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MALAYSIAN DIETARY GUIDELINES 2020

National Coordinating Committee on Food and Nutrition (NCCFN)

MINISTRY OF HEALTH MALAYSIA

2020

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National Coordinating Committee on Food and Nutrition
Ministry of Health Malaysia

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MINISTRY OF HEALTH

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National Coordinating Committee on Food and Nutrition
Ministry of Health Malaysia

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Message by
Minister of Health Malaysia

Effective messaging promoting healthy eating is a critical strategy that will allow for prevention, and help control the burden of malnutrition in the country. It is for this reason the Malaysian Dietary Guidelines (MDG) were formulated in 1996 and were revised in both 2010 and 2020 to ensure that all Malaysians have access to reliable and accurate nutritional information. The Malaysian Dietary Guidelines 2020 were thoroughly reviewed, taking into consideration diet-related non-communicable diseases and dietary patterns of Malaysians from all walks of life.

The Malaysian Dietary Guidelines 2020, intended for adults aged 18 to 59 years old, provide key messages to assist healthcare practitioners in guiding Malaysians on healthy eating practices. It is also an essential resource for health professionals, academicians, non-government organisations, and other stakeholders and policymakers to design practical healthy eating recommendations for Malaysians. I hope that these MDGs are beneficial in our effort to curb malnutrition in Malaysia.

I would like to express my heartfelt gratitude and congratulations to the Malaysian Dietary Guidelines 2020 Technical Working Group members and to those who have contributed to the development of the MDGs directly or indirectly.

Khairy Jamaluddin
Minister
Ministry of Health Malaysia

Foreword by
Director-General of Health

Diet-related non-communicable diseases are an undeniable consequence of an unhealthy lifestyle. Apart from sedentary or inactive lifestyles, unhealthy dietary practices have further aggravated the problems. The prevalence of these chronic diet-related diseases is increasing at an alarming rate. The non-communicable diseases burden forms a public health risk with a high financial impact and intangible losses due to decreased productivity. Therefore, it is timely for the Ministry of Health Malaysia to strengthen the advocacy of healthy lifestyles, including healthy eating to the population.

The Malaysian Dietary Guidelines were developed at the national level to assist health professionals and other stakeholders in educating the Malaysian population about healthy eating. Since 1999, this document has been reviewed periodically to ensure that it continues to be relevant to the current and future nutritional situation in the country. The Malaysian Dietary Guidelines was moulded on from the latest peer-reviewed scientific evidence to warrant substantiate and effective recommendations, and it will complement other initiatives to cultivate healthy eating practices amongst Malaysian adults.

Therefore, I envisioned the Malaysian Dietary Guidelines 2020 as the main reference in the country for healthy eating practices. Last but not least, I would like to take this opportunity to congratulate and convey my gratitude to those who were involved in the review of the document, particularly the Malaysian Dietary Guidelines Technical Working Group members.

YBhg. Tan Sri Dato' Seri Dr. Noor Hisham Abdullah
Director-General of Health, Malaysia
Ministry of Health Malaysia

Preface by

Deputy Director-General of Health Malaysia (Public Health) Malaysia

Since the past decades, Malaysia has been experiencing nutrition transition and lifestyle changes. These include a change from a traditional to a more 'westernized' or global diet and lifestyle. The National Health and Morbidity Survey (NHMS 2019) showed that about half of the adults population in Malaysia were obese, with 30.4% and 19.7% being overweight and obese, respectively. There was also an increase of other diet related non-communicable diseases such as diabetes and hypercholesterolemia. This situation is aggravated by the Covid-19 pandemic which has imposed a significant economic burden on individuals, families, and nations.

Therefore, the revised Malaysian Dietary Guidelines 2020 focuses on adults which were developed based on the recommended nutrient intake (RNI, 2017), the latest nutritional status and scientific evidence. In the Malaysian Dietary Guidelines 2020, all the 14 key messages, key recommendations and how to achieve were written by a group of nutrition experts to ensure appropriate and meaningful recommendations and achievable to be practiced.

I do hope that these guidelines would be a valuable resource for health care, personnel, academicians, non-government organisations and other stakeholders in disseminating appropriate nutrition messages. Finally, I would like to express my heartfelt gratitude to all those who have been involved in the completion of this Malaysian Dietary Guidelines 2020.

Datuk Dr. Chong Chee Kheong
Deputy Director General Of Health (Public Health)
Ministry of Health Malaysia

Preface by
Chairman of Technical Working Group on Nutritional Guidelines

Individuals' dietary behavior are of primary interest to public health professionals, nutritionists/dietitians and food industry alike. The impact of what an individual eat on health outcomes is rarely influenced by any one eating event or single food. Instead, health outcomes related to diet are a result of complex combinations of foods eaten together over time.

Dietary guidelines remain a useful tool in providing nutrition information and advice for the public that is credible from a scientific perspective and easy to understand and follow.

The Malaysian Dietary Guidelines 2020, a revised version on MDG 2010 comprise of 14 Key messages with 52 key recommendations and how to achieve, prepared by the Technical Working Group Nutritional Guidelines provide valuable information to related stakeholders to help individuals make healthier food choices.

The Technical Working Group are hopeful that the guidelines will be widely used as a reference and we look forward for feedback from stakeholders and end users to help us update and improve the guidelines from time to time.

I would like to thank members of the Technical Working Group, the writers, the Focus Discussion Group, the Editorial team, the Consensus Workshop participants, the TWG Secretariat and all those who assisted this valuable document for their hard work and dedication.

Emeritus Prof. Dr. Mohd Ismail Noor
FASc, FIUNS, FCFAM.
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Acknowledgement

Individuals from various Departments and Institutes, the Ministry of Health Malaysia, academicians from local universities, nutritionists, dietitians, representatives from related professional bodies, representatives from the food manufacturing and trading industry, and consumer bodies are all acknowledged by the Technical Working Group on Nutritional Guidelines. Their invaluable contributions and dedication to completing this document successfully are sincerely appreciated.

A word of gratitude is also conveyed to the:

- Director of National Institutes of Health
- Director of Disease Control Division
- Director of Food Safety and Quality Division
- Directors of State Department of Health (all over Malaysia)
- Dean of Allied Health Sciences Faculty, Universiti Kebangsaan Malaysia
- Dean of Health Sciences Faculty, Universiti Kebangsaan Malaysia
- Dean of Education Faculty, Universiti Kebangsaan Malaysia
- Dean of Medical and Health Science Faculty, Universiti Putra Malaysia
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for their generous support and cooperation.

