | 1 | 4 | 0 | 0 | 0 |
| Every day (when schooling) | 1 | 5 | 1 | 0 | 2 | 0 |
| Every day | 4 | 1 | 0 | 3 | 0 | 0 |
| At least 3 times per week | 1 | 0 | 0 | 3 | 0 | 0 |
| At least 4 times per week | 0 | 0 | 0 | 0 | 0 | 1 |
| Less than 3 times per week | 0 | 0 | 0 | 0 | 4 | 4 |
| No. of participants | 6 | 7 | 6 | 6 | 7* | 6 |

**FG2, P2 did not give her opinion*

For all the focus groups, most of the participants had out of home food for lunch on school days, with the exception of Participant 1 from FG1. The majority of them also had one weekend day per week having out of home meals. FG3, Participant 3 had outside food for lunch if she went to school. However, if this participant was not working or at school, she would have lunch at home. FG3, Participant 6 preferred to have lunch outside instead of home-cooked food so that she could eat with her friends as most of her friends' mums did not cook.

For FG1, approximately half of the participants had out of home food for dinner every day while the other half was having it at least 3 times per week. For FG2 and 3, the majority of the participants had their dinner at home, even on weekdays. FG2, Participant 3 had dinner twice as she went home usually late. Hence, she would have her dinner one time outside and then when she reached home, she would still eat the dinner cooked by her mum.

The next part of the focus group session was to explore the reasons for eating out for lunch. A summary of the major themes expressed by participants is presented in Table 28 below.

*Table 28 - Themes and evidence obtained from focus groups for having OH food for lunch*

| Themes | Evidence from focus groups |
|---|---|
| No time to prepare food | *"Singapore [sic] very rushing. [There is] no time"*<br>FG1, Participant 3, M, Malay<br>*"…expecting parents to wake up early in the morning to cook for their kids is very harsh."*<br>FG2, Participant 3, F, Indian<br>*"[I /my family members] don't have the time to prepare food in the morning"*<br>FG2, Participant 5, F, Malay<br>*"…work environment is very fast paced….they (parents) won't also have the time to prepare foo*d"<br>FG2, Participant 4, F, Chinese<br>*"It is a luxury [to have home cooked food for lunch]."*<br>FG2, Participant 3, F, Indian<br>*"We don't actually find time to cook our own food"*<br>FG2, Participant 5, F, Malay |
| Not a social norm | *"…very embarrassed [to be seen eating home packed food]… everyone will look at you."*<br>FG3, Participant 4, F, Chinese<br>*"…[eating home packed food is] like so pathetic"*<br>FG3, Participant 4, F, Chinese |

The participants were also asked if they could have home-cooked food, would they still prefer to purchase the food outside. Mixed responses were obtained.

Table 29 - Responses obtained from participants on the question, "Would you have home-cooked food for lunch?"

| "No" | "Yes" |
|---|---|
| *"I don't want to eat a cold meal"*<br>FG2, Participant 3, F, Indian | *"When you are on a budget, bring food from home is better"*<br>FG2, Participant 2, F, Malay |
| *"[outside food] more fresh", "food has variety", "more choices"*<br>FG2, Participant 2, F, Malay, Participant 4, F, Chinese, Participant 5. F, Chinese and Participant 6, F, Chinese | *"home cooked food taste nice"*<br>FG1, Participant 2, F, Indian, FG2, Participant 4, F Chinese |
| *"for convenience,…, [it is ] troublesome to pack the lunch…[the packed food will] add weight to the bag"*<br>FG2, Participant 7, F, Chinese | *"[eating home-cooked food] can save time on queuing", "packed lunch is faster"*<br>FG2, Participant 5, F, Malay, FG3, Participant 2, F, Chinese |
| "not everyday,…, will get sick of the food…"<br>FG3, Participant 1, F, Chinese | *"Home cooked food is healthier."*<br>FG1, Participant 3, M, Malay, FG2, Participant 6, F, Chinese<br>*"save money"*<br>FG1, Participant 3, M, Malay<br>*" [I] prefer [to eat] home cooked food if I can go home to eat"*<br>FG2, Participant 3, F, Indian |

Participants were next asked about the location of lunch and how they would decide what they would eat for lunch. Six main themes were obtained from the three focus groups.

Table 30 - Themes and evidence on deciding what to eat for lunch

| Theme | Evidence |
|---|---|
| Time | *"[I will choose the] shortest queue because our break is always at the peak hour"* FG2, Participant 4, F, Chinese<br>*"Sometimes I will look at the queue [to decide]."* FG2, Participant 7,FG3, Participant 3, F, Indian<br>*"if there is time and I have enough money, then I will eat what I feel like eating"* FG2, Participant 3, F, Indian<br>*"if [I have] no time, [I] will go for snacks"* FG2, Participant 3, F, Indian<br>*"[I will go for the] shortest queue"* FG3, Participant 4, F, Chinese and Participant 6, F, Chinese<br>*"depending on time"* FG3, Participant 2, F, Chinese |
| Follow what others buy | *"depending on my friend, I just follow them"*<br>FG3, Participants 1, F, Chinese, Participant 4, F, Chinese and Participant 6, F, Chinese |
| Checking out on the available food | *"I will stare at people who are already eating and then see what they eat, looks nice, then I go and buy."*<br>FG2, Participant 4, F, Chinese |
| Routine | *"I buy from the same stall"* FG2, Participant 5, F, Malay |
| Depends on moods/ cravings | *"I see what I feel like eating"* FG1, Participant 3, M, Malay<br>*"Based on my feeling, what I want to eat then I go to buy"* FG2, Participant 6, F, Chinese<br>*"…whatever I want to eat for the day."* FG3, Participant 2, F, Chinese<br>*"[I] go by my mood of the day"* FG3, Participant 4, F, Chinese<br>*"[It] depends on my cravings"* FG3, Participant 1, F, Chinese and Participant 2, F, Chinese |
| Available pocket money | *"When you are broke, then you will look for the cheapest"* FG3, Participant 3, F, Indian<br>*"[I choose food which are] cheap and nice"* FG3, Participant 5, F, Chinese |

In general, the participants commented they would eat in the school canteen for lunch due to the limited time given.

In Singapore, there is a healthier dining programme (HDP) which was launched by the Singapore Health Promotion Board in 2017 (Health Promotion Board Singapore, 2017c). HDP is a programme which encourages food establishments such as restaurants, food stalls and catering companies to offer healthier options. Guidelines were slightly for different types of food establishments. For instance, restaurants have to offer more than three dishes which are of lower-calories (less than 500kcal), and/or wholegrain staple main dish and/ or lower-sugar dish (if applicable). For food courts, all stalls have to offer at least one main dish which is lower-calorie and/or wholegrain staple. The food court has to offer and promote more than one lower/ no-sugar packaged drink and more than one no-sugar and non-dairy freshly prepared drink option. There is also mandatory caloric labelling for dishes which are of lower-calorie.

Focus group participants were asked whether they would consider buying from stalls that offer the healthier option and the reason for their choice. This was to find out their awareness of the programme. However, in general, the participants were not aware of the programme. For those who had seen the logo, they did not put it as their main consideration in their food choice.

*Table 31 - Participants' responses to "Would you consider the healthier option when you purchase OH food?"*

| "No" | "Yes" |
|---|---|
| *"[I] don't like the fact that they [the HDP* logos] indicate calories…Because, generally there is a lot of teenagers that have anorexic and bulimic, so by putting the calories sign is making it worst."* FG2, Participant 3, F, Indian<br>*"I don't see it [the healthier dinning logo]"* FG2, Participant 2, F, Malay | *"didn't see much of the logo. But if there is a dish that have the logo, I will choose the dish"* FG2, Participant 7, F, Chinese |
| *"[I] don't really care about that one. Focus more on price and taste", "[I] don't really take note of the healthier choice logo, [I] look for taste and pricing"* FG2, Participant 4, F, Chinese, Participant 3, F, Indian and Participant 5, F, Malay | *"for me, [choosing food with the healthier dinning logo] is the first thing [sic]* FG2, Participant 1, M, Malay |
| *"[I] ignore the logo"* FG2, Participant 6, F, Chinese | |
| *"I just eat whatever I take"* FG3, Participant 5, F, Chinese<br>*"[I] just eat"* FG3, Participant 2, F, Chinese | |
| *"[The healthier dinning logo has] no impact to me…[the heathier dinning logo is] more [applicable] for the fat people"* FG1, Participant 3, M, Malay | |
| *"I don't care"* FG1, Participant 2, F, Indian | |

*HDP – Healthier Dinning Programme

FG2, Participant 3 suggested promoting meals based on nutrient content instead. She gave the example of indicating that chicken is a good source of protein. FG2, Participant 1 felt that having the healthier dining logo could indicate that the dishes were more expensive. Participants were also asked whether they would generally request less oil or ask for more vegetables as it was an on-going effort by HPB to encourage Singaporeans to ask stall-holders for no/ less salt or more vegetables. All participants from all focus groups replied that they would not make such a request.

## 6.5 Discussion

In this study, it was decided to use the place of preparation of the food as the criterion for OH foods (Nago et al., 2010, van't Riet et al., 2002). This definition was selected because the place of preparation would be expected to influence the quality of food. For instance, cooking at home allows one to choose the amount and type of oil, the amount of salt or the quantity and quality of ingredients to be used. Haines et al. (1992) found that OH foods were higher in energy saturated fat, cholesterol and sodium, but low in fiber, calcium, vitamin C and folate, in comparison with home prepared food. Gewa et al. (2007) defined OH foods as food consumed outside home while Adamson et al. (1996) and Orfanos et al. (2007) defined OH foods as outside sources irrespective of the place of purchase or preparation, citing examples such as school canteens, cafes or shops. However, defining foods based on the venue of consumption of food was not selected to be the criterion in this post-secondary students study as it is very common to have take-away meals or meals delivered to home in Singapore (TodayOnline, 2018). If the definition was based on the venue of consumption, it may result in under-estimating the OH contribution to the diet.

This study observed that the contribution of out-of-home foods to the daily diet of the late adolescents was substantial, forming the main part of their diet on school days. Out-of-home foods contributed more than 75% of the daily energy, carbohydrate, protein, fat, saturated fat, calcium, cholesterol, sodium and dietary fiber intake for the ITE participants and contribution of OH foods to their energy, protein and cholesterol were significantly higher when compared to intake by the JC and POLY students (reference to Table 22). There was no significant difference observed between gender or BMI classes (reference to Table 21 and Table 26).

The percentage of OH foods contributing to the diet in this study was observed to be much higher than other studies. Even for JC participants who had the lowest OH contribution to daily energy intake, 66.56% (IQR 45.9%) came from OH foods. In a large cross-sectional study of 10 European countries, Orfanos et al. (2007) examined the level to which eating out of home contributed to the total energy using the data obtained from The European Prospective Investigation into Cancer and Nutrition (EPIC) study. It was found that mean percentage of energy contributed from OH foods ranged from 12% to 28% for the men and 11% to 28% for the women. In a USA study using the NHANES (National Health and Nutrition Examination Survey) 2007-2008 data, the OH foods contributing to the daily energy ranged stood at 28%, 31% and 25% for the low, middle and high income adults respectively (Smith et al., 2013). In another study conducted in Vietnam which consisted of 976 adolescents, total energy contributed from OH ranged from 11.8% for the adolescents living in the rural areas and 30.3% for adolescents living in the urban areas. Possible reasons attributing to the high percentage of OH in Singaporean late adolescents were explored in the focus groups, which are discussed in subsequent paragraphs.
Out of the three main meals in a day, from the focus group discussions, the majority of participants had one meal (lunch) in a day out of home during school days. Even for weekdays, there was a large percentage of them having dinner OH at least 3 times or more in a week, as illustrated in Table 27. The data obtained from the focus groups illustrated a similar trend to that obtained from the 24-h recall.

In terms of ethnicity, the Chinese participants were observed to have a consistently higher contribution of OH foods to their daily intake of energy, carbohydrates, protein, fat, saturated fat, cholesterol and sodium, compared to the Indians and the Malays (reference to Table 24). There are limited studies that have reviewed the OH eating behavior in terms of ethnicity. Also, the Chinese participants may not have only Chinese foods for meals, making it more difficult to decipher the reasons for the high percentage of OH foods observed in their diet. A possible reason for this observed trend could be that there were more dual-income Chinese families compared to other ethnicities. However, available data on dual income in Singapore only reported in terms of gender difference but not ethnicity (Ministry of Social and Family Development Singapore, 2017). In many studies, researchers found increased

prevalence of obesity was linked to increased frequency of OH eating, as OH foods were usually higher in energy (Kant and Graubard, 2004, Nielsen et al., 2002, Clemens et al., 1999, McCrory et al., 1999, Cao et al., 2014). However, our findings did not support this view as OH eating was found not to be significantly associated with the BMI classes. This could be attributed to the fact that the sample size is not big enough to capture a difference as the sample were divided into four BMI classes, with unequal distribution. The proportion of individuals having a BMI of high risk is fairly low (n = 36) compared to those having a healthy BMI (n = 147). Thus the absolute number involved would likely to reduce the chances of seeing a difference with a statistical test if one truly existed. For the other three factors, gender, education institute and ethnicity, there is equal percentage in terms of sampling.

In this part of the study, reasons for having OH foods were explored via the focus groups. It is unsurprising that a lack of time was cited as a main factor for having out of home foods instead of cooking a nutritious meal at home in this study (Asp, 1999). The proportion of dual income families in Singapore in 2015 stood at a high percentage of 65.5%, prompting parents to save time by having OH foods, instead of planning and cooking a meal for the family (Ministry of Social and Family Development Singapore, 2017). In a study conducted in the US, it was reported that, as the number of working women increased, the time spent in food preparation decreased (Mancino and Newman, 2007). The scarcity of time, which led to having more OH foods instead of home-cooked food, was also reflected by the participants' responses. For instance, participant 3, FG2 felt that that it was a luxury to have home cooked food. Jabs and Devine (2006) highlighted health policies usually aimed at how to eat healthily but often missed out the fact that for working parents, they might not even have the capacity to devote 20 minutes to prepare a meal after a busy working day. This notion was also echoed in the focus group discussion.

> "…work environment (in Singapore) is very fast paced….they (parents) won't have the time to prepare food…" (FG2, participant 4)

FG3, participant 4 also highlighted that it was not a social norm to have packed home-cooked lunch in Singapore and it would look embarrassing for them. This emphasized their desire to be part of the social group.

It was also interesting to note from the focus group discussions that there were mixed responses if they were given an opportunity to have home cooked food. Some found it troublesome to carry a lunch box to school while others find that OH food had more variety and was freshly cooked while there may be limited variety for home cooked food. Conversely, some participants welcomed the idea as they felt that home cooked foods were healthier and tastier. Also, they could save time in queuing up for food and reduce expenditure.

In this study, part of the work explored how the participants derived their food choices and examined their awareness of the healthy eating programme. The current findings from the focus groups converged into five main themes as summarised in Table 30. A perception of limited time once again surfaced as a theme that affected food choice. Generally, participants suggested that they would go for the shortest queue and may even just opt for a snack if there is a lack of time. Peer influence was also cited as one of the influencing factors in their decision of food choices. As participants were late adolescents/young adults, it is perhaps unsurprising that peer group influences could have played an important role in their decision-making (Bandura, 1969). Conformity allowed them to feel part of the group.

> "…I just follow them (friends)…" (FG3, Participants 1, 4 and 6)

Participants also chose food based on their mood or cravings or feelings while others gave the pragmatic deciding factor – based on their available pocket money.