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Key Message 6 :	Eat adequate amounts of rice, other cereals, whole grain cereal-based products and tubers

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Coordination and Documentation

The documentation of the Malaysian Dietary Guidelines (MDG) 2020 was coordinated by the Technical Working Group (TWG) on Nutritional Guidelines, which is under the purview of the National Coordinating Committee on Food and Nutrition (NCCFN), Ministry of Health Malaysia. The Nutrition Division, Ministry of Health Malaysia served as the secretariat for the MDG 2020.

Chairperson, TWG on Nutritional Guidelines	Emeritus Prof. Dr. Mohd Ismail Noor Universiti Kebangsaan Malaysia

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MALAYSIAN DIETARY GUIDELINES 2020

EXECUTIVE SUMMARY

Malaysian Dietary Guidelines (MDGs) are government endorsed documents intended to provide specific recommendations and advice on healthy diets and lifestyles. They are intended to influence consumer food choice based on latest scientific findings on food and nutrient intakes, food supplies, prevalence and public health importance of diet-related health and nutrition outcomes, cultural preferences, and other considerations. It forms the basis for educational programmes and the national food and nutrition policies. The challenge for any dietary guidelines would be to have a coherent policy that take into consideration not only the healthy dietary choices and personal health but also the wider social and environmental impact towards achieving a global environmental sustainability.

The first Malaysian Dietary Guidelines was published in 1999 and revised in 2010. Over the last decade, our population continues to face the double burden of malnutrition by the coexistence of undernutrition problems (e.g. anaemia, stunting and wasting) along with overweight, obesity and diet-related non-communicable diseases (e.g. hypertension, diabetes mellitus, cardiovascular diseases and certain forms of cancers). The recent NHMS (2019) revealed 50% (1 in 2) of adult population are either overweight or obese. It has been shown that the traditional diets have been replaced by diets higher in fats, salt, sugar and low fiber as well as increase in sugar-sweetened beverages consumption; lower intakes of vegetables and fruits as well as higher weekly frequency of eating out. Therefore, the need to review and update the MDG 2010 in line with the latest review of Recommended Nutrient Intakes (RNI), 2017 was undertaken by the Technical Working Group for Nutritional Guidelines under the auspices of the National Coordinating Committee for Food and Nutrition (NCCFN), Ministry of Health Malaysia.

The MDG 2020 is written by a group of experts from the academia, Ministry of Health Malaysia and related professional bodies who have extensive knowledge of Nutrition and Health Science. Several drafts were reviewed, validated and approved by the TWG Nutritional Guidelines. The Key Messages, Key Recommendations and how to achieve were then vetted through Focus Group Discussion on 5-7 February 2020 comprising of Public Health personal (end-users) to determine the relevance and clarity of the statements. The final draft was then presented in a 3-day Consensus Workshop on 22-24 July 2020 involving relevant stakeholders from various Ministries, Government Agencies, Academia, Professional bodies, Industries and Consumer Associations for revision and approval.

The Malaysian Dietary Guidelines 2020 are intended for health professionals, policy makers, educators, food manufacturers, and researchers. It applies to all healthy adult Malaysians, as well as those with common health conditions such as being overweight. They do not apply to people who need special dietary advice for a medical condition.

The revised MDG 2020 features some of the following key updates:

- The MDG use the Recommended Nutrient Intakes for Malaysia (2017) that provide nutrient intake requirements for adults and suggested individual foods from various food groups that can be combined within diets to meet these requirements.
- The MDG 2020 is based on foods that are available, accessible and culturally appropriate for the population. These are used to construct recommended diet patterns that meet nutrient intake requirements and address our nutrition concerns including the excessive consumption of ultra-processed foods and drinks.
- It is primarily designed for adults population aged 18-59 years old.
- However, the Malaysian Food Pyramid 2020 is not just targeted for adults but it can be a reference of daily food intakes for the healthy population starting at the age of 7 and above. The recommended servings of each food group in the food pyramid is within a calorie range of 1500 – 2300 kcal.
- The Malaysian Food Pyramid 2020, maintained the five food groups which are placed at four levels however, it differs from the previous MDGs, in which, vegetables and fruits groups form the base of the new pyramid replacing the Carbohydrate food group. It is reconstructed taking into consideration the number of servings contributed by vegetables and fruits which constitute the most as compared to other food groups. Pictorial representation of the food pyramid has been improved to appreciate the relative portion size of each food group.
- The introduction of Malaysian Healthy Plate helps complement the Food Pyramid and guide users to create a healthy balanced meal.
- The 14 Key messages in the MDG 2020 are quite similar to the 2010 version however, each key message in the Malaysian Dietary Guidelines (MDG) 2020 have been revised and updated with recent scientific evidence.
- In view of a very high prevalence of “eating out” among adults, a new key message *“Cook Nutritious Food at Home More Often and Choose Healthier Options When Eating Out”* has been introduced to replace key message on “Breastfeeding” found in MDG 2010.
- The Malaysian Dietary Guidelines 2020 provide many options in their recommendations. The advice focuses on dietary patterns that promote health and wellbeing. It offers approximately 52 Key Recommendations and 244 statements on “how to achieve” to help users make informed choices toward healthier eating habits.

Key Messages of the **Malaysian Dietary Guidelines 2020**

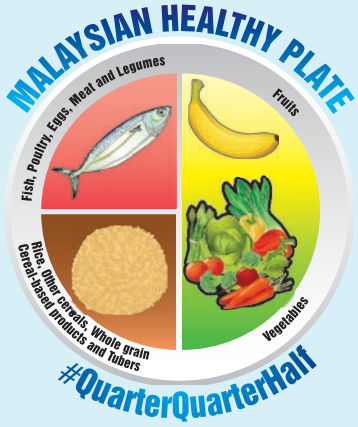
KM1	Eat a variety of foods within the recommended servings.
KM2	Achieve and maintain a healthy body weight.
KM3	Be physically active every day.
KM4	Cook nutritious foods at home more often and choose healthier options when eating out.
KM5	Eat plenty of vegetables and fruits every day.
KM6	Eat adequate amount of rice, other cereals, whole grain cereal-based products and tubers.
KM7	Consume moderate amount of fish, meat, poultry, egg, legumes and nuts.
KM8	Consume adequate amounts of milk and milk products.
KM9	Reduce intake of foods high in fat and limit saturated fat intake.
KM10	Choose and prepare foods with less salt, sauces and flavour enhancers.
KM11	Limit sugar intake in foods and beverages.
KM12	Drink plenty of water daily.
KM13	Consume safe and clean foods and beverages.
KM14	Make effective use of nutrition information on food labels.

KEY MESSAGE 1

Eat a variety of foods within the recommended servings

KEY MESSAGE

1



EAT A VARIETY OF FOODS WITHIN THE RECOMMENDED SERVINGS

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1.1 Terminology

Adequate diet

An adequate diet provides enough energy, nutrients and fibre to maintain an individual's health. A diet that is adequate for an individual may not be adequate for another.

Balanced diet

A balanced diet is a diet that contains a combination of foods that provide a proper balance of nutrients. The body needs many types of foods in varying amounts to maintain health. The right balance of nutrients needed to maintain health can be achieved by eating proper balance of all healthy foods including fruit, vegetable, cereal, fish, meat, legume and milk.

Food groups

A food group puts together foods of similar nutrient content and function. There are five food groups which are vegetables; fruits; rice, other cereals, whole grain cereal-based products and tubers; fish, poultry/ eggs/ meat, and legumes; milk and milk products. These food groups contain foods that are similar in calories, carbohydrate, protein and fat contents.

Healthy diet

A healthy diet is a diet which provides a proper combination of energy and nutrients. The four characteristics of a healthy diet are varied, adequate, balanced and moderate.

Malaysian Food Pyramid 2020

A food pyramid is a visual tool that is used as a guide to your DAILY food intake in achieving a healthy diet. It is developed to provide a guide for the types and amounts of food that can be eaten in combination to provide a balanced diet. A food pyramid consists of four levels that represent five food groups. The recommended number of servings per day for each food group is indicated next to it. From the bottom to the top of the food pyramid, the number of servings of each food group becomes smaller indicating that an individual should eat more of the foods at the base of the pyramid and less of the foods at the top of the pyramid.

Malaysian Healthy Plate

Malaysian Healthy Plate (MOH, 2016) is a visual guide to show the total food in each food group that needs to be consumed in a meal to achieve a healthy and balanced diet based on the principle of quarter, quarter, half. It is used to translate recommendations from the Malaysian Dietary Guidelines and Malaysian Food Pyramid to help Malaysian practise healthy eating habits by planning their daily meal.

Moderation

Moderation is a key to healthy diet. Moderation refers to eating the right amount of foods to maintain a healthy weight and to optimise the body's metabolic process.

Processed Foods

Edible parts of plants and animals after separation from nature or modified/preserved by minimal processes or modified with the addition of salt, sugar, oils or fats to preserve and enhance their sensory qualities. These include canned or bottled vegetables or legumes (pulses) preserved in brine; whole fruit preserved in syrup; tinned fish preserved in oil; some types of processed animal foods such as ham, nuggets, sausage, and smoked fish; most freshly baked breads; and simple cheeses to which salt is added (Monteiro *et al.,* 2019).

Recommended Nutrient Intakes (RNIs)

Recommended nutrient intakes are nutrient standards that used to plan and assess dietary nutrient intakes of healthy individual or population. Nutrient recommendations in RNI are differ with age, sex, and physical activity level. The range of intakes encompassed by the RNI should be considered sufficient to prevent deficiency, maintain optimal health while avoiding toxicity (NCCFN, 2017)

Serving size

In the Malaysian Food Pyramid, serving size is the recommended amount of foods consumed daily in household measures used for foods and drinks, for example cup, plate, bowl, tablespoon, teaspoon and glass. However, serving size defined in the Malaysian Food Pyramid may not be equal to a serving size defined in a food label.

Unprocessed and minimal processed foods

Unprocessed (or natural) foods are the edible parts of plants (such as fruit, leaves, stems, seeds, roots) or from animals (such as muscle, offal, eggs, milk), and also fungi, algae and water, after separation from nature. Whilst, minimally processed foods are natural foods altered by methods that include removal of inedible or unwanted parts, and also processes that include drying, crushing, grinding, powdering, fractioning, filtering, roasting, boiling, non-alcoholic fermentation, pasteurization, chilling, freezing, placing in containers, and vacuum packaging. Unprocessed and minimally processed foods vary in energy density and in their content and balance of fats, carbohydrates, proteins, and their fractions, and in vitamins, minerals and other bioactive compounds. (Monteiro *et al.,* 2019b; Lane *et al,* 2020).

Ultra-Processed Foods (UPFs)

Ultra-processed foods are characterised by NOVA as industrial formulations generated through compounds extracted, derived or synthesized from food or food substrates. Ultra-processed foods also commonly contain artificial substances such as colours, sweeteners, flavours, preservatives, thickeners, emulsifiers and other additives used to promote aesthetics, enhance palatability and increase shelf life. Ready to eat food and beverage, spreads, packaged snacks and pastries, cakes, instant noodles, pre-prepared ready to heat products are some examples of ultra-processed foods high in sugar, salt, fat and artificial substances (Monteiro et al., 2019b; Lane *et al,* 2020).

Variety

Variety refers to eating many different types of foods each day and to ensure better selection of healthier foods. By selecting a variety of foods, the chances of consuming the multitude of nutrients the body needs are optimised.