Generally, the participants did not show awareness of the Healthy Dining Programme launched by the Health Promotion Board (Health Promotion Board Singapore, 2017c) and neither did they go for healthier options such as less salt and less oil or more vegetables or to opt for dishes with less than 500 kcal. One participant even highlighted that by putting calories on the signboard for the food item, it may backfire as it could be detrimental for those anorexic and bulimic and another even felt that the healthier options were more likely applicable only for the "fat people". Instead, the physical appeal of food seems to be their priority. This is in line with the research conducted by Stevenson et al. (2007) in which taste and appeal of the food was one of the leading factors in food choice. Contento et al. (2006) also suggested that the primary deciding factors for adolescents in their choice of food were taste, and familiarity/ habit.

Obesity has been hypothesized to be associated with the increased in consumption of OH foods (World Health Organization, 2000). Obesity (defined as BMI > 30kg/$m^2$) among Singapore adults has increased from 5.5% in 1992 to 8.6% in 2013, in which the Malays were observed to have the highest proportion among the three ethnicities who were considered obese (Health Promotion Board, 2016). Studies focusing on youths with eating disorders may have under-reported as they usually concentrated on youths who meet the full threshold criteria for eating disorders (Swanson et al., 2011). Full threshold criteria include anorexia nervosa, bulimia nervosa, binge-eating disorder and eating disorder not otherwise specified. For instance, Merikangas et al. (2010) reported that the prevalence of full-threshold bulimia nervosa in youth is 0.1% to 2%. However, for community studies which do not apply the full threshold criteria for eating disorders, found far greater prevalence of 14 to 22% (Jones et al., 2001).

## 6.6 Strengths, limitations and future directions

The strength of this study is that data collected on OH foods contribution to energy, dietary fiber, macronutrients such as carbohydrates, fat and protein, and micronutrients such as calcium, cholesterol and sodium, adds to the current data available in Singapore.

Similarly, to other sections of this report, one limitation of this study is that there is not an equal distribution of participants in terms of their BMI which makes comparison among the BMI difficult. Another limitation of the study is that it did not determine whether the meals consumed away from home are of poorer nutrient quality than those consumed at home. Although the answer to this question could be implied (as HEI-SG was low and OH was major contribution to the post-secondary school students' dietary intake), it was not answered empirically in this study.

For future works, as OH foods contribute to a significant part of the post-Secondary school students' diet, monitoring the composition of OH foods is potentially an informative indicator for a surveillance program to track the dietary intake of late adolescents. Focus groups could be conducted to determine the lack of awareness of healthy dinning programmes in Singapore among the post-Secondary students and how awareness on healthy eating could be improved.

## 6.7 Conclusion

In conclusion, the studied group had a high percentage of OH foods contributing to their daily energy intake. As evaluated in Chapter 4, the overall HEI of the late adolescents was also at a low score of 47.20 (IQR 16), suggesting that the nutritional content of OH foods may be poor. Time, taste of food and eating according to their moods seems to be the participants' main factors in food choices. As the trend for eating out of home foods is likely to continue, it may be advisable for health policy makers to work with the street vendors or the food service providers to improve the nutritional quality of OH foods. Solely relying on health messages may not be adequate for the late adolescents as eating healthily does not seem to be a priority to them at this stage of their lives (Croll et al., 2001). Institutes of higher learning such as the ITEs, JCs and POLY could possibly re-look into the planning of their school timetable and allow advance purchase of meals in order to address the factor of

limited time. They could also look into the food provision within the school environment by directly influencing the range and price of food sold. As the age group studied here spent a substantial amount of time in school, improving the food provision in school would likely improve their overall diet quality and potentially improve their health. Parents could also be educated on opting for healthier OH choices when they dine out or taught how to prepare simple and easy healthy meals.

# Chapter 7 Snacking Behaviour

## 7.1 Introduction

It has been reported that snacking has increased globally and this may be a contributing factor to the obesity epidemic (Kubik et al., 2005). The wide availability of energy-dense snacks is cited to be a possible cause of increased levels of adiposity in children (Farley et al., 2010). The daily energy intake derived from snacks for Irish adolescents has moderately increased from 30% in 1997 to >32% in 2005 (Kerr et al., 2009), while in US, the contribution of snacking to energy intake from 1933-1978 to 2003-2006 has increased from 18 to 24% (Piernas and Popkin, 2010). It was also reported in a study which examined the dietary intake of US adults from 1988 to 1994 that those who skipped a meal but had multiple snacks, ended up consuming more calories but less nutritious food compared to those who had three meals only (Kerver et al., 2006) . Snacks tend to be energy-dense but nutrient-poor with snacks such as cakes and cookies well-liked among US adolescents (Cross et al., 1994) and sweet bakery goods, sweets and chocolates popular among Finnish adults (Ovaskainen et al., 2006).

Given public health concern with the increasing prevalence of obesity and the fact that empirical observation has indicated a positive relationship between obesity and snacking, exploring how snacking contributes to an adolescent's diet could offer insights to help combat weight gain (Bes-Rastrollo et al., 2010).

## 7.2 Literature Review

### *7.2.1 Definition of snack*

Before examining snacking behavior, it is important to consider the definition of a snack or a meal. The perception of what constitutes a snack differs from person to person. It is postulated that whether an individual perceives an eating occasion is a meal or as snack may influence the amount one eats and the subsequent amount that they will eat at the next eating occasion (Pliner and Zec, 2007). Snacking is often defined as any food consumed between meals (Savige et al., 2007) . The challenge would then be to determine what constitutes a meal. Wansink et al. (2010) attempted to differentiate a meal or a snack by using two broad cues-environmental and food. Environmental cues include eating alone versus with family members, the rate at which a meal is consumed, the type of cutlery used, use of cloth

versus paper napkins and whether the meal is consumed while sitting or standing. Food cues include the price, portion size, quality and nutritional value of food. In another study, there were 6 classifications of eating occasions: breakfast, brunch, lunch, supper, dinner and snacks which were coded by respondents (Howarth et al., 2007). In addition, it was defined in the study that if the eating occasions were within 59 minutes, the eating occasion with a larger energy content would be re-coded to a meal, even if the participant coded it as a snack, while the other would be coded as a snack.

Table 32 illustrates a range of snacking definitions from existing literature. With no clear consensus in the literature on what a snack or meal is, it will be useful to examine how applying different definitions will affect the results.

*Table 32 - Snacking definitions obtained from obtained from journal articles*

| Snacking definitions | Journal articles |
|---|---|
| **Time** | |
| Foods and drinks eaten between meals including milk drinks, regular soft drinks, sport drinks and energy drinks | (Savige et al., 2007) |
| A snack is defined as 'any food taken out with a regular mealtime (namely breakfast, lunch and dinner) or snack item taken in place of such meal.' | (Drummond et al., 1996) |
| Time of day (A morning snack is anything eaten between breakfast and lunch, afternoon snack is anything eaten between lunch and dinner, and evening snack is anything eaten after dinner.) | (Devaney et al., 1995) (Summerbell et al., 1995) |
| Foods consumed between 8:00 and 10:00 am, between 12:00 and 2:00 pm and between 6:00 and 8:00 pm are considered meals. Every food item consumed between meals is thus considered a snack. | (Toornvliet et al., 1996) |
| Snacking is based on time (morning, afternoon and late-evening snacks) | (Matthys et al., 2003) |
| Snacking is based on time (all eating events between main meals were classified as snacks) | (Ovaskainen et al., 2006) |
| **Food category** | |
| Sweet and starchy food, carbohydrate rich food | (Wurtman et al., 1993) |
| **Energy intake** | |
| Meal is defined as food(s) consumed together that provided at least 90 kcal. | (Bernstein et al., 1981) |
| Snack is defined as any eating episode comprising <15 % of total energy intake, or time of day | (Murakami and Livingstone, 2016) |

| **Others** | |
|---|---|
| Self-defined by respondents | (Jahns et al., 2001)<br>(Zizza et al., 2001) |
| An intake during a period of satiety | (Chapelot, 2011) |
| Time of consumption or type of snacks<br>- the type of the snack (a sweet snack, sweet snack, savory snack or a generic snack) or<br>- the time when the snack was eaten | (Gregori et al., 2011) |
| Use of utensil | (Douglas, 2002) |

### *7.2.2 Impacts of snacking*

One usually has three meals per day, that is breakfast, lunch and dinner. However, this habit has declined over years, coupled with an increase in “snacking”. This has incidentally coincided with the rise in overweight and obesity among children and adolescents, suggesting a possible causal link between obesity and snacking (Jebb et al., 2004, Zizza et al., 2001). However, the contribution of snacking to overeating and body weight remains unclear.

An initial review by Drummond et al. (1996) reported that snacking may not cause one to be obese and may even have positive advantages in terms of body weight control. The definition of snack used in this study is “any food taken out of a regular mealtime (breakfast, lunch and dinner) or snack item taken in place of each meal”. A snack in the study therefore a dual definition, because snacks could be food items or eating occasions. In studies which involved adults of different age groups, higher values of BMI have been found to be related to lower eating frequency (Bellisle et al., 1997, Metzner et al., 1977), suggesting that snacking may not necessarily correlate to obesity.

However, the above observation was contrary to other studies. Higher energy intake, attributed to snacking, was observed in obese individuals in a large scale ( n > 5000) Swedish study (Forslund et al., 2005). It was also reported that the increased energy intake from energy-dense snacks was not compensated for in subsequent eating occasions (de Graaf, 2006). Hence it was concluded that consumption of snacks is associated with an increase in total energy and thus may predispose an individual to be in positive energy balance. Similarly, in another study of 11-to 13-year-old adolescents, it was observed that higher intake of snacks was associated with higher prevalence of overweight (Bo et al., 2014)

The impacts of snacking may not be consistent in the studies as the snack portion size was found to increase over the years while the quality of snacks declined, resulting in an increase in energy dense snacks and increased energy intake as reported in a study conducted in U.S. (Piernas and Popkin, 2010). de Graaf (2006) suggested that our grazing habits may not have changed. However, the energy-density of snacks may have increased instead. Other possibility includes

underreporting of consumption of energy-dense snack foods especially by obese people (Schoeller, 1995).

Beside impacting on the body weight, snacking may also impact the risk of metabolic diseases (McCrory and Campbell, 2010). In the Health Professionals Follow-Up Study in which eating patterns of US men in the Health Professionals were followed for 16 years, it was reported that an increase in consumption of snacks resulted in an increased risk of type 2 diabetes (Mekary et al., 2012).

Other studies suggest that snacking may improve cognitive performance. For instance, it was found that a carbohydrate-based snack (25g of cornflakes with milk) consumed 1.5 hours after breakfast improved mood compared to when no snack was consumed in 150 young female adults. Consumption of the morning snack was also found to improve the recall of a list of words which was a cognitive test for memory (Benton et al., 2001). Kanarek and Swinney (1990) suggested that having a late afternoon energy-containing snack would improve cognitive performance. However, in an associative study conducted in Santiago Metropolitan Region (Chile), it was suggested that the quality of snacks may be more important in affecting cognitive performance. Students who had snacks which are high in fat, sugar, salt and energy, were associated with poorer performance in Language and Mathematics (Correa-Burrows et al., 2015).

Other studies suggested that snacking may improve the intake of micronutrients such as vitamin C, vitamin E, calcium, magnesium, potassium, iron and folate (Haveman-Nies and van Staveren, 1998, Stroehla et al., 2005, Kerver et al., 2006, Talegawkar et al., 2007).

However, the lack of universal definition of a snack and other confounding factors such as physical activities, make it difficult to compare among studies or to conclude whether there are positive or negative impacts of snacking.

### 7.3 Aim

The aims of this work were to understand late adolescents' perceptions of snacking using focus groups, determine models suitable for definition of a snack, evaluate the

snacking behavior of the late adolescents and consider how snacking habit is associated with educational institute, ethnicity, gender and BMI.

## 7.4 Method

In this section, determination of the definition of a snack and snacking behavior from focus groups with late adolescents will be discussed. A total of three focus groups with a total of 17 participants (10 Chinese, 3 Malays and 4 Indians) were conducted. In addition, the method used to derive the models of a snack and to determine the quantity of snacks consumed using data collected from the 24-h recall in Phase 2 and 3 will be discussed.

### *7.4.1 Definition of snack and snacking behaviour from focus groups*

Focus groups were conducted to gather late adolescents' perception of a snack. The details of the set-up of focus groups were discussed in Chapter 3. Three sessions of focus groups were held to gather the late adolescents' views on snacking. Respondents were first asked to write down their definition of a snack and were asked to elaborate on it. They were then given five options to decide whether they agreed with the definitions. Respondents were then asked to rate their snacking frequency. Respondents were also asked to discuss the common venues for purchase of snacks, the types of snacks and the reasons for snacking. The data was examined thematically using the qualitative data management package NVivo Pro 11 (QSR International Pty. Ltd, Doncaster, VA, Australia).

### *7.4.2 Models of a snack*

Snacks were defined based on the three criteria presented below. Statistical analysis was conducted to determine whether there was any significant difference in the number of snacks reported using the three criteria. Four models were proposed to define a snack. These models were based on a combination of the following criteria.

<u>Criterion 1- Time of food consumption (C1)</u>

For the 'Time of consumption' criterion, the following classification was to be adopted:
Breakfast – a consumption of at least 100kcal of food and/or beverage within 2-3 hours after waking (the same definition as stated in Chapter 5.
Lunch – 1200 to 1400,

Dinner – 1800 to 2000.
Any other food consumed outside of these times will be considered a snack.

Criterion 2- Portion size (C2)

If the amount of food in one eating occasion falls below 570g, it was classified as a snack. The value of 570g was defined as the portion size derived from one proper meal and it was derived from HPB My Healthy Plate Guide (Health Promotion Board, 2017b). Typically, a meal for a day includes 2 servings of rice and/or alternatives (200g), 1 serving of fruit (130g) and vegetables (150g) each and 1 serving of meat and alternatives (90g). Based on the guide, all these servings of food added up to 570g, including beverages (but excluding water).

Criterion 3- Energy value (C3)

An eating occasion that comprises more than 15% of total energy intake was considered a meal. If an eating occasion is less than 15% of total energy intake, then it is considered a snack (Murakami and Livingstone, 2016).

Three models for defining a snack were derived based on the combination of the above three criteria, as illustrated in Figure 13. For model 1(M1), it comprised criteria 1 and 2; model 2 (M2) comprised criteria 2 and 3; model 3 (M3) comprised criteria 1 and 3.

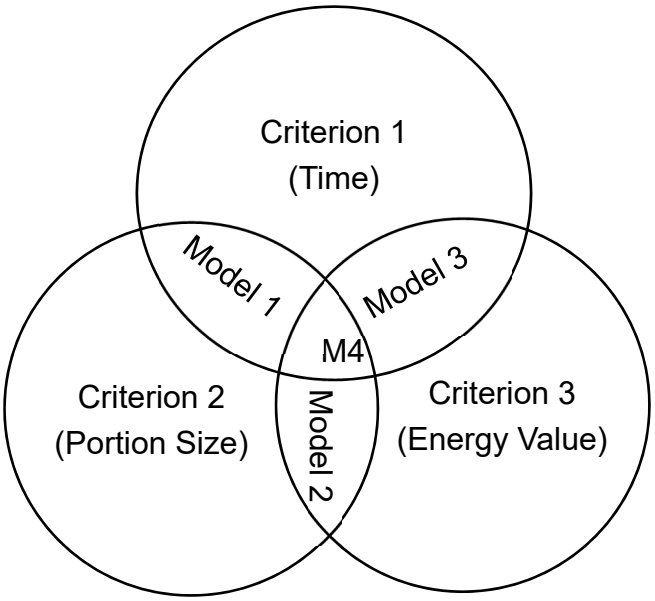



*Figure 13 - Proposed snacking models based on three criteria*

Hence to fulfil Model 1 (M1), the eating occasion needed to be outside the meal times stated in Criterion 1 and have a portion size of less than 570g. For Model 2 (M2), an eating occasion had to have a portion size of less than 570g and contributes less than 15% to the total energy intake to be considered a snack. For Model 3 (M3), an eating occasion needed to be outside the meal times stated in Criterion 1 and contribute less than 15% to the total energy intake to be considered a snack. Similarly, Model 4 (M4) would have to fulfil criteria 1, 2 and 3.