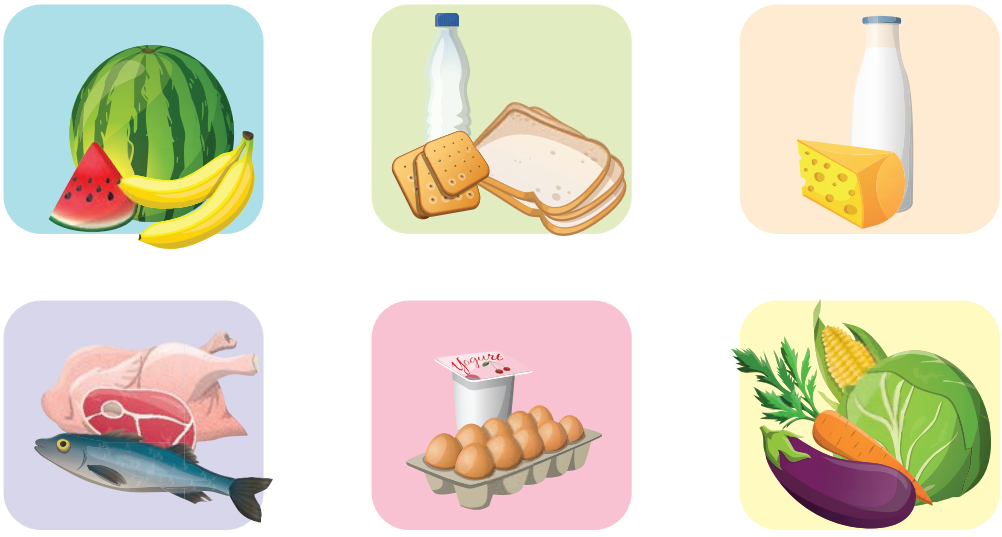
1.2 Introduction

A healthy diet is important to supply nutrients, reduce risk and to manage certain diseases. Healthy and balanced eating habits provide energy and nutrients required by the body. The Malaysian Dietary Guidelines 2010, suggested three important considerations when planning healthy meals, specifically, (i) eating a balanced diet (ii) consume a wide variety of foods and (iii) consume foods in moderation (NCCFN, 2010). These recommendations have also been suggested by other dietary guideline from various countries such as USA (USDA, 2015), and Australia (NHMRC, 2013).

The accelerated phase of urbanisation and food industrialisation in recent decades has inevitably brought changes in the Malaysian dietary habits (NCCFN 2017). A major shift can be seen in the availability, accessibility, affordability of processed and convenient foods which influenced the consumer's food preferences and choices. The dietary changes towards affluent and convenient processed foods have been associated with the increasing prevalence of obesity irrespective of age, ethnic and social status. The adoption of Malaysian Food Pyramid 2020 recommendation in daily diet would benefit increasing consumption of freshly prepared dishes made from unprocessed or minimally processed foods and reducing consumption of processed foods especially ultra-processed foods and beverages. NOVA classification is one of the superlative techniques recognized by the Food and Agriculture Organization of the United Nations and the Pan American Health Organization as a valid tool to observe ultra-processed food (UPP) consumption FAO (2019).

It is very important that an individual ensures getting appropriate foods and incorporates the principle of good nutrition such as variety, a balanced intake of nutrients and in moderation. To ensure varieties in the daily diet, an individual is required to eat different types of foods within each level of food pyramid. This will enhance and optimise the nutrient needs of the body. In addition, eating food within the recommended number of servings is crucial. Thus, the recommendations from the Malaysian Food Pyramid are translated into practice using the Malaysian Healthy Plate which guides us to plan our main meals. The Malaysian Healthy Plate (MOH, 2016) incorporates the principles of quarter, quarter, half. To estimate food portion, a 10-inch (25 cm) plate is used. It is recommended that the first quarter of the plate is filled with either rice, noodles, breads, grains, cereal products or tubers. This is followed by filling the second quarter of the plate with either fish, poultry, meat or legumes. The other half of your plate should be filled with vegetables and fruits. It however does not reflect the daily calories intake and serving sizes for each food group. In addition, plain water or unsweetened beverages, milk or dairy products should be consumed with the meal. Water is essential for many body functions for example regulating body temperature and digestion.

The MDG 2010 is revised and updated taking into consideration the many studies reporting the changes in food consumption patterns and dietary habits of Malaysians as well as nutritional and health related problems in Malaysia (IPH, 2014; Ahmad Ali *et al.*, 2019a; Ahmad Ali *et al.,* 2019b; Balasubramanian *et al.*, 2020; IPH, 2020). The recent national prevalence of overweight and obesity as reported in the NHMS 2019 was 50.1% (IPH, 2020). The prevalence was the highest among women (54.7%), Indians (63.9%) and the 55-59 years old age group (60.9%). Similarly, abdominal obesity was present in 50% of adults, again highest among women (64.8%) and Indians (68.3%). It has been shown that the traditional diets have been replaced by diets higher in fats, salt and sugar-sweetened beverages; usually with lower intakes of fresh fruits and vegetables as well as higher weekly frequency of eating out (Balasubramanian *et al.*, 2020). In an earlier study, Fournier *et al.* (2016) reported about 64% of Malaysians had at least one meal per day outside of home, 23.4% had meals at home, and 12.5% will eat at home with outside food. Thus, it is very important that this revised MDG 2020 addresses these emerging dietary issues and diet-related health problems to guide Malaysian to eat a variety of foods within the recommended servings.



1.3 Scientific basis

1.3.1 Food groups

A healthy and balanced diet should include a variety of choices from each of the following five food groups, namely vegetables; fruits; rice, other cereals, whole grain cereal-based products and tubers; fish, poultry/ eggs/ meat, and legumes; milk and milk products. Each of these food groups provides an array of nutrients, and the amounts recommended that promote positive health outcomes. The WHO (2003) suggested the consumption of a variety of foods from different food groups, with emphasis on plant-based foods. Consuming foods from each group in the appropriate amount each day allows the individual to achieve the requirements for energy, carbohydrates, proteins, and fats as well as vitamins and minerals. In addition to the essential nutrients, different foods also provide fibre and phytochemicals (found in plants), many of which are protective against diseases. Some of these compounds act as antioxidants, which protect the body's cells from being damaged. Eating a variety of foods also keeps our meals interesting and full of flavour (McCrory *et al.*, 2012; NHMRC, 2013). The following sections describe the food groups in general and highlight nutrients for which the food group is a key contributor.

In this revised MDG 2020, the food groups are still placed in the four levels of the Malaysian Food Pyramid. The Malaysian RNI (NCCFN, 2017) recommends that carbohydrate, protein and fat contribute to 50-65%, 10-20% and 25%-35% of the total caloric intake per day. This recommendation is used to calculate the number of servings to be consumed per day for each food group. The Malaysian Food Pyramid 2020 is reconstructed taking into consideration the number of servings contributed by vegetables and fruits which constitute the most as compared to other food groups.

There are many types of vegetable that are often classified based on their edible part mainly leaves, stems, roots, flowers and fruits vegetable. Vegetables are low in fat and carbohydrate but high in vitamins, minerals and fibers. Consumption of a variety of vegetables contributes an array of nutrients. For example, green leafy vegetables such as spinach *(bayam),* mustard green *(sawi*), and swamp cabbage *(kangkung*) are generally high in folate, vitamin K and potassium, while red and orange vegetables (i.e., carrots, tomatoes, pumpkins) provide the most vitamin A. Vegetables are a good source of dietary fibers and it can prevent constipation. Vegetable should be eaten either raw or cooked instead of as juices to optimise its health benefits. While it is best to cook certain vegetables to make them more palatable and increase the availability of the nutrients (Colle *et al,* 2010), with minimal cooking process as well as minimal use of cooking oil or coconut milk *(santan*).