The percentage of energy contributed from snacks using the above 3 criteria and models were tabulated. The mean difference between the values derived from each criteria and model was calculated (that is C2 – C1, C3 – C1, C2 – C3, M2 – M1, M3 – M1, M2 – M3). One sample t-test, with the mean difference as the test variable and test value = 0, was performed to evaluate the significance of any differences among the criteria and models. The hypothesis is that there was no significant difference between the two criteria/ models. If there was no significant difference between the two criteria/ models, then the Bland Altman plot would be constructed to evaluate the congruence of the criteria/ models.

*7.4.3 Determination of snacking behavior using data collected from 24-h recall*

The above defined three criteria and models were then used to apply to the set of 24-h recall data. The data was processed and collated in Excel 2013. All statistical analysis was performed using the Statistical Package for Social Sciences, SPSS, version 23 for Windows and statistical significance for all the tests was defined at p-value $<0.05$.

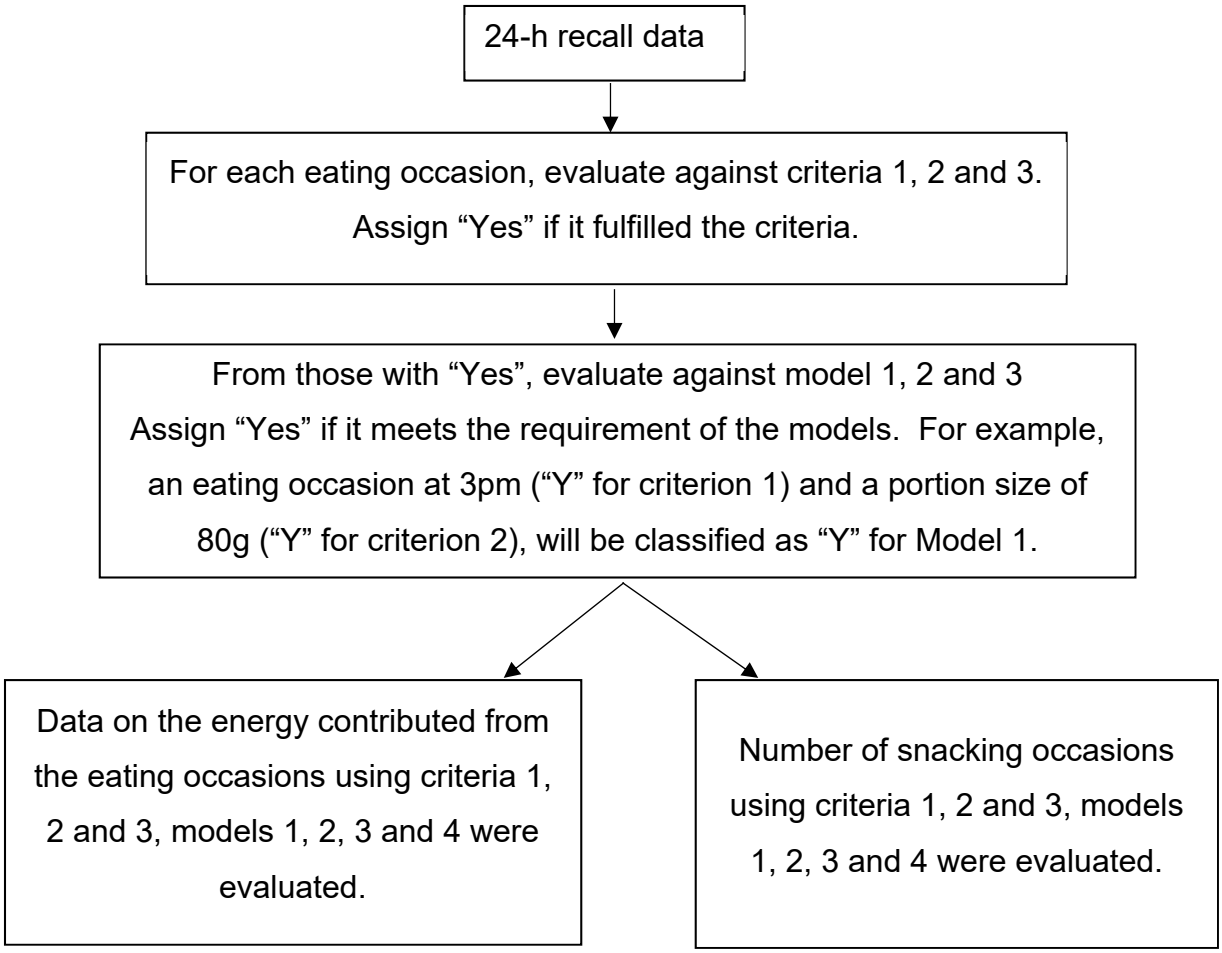



*Figure 14 - Flowchart of how the snacking models were evaluated*

Using the 24-h recall data, the energy content of each eating occasion was calculated. Figure 14 illustrates the flow to determine whether each eating occasion was considered a snack or a meal, using the three different criteria and models.

From the number of snacking occasions, a light-snacker was defined as one who had less than or equal to 2 snacks in a day. A medium snacker was defined as one who had 3 to 4 snacks per day while a high snacker was defined as one who had more than 5 snacks per day. The Pearson Chi-square test was then performed to determine the likelihood of association of snacking with gender, BMI, ethnicity and educational institute. The impact of gender, BMI and ethnicity was reviewed based on the data collected solely from the POLY at phases 2 and 3. The impact of educational institutes was reviewed based on the data collected from an Institute of Technical Education (ITE), junior college (JC) and polytechnic (POLY) at phase 2.

In addition, the total number of eating occasions was also evaluated. Low number of eating occasions was defined as 0 to 2, moderate number of eating occasions was defined as 3 to 4 occasions while high number of eating occasions was defined as more than 5 occasions. The same analysis as the number of snacking occasions was done.

## 7.5 Results

### *7.5.1 Definition of a snack from focus groups*

Qualitative data collected from the focus groups on how they would define a snack were analyzed and were broadly grouped into the following four themes as illustrated in Table 33.

The majority of the respondents from all three focus groups associated snacking as food consumed outside the normal three meal times and snacking linking to their emotions. To them, a snack was a food that could help to elevate their emotion and make them feel less stressful. Some respondents felt that a snack was small in size and they could grab and eat it, without the need for cutlery. A few of the respondents associated snacks as foods with poorer nutrients and labelled them as “junk food”.

*Table 33 - Definitions of a snack gathered from focus groups*

| Themes | Evidence from focus groups |
|---|---|
| Time | *"A snack is something that you eat in between your meal times":* FG 1, Participant 1, F, Chinese, FG 2, Participant 2, F, Indian<br>*"You eat snack when you still feel hungry after a full meal":* FG 2, Participant 4, M, Malay<br>*"Not a proper meal, …anything not breakfast, lunch or dinner":* FG 2, Participant 5, F, Indian<br>*"Anything to eat apart from normal meal":* FG 3, Participant 6, F, Chinese |
| Emotions | *"satisfy your cravings":* FG 1, Participant 1, F, Chinese FG 3, Participant 4, F, Indian<br>*"associated with leisure":* FG 1, Participant 4, F, Chinese<br>*"comfort food":* FG 1, Participant 3, F, Chinese<br>*"helps satisfy cravings and helps in emotional stress":* FG 1, Participant 5, F, Chinese<br>*"I feel very stressful because the class is too hard for me then I just want to eat", "A snack is like something you can like (to eat)":* FG 2, Participant 1, M, Malay<br>*"something that I can munch on when I am hungry or bored.....It keeps me happy":* FG 3, Participant 1, F, Chinese<br>*"can kill the time and relieve stress":* FG 3, Participant 3, F, Chinese<br>*"satisfy your craving"; "just munch when I am sleepy":* FG 3, Participant 6, F, Chinese<br>*"it's just something to eat whenever I feel like":* FG 3, Participant 6, F, Chinese |
| Portion Size | *"smaller, not having cutlery to eat":* FG 1, Participant 3, F, Chinese<br>"Won't really make us full": FG 1, Participant 2, F, Chinese<br>"not in a large quantity": FG 2, Participant 4, M, Malay |

| | |
|---|---|
| | *“hold on your hand to eat”; “you can go anywhere with the snack”;* |
| | *“A snack is like a bite-size version of food”:* FG 2, Participant 3, F, Indian |
| | *“Snack to me is like a delicious packet of thing that can eat whenever I want to.”: F*G 3, Participant 2, F, Chinese |
| Food category | “junk food”, FG 1, Participant 4, F, Chinese |
| | *“like a light food that you eat”* FG 3, Participant 5, F, Chinese |

Five definitions of a snack were then presented to the respondents and they were asked for their consensus.

*Table 34 - Consensus of definitions of snacks (focus groups)*

| Definitions | FG 1 | | FG 2 | | FG 3 | |
|---|---|---|---|---|---|---|
| | Y | N | Y | N | Y | N |
| A snack is anything eaten in between proper meals, such as breakfast, lunch, dinner. | All | - | All | - | All | - |
| A snack is anything eaten on the move | 2 | 3 | 2 | 3 | All | - |
| A snack is anything quick to eat | 4 | 1 | - | All | - | All |
| A snack doesn't require sitting down at a table and involves the use of proper cutlery) | 4 | 1 | - | All | - | All |
| A snack is anything that doesn't fill you up. | All | - | All | - | All | - |
| Total number of respondents | 5 | | 6 | | 6 | |

*Note:*

- *"Y" denotes agree and "N" denotes don't*
- *"FG" denotes focus groups*
- *The number denotes the number of respondents*

Respondents generally agreed that a snack is an eating occasion outside the normal eating meal times and a snack was usually low in energy value and hence would not fill them up. The definition of a snack being eaten on the move and "a snack doesn't require sitting down at a table" did not fit well with respondents' definition of a snack as they quoted that cake and waffle with ice cream topping were typical snacks to them and these foods were usually consumed while sitting down.

### *7.5.2 Snacking behavior from focus groups*

In determining the frequency of snacking via focus groups the majority of the respondents were found to consume snacks frequently and some reported their friends and themselves consume snacks every day. It was noted that a few respondents commented that they snacked according to their feelings such as feeling stressed or as a comfort food.

Most of the respondents in all the focus groups commented that they bought their snacks from school. Only two respondents from focus group 2 reported they brought snacks from home. Typical snacks that they bought from the school canteens were energy dense and nutrient poor food such as waffle/ pancakes, ice cream, nuggets, chocolate and cakes. Snacks which were brought from home were basically convenient snacks such as biscuits and chocolates. Few respondents looked for the healthier choice symbol when purchasing their snacks. Taste was their top priority in the choice of snack. In addition, a few respondents commented that they would not consider fruits as their snacks as fruits made them feel hungrier and commented that the high sugar content in fruits may not be suitable as a snack.

The reasons for snacking were broadly classified as follows:

*Table 35 - Reasons for snacking*

| Reasons | Evidence from FGs |
|---|---|
| Emotions | *"Sometimes I feel very stressful because the class is too hard for me then I just want to eat."; "cravings"* (FG 1, participant 4)<br>*"Just feel like eating"* (FG 2, participant 2, FG 3, participant 4)<br>*"Just want to munch"* (FG 3, participant 1)<br>"*Depend on mood. If it is a bad week, I'll every day eat [snack]"* (FG1, participant 5)<br>*"It [snacking) keeps me happy…"* (FG 3, participant 1) |
| Social occasion | *"When [I] meet up with friends"* (FG 1, participant 4)<br>*"If I see my friend eat then I will eat."* (FG 2, participant 3) |
| Hunger | *"I feel hungry."* (FG 1, participant 1, FG 2, participant 3, FG 3, participant 1)<br>*"Something [snack] to eat that fill up your stomach."* (FG 3, participant 4)<br>"*Hungry. [Main meal] doesn't fill me up"* (FG 2, participant 1) |

The majority of the respondents typically took a snack because they were hungry before lunch or dinner or if they had skipped a meal due to their busy schedule. Other reasons cited included cravings or eating because of peer pressure.

### *7.5.3 Models of a snack*

The following table illustrates the results obtained from the one sample t-test on the mean difference between the criteria or models.

*Table 36 - Results from one sample t-test*

| | *P*-values | Mean difference (kcal) | Standard Deviation (kcal) |
|---|---|---|---|
| C2 – C1 | <0.0005 | -29.35 | 47.33 |
| C3 – C1 | <0.0005 | -26.27 | 32.69 |
| C2 – C3 | <0.0005 | 55.63 | 33.78 |
| M2 – M1 | <0.0005 | 14.21 | 26.70 |
| M3 – M1 | <0.0005 | -20.14 | 24.92 |
| M2 – M3 | <0.0005 | 5.93 | 7.87 |

*Table 37 - Percentage of energy contributed from snacks*

| | Criterion 1 (%) | Criterion 2 (%) | Criterion 3 (%) | Model 1 (%) | Model 2 (%) | Model 3 (%) | Model 4 (%) |
|---|---|---|---|---|---|---|---|
| [a]Mean | 37.8 | 67.2 | 11.6 | 25.3 | 11.1 | 5.2 | 5.0 |
| [a]S.D. | 31.4 | 33.2 | 10.9 | 25.8 | 10.7 | 7.3 | 7.2 |
| [b]Mean | 1.746 | 3.378 | 1.593 | 1.423 | 1.544 | 0.743 | 0.717 |
| [b]S.D. | 1.3336 | 1.8133 | 1.5234 | 1.2871 | 1.4953 | 0.9679 | 0.9537 |

a: Percentage of energy contributed from snacks

b: Mean number of snacks

One sample T-test illustrated that using the three criteria and the three proposed models (using percentage of energy contributed from snacks) arrived at significantly different values ($P < 0.05$) for the snacking behavior. Hence the Bland Altman analysis was not performed. The mean difference obtained from using criteria only

was much higher than that obtained from using models. Table 36, shows that model 2 (portion size and energy value) and model 3 (time and energy value) were closest in congruency. Model 3 resulted in having the least energy contributed from snacks and the smallest standard deviation while criteria 2 (portion size) resulted in the highest energy contributed from snacks. Table 37 shows that among the three criteria or models, the results obtained could vary by more than 50%.
Inter-agreement between different criteria and models was evaluated by performing the Kappa statistic on the snacker profiles using SPSS. Table 38 illustrates the number of cases of agreement among the criteria 1, 2 and 3.

*Table 38 - Inter-agreement among C1, C2 & C3*

| | Snackers (C2 vs C1) | | | Snackers (C3 vs C1) | | | Snackers (C2 vs C3) | | |
|---|---|---|---|---|---|---|---|---|---|
| | low | Medium | high | low | medium | high | Low | medium | high |
| Low | 91 | 115 | 23 | 201 | 27 | 1 | 91 | 3 | 0 |
| medium | 3 | 32 | 33 | 43 | 20 | 5 | 125 | 24 | 0 |
| High | 0 | 2 | 8 | 1 | 4 | 5 | 29 | 24 | 11 |
| Total | 94 | 149 | 64 | 245 | 51 | 11 | 245 | 51 | 11 |
| Kappa Value | 0.128 (*p<0.005)* | | | 0.281 (*p<0.005)* | | | 0.117 (*p<0.005)* | | |

*Table 39 - Interpretation of Kappa (Viera and Garrett, 2005)*

| Kappa | Agreement |
|---|---|
| <0 | Less than chance agreement |
| 0.01 – 0.20 | Slight agreement |
| 0.21 – 0.40 | Fair agreement |
| 0.41 – 0.60 | Moderate agreement |
| 0.61 – 0.80 | Substantial agreement |
| 0.81 – 0.99 | Almost perfect agreement |

The Kappa value illustrated that there was only slight agreement between the results obtained using C1 and C2, C2 and C3, and with $p<0.005$, it is unlikely to be due to chance. Result obtained using C1 and C3 has the highest Kappa value and there is fair agreement between the two criteria.

*Table 40 - Inter-agreement among M1, M2 & M3, M4*

| | Snackers (M2 vs M1) | | | Snackers (M3 vs M1) | | | Snackers (M2 vs M3) | | | Snackers (M3 vs M4) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L | M | H | L | M | H | L | M | H | L | M | H |
| L | 219 | 29 | 1 | 249 | 0 | 0 | 249 | 0 | 0 | 289 | 0 | 0 |
| M | 29 | 17 | 5 | 39 | 12 | 0 | 39 | 9 | 0 | 0 | 17 | 0 |
| H | 1 | 2 | 4 | 1 | 5 | 1 | 1 | 8 | 1 | 0 | 0 | 1 |
| Total | 249 | 48 | 10 | 289 | 17 | 1 | 289 | 17 | 1 | 289 | 17 | 1 |
| Kappa Value | 0.308 ($p$<0.005) | | | 0.355 ($p$<0.005) | | | 0.313($p$<0.005) | | | 1.000 ($p$<0.005) | | |

*L - Low, M - Medium, H - High*

Table 40 illustrates the number of cases of agreement among the models 1, 2 and 3. By using a combination of the criteria, the models arrived at better agreement. The Kappa value shows that all the three models (M1, M2 and M3) arrived at fair agreement, with Kappa values more than that obtained from the comparison using the three different criteria. Table 37 illustrated that results obtained from Model 3 (time and energy value) and Model 4 (time, portion size and energy value) were very close. Hence the Kappa analysis was performed only for Model 3 and Model 4. With a Kappa value of 1.000, it indicated that M3 and M4 were in perfect agreement.

### *7.5.4 Snacking behavior*

The median percentage of energy contributd from snacks was next evaluated using the three criteria and models. The profile of snackers was also evaluated using the three criteria and models. The results were analysed in terms of gender, BMI, ethnicity and educational institutes. Table 41 illustrates the percentage of energy contributed to daily total energy from snack while Table 42 illustrates the distribution of the snackers (light, medium and higher snackers) when the three criteria ( time, portion size and energy value) were applied to the data. Light snacker is defined as a person who has less than or equal to 2 snacks per day. Medium snacker is defined as a person who has 3 to 4 snacks per day while a high snacker is one who has more than 5 snacks per day. Table 43 illustrates the profile of snackers when evaluated using the 3 models (Model 1 – time & portion size, Model 2 – portion size and energy value, Model 3 – Time & energy value).

From Table 42, using C1 and C3, more than 70% of the participants had an overall snacker profile as light snackers (having less than or equal to 2 snacks per day), while C2 resulted in only 30.3% as light snackers. Using C1 and C3, less than 5% are high snackers (having more than 5 snacks per day) but using C2 resulted in a high 20.8% as high snackers. From Table 43, all three models resulted in more consistent results with more than 80% as light snackers and less than 5% are high snackers.

From Table 41, all three criteria and models resulted in the percentage of energy contributed from snacks higher for the females than the males. Percentage of energy contributed from snacks ranged from as low as 0.0% (IQR 8.4) from M3 to as high as 91.4% (IQR 46) from C2. All criteria and models resulted in more female medium and high snackers. Using the Mann-Whitney U test, significant difference between males and females was observed for C2, C3 and M2 only.

Among the BMI ranges, C2 resulted in the highest percentage of energy contributed from snacks for those with a BMI in the high risk range, as illustrated in Table 41. Using the Kruskal-Wallis test, there was no significant difference among the BMI ranges for C1 to C3 and M1 to M3. In terms of snackers profile, using C1 and C3, more than 65% of the late adolescents were light snackers (having less than or equal to 2 snacks per day) across the range of BMI, while C2 resulted in a higher percentage of medium snackers for the BMI ranges of <18.5, 18.5 – 22.9, 23 – 27. All three criteria do not result in more than 25% as high snackers. However, all three models resulted in more than 75% as light snackers across all ranges of BMI.

*Table 41 - Percentage of energy contributed from snack to daily total energy (gender, BMI, ethnicity, educational institutes) **

| | C1 | C2 | C3 | M1 | M2 | M3 |
|---|---|---|---|---|---|---|
| **Gender** | | | | | | |
| Female | 34.7 [a] (56) [a] | 91.4 (46) | 11.5 (15.4) | 23.6 (47) | 11.2 (15) | 0.9 (11.4) |
| Male | 34.3 (59) | 59.4 (69) | 8.05 (16) | 19.0 (39) | 7.39 (15) | 0.00 (8.4) |
| [b]*p*-value | 0.885 | **0.001** | **0.041** | 0.130 | **0.006** | 0.112 |
| **BMI** | | | | | | |
| Risk of nutrients deficiency, BMI<18.5 | 46.3 (50) | 64.3 (61) | 10.3 (16) | 28.1 (44) | 9.24 (13) | 0.00 (10) |
| Healthy, BMI: 18.5 – 22.9 | 34.3 (61) | 69.1 (59) | 11.2 (17.2) | 20.2 (42) | 9.72 (17) | 0.00 (11) |
| Moderate risk, 23 – 27 | 32.5 (59) | 81.6 (62) | 9.05 (17) | 16.7 (39) | 9.05 (18) | 0.79 (11) |
| High risk, BMI >27 | 24.9 (56) | 81.6 (52.8) | 10.2 (15) | 18.3 (42) | 9.31 (15) | 0.00 (4.5) |
| **p*-value | 0.099 | 0.903 | 0.971 | 0.171 | 0.985 | 0.279 |

| | C1 | C2 | C3 | M1 | M2 | M3 |
|---|---|---|---|---|---|---|
| **Ethnicity** | | | | | | |
| Chinese | 32.2 (57) | 64.6 (58) | 10.6 (17) | 17.6 (39) | 9.67 (17) | 0.00 (8.4) |
| Malays | 44.3 (53) | 68.6 (69) | 8.20 (16) | 24.2 (43) | 7.16 (15) | 0.00 (12) |
| Indian | 32.9 (54) | 81.7 (52) | 11.4 (13) | 20.2 (44) | 11.1 (13) | 0.825 (8.8) |
| [d]*p*-value | 0.095 | 0.745 | 0.315 | 0.456 | 0.112 | 0.730 |
| **Educational Institutes** | | | | | | |
| ITE | 41.3 (43) | 54.3 (63) | 7.68 (16) | 17.4 (30) | 5.97 (16) | 0.00 (7.2) |
| JC | 20.1 (44) | 100 (43) | 13.6 (19) | 12.3 (32) | 13.6 (18) | 1.53 (9.6) |
| POLY | 34.1 (55) | 69.0 (53) | 11.5 (15) | 21.2 (41) | 11.0 (15) | 0.860 (12) |
| [d]*p*-value | **0.001** | **<0.001** | **0.003** | 0.150 | **<0.001** | 0.188 |

[a]Data includes median and IQR

[b]Based on Mann-Whitney U Test

[c, d]Based on Kruskal-Wallis Test

*Table 42 - Profile of snackers using the three criteria (time, portion size, energy value)*

| | Light Snacker[a] | | | Medium Snacker[b] | | | High Snacker[c] | | |
|---|---|---|---|---|---|---|---|---|---|
| | **C1** | **C2** | **C3** | **C1** | **C2** | **C3** | **C1** | **C2** | **C3** |
| Participants | 229 (74.6%) | 94 (30.6%) | 249 (81.1%) | 68 (22.1%) | 149 (48.5%) | 51 (16.6%) | 10 (3.3) | 64 (20.8%) | 11 (3.6%) |
| **Gender** | | | | | | | | | |
| Female | 111 (70.7%) | 35 (22.3%) | 117 (74.5%) | 39 (24.8%) | 83 (52.9%) | 32 (20.4%) | 7 (4.5%) | 39 (24.8%) | 8 (5.1%) |
| Male | 116 (77.3%) | 58 (38.7%) | 128 (85.3%) | 31 (20.7%) | 67 (44.7%) | 19 (12.7%) | 3 (2.0%) | 25 (16.7%) | 3 (2%) |
| **BMI** | | | | | | | | | |
| Risk of nutrients deficiency, BMI < 18.5 | 41 (66.1%) | 18 (29.05%) | 53 (85.5%) | 18 (29.0%) | 31 (50.0%) | 8 (12.9%) | 3 (4.8%) | 13 (21.0%) | 1 (1.6%) |
| Healthy, BMI: 18.5 – 22.9 | 107 (72.8%) | 43 (29.3%) | 113 (76.9%) | 35 (23.85%) | 69 (46.9%) | 27 (18.4%) | 5 (3.4%)) | 35 (23.8%) | 7 (4.8%) |
| Moderate risk, BMI: 23 – 27 | 47 (75.8%) | 16 (25.8%) | 50 (80.6%) | 13 (21.0%) | 37 (59.7%) | 10 (16.1%) | 2 (3.2%) | 9 (14.5%) | 2 (3.2%) |
| High risk, BMI > 27 | 32 (88.9%) | 16 (44.4%) | 29 (80.6%) | 4 (11.1%) | 13 (36.1%) | 6 (16.7%) | 0 (0.0%) | 7 (19.4%) | 1 (2.8%) |

| | | Light Snacker[a] | | | Medium Snacker[b] | | | High Snacker[c] | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **C1** | **C2** | **C3** | **C1** | **C2** | **C3** | **C1** | **C2** | **C3** |
| **Ethnicity** | | | | | | | | | | |
| | Chinese | 79 (73.8%) | 27 (25.2%) | 84 (78.5%) | 26 (24.3%) | 55 (51.4%) | 19 (17.8%) | 2 (1.9%) | 25 (23.4%) | 4 (3.7%) |
| | Malays | 72 (72.0%) | 40 (40.0%) | 81 (81.0%) | 24 (24.0%) | 45 (45.0%) | 15 (15.0%) | 4 (4.0%) | 15 (15.0%) | 4 (4.0%) |
| | Indian | 76 (76.0%) | 26 (26.0%) | 80 (80.0%) | 20 (20.0%) | 50 (50.0%) | 17 (17.0%) | 4 (4.0%) | 24 (24.0%) | 3 (3.0%) |
| **Educational Institutes** | | | | | | | | | | |
| | ITE | 82 (82.0%) | 42 (42.0%) | 81 (81.0%) | 17 (17.0%) | 50 (50.0%) | 19 (19.0%) | 1 (1.0%) | 8 (8.0%) | 0 (0.0%) |
| | JC | 77 (77.0%) | 14 (14.0%) | 65 (65.0%) | 22 (22.0%) | 44 (44.0%) | 28 (28.0%) | 1 (1.0%) | 42 (42.0%) | 7 (7.0%) |
| | POLY | 68 (68.0%) | 21 (21.0%) | 63 (63.0%) | 27 (27.0%) | 48 (48.0%) | 27 (27.0%) | 5 (5.0%) | 31 (31.0%) | 10 (10.0%) |

[a]Light snacker - one who has less than or equal to 2 snacks per day; [b]Medium snacker – one who has 3 to 4 snacks per day; [c]High snacker- one who has more than 5 snacks per day.

*Table 43 - Profile of snackers evaluated using the 3 models*

| | Light Snacker[a] | | | Medium Snacker[b] | | | High Snacker[c] | | |
|---|---|---|---|---|---|---|---|---|---|
| | **M1** | **M2** | **M3** | **M1** | **M2** | **M3** | **M1** | **M2** | **M3** |
| Participants | 249 (81.1%) | 249 (81.1%) | 289 (94.1%) | 51 (16.6%) | 48 (15.6%) | 17 (5.5%) | 7 (2.3) | 10 (3.3%) | 1 (0.3%) |
| **Gender** | | | | | | | | | |
| Female | 119 (75.8%) | 118 (75.2%) | 143 (91.1%) | 33 (21.0%) | 32 (20.4%) | 13 (8.3%) | 5 (3.2%) | 7 (4.5%) | 1 (0.6%) |
| Male | 127 (84.7%) | 131 (87.3%) | 146 (97.3%) | 21 (14.0%) | 16 (10.7%) | 4 (2.7%) | 2 (1.3%) | 3 (2.0%) | 0 (0.0%) |
| **BMI** | | | | | | | | | |
| Risk of nutrients deficiency <18.5 | 50 (80.6%) | 53 (85.5%) | 59 (95.2%) | 10 (16.1%) | 9 (14.5%) | 3 (4.8%) | 2 (3.2%) | 0 (0.0%) | 0 (0.0%) |
| Healthy 18.5 – 22.9 | 114 (77.6%) | 115 (78.2%) | 137 (93.2%) | 28 (19.0%) | 25 (17.0%) | 9 (6.1%) | 5 (3.4%) | 7 (4.8%) | 1 (0.7%) |
| Moderate risk 23 – 27 | 49 (79.0%) | 51 (82.3%) | 58 (93.5%) | 13 (21.0%) | 9 (14.5%) | 4 (6.5%) | 0 (0.0%) | 2 (3..2%) | 0 (0.0%) |
| High risk >27 | 33 (91.7%) | 30 (83.3%) | 35 (97.2%) | 3 (8.3%) | 6 (13.9%) | 1 (2.8%) | 0 (0.0%) | 1 (2.8%) | 0 (0.0%) |

| | Light Snacker[a] | | | Medium Snacker[b] | | | High Snacker[c] | | |
|---|---|---|---|---|---|---|---|---|---|
| | **M1** | **M2** | **M3** | **M1** | **M2** | **M3** | **M1** | **M2** | **M3** |
| **Ethnicity** | | | | | | | | | |
| Chinese | 87 (81.3%) | 84 (78.5%) | 103 (96.3%) | 18 (16.8%) | 19 (17.8%) | 4 (3.7%) | 2 (1.9%) | 4 (3.7%) | 0 (0.0%) |
| Malays | 78 (78.0%) | 84 (84.0%) | 91 (91.0%) | 19 (19.0%) | 12 (12.0%) | 8 (8.0%) | 3 (3.0%) | 4 (4.0%) | 1 (1.0%) |
| Indian | 81 (81.0%) | 81 (81.0%) | 95 (95.0%) | 17 (17.0%) | 17 (17.0%) | 5 (5.0%) | 2 (2.0%) | 2 (2.0%) | 0 (0.0%) |
| **Educational Institutes** | | | | | | | | | |
| ITE | 96 (96.0%) | 85 ( 85.0%) | 97 (97.0%) | 3 (3.0%) | 15 (15.0%) | 3 (3.0%) | 1 (1.0%) | 0 (0.0%) | 0 (0.0%) |
| JC | 82 (82.0%) | 66 (66.0%) | 90 (90.0%) | 17 (17.0%) | 29 (29.0%) | 10 (10.0%) | 1 (1.0%) | 5 (5.0%) | 0 (0.0%) |
| POLY | 73 (73.0%) | 65 (65.0%) | 89 (89.0)% | 23 (23.0%) | 26 (26.0%) | 10 (10.0%) | 4 (4.0%) | 9 (9.0%) | 1 (1.0%) |

[a]Light snacker - one who has less than or equal to 2 snacks per day; [b]Medium snacker – one who has 3 to 4 snacks per day; [c]High snacker- one who has more than 5 snacks per day.