Together with vegetables, fruits are now placed at the base of the Malaysian Food Pyramid 2020. Fruits generally taste sweet, juicy and most of fruits areeaten fresh and raw. Fruits are excellent source of vitamins, minerals, fibers which rich in antioxidants including flavonoids, polyphenols and etc. Consumption of adequate fruits in a daily diet will improve immune system, prevent constipation and other chronic diseases. Most of fruits are low in fat, sodium, calorie and high in potassium. It is advised to eat fruits in the whole form, although it can be taken in the form of fruit juice (without added sugar) limit to once a day. Processing of fruits into juices lower fruit juice can be part of healthy eating patterns, processing of fruits into juiceslower its dietary fibre content and can spikes blood glucose level. Fruit juice drink and fruit drink products sold in the market are considered to be sugar-sweetened beverages rather than fruit juice because they are primarily composed of water with added sugars. More information on vegetables and fruits can be found in Key Message 5.

Cereal especially rice is the staples for Malaysian. The Malaysian Food Pyramid 2020 is differs from the previous food pyramid, in which, vegetables and fruits groups form the base of the new pyramid replacing the carbohydrate food groups. Nevertheless, rice remain as staple food for Malaysian. It is recommended to consume at least half from the total serving size of the cereal and cereal-based products in form of whole grains. Wholegrains (e.g., brown rice, oats, barley, quinoa) contain the entire kernel,including the endosperm, bran, and germ. Refined grains differ from wholegrains in that the bran and germ are removed, whereby essential components such as dietary fibre, iron, vitamin Bs and other nutrients are minimally retained. A higher intake of wholegrains are associated with lowered risk of non-communicable diseases (NCDs) (Reynolds *et.* 2019). The intake of refined grains and products especially those high in saturated fats,sugars, and salt, such as cakes,crackers, and creme-filled biscuits and buns should be limited. More information on grains and cereal products can be found in Key Message 6.

Lean meats, fish, poultry, eggs and plant-based alternatives such as *tauhu*, legumes, nuts and seeds are protein foods. This is placed in the third level of the Malaysian Food Pyramid 2020. Besides protein, this food group provides a wide variety of other nutrients including iron, zinc, iodine, phosphorus, B vitamins (e.g., niacin, cobalamin, pyridoxine, and riboflavin), and essential fatty acids (omega 3 polyunsaturated fatty acids) among others. As in other food groups, each of the protein foods may provide different nutrients. For example, red meats are good sources of heme iron, which is more bioavailable than the non-heme iron found in plant sources. Fish and shellfish such as prawns provide more cobalamin and vitamin D, and essential fatty acids namely eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Similar with previous recommendation of daily protein intake, fish should be consumed everyday. In addition, the Malaysian Food Pyramid 2020 also recommended a serving of legumes daily.Legumes include peas, beans, lentils, and peanuts are rich sources of plant protein which contained phytosterols and dietary fibre (Trinidad *et al.,* 2010).

Nuts and seeds are highly nutritious and are of prime importance for people in Asia and Africa (Carlsen, Halvorsen & Blomhoff, 2011). Most nuts and seeds contain substantial amount of fat (55-70%) and protein (10-30%). In effort to increase intake of unsaturated fatty acids, 1 serving of seeds is included in the calculation of total energy intake from fat. Besides fats, protein and vitamins, nuts and seeds are rich sources of phytochemicals including flavanoids (almonds, peanuts and pistachios), resveratrol (peanuts and pistachios), polyphenols and tocopherols (walnuts) (Carlsen, Halvorsen & Blomhoff, 2011), which may potentially reduce oxidative stress and risk of related diseases (Kim *et al.*, 2019, Moghtaderi *et al.*, 2020). More information on protein foods including nuts can be found in Key Message 7.

Milk and milk products, which are also placed in the third level of the Malaysian Food Pyramid 2020, provide a package of essential nutrients that is difficult to achieve in low-dairy or dairy-free diet (Rozenberg *et al.,* 2016). Besides calcium, milk and milk products such as cheese and yoghurt have various health benefits and are a good source of many nutrients, including protein, vitamin A, vitamin D, riboflavin, cobalamin, zinc, phosphorus, vitamin K_1, vitamin K_2 and milk fat globule phospholipids (Dehghan *et al.,* 2018). Low fat or skimmed varieties of milk and milk products are recommended. Individuals who are lactose intolerant can choose low-lactose and lactose-free milk products. More information on milk and milk products can be found in Key Message 8.

Fats and oils, sugars and salt are placed at the top of the Malaysian Food Pyramid 2020 because these foods should be consumed sparingly. Fats and oils, sugars and salt are not considered as food groups, but they are often found in foods. Sugars and salt improve foods palatability, however it can be replace or reduce by natural flavour enhancer such as spices and herbs. Fats and oils are good sources for energy and essential fatty acids (arachidonic acid and alpha-linolenic acid). Fats also have other important physiological functions including fat metabolism generates bioactive lipid molecules, which are fundamental mediators of multiple signaling pathways (Orsavova *et al.*, 2015). Nevertheless, in light of Malaysian generally being physically inactive (IPH, 2020), excessive fat intake (more than 35% of energy intake) may lead to overweight and obesity. More information on fat and oils, sugars and salt can be found in Key messages 9, 10 and 11 respectively.

Malaysians have betrothed extensive actions to alleviate the upsurge in obesity prevalence. One of the major challenges to curb obesity in Malaysia is due to abundant supplies of unhealthy foods and beverages products in the market. The over-reliance on processed foods, especially ultra-processed foods which high in energy, sugar, fat, salt and generally in combination with artificial substances such as flavour enhancers, colours, emulsifiers, and other additives to prolong shelf-life of the product (FAO, 2019). For instance, ready to eat food and beverages such as carbonated drinks, sweet or savoury snacks, chocolate, candies, ice-cream, mass-produced packaged breads and buns, spreads, cream filled biscuits, pastries, cakes including pre-prepared ready-to-heat products such as frozen currypuff, pasta and pizza dishes. It is gradually displacing home-prepared meals and the consumption of fresh fruit and vegetables in daily diets. Nowadays, ultra-processed foods are now often reformulated and advertised as if they are healthy, being labelled as for example 'light' or 'diet', or low in fat or sugar, or free from trans fats, or high in fibre or vitamins and minerals. These adjustments may improve the products which however remain ultra-processed and unhealthy (Monteiro *et al.,* 2019b). A systematic review and meta-analysis investigated the association between consumption of ultra-processed food and noncommunicable disease risk, morbidity and mortality demonstrated consumption of ultra-processed food was associated with increased risk of overweight, obesity, abdominal obesity, all-cause mortality, metabolic syndrome and depression in adults. In addition, consumption of ultra-processed food was associated with cardiometabolic diseases, frailty, irritable bowel syndrome, functional dyspepsia and cancer (breast and overall) in adults (Lane *et al,* 2020).