*Table 44 - Pairwise comparisons of education institute (% of energy contributed from snacks)*

| Sample 1 – Sample 2 | *Adjusted *P*-value | | | |
|---|---|---|---|---|
| | C1 | C2 | C3 | M2 |
| JC – POLY | **0.034** | **0.034** | **0.034** | **0.034** |
| JC – ITE | **<0.001** | **<0.001** | **<0.001** | **<0.001** |
| POLY – ITE | 0.204 | 0.204 | 0.204 | 0.204 |

**Significant values have been adjusted by the Bonferroni correction for multiple tests.*

**Based on Kruskal-Wallis multiple comparisons.*

Among the three ethnicities, the Indians had the highest energy contributed from snacks using C2, C3, M2 and M3, while the Malays had the highest energy contributed from snacks using C1 and M1 (reference to Table 41). Using C1 and C3, all three ethnicities had more than 70% as light snackers and less than 5% as high snackers (reference to Table 43). However, C2 resulted a more even spread of snacker profiles among the ethnicities. The Malays had the highest percentage of light snackers (using M2), medium snackers (using M1) and high snackers (using M1, M2 and M3). Using M1, M2, M3, all ethnicities had more than 75% as light snackers and less than 5% as high snackers. However, using the Kruskal-Wallis Test, there was no significant difference among the ethnicity when using C1, C2, C3, M1, M2 or M3.

Among the three educational institutes, energy contributed from snacks using C2, C3, M2 and M3 was significantly highest for the JC while the POLY had the highest energy contributed using M1 (although this was not a significant difference). Using the three criteria and three models, the ITE had the highest percentage of light snackers. There is no obvious trend for medium or high snackers when using the three criteria. Using the three models, the POLY had the highest percentage as high snackers.

Table 45 - *p*-value (Cramer's value) for the snacking models (C1 to C3 and M1 to M3)

| | C1 | C2 | C3 | M1 | M2 | M3 |
|---|---|---|---|---|---|---|
| Gender | 0.291 | ***0.006 (0.183)** | 0.052 | 0.132 | ***0.024 (0.156)** | 0.06 |
| BMI | 0.351 | 0.274 | 0.864 | 0.377 | 0.712 | 0.930 |
| Ethnicity | 0.810 | 0.110 | 0.979 | 0.964 | 0.700 | 0.405 |
| Educational Institute | 0.085 | ***<0.001 (0.256)** | ***0.007 (0.153)** | ***<0.001 (0.187)** | ***0.002 (0.168)** | 0.154 |

**Cramer's value indicated in bracket if p-value<0.05.*

The review of the association of different factors (gender, BMI, ethnicity, educational institute) with snacking was evaluated using the Pearson Chi-squared test with the values from Table 42 and Table 43. For gender, both C2 and M2 illustrated that gender was significantly associated with snacker profile (Cramer's value at 0.183 and 0.156 respectively). There were more male light snackers for M1, M2 and M3. But for medium and high snackers, females were found to be consistently higher for all models. Snacking was found to be not significantly associated with BMI and ethnicity for all criteria and models. There were the highest number of light snackers, with a BMI of high risk using M1 and M3, while light snackers with BMI of risk of nutrient deficiency was found to be the highest when evaluated using M2.

For the factor educational institute, the results derived seem to suggest that snacking was associated with educational institutes as snacking was found to be significantly associated using criteria 2 and 3, and models 1 and 2, with a small to medium effect size. ITE participants were found to be consistently having the highest percentage of light snackers.

### *7.5.5 Number of eating occasions*

Using the 24-h recall data, eating occasions per day were analysed using the EXCEL spreadsheet. Eating occasion per day was defined as consumption of any food and/or beverage which resulted in an increase in energy. Table 46 and

Figure 15 illustrate the results obtained from analyzing the number of eating occasions. Figure 16 illustrates the distribution of eating occasions based on the four factors – gender, BMI, ethnicity and educational institute.

*Table 46 - Number of eating occasions per day*

| | | Mean (S.D.) |
|---|---|---|
| **Gender** | Female | 4.331(1.68) |
| | Male | 3.95 (1.55) |
| **BMI** Risk of nutrients deficiency, <18.5 | | 4.29 (1.45) |
| | Healthy, 18.5 – 22.9 | 4.22 (1.80) |
| | Moderate risk, 23 – 27 | 4.03 (1.44) |
| | High risk, >27 | 3.81 (1.45) |
| **Ethnicity** | Chinese | 4.29 (1.55) |
| | Malays or those of Malay ethnic | 3.89 (1.86) |
| | Indian | 4.25 (1.43) |
| **Educational Institutes** | ITE | 3.93 (1.35) |
| | JC | 4.82 (1.57) |
| | POLY | 4.73 (1.86) |

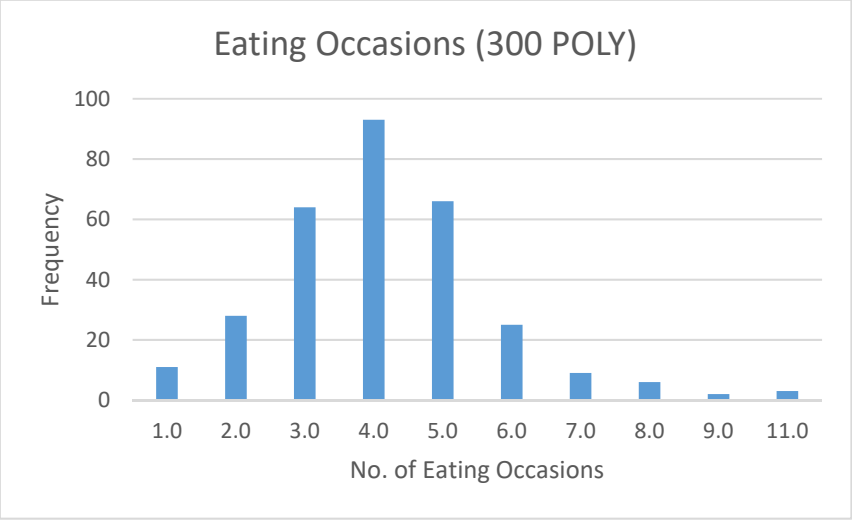
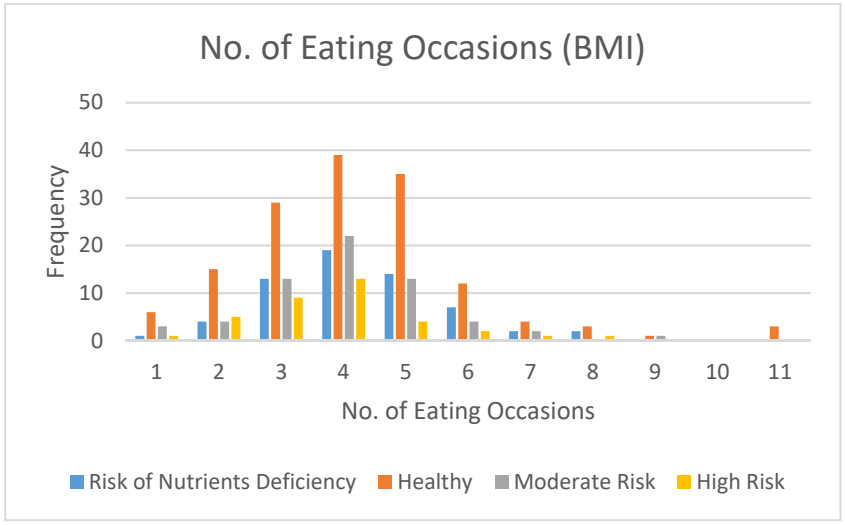
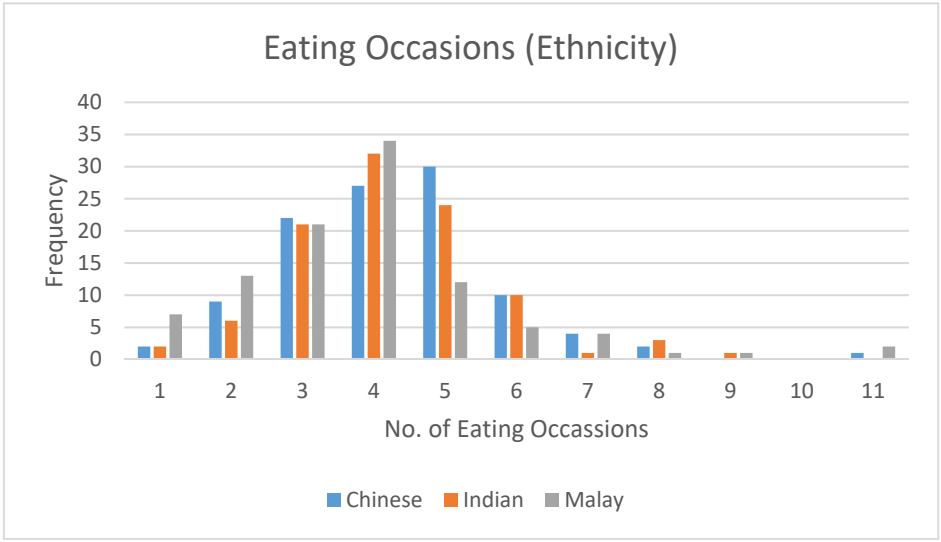



Figure 15 - Overall frequency of Eating Occasions per day based on POLY students

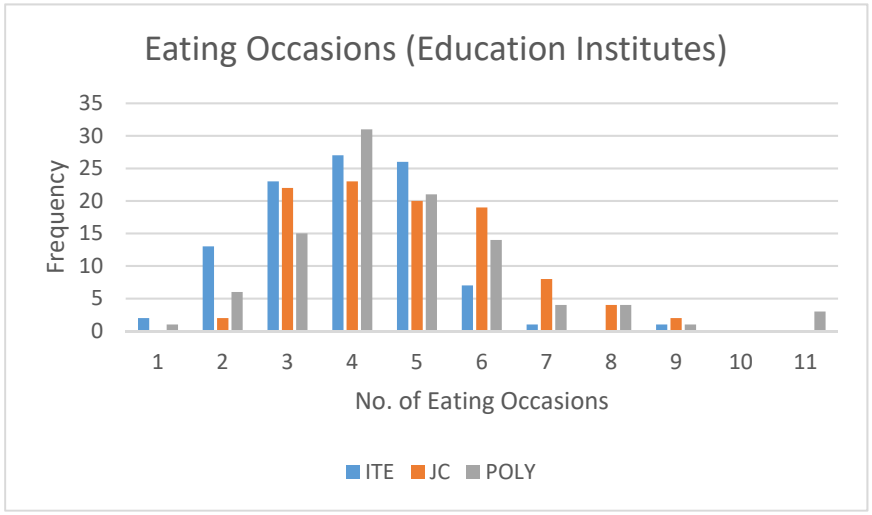




*Figure 16 - Eating Occasions per day (gender, BMI, ethnicity and education institutes)*

The following table illustrates the number of respondents classified as having a low, normal and high number of eating occasions. The review of the association of different factors (gender, BMI, ethnicity, educational institute) with the number of eating occasions was evaluated using the Pearson Chi-squared test. Only ethnicity and educational institute suggested a significant association, with Malays having the highest number of low and normal number of eating occasions while the Chinese had the highest number of "high" eating occasions.

*Table 47 - Number of eating occasions per day based on Low, Normal and High criteria*

| | Low[a] | Normal[b] | High[c] |
|---|---|---|---|
| Participants | 39 (12.7%) | 157 (51.1%) | 111 (36.2%) |
| **Gender/** *p*-value | | 0.081 | |
| Female | 17 | 78 | 62 |
| Male | 22 | 79 | 49 |
| **BMI/** *p*-value | | 0.103 | |
| Risk of nutrients deficiency, BMI <18.5 | 5 | 32 | 25 |
| Healthy, BMI = 18.5 – 22.9 | 21 | 68 | 58 |
| Moderate risk, BMI = 23 - 27 | 7 | 35 | 20 |
| High risk, BMI>27 | 6 | 22 | 8 |
| **Ethnicity/** *p*-value (Cramer's value)* | | **0.012 (0.145)** | |
| Chinese | 11 | 49 | 47 |
| Malays or those of Malay ethnic | 20 | 55 | 25 |
| Indian | 8 | 53 | 39 |
| **Educational Institutes/** *p*-value (Cramer's value)* | | **0.005 (0.157)** | |
| ITE | 15 | 50 | 35 |
| JC | 3 | 45 | 53 |
| POLY | 7 | 46 | 47 |

[a]Low – 0 to 2 eating occasions per day; [b]Normal – 3 to 4 eating occasions per day; [c]High – more than 5 eating occasions per day. *Cramer's value indicated in bracket if p-value<0.05.*

## 7.6 Discussion

An initial part of this study was to review the snacking pattern of the post-secondary students. However, through a literature review of available journals, it was found that there is no consistent definition of what a snack is. Hence, this part of the study explored the definition of a snack, through different models and how it could affect the analysis of snacking. In addition, the views of what a snack is to the late adolescents, the reasons for snacking and what they snacked on were also gathered via the focus groups.

### *7.6.1Deriving a definition of a snack*

The definition of a snack or snacking varies among studies making comparison among studies difficult (Gregori et al., 2011). An initial literature review was conducted to gather the definitions used in research. Table 32 illustrates some of the common definitions used in research. The definitions were then grouped and posed as questions during the focus group discussions. Focus groups were then conducted to gather late adolescents' perceptions of a snack or what snacking means to them and to understand what triggers them to snack and what foods they snack on.

The definitions gathered from the focus groups were broadly clustered in four themes, namely time, emotions, portion size and food category. Participants were also given specific definitions of snacks, illustrated in Table 34, and a mini-poll was conducted. Participants generally agreed that a snack is anything eaten in between the three proper meals of breakfast, lunch and dinner and a snack is anything that does not fill one up. However, questions on what a meal is to the participants was not posed as a question during this focus group. Participants agreed that generally meals referred to something that would fill up their stomach, but snacks tend to have a lower energy content.

The next popular definition of snack cited during the focus groups was based on emotion. This definition is similar to having a self-defined criterion (Jahns et al., 2001). However, emotion as a definition for snacks or having a self-defined criterion would be difficult as it would be very dependent on the respondents and could be compounded by other factors such as gender, ethnicity, social-economic status,

education background, making it difficult to collect data and to compare across studies. Hence it may be not a very objective definition to be used for snack.

Portion size is another definition that was cited. Some participants felt that a snack is something small and one could hold on your hand and eat and go anywhere with the snack.

Other considerations for a definition of a snack include food types or food categories. However, Singapore is a multi-racial country and there is no specific food type to be considered as a snack. For instance, chicken nuggets, a popular snack as evident from the focus groups, could be served as a main food item in a set of *Nasi Lemak* (coconut rice) which is a popular Malays or those of Malay ethnic meal, although it could be consumed by other ethnicities as well. Waffles can also be eaten as a snack or as a meal for breakfast. Potato chips, prawn crackers or poppadums, which can be considered as a snack, might be served together with a larger meal. Hence, it was decided not to use food types or food categories for the classification of a snack.

With the inputs from the focus groups and the definitions obtained from the literature review, three criteria (time, portion size and energy value) were decided to be used to examine the congruence of the different criteria.

Another method which is commonly used to classify snacks is to allow respondents to classify their eating occasions (Jahns et al., 2001). However, this method does not allow retrospective analysis of data which did not include classification of the eating occasions and it could result in more inconsistencies as different individuals could have different perceptions. Another method includes the use of a “mouth-entering” utensil (Douglas, 2002) which may be not be appropriate with the advent of fast food in which it is usually eaten using one’s hands.

### *7.6.2 Models of a snack*

The criterion of “time” as a definition of snack has been frequently used in many studies as illustrated in Table 32. However, this definition is dependent on individuals’ lifestyle. For instance, adolescents may have erratic sleeping or waking times, and this will subsequently affect their meal patterns (Dahl and Lewin, 2002,

Carskadon, 1990). In addition, adolescents' meal times could also be affected by their school schedules. Hence using this definition may lead to misclassification of meals as snacks. The breakfast time adopted in this snacking behavior is the same as that being used in the breakfast chapter. In a study carried out by Toornvliet et al. (1996) breakfast was defined as 0800 to 1000. However primary schools, secondary schools and JCs generally start at 0730. POLY and ITE usually start at 0800 or 0900. Hence adolescents may take their breakfast as early as 6am prior to travelling to school. Some other articles which used time as snacking definition did not state the meal-time. Instead respondents will classify their eating occasions as morning, afternoon evening snacks (Savige et al., 2007, Drummond et al., 1996, Devaney et al., 1995, Summerbell et al., 1995). This made comparison across studies even more difficult.

The next definition used in the current study is portion size. To decide a suitable "weight" for a snack is difficult due to its variety. For instance, a single cookie might weigh approximately 10g while a regular pack of fries weighs around 85g. But one cup of large coke from McDonalds is 500ml (approximately 500g) (McDonalds, 2017). Hence, a typical meal portion was defined instead. It was decided to use a portion size of 570g to depict as a meal, based on Singapore Health Promotion Board's recommendation of a proper meal. It was noted that this amount could be an over-estimate for breakfast intake. However, breakfast in Singapore is unique in nature as the same dish, for instance fried *bee hoon, mee rebus, nasi lemak,* could be consumed for breakfast or for lunch or dinner. Hence it was decided not to use a smaller portion size for breakfast. Table 40 illustrated that M3 and M4 were in perfect agreement. The difference between M3 and M4 is the addition of the criterion for portion size. Hence, this further illustrated that portion size as a criterion, may not provide further information and may not be a discriminating criterion, when compared to time or energy value as criteria.

The next definition used was the percentage of energy contributed from an eating occasion to the total daily energy intake. Bernstein et al. (1981) used a minimum of 90 kcal for a meal while McBride et al. (1990) defined a meal as 375kcal. Using an absolute value for definition of a meal may be not suitable as, particularly within this age group and between the genders, energy requirements will vary greatly. Hence a

percentage (less than or equal to 15%) of the total energy contributed from snack is used instead (Murakami and Livingstone, 2016). The assumption is that the largest proportion of total energy of the adolescents comes from foods consumed in their main meals.

Three models were then proposed based on a combination of any two criteria. There are other hybrid definitions proposed. For instance, Lennernäs and Andersson (1999) proposed six types of eating episodes based on a combination of nutritional classification and temporal pattern. In another study, it was proposed a combination of energy intake and interval between eating occasions to define a meal. Five different combinations of these criteria were used: ⩾50 kcal separated by ⩾15 minutes, 50 kcal/45 minutes, 100 kcal/45 minutes, 200 kcal/45 minutes, and 50 kcal/90 minutes (de Castro, 1993).

Based on Table 37, it seems that the late adolescents' eating occasions are usually less than 570g and the late adolescents could be having many small eating occasions instead of a having three main meals.

Table 42 illustrated that a high percentage of 48.5% of the participants had 3 to 4 "snacks" or eating occasions of less than 570g per day. Although the criterion may have over-estimated the snacking, it suggested that late adolescents' eating pattern could be grazing instead of having three main meals. C1 (time) and C3 (percentage of energy) agreed much better with each other as illustrated in Table 38 as it has the highest Kappa value. Also, the snacker profiles obtained from using the different models are in better agreement compared to that obtained from the single criterion-based approaches. Hence it suggests that having a combination of criteria for snacks could be a better option to define snacks.

In recent years, instead of evaluating snacking behavior with different criteria, studies evaluated behavior in terms of eating occasions, rather than main meals and snacking (Duffey and Popkin, 2011, Kant et al., 1995).
Figure 15 illustrated that the mean number of eating occasions was four, although there were a few extreme participants having more than six eating occasions or only

two eating occasions per a day. This suggested that beside the main meals of breakfast, lunch and dinner, the participants had at least one snack.

### *7.6.3 Snacking behavior*

In this study, four factors were hypothesized to have an association with the snacking behavior, namely gender, BMI, ethnicity and educational institutes.

From Table 41, all methods, except C1, proposed that energy contributed from snacks is higher for the females than the males. In terms of significance, only results obtained using C2 and M2 suggested that gender is significantly associated with snacker profile (reference to Table 45).

From Table 42 and Table 43, all methods proposed that more males are light snackers while more females are medium to high snackers. Grogan et al. (1997) who conducted a study at the Manchester Metropolitan University (United Kingdom) with participants aged 18 to 40 years, suggested gender could influence the snacking attitudes and behavior while a study in Australia secondary schools conducted by Savige et al. (2007) found that females were more likely to snack in several snacking contexts, such as while travelling, hanging out with friends, or while doing homework or working.

Snacking often has a negative connotation as it is linked to overweight and obesity, although in one study, it was suggested that snacking could help older adults in meeting their energy requirements (Zizza et al., 2007). A study conducted with a Spanish cohort reported that snacking could be a likely cause for obesity (Bes-Rastrollo et al., 2010). In the XENDOS study in which a self-administered meal pattern questionnaire was used, it was found that frequent Sweden snackers (≥3 snacks) were obese and there was a positive relationship between eating snacks and energy intake, regardless of their physical activity (Forslund et al., 2005). However in this study, it was found that BMI was not significantly associated with snacking using C1 to C3 and M1 to M3. This result is similar to the findings from the study conducted by Chaplin and Smith (2011) in which it was found that snacking may not be a contributing factor to obesity. Also Murakami and Livingstone (2016) suggested that snacking may not be the cause of obesity, instead snacking or increase in number of

eating occasions will affect the diet quality. Intriguingly, in one study conducted with French obese children, Swiss obese adults and the Finnish general population, it was found that snacking prevalence was associated with gene rs17782313 allele which was reported to be linked with an increase risk of obesity (Stutzmann et al., 2009). Obesity is a multi-dimensional issue in which there could be more than one cause, hence making it difficult to justify that obesity is directly associated with snacking.

The ethnicities, which consisted of the Chinese, Malays and Indians, examined in this study is unique to the Southeast Asia context. This study suggests that snacking behavior is not associated with the three ethnicities examined.

Interestingly, in this study, educational institute is one factor that suggested significant association with snacking behavior, using C2, C3, M1 and M2 (reference to Table 45). However, there was no consistent result. The JC students had a significantly higher energy contributed from snacking using C2, C3, and M2, while the POLY students had a significantly higher energy contributed from snack using M2 (reference Table 41). Using M1 to M3, the POLY participants were the ones with the highest percentage of high snackers (reference Table 43).

### *7.6.4 Why do they snack and what do they snack on?*

For any health intervention to be effective, it is important to find out the reasons for snacking. In this study, using focus groups, reasons for their snacking behavior were explored along with their rationale for the choice of snacks. Hunger may seem the apparent reason why adolescents snack, since some may be within the adolescent growth period, and this was cited as one reason for this snacking. However, in a study conducted in Finland which explored the reasons for eating, only 21% of the eating episodes were triggered by hunger (Tuomisto et al., 1998). This is in line with two studies conducted in Germany which reported that negative emotions, such as stress or feeling sad, could trigger consumption of unhealthy food (Renner et al., 2012) or the desire to eat ((Kubiak et al., 2008).

Another reason cited for snacking was eating for social occasions. The reasons given were similar to a study conducted in Netherland which attempts to investigate people's rationale for having unhealthy snacks; it was found that the top reason was

“to enjoy a special occasion” which included social occasions or being with friends (Verhoeven et al., 2015).

It was not surprising that at this stage of their life, the deciding factor for the choice of snack is its palatability and availability. Only a few will review the nutrient value of a snack (Cross et al., 1994). For instance, participant 2 of FG1 would not opt for a healthier choice.

> “…I’ll buy whatever I can see…” (FG1, participant 1)

Participants also cited the other reason snacking is due to their emotions such as feeling stressful, mood swings or craving.

The intent of having the focus group in this section was to capture data which could provide an insight on how the participants view snacking and the reasons they snacked. Focus groups offer a quick and easy way to capture information, capitalizing on the synergy of the group, as compared to a one-to-one interview. Spontaneous discussions among the participants also allowed exploration of new ideas, which may not be possible with individual interviews (Green et al., 2003). The downside of focus groups could be that the participants may be influenced by the comments of the general group, as well as the effect of the interviewer, and just agree with the main flow of the group, without giving their own inputs. This could, however, be overcome by organizing the focus groups in such way that there is no pre-existing relationship among the participants (Thomas et al., 1995). In this study, care was taken in organizing the focus groups. Where possible, the participants were grouped in such a way to ensure that there is no pre-existing relationship and there is a mix of different ethnicities.

## 7.7 Strengths, limitations and future studies

One of the strengths in this study is that it provides a unique comparison of snacking when three different criteria and three different models were applied to a set of 24h recall data. This highlights that without having a universal definition of snacking, it is difficult to draw comparisons between different research studies. It is proposed to have at least two criteria, such as model 1 or 2 to better evaluate snacking. This study also adds to the current data available for snacking in the context of Singapore post-secondary students.

One limitation of this study is that the health status of the participants was not obtained, although self-declared weight and height were obtained. This impedes further review of the correlation of health status with snacking. Also, in the focus group, the definition of what a meal is was not discussed. For future studies, it is proposed to validate the proposed models (M1, M2, M3) with a 3-day food records and participants to denote what each eating occasion means to them (e.g. whether it is breakfast, lunch, dinner, morning snack, afternoon snack, evening snack). It is also recommended to conduct the studies among different age groups to investigate whether there is a difference in their view.

## 7.8 Conclusion

The impact of snacking on the diet is difficult to assess because a variety of approaches have been used to define snacking (and snack foods) in the literature. As seen from the results section, the snacking behaviour determined using the three criteria or the three proposed models varied greatly. This lack of a universally accepted definition impaired the comparison among the studies and limits the development of science-based recommendations for consumers. An alliance of stakeholders could develop a universally accepted definition for snacking as a template for future research and this would encourage the development of well-substantiated dietary recommendations.

# Chapter 8 Conclusion and recommendation for future studies

This thesis examined the dietary intake of the post-secondary students in Singapore via mainly the 24-h recall method and focus groups. It was concluded that the diet quality, which was examined using a proposed HEI-SG index, of this group of students was far from ideal. Singaporean late adolescents appear to frequently consume OH foods and skip breakfast. Skipping breakfast is not a desirable habit as studies have reported it may affect their mental distress and affect their academic performance negatively (Lien, 2007). In addition, the choice of OH food was far from ideal as it formed a major part of their diet and the HEI-SG of the daily intake reflected a low score. As adolescents usually continue their eating habits into adulthood, it would be of paramount importance to inculcate the healthy eating habits at this juncture of their life (Must et al., 1992). As the post-secondary students are still within the school compound (ITE, JC and POLY), there will be opportunities for intervention to help support them in making healthier choices throughout their future lives. Adolescents may lack knowledge of healthy eating habits but equally may not want to adhere to it due to lack of time (which was also a factor surfaced in this study) or due to lack of concern (Croll et al., 2001). It was also found in this study that among the three ethnicities, the Malays have a lowest score for HEI-SG index. Hence interventions could be targeted at this ethnicity as well.

## 8.1 Strengths of this study

The strengths of this research work were the publication of a compendium of food pictures of Singapore local food, which is made available in the National library of Singapore, the development of a unique healthy eating index (HEI-SG), models for snacking and unique set of data for diet quality, breakfast and OH food consumption of Singapore post-secondary school students. The data provides an insight of how well the Singapore post-secondary school students eat and their views of healthy eating.

The developed compendium of food pictures is a useful guide for dietitians and nutritionists when they carry out dietary recalls as it allows the respondent to gauge the portion size, as well as to identify the food consumed in the categories of noodles, vegetables, fish, and local snacks. Initial plan of capturing packaged food in the compendium was eventually abolished as the packaged food was being replaced

in a relatively fast rate and it was difficult to obtain approval from individual food manufacturers. The compendium of food pictures is a useful guide when conducting the 24-h recall. Respondents can easily identify the consumed portion sizes and hence minimizing errors due to incorrect reporting of portion size. However, for this compendium, the portion size is based on the common food sources such as the food courts and hawker centers. Validation of the compendium could be done by taking more samples from various major eating outlets and obtain the average.

Although the developed HEI-SG could not predict specific health outcomes, it gives a good indication of the diet quality of Singapore post-secondary school students. The HEI-SG is based on the recommendation of the Singapore *My Healthy Plate.* The HEI-SG could be strength with addition of data (the activity level). Another strength of this research is that a holistic approach was taken with regards to the data collection on the dietary intake. Beside the 24-h recall, focus groups were conducted to understand the views of this groups of post-secondary students. Breakfast consumption was moderate, with the highest consumption rate by the Chinese (79.4%) and JC 66.9%) respondents. Insights, such as skipping breakfast due to the lack of time even though they generally were aware of the importance of breakfast, and bread/ pastries being the most popular type of breakfast, gathered from the breakfast consumption data and focus groups provide good data to policy makers, as well as food manufacturers so that the nutritional needs of this cohort could be tailored.

Out-of-home data provides a good understanding of what proportion of calories and nutrients were contributed from the OH foods in the diet of the studied cohort. Energy contribution from OH was as high as 72.24% (S.D. 29.86) for the POLY respondents. However, despite having many meals of OH foods, the respondents generally were not aware of the Healthier Dinning Programme. Hence more awareness is needed to be created to encourage healthier choices for OH foods.

The three models for snacking illustrate the complexity of evaluating snacking and provides insights to snacking habits of the studied cohort. It illustrates the importance of having a universal definition before any comparisons could be made among studies. Data from the focus groups also illustrated that the respondents had

different views of how a snack should be defined. The most accepted definition of a snack among the respondents is anything eaten in between proper meals. Using a single criterion for a snack, the percentage of energy contributed from snacks can vary as much as 67.2% to 11.6%. By using two criteria, the variation is lower - energy contributed from snacks using the models varied from 25.3% to 5.2%. Nonetheless, in order to systematically evaluate the best model to be used, the models would first need to be validated.

### 8.2 Limitations of this study

Weight and height of the respondents were obtained based on self-declaration. Self-declaration of weight and height is logistically easier for researchers, but it would not be as accurate as taking the actual measurement (Tsigilis, 2006). Post-secondary students have to undergo physical education and usually their weight and height are measured. Hence, it was decided to use self-declared weight and height instead of via measurement. It is noted that physical education is compulsory for the ITE and JC students throughout their years of study at the institutes. However, physical education is only compulsory for year 1 female POLY students, while the male POLY students have to undergo physical education throughout their years of study.

Another limitation of the study is that the data analysed was based on one weekday 24-h recall. A single 24-h recall should not be used to represent one's diet as one's diet may vary from day to day and thus does not estimate within-subject variation of food intake. The usual intake of nutrients by individuals can neither be calculated nor be compared with recommendations to estimate the proportion at risk of inadequate intake. However, when conducted with a large sample on different days in the week, registering one day is appropriate for estimating mean intakes on a group level (Willett, 2012, Black, 2000). In this study, additional care was exercised by asking the respondents whether the dietary intake was their typical diet before starting the 24-h recall. This would help to minimize the potential difference due to a single 24-h recall but it took a longer time to complete the recruitment. Also, collecting multiple days of food intake could also minimize the chances of errors but this would require more resources. With a large sample size, the collective data could be used to represent the dietary intake of the cohort. Adolescents may eat slightly different during weekends and the analyzed data should be interpreted with that in mind.

Social economic status of the respondents could also have been obtained as it could be a factor affecting the respondents' dietary habits. Another limitation of the study is that the data is collected from three education institutes which are centrally located and of close proximity to one another. In Singapore, there are five polytechnics, three institutes of technical education and 16 junior colleges or institutes that post-secondary students could select. Justification for the sampling was probably due to convenience of sampling and entry to these institutes is based on merits in Singapore and hence difference due to location may not be a factor. However, for a comprehensive study, the sampling for participants could be from more than one JC, ITE and POLY in order to take into account the SES, educational attainment and the food environment that they are being exposed to.