1.3.2 Serving size

Based on the Recommended Nutrient Intakes for Malaysia (NCCFN, 2017) and the population's habitual intake (IPH,2014), the number of servings calculated for the Malaysian Dietary Guidelines 2020 is based on 50-65% carbohydrate, 10-20% protein and 25-35% fat. The macronutrient contribution to the total energy intake (TEI) is then converted to exchange list to optimize the consumption of carbohydrate, protein and fat, subsequently converted to serving size (Shahar *et al.*, 2015). The number of servings for daily meal planning provide intakes of at least 90% of the Recommended Nutrient Intakes for Malaysian (RNI) for energy, carbohydrate, protein and fat. In MDG 2020, the number of servings recommended for the five food groups is based on 1500 kcal, 1800 kcal and 2000 kcal per day.

In the revised Malaysian Food Pyramid 2020, the five food groups are placed at four levels. Different from the previous MDG, vegetables and fruits group form the base of the new pyramid. It is reconstructed taking into consideration the number of servings contributed by fruits and vegetables which constitute the most as compared to other food groups. Such recommendation is also in line with the intention to consume more vegetables and fruits, considering the increasing prevalence of non-communicable diseases especially obesity and diabetes in Malaysia. The recommended number of servings is at least three servings or more of vegetables and two servings of fruits. One serving of vegetable is considered as zero calorie while one serving of fruit provides 15 g of carbohydrate and 60 kcal. In our main meal, the vegetables and fruits food groups should fill up half of the Malaysian Healthy Plate (MOH, 2016).

The second level is rice, other cereals, wholegrain cereal-based products and tubers group. The number of servings recommended for this group is three to five servings per day, based on the energy requirement. One serving of food in this food group contains 30 g of carbohydrate, 4 g of protein, 1 g of fat and 150 kcal. In our main meal, this food group should fill up only a quarter of Malaysian Healthy Plate.

The third level in the food pyramid 2020 consist of protein sources which are categorised into 3 groups namely i) fish, ii) poultry, meat and egg and iii) legumes. It is recommended to have one serving of fish daily, whereby one serving contains 14 g protein and 2 g of fat and 70 kcal. The recommendation for poultry/ meat/ eggs is one to two servings a day, of which one serving contains 14 g protein, 8 g of fat and 130 kcal. The cooked lean meat is limited to 500 g per week. Whilst, for protein from plant sources namely legumes are recommended one serving daily which contains 14 g protein, 0.5 g of fat and 220 kcal. Other than that, nuts and seeds are also protein sources but it contained high fat which contribute to high calorie, hence they can be consumed as snacks on a weekly basis. Both animal and plant based protein food should fill up only a quarter of Malaysian Healthy Plate.

In the Malaysian Food Pyramid 2020, the recommended number of servings for milk and milk products is 2 servings, in which one serving contains 15 g carbohydrate, 8 g protein, 1 g of fat and 90 kcal.

1.4 Current status

A number of nutritional surveys have been conducted to assess the dietary intake of Malaysians since 2010. The second Malaysian Adults Nutrition Survey (IPH, 2014) was a nationwide cross-sectional study of Malaysian adult population aged 18-59 years old (N = 2,973). This survey reported that the median energy intake of Malaysians (overall) was 1,466 kcal/day, with men reported to be consuming 1,489 kcal/day and women 1,445 kcal/day. The findings were comparable with previous MANS in 2003 (median overall 1,540 kcal/day; men 1,722 kcal/day; women 1,400 kcal/day) (Ahmad Ali *et al.*, 2019b). However, the MANS findings should be interpreted with caution as further analysis revealed that under-reporting of dietary intake has increased significantly from 53% in MANS 2003 to 61% in MANS 2014. The MANS in 2003 and 2014 showed that under-reporting of energy and nutrient intake still persisted. Dietary reanalysis after excluding of under-reporters showed that the revised mean energy intake was 2,097 kcal in MANS 2003 and 2,123 kcal for MANS 2014 (Ahmad Ali *et al.*, 2019b), respectively.

The Socio Cultural Research in Protein Transition (SCRiPT) study involving 1,604 Malaysian adults reported a mean energy intake of 1,776 kca/day (men 1,869 kcal/day; women 1,699 kcal/day) (Drenowski *et al.,* 2020). In addition, the Malaysia Lipid Study which was conducted among Malaysian urban dwellers (N = 577) reported a mean energy intake of 1,825±413 kcal/day (Karupaiah *et al.*, 2019).

The findings of the MANS 2014 demonstrated that the median percentage of total energy contributed by macronutrients was 55% for carbohydrate, 16% for protein and 29% of fat. This was found to be similar in men and women (IPH, 2014). A more recent study reported a mean macronutrient distribution of approximately 54% carbohydrate, 14% protein, and 32% fat, respectively (Karupaiah *et al.*, 2019). Both nationwide and individual studies included in a review and meta-analysis consistently showed that Malaysian adults generally consumed adequate or higher protein (80% of RNI) and fat (≤ 30% of total energy intake) across different groups of respondents, regardless of the dietary assessments tool used (Shahar *et al.*, 2018). However, the findings were inconsistent with respect to carbohydrates with smaller studies reporting adequate intake (50-65% RNI) while a nation-wide survey (MANS 2014) reported a lower intake (Shahar *et al.,* 2018).

More recently, a literature review and meta-analysis was conducted to evaluate the best available evidence regarding energy and macronutrient intake among adults (aged 19 to 59 years) in Malaysia (Shahar *et al.,* 2018). Information regarding levels and status of intake in comparison to the Malaysian Recommended Nutrient Intake (NCCFN, 2017), and sources of macronurients among the population, was collated from food balance sheets, national surveys, as well as individual studies. A total of 20 studies (five nationwide and 15 smaller studies) were included. Both the review and meta-analysis results indicated that Malaysian adults generally met or exceeded recommendation for fat and protein but were inconsistent with respect to energy and carbohydrate. For example, the MANS 2003 and MANS 2014 studies showed inadequate energy intakes among Malaysian adults. However, the findings of the meta-analysis did not take into consideration the re-analysis of the MANS 2003 and 2014 data (Ahmad Ali *et al.*, 2019a).

The MANS 2014 evaluated the frequency of food consumption based on habitual intake of Malaysian adults aged 18 and 59 years during the last one year. The key findings of MANS 2014 revealed that the top ten foods consumed by Malaysians were rice (98.4%), hen egg (95.2%), green leafy vegetables (94.8%), chicken (94.5%), marine fish (93.5%), local kuih (79.9%), bread (78.3%), mee-hoon/ kuew-teow (77.5%), noodles (76.8%), and soy sauce (76.6%). In addition, white rice and sugar were the two top most foods consumed on daily basis as these were consumed by 89.8% and 55.9% of the Malaysian adults, respectively (IPH, 2014).

A recent review and meta-analysis on energy and macronutrient intake among adults (Shahar *et al.*, 2018) demonstrated that the major macronutrient sources in Malaysian adults' diet were animal products (poultry, meat, and fish) for protein, vegetable oils (palm oil and palm kernel oil) for fat, and white rice, vegetables, and sugar for carbohydrates. The most recent National Health and Morbidity Survey, NHMS 2019 (IPH, 2020) demonstrated that 94.9% (95% CI = 93.82, 95.79) of the Malaysians did not consume adequate fruits (2 servings per day) and/ or vegetables (3 servings per day) as recommended by the World Health Organization (WHO, 2003) or MDG 2010. This prevalence is consistently showing an increasing trend from 92.5% in the NHMS 2011 and 94.0% in the NHMS 2015 (IPH, 2020).

Attributed to the rapid urbanisation, increased household incomes, and greater dependence on processed food or eating out, Malaysia is experiencing a change in dietary trends. This nutrition transition involves the change from a traditional or agro-based, to a more 'westernised' or global diet and lifestyle (Popkin, 2006). This was evidenced by the findings of a study on an urban-living cohort comprising of typical racial mix of Malaysia (Balasubramanian *et al.*, 2020). The findings revealed four dietary patterns: 'Home Meal' pattern which represented a high intake of white rice, sugar-sweetened beverages, and non-starchy vegetables; 'Chinese Traditional' pattern – high intake of noodle dishes, unsweetened plain coffee or tea; 'Plant Foods' pattern – a high intake of fruit and non-starchy vegetables and low eating out frequency; and 'Sugar-sweetened Beverages' pattern – a high intake of sugar-sweetened beverages such as tea or coffee added with sugar or sweetened condensed milk, cocoa and malted beverages, and cordial or carbonated beverages. Among these, the 'Sugar-sweetened Beverages' pattern which was more dominant with Malay

and Indian subjects, made up the largest proportion (35.1%). The study also found that men were least likely to practise the 'Plant Foods' pattern but most likely to have a diet that follows the 'Sugar-sweetened Beverages' pattern, whereas it was entirely reversed in women.

In a recent study, Drewnowski *et al.* (2020) reported energy intakes were 1,869 kcal/d for men and 1,699 kcal/d for women. Protein intakes were 78.5 g/d for men and 72.5 g/d for women. Higher energy and protein intakes were associated with Chinese ethnicity, higher education and incomes. Frequency counts identified plant proteins in 50% of foods, followed by meat (19%), fish (12%), eggs (12%), and dairy (7%). Most frequent source of meat was chicken (16%) rather than pork or beef (1.5% each). In multivariate regressions, education, urbanization and ethnicity were associated with animal proteins; rural setting, age, ethnicity, and religion were associated with plant proteins. Protein choices involve socio-cultural as well as economic variables.

Notes:

- The number of servings is calculated based on 1500 to 2300 kcal.
- This pyramid is meant for children aged 7 years and older; for younger children, refer to the Malaysian Dietary Guidelines (MDG) for Children and Adolescents.
- For adolescents aged 13 to 15 years, the recommendation for fruits is 2-3 servings and for milk and milk products 2-3 servings.
- For adolescents aged 16 to < 18 years, the recommendation for fruits is 2-3 servings, milk and milk products 2-3 servings and for rice, other cereals, whole grain cereal-based products and tubers 3-6 servings.

* This includes ultra-processed foods which contain artificial substances such as colours, sweeteners, flavours, preservatives, and other additives.

Figure 1.1. Malaysian Food Pyramid 2020

1.5 Key Recommendations

Key Recommendation 1

Choose your daily food intake based on recommended number of servings in the Malaysian Food Pyramid 2020.

How to Achieve

1. Choose a combination of all food groups in the Malaysian Food Pyramid 2020 (Figure 1.1) to ensure the body gets all the nutrients needed within the recommended amount.

2. Choose the recommended number of servings for each food group based on your caloric needs (Table 1.1 and Table 1.2). For food serving equivalent list, please refer Table 1.3 to Table 1.9.

3. Plan your daily menu based on your recommended number of servings for each food group (Refer to Table 1.10 to Table 1.13 for menu examples).

4. Limit intake of fats and oils as well as salt and sugars in your daily diet.

5. Limit intake of processed and ultra-processed foods.

Table 1.1: Recommended number of servings for each food group based on 1500 kcal, 1800 kcal and 2000 kcal per day

Food group	Recommended number of servings		
	1500 kcal*	1800 kcal*	2000 kcal*
Vegetable[1]	≥ 3	≥ 3	≥ 3
Fruit[2]	2	2	2
Rice, other cereals, wholegrain cereal-based products and tubers[3]	3	4	5
Poultry/ Meat/ Egg[4]	1	1	2
Fish[5]	1	1	1
Legumes (combine bean, lentil and soy)[6]	1	1	1
Milk & milk products[7]	2	2	2
Fats /oils (including 1 serving from nuts and seeds)[8]	6	8	9
Sugar[9]	1	1	2

Notes:
Tips to remember, the more physically active you are, the more calories are required per day. However, if you are very sedentary, less calories are needed per day.
[1] Calorie free
[2] Based on 15 g carbohydrate and 60 kcal per serving;
[3] Based on 30 g carbohydrate, 4 g protein, 1 g fat and 150 kcal per serving;
[4] Based on 14 g protein, 8 g fat and 130 kcal per serving;
[5] Based on 14 g protein, 2 g fat and 70 kcal per serving;
[6] Based on 40 g carbohydrate, 14 g protein, 0.5 g fat and 220 kcal per serving.
[7] Based on 15 g carbohydrate, 8 g protein, 1 g fat and 90 kcal per serving;
[8] Based on 5 g fat and 45 kcal (including 1 serving of nuts & seeds = 5 g of fat and 65 kcal);
[9] Based on 15 g CHO and 60 kcal. 1 serving of sugar = 3 teaspoons; 1 teaspoon = 5 g of carbohydrate and 20 kcal.
Sources: Suzana *et al.* (2015); *RNI (2017)

Table 1.2: Example of common foods (per serving) in household measurement for intake of 1800 kcal per day

Food group	Servings/ day	Serving size in household measurement
Vegetables	3	½ cup spinach, cooked 1 cup ulam ½ cup mixed vegetables, cooked (i.e., cabbage + carrot + baby corn + french bean)
Fruits	2	1 whole medium *pisang berangan* 1 whole medium apple
Rice, other cereals, wholegrain cereal-based products and tubers	4	2 slices wholemeal bread 2 scoops white rice, cooked 1½ cups spaghetti, cooked 4 pieces wholegrain crackers
Poultry/ Meat/ Egg	1	1 medium chicken drumstick OR 1 palm size lean beef OR 2 hen eggs
Fish	1	1 medium Indian Mackerel *(ikan kembung)*
Legumes	1	1½ square pieces tauhu
Milk & milk products	2	1 glass low fat milk 2 slices cheese
Fats/ oils	8	8 tsp
Sugar (including free sugar)	1	3 tsp

Note:
Please refer to Table 1.3 to Table 1.9 for list of foods in each food group with serving size.

Key Recommendation 2

Eat your main meals (breakfast, lunch and dinner) as recommended by the Malaysian Healthy Plate.

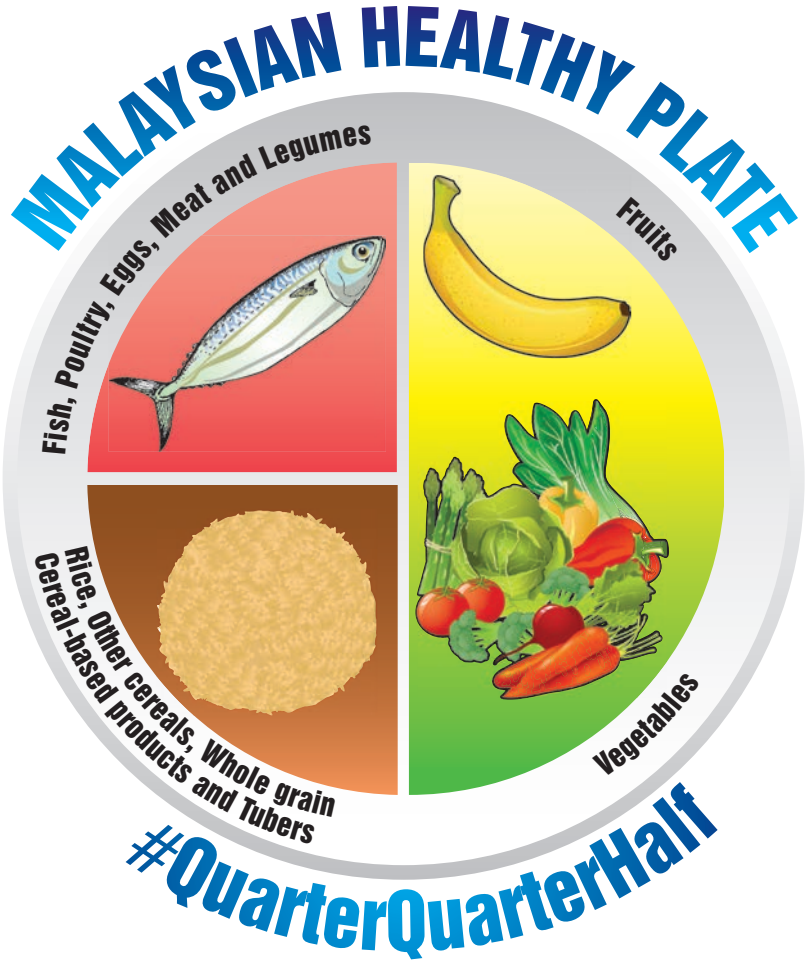


Figure 1.2: Malaysian Healthy Plate

How to Achieve

1. Use the Malaysian Healthy Plate for your daily main meals, which is based on the quarter-quarter-half concept (Figure 1.4).

    a. Fill in the first quarter of your plate with rice/ other cereals (e.g: meehoon)/ wholegrain cereal-based products (e.g: wholegrain bread)/ tubers (e.g: sweet potato). It is recommended to fill in this first quarter with whole grains.

    b. Fill in the second quarter of your plate with fish/ poultry/ meat/ egg/ legumes (e.g: dhall, tempeh, soy beancurd)/ dairy products.

    c. Fill the other half of your plate with vegetables and fruits.

2. Drink plain water or unsweetened beverages with the meal.

3. Consume milk or milk products as recommended.

4. Add legumes as snacks if legumes are not included in your main meals.

5. Limit additional soy sauce, tomato sauce, chilli sauce and gravies high in salt, sugar and fat to your main meal.

Key Recommendation 3

Limit intake of processed and ultra-processed food.

How to achieve

1. Limit intake of ultra-processed foods such as soft drinks, sweetened breakfast cereals, salty fatty packaged snacks and instant noodles, which are nutritionally unbalanced.

2. Prepare or choose natural ingredients for cooking instead of using ingredients made from commercially prepared processed or ultra-processed foods such as fish ball, meat balls, salami, sausage and etc.

3. Reduce frequency of eating at fast food outlets and buying ready to eat frozen foods sold in convenient stores.

4. Be aware that advertising of ultra-processed products dominates commercial advertising of food; it often conveys incorrect or incomplete information about diet and health.

5. Shop mindfully. Limit purchasing of processed and ultra-processed products.

Additional recommendation: Nutrient supplements

Eating a variety of foods daily as guided by the Malaysian Food Pyramid should provide all the nutrients needed by the body. Therefore, supplements are not necessary for most individuals. Supplements of vitamins, minerals or fibre do not supply the nutrients and other essential components present in foods that are important to health. Nutrient supplements cannot be used as a substitute for proper food choices and supplements of some nutrients taken regularly in large amounts are harmful. However, supplements may be needed to meet specific nutrient requirements such as during convalescence