### 8.3 Recommendation for future works

With a score of 46.38 (S.D. 12.54) out of 100, calculated based on the proposed HEI-SG, it suggests that the future works can focus on how to effectively encourage health eating among the post-secondary students. Currently there are many health promotion programmes implemented by the Singapore Health Promotion Board, as early as at the primary schools. The data from this study provides an insight of what the post-secondary school students feel when it comes to healthy eating. Often other factors such as limitation of time and their schedule play a greater role in their decision making of food choices. Future works can also examine other factors such as food environment and social economic status influence this group of respondents. In this study, the activity level of the respondents was not evaluated. Overall lifestyle, such as intake of alcohol, sugared and sweetened beverages, smoking, sleeping patterns, of the post-secondary schools could be considered as part of the future works.

### 8.4 Overall conclusion

This study provides an insight to the dietary habits of the post-secondary students in Singapore and the importance of having a universal definition for breakfast and snacks as this study illustrates that without a universal definition, the comparison among the studies would be difficult. This study also highlights the areas of concerns, such as relatively low breakfast intake, low intake of fruits and vegetables,

wholegrains and dairy products, and a high intake of sodium, in the dietary intake of the post-secondary school students.

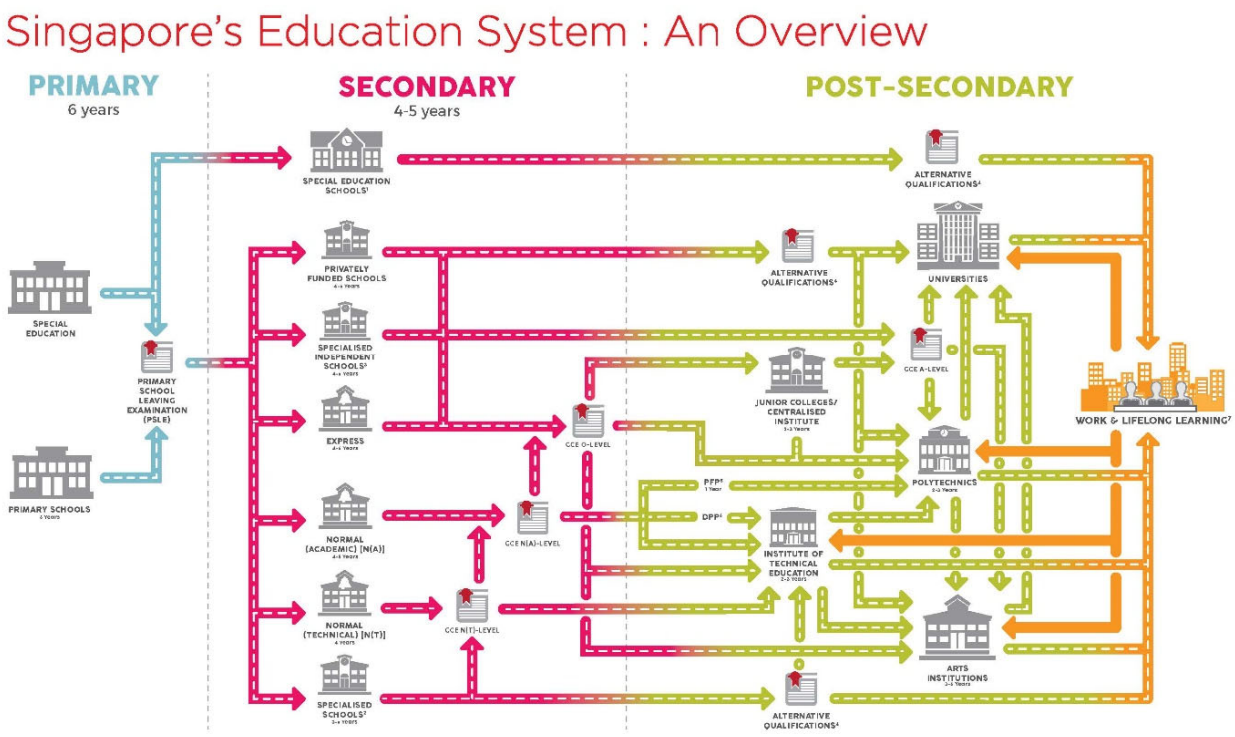
## Chapter 9 Publications

ENG, T. M., CHIEN, C. Y., FOSTER, E. & BROWNLEE, I. A. 2017. Comparison of different snacking models in post-secondary students in an urban setting. *PROCEEDINGS of the NUTRITION SOCIETY,* 76.

Santos-Merx, L., Firdaus, S., Tay, M., & Brownlee, I. (2017). Delaying breakfast: Impact on breakfast and subsequent meal quality among young Singaporeans. *Proceedings of the nutrition society, 76*(OCE4).

# APPENDICES

*Appendix 1 - An Overview of Singapore's Education System*



*Appendix 2 - Recruitment poster*

Newcastle University

**RESEARCH STUDY SUBJECT RECRUITMENT DRIVE**
Study title: Eating Patterns of mid and late adolescents in Singapore

The School of Agriculture, Food and Rural Development of Newcastle University is looking for participants in a research study to examine the eating patterns of mid and late adolescents (age 17 to 21) in Singapore.

The study involves a 3-day recording of the food and beverages consumed or a 24-hour recall.

In the 3-day recording of the food and beverages, participants will be given a booklet to record the consumption of the food and beverages over a period of consecutive 3 days (either 2 weekdays followed by one day of a weekend or 1 day of a weekend followed by 2 weekdays). Participants DO NOT have to change their diet or food consumption during these three days. Participants will have to attend a 30 minutes briefing session at your educational institute on how to conduct the recording.

In the 24-hour recall, participants will have to recall the food and beverages consumed in the past 24 hours. Suitable questions will be asked in order to assist you in the recall. The session will take approximately 30 minutes.

We are looking for people who are:

- Age 17 to 21, healthy
- Either one of the following ethnicity: Chinese, Malay or Indian
- Residing in Singapore

For participants below the age of 18, a parental consent form is required to be completed. The form will be made available via email upon signing up and you will be asked to bring along the form during the briefing session.

Interested? Contact us!

 : 65-6550 1543

 : m.e.tay@newcastle.ac.uk

*Appendix 3 - Sample of Parental Informed Consent Form*

Newcastle University

**Parental Informed Consent Form**
Participant Information Sheet
Research Study on Eating Patterns of Mid and Late Adolescents in Singapore

**INTRODUCTION**
Your child has been invited to join a research study to look at eating patterns of mid and late adolescents (age 17 to 21 inclusive) in Singapore. Please take whatever time you need to discuss the study with your family and friends, or anyone else you wish to. The decision to join, or not to join, is up to you.

**AIM OF THE STUDY**
The aim of the study is to gain a better understanding of how 'out of home' foods are consumed by middle and late adolescents in Singapore.

**WHAT IS INVOLVED IN THE STUDY?**
Your child can choose to participate in either one of the following:

a) Your child will be asked to record the food and beverages consumed in a booklet over a period of 3 consecutive days (either 2 weekdays followed by 1 day of a weekend or 1 day of a weekend followed by 2 weekdays). Prior to the recording, your child will have to attend a 30 minute briefing session at Nanyang Polytechnic (NYP) on how to conduct the recording. He/ she DOES NOT have to change his/ her diet or food consumption during these three days. Each recording will take approximately 5 to 10 minutes. Upon completion, the booklet will be collected from your child at NYP.

   If you agree to let your child take part in this study, the following will happen to your child:
   1. Attend a briefing on the methodology of the study at Nanyang Polytechnic
   2. Commencement of the recording of the 3-days food record over two weekdays and one day of a weekend. It is recommended to commence this recording within 2 weeks after attending the briefing.
   3. Submission of the 3-day food record.

b) Your child will be asked to recall food and beverages consumed during the last 24 hours. The session will take approximately 30 minutes.

   If you agree to let your child take part in this study, the following will happen to your child:
   1. Attend a briefing on the methodology of the study at Nanyang Polytechnic.
   2. At a scheduled date and timing, a 24-hr food recall will be conducted. The session will take approximately 30 minutes. Your child will be asked to recall food and beverages consumed in the past 24 hours. Suitable questions will be asked in order to assist him/ her in the recall.
   3. A debrief will be conducted after the session.

The full study will recruit an approximate 1200 subjects from three educational institutes over a period of 2.5 years. About 200 subjects from NYP will be involved in this study over a period of six months. The investigators may stop the study or take your child out of the study at any time they judge it is in his/ her best interest. They may also remove him/ her from the study for various other reasons. They can do this without your consent. Your child can stop participating at any time by informing via an email (m.e.tay@newcastle.ac.uk).

**RISKS**
Loss of confidentiality is a potential risk to the participants. There may also be other risks that we cannot predict.

Newcastle University

**BENEFITS TO TAKING PART IN THE STUDY?**

It is reasonable to expect the following benefits from this research:

- Results obtained from this study will add to the knowledge about the eating patterns of mid and late adolescents in Singapore. This could aid in further development in suitable nutritional education programs;
- A brief summary report on the nutrients intake (mainly carbohydrates, proteins and fats) patterns of the study cohort will be furnished to your child via email at a later date.

**REIMBURSEMENT**

Your child will be reimbursed for your time as follows:

- If your child attend the briefing and complete the study, he/she will be paid a $20 voucher.

**CONFIDENTIALITY**

Information collected for this study will be kept confidential. Your child's records, to the extent of the applicable laws and regulations, will not be made publicly available. Your child's name will not be used when data from this study are published. Every effort will be made to keep research records, and other personal information confidential.

We will take the following steps to keep information confidential, and to protect it from unauthorized disclosure, tampering, or damage:

- Your child's personal particulars will only be accessible to the principle researcher.
- The booklet will not include your child's name and hence only 'blind' data will be analyzed.
- Data hardcopies will be filed and kept in locked cabinets.
- Soft copy of the data will be kept on a computer which is password protected.

**ELIGIBILITY REQUIREMENTS**

- Healthy individuals
- Age 17 to 21 years old
- Ethnicity: Chinese, Malay and Indian

**YOUR CHILD'S RIGHTS AS A RESEARCH PARTICIPANT?**

Participation in this study is voluntary. Your child has the right not to participate at all or to leave the study at any time. Deciding not to participate or choosing to leave the study will not result in any penalty or loss of benefits to which your child is entitled, and it will not harm your child's relationship with the school.

If your child decides to leave the study, the procedure is:

- Email to the principle researcher to inform the withdrawal, stating his/her name and booklet ID.
- Reason for withdrawal (optional)

**CONTACTS FOR QUESTIONS OR PROBLEMS?**

Call Tay Mia Eng (principle researcher) at 6550 1543 or email at m.e.tay@newcastle.ac.uk if you have questions about the study or encounter any problems.

The study has been reviewed by the Newcastle University Ethics Committee and NYP Institutional Review Board (the ethics committee) for ethics approval.

If you want an independent opinion of your rights as a research subject you may contact the NYP IRB Analyst at 6550-1566.

If you have any complaints about this research study, you may contact the Principal Investigator or the NYP Institutional Review Board Analyst.

One copy for the participant and one copy for the research team (to be held by project supervisor).

Newcastle University

PARENTAL CONSENT OF SUBJECT

Protocol Title: Research Study on Eating Patterns of Mid and Late Adolescents in Singapore

Principal Investigator & Contact Details:
Name: Tay Mia Eng
Address: 180 Ang Mo Kio Avenue 8 Singapore 569830
Phone Number: 6550 1543
Email: m.e.tay@newcastle.ac.uk

Please tick all of the boxes that you agree with:

| | |
|---|---|
| | As parent or legal guardian, I authorise my child (stated below) to become a participant in the research study described in this form. |
| | I have fully discussed and understood the purpose and procedures of this study. |
| | This study has been explained to me in a language that I understand. I have been given enough time to ask any questions that I have about the study, and all my questions have been answered to my satisfaction. |
| | I confirm that my child would like to take part in the 3-day food record study. |
| | I confirm that my child would like to take part in the multiple-pass 24-hour recall. |

| Name of Parent or Legal Guardian | Signature | Date |
|---|---|---|

**Investigator Statement**

I, the undersigned, certify that I explained the study to the participant and the parent/ legal guardian and to the best of my knowledge the parent/ legal guardian signing this parental consent form clearly understands the nature, risks and benefits of his/ her participation in the study.

| Name of Investigator/ Person administering consent | Signature | Date |
|---|---|---|

One copy for the participant and one copy for the research team (to be held by project supervisor).

Newcastle University

**BENEFITS TO TAKING PART IN THE STUDY?**
It is reasonable to expect the following benefits from this research:

- Results obtained from this study will add to the knowledge about the eating patterns of mid and late adolescents in Singapore. This could aid in further development in suitable nutritional education programs;
- A brief summary report on the nutrients intake (mainly carbohydrates, proteins and fats) patterns of the study cohort will be furnished to you via email at a later date.

**REIMBURSEMENT**
You will be reimbursed for your time as follows:

- If you attend the briefing and complete the study, you will be paid a $20 voucher.

**CONFIDENTIALITY**
Information collected for this study will be kept confidential. Your records, to the extent of the applicable laws and regulations, will not be made publicly available.Your name will not be used when data from this study are published. Every effort will be made to keep research records, and other personal information confidential.
We will take the following steps to keep information confidential, and to protect it from unauthorized disclosure, tampering, or damage:

- Your personal particulars will only be accessible to the principle researcher.
- The booklet will not include your name and hence only 'blind' data will be analyzed.
- Data hardcopies will be filed and kept in locked cabinets.
- Soft copy of the data will be kept on a computer which is password protected.

**ELIGIBILITY REQUIREMENTS**

- Healthy individuals
- Age 17 to 21 years old
- Ethnicity: Chinese, Malay and Indian

**YOUR RIGHTS AS A RESEARCH PARTICIPANT?**
Participation in this study is voluntary. You have the right not to participate at all or to leave the study at any time. Deciding not to participate or choosing to leave the study will not result in any penalty or loss of benefits to which you are entitled, and it will not harm your relationship with the school.

If you decide to leave the study, the procedure is:

- Email to the principle researcher to inform the withdrawal, stating your name and booklet ID.
- Reason for withdrawal (optional)

**CONTACTS FOR QUESTIONS OR PROBLEMS?**
Call Tay Mia Eng (principle researcher) at 6550 1543 or email at m.e.tay@newcastle.ac.uk if you have questions about the study or encounter any problems.

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If you have any complaints about this research study, you may contact the Principal Investigator or the NYP Institutional Review Board Analyst.
One copy for the participant and one copy for the research team (to be held by project supervisor).

*Appendix 5 - Sample of 3-day Food Record*

**3-day Food Record**

Serial Number:

Survey dates: Day 1.

Day 2.

Day 3.

Should you have any problems or queries, please contact:

Tay Mia Eng, 9747 8072 (HP), 6550 1543 (O), email: m.e.tay@newcastle.ac.uk

Important:

1. Please complete this booklet on two weekdays and one day over a weekend.
2. Record **ALL** the foods and drinks that you consume, including snacks.
3. Record ONE food item on one line.
4. Give as much detail about the foods as possible. For instance, the brand names (E.g. Gardenia or Sunshine bread), portion, method of cooking (E.g. steamed, stir-fried, deep fried).
5. Where it is not possible to describe the portion size, please use the portion size guide.
6. Home cooked food (HC) refers to food that are prepared and cooked at home. E.g. stir-fried chicken with ginger.
7. Out of home food (OH) refers to food that you do not have any control over the cooking method. For instance, the amount of oil or salt that are added in the cooking process.
   E.g. chicken rice bought from canteen, bubble tea from KOI and cheese burger from McDonald.
8. Processed food (PC) refers to food that requires minimum cooking and ready to eat. E.g. ready-to-eat meals that require just heating, canned food, bread, 3-in-1 coffee mix.

**Example**

Day 1: 16 January (Thursday)

| Time | Food or Drink | Quantity | Left Over | Home cooked (HC) or Out of home (OH, location) or Processed Food (PF, location) |
|---|---|---|---|---|
| 0700 | Sunshine white bread with peanut butter | 2 slices, 2 tablespoons | - | PF (home) |
| " | Milo | 1 glass | | PF (home) |
| 1030 | Nuggets | 5 pieces | | OH (school canteen) |
| " | 100-plus drink | 250ml | Half a bottle | PF (school canteen) |
| 1200 | Rice | 1 bowl, size 1 | - | OH (school canteen) |
| " | Baked chicken meat | 1 portion, size 2 | | OH (school canteen) |
| " | Stirred fry potato wedge | 1 portion, size 1 | | OH (school canteen) |
| " | Stirred fry Cai Xin | 1 portion, size 1 | | OH (school canteen) |
| " | Braised Toufu | 1 piece, size 1 | | OH (school canteen) |
| " | Bubble tea | 1 cup, 250ml | | OH (school canteen) |
| 1500 | Waffle with chocolate | 1 piece, size 2 | - | OH (school canteen) |
| " | 100-plus drink | 250ml | Half a bottle | PF (school canteen) |
| 1750 | Biscuits | 1 packet, 200gm | - | PF (supermarket) |
| 1900 | Rice | 1 bowl, size 1 | - | HC |
| " | Chicken soup | 1 bowl, size 1 | | HC |
| " | Fried fish | 1 portion, size 1 | | HC |
| " | Stir fry broccoli | 1 portion. size 1 | | HC |
| 2000 | Royal gala apple | 1 | | HC |
| 2100 | Sunshine white bread with peanut butter | 2 slides | | PF (home) |
| " | HL Hi-cal milk | 100ml | | PF (home) |

Date: _____

| Time | Food or Drink | Quantity | Left Over | Home cooked (HC); Out of home (OH, location); Processed Food (PF, location) |
|---|---|---|---|---|

*Appendix 6 - Interviewer's script for multiple pass 24-h recall*

*Interviewer's script:*

"Hi, my name is Mia Eng (or trained interviewer's name). Thank you for participating in this study. The aim of the study is to understand the eating patterns of mid and late adolescents. What we are going to do now is known as the Multiple-pass 24-hour recall. Basically, it is to understand what you have consumed during the past 24 hours. Rest assured that the information and personal details that you have provided will be kept confidential. For the whole process, I would like you to stay on track with me in order to achieve accurate and better results for the recall. As your data will be entered into the computer system, I will appreciate if you could write neatly in a form that is easily readable so that the information can be keyed in correctly and accurately. We will start from the top, please fill in today's date and your serial number. Now, please take a few minutes to read the instruction on 1st page. Please flip to 2nd page. Write down yesterday's date.

Quick List

Please write down all the food and drinks that you have eaten during the past 24 hours. It can be from midnight to midnight or 7am to 7am the next morning. You can try recalling the food you last ate and work backwards, this might be easier for you to recall what you have eaten. You just have to recall what you ate yesterday, do not worry about the quantity you ate or where you got the food from, we will fill in that column later. I would like you to record down each food you have eaten on a separate line."

Forgotten List

"There are a lot of foods or snacks that people tend to forget eating them. This is the list of the usual forgotten food items (show them the Forgotten List). Could you identify any item that you have missed out? Did you pass by the vending machines or convenience stores and grab a sandwich/ a packet of chips or a cup of milo? Did you have any coffee, tea or other beverages in-between lunch and dinner or at any time of the day? Did you have any alcoholic beverages like beer, wine, cocktails etc? Did you eat any sweets, biscuit or cracker for snacks? Did your friends offer you any

snacks or drinks during break time? Did your friends offer you anything to eat while having a lecture? Did you stop by any convenience stores like 7-eleven, supermarket or “mama” shop to get a drink or biscuit to eat while going home? Did you munch on anything like potato chips or any other snacks while watching television? As it is a 24-h time frame from now counting back, did you have any food like a glass of milk or fruits before you went to sleep?”

Time

“For each of the foods you have eaten, please indicate the time when you ate it.”

Detail Cycle

“Next, we will now move on to the more detailed information about the foods that you have eaten. What brand is the biscuit or bread that you have eaten? Is it just white bread, wholemeal or raisin bread? What brand were your drinks? If you had juice, what fruit juice was that? Which brand is it from? Did you have any sauce added to your rice or noodles? If you had any meat, was the meat chicken, pork or beef? Did the meat had any gravy on top of it? Please write down the way the food was prepared for example was it fried, steamed, barbequed or prepared by any other methods? Please write down the brand of each packaged food or drinks.”

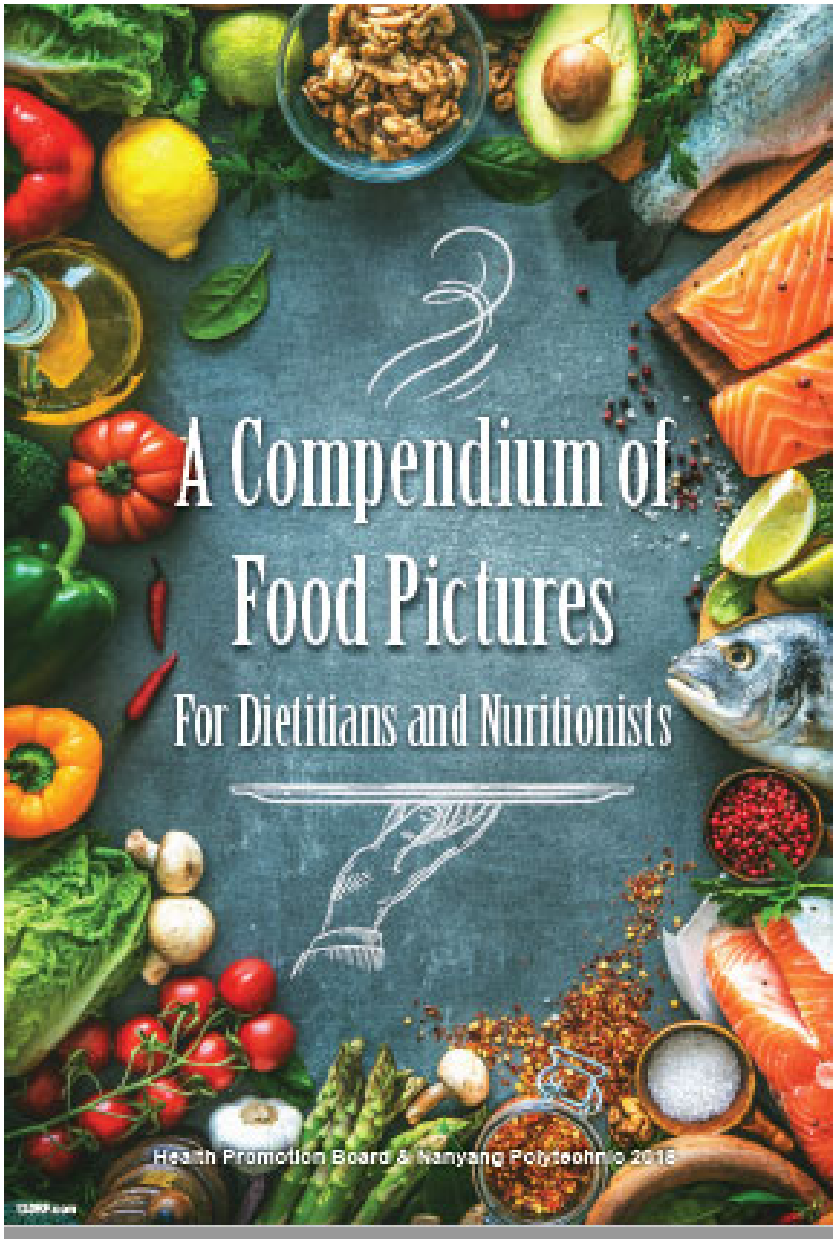
“Now, we will move on to recalling the portion size for each food item consumed. On the tables, there are several different sizes of plates, bowl, cups and portion size kits to help you in estimating the portion size. There are big plates, small plates, big bowl, small bowl, different sizes of cups with different volume, different bean bags and cut out circles that can be used to represent the portion you have eaten on the different plates, bowls or cups. All the bowls, cups and plates are labelled. Please write down the labelled code of the crockery you have used for that particular food. You can choose the bowls, plates or cups you have used that closely represent the ones that you used. Now, I will give you some time to recall and record down the portion size of each food and beverages you have consumed.”

Final Review Probe

“Now, we are now at the last stage of the food recall. Here are just a few questions that I would like to ask you to see if you have left out anything that you have eaten or

any other food or drinks you have not recorded. Along the way, you can record any food or drinks you have consumed not identified or you have thought of along the way when I ask you the few questions. Did you have anything when walking to school? Did you have anything when you were on the bus, MRT or in the car while on the way to school? Did you have any food or drinks while waiting for your friends to arrive? Did you have any food and drinks while waiting for dinner to start? Did you have anything, even if it is in a very small amount, before you went to bed? I will give you a few minutes to finish up those things that you will like to record. After you are done, please return the form to me.  Lastly, I will like to thank you for your time and participation in this recall."

*Appendix 7 - A Compendium of Food Pictures: Food Portion Section*



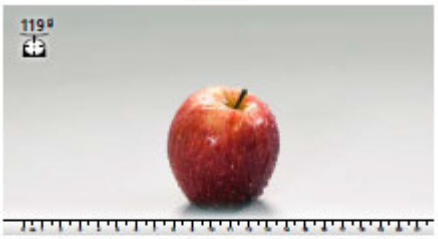
Fried Bee Hoon

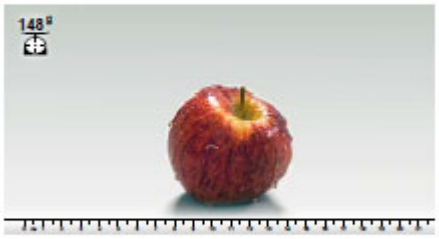


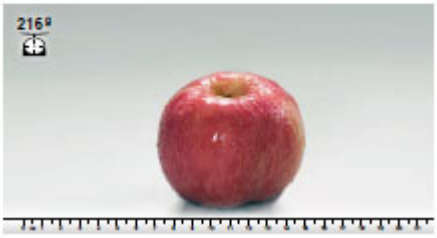

Chicken Chop, grilled




Apple




Banana


Cake


*Appendix 8 - Other sections of the food compendium*

Macaroni

Soba

Udon

Pale green leafy

Celery cabbage (wong nga pak)

Chinese cabbage (pak choy)

Chrysanthemum leaves (tung ho)

Dark green leafy

Baby kailan

Ceylon spinach

Chan nong baby wongbok

White fish

Atlantic pollock

Cod slice

Fresh rabbitfish

Oily fish

Barred spanish mackerel (tenggiri batang)

Barred spanish mackerel (slice)

Carp

With coconut/coconut milk

Getok ubi

Hoon kuih

Kuih bangkit

Athirasam

Jangiri

Laddu (pakoda/ vadai)

*Appendix 9 - Perception on breakfast consumption*

a How would you define breakfast?
Let the participants think around 5-10 mins and ask them to write what they think breakfast is on the post-it pads. Get them to share their ideas.

b In your opinion, do you think breakfast is very important?
1. Yes
2. No
3. Maybe

And why? Where do they get the idea from?

c How often do you eat breakfast?
1. Daily
2. Never
3. Sometimes (a few times a week)
4. Only weekends

d What are the reasons for not having breakfast? Let them discuss first.

e Rank their reasons for skipping of breakfast:
Possible reasons:
1. No time
2. Not hungry in the morning
3. Does not feel like eating
4. Or other factors that they have said

f Do your parents have breakfast?
1. Yes
2. No
3. Don’t know

g If you have breakfast, what do you have? Let them discuss first.

Food

1. Western type- Bread with spread, bread with ham/ cheese
2. Western type- Cereal
3. Western type- Energy bar
4. Asian type - porridge, noodles, macaroni soup, yam cake
5. Asian type- lor mai kia, chiew kueh, soon kueh,
6. Cookies, biscuits, muffins

Beverage

1. Milo
2. Coffee
3. Tea
4. Milk
5. Fruit juice
6. Cereal drink
7. Soft drink

h Where do you have your breakfast usually?

1. At home
2. In school
3. On the way to school

If you can offer one/ two methods to encourage adolescents to take breakfast, what will it be?

*Appendix 10 - Perception on Out of home food consumption*

Out of home food is defined as food not cooked or prepared by yourself/ at home. Ready to eat food such as instant noodles, bread that you prepared by yourself is considered as home food as you have control over how you prepare it.

a. How often do you eat out of home food for lunch?
    1. Every weekday
    2. Every weekday (when schooling)
    3. Everyday
    4. At least 3 times per week
    5. At least 4 times per week
    6. Less than 3 times per week

b. How often do you eat out of home food for dinner?
    1. Every weekday
    2. Every weekday (when schooling)
    3. Everyday
    4. At least 3 times per week
    5. At least 4 times per week
    6. Less than 3 times per week

c. Why do you eat out of home food for lunch?

d. Why do you eat out of home food for dinner?

e. Where do you eat, if you consume out of home food?
    1. School canteen
    2. Nearby coffee shops/ hawker centre
    3. Fast food
    4. Vending machines
    5. Others

f. How do you decide what to buy/ eat?
    1. Shortest queue
    2. Cheapest food
    3. Whatever I feel like eating
    4. The stall that serves the healthier choice food
    5. Others

g. Some stalls offer healthier choice options such as less oil/ salt or with the healthier dining logo. Do you go for that?

*Appendix 11 - Perception on fruits and vegetables intake*

For fruits and vegetables intake, the following is a list of questions posed to the participants.

a. What is your usual intake of fruits and vegetables? Do you include one vegetable and one fruit for every lunch and dinner?

    E.g. 2 fruits and 2 servings of vegetables every day, one serving of vegetables for every meal, excluding breakfast.

b. Would you opt for a fruit for a snack? Why?

c. Who or what do you think influence the intake of fruits and vegetables?

    E.g. parents, friends, social media (e.g. advertisements, blogs/ postings on Facebook that promotes the health benefits associated with fruits and vegetables intake), habits.

d. When dining with parents, do they ensure that you will have vegetables? Are there always fruits available at home?

e. What do you think can be done to increase fruits and vegetables intake among adolescents?

    E.g. health messages sent to create awareness of the goodness of the fruits/ vegetables, posters, free fruits day, vending machines selling salads/ fruits.

*Appendix 12 - Perception on snacking*

The following is a list of questions planned for snacking:

a. Write down what do you think a snack is.
b. Tick if you agree with the following:
    - A snack is anything eaten in between proper meals, such as breakfast, lunch, dinner.
    - A snack is anything eaten on the move
    - A snack is anything quick to eat
    - A snack doesn't require a proper sitting down (e.g. use of proper cutlery)
    - A snack is anything that doesn't fill you up.
c. How often do you snack or you observe your friends snacking?
    - Everyday
    - Frequently (3 to 4x per week)
    - Once in a while (1 to 2x per week)
    - Seldom

d. Where do you purchase your snacks?
    - School canteen
    - School vending machine
    - Brought from home
    - Given by friends
    - Bought along the way to school
e. Are you or your friends particular about the type of snacks that you eat?
    E.g. do you purposely snack on fruits/ select snacks that have a healthier choice snack logo?
f. Lastly, why do you or your friends snack?

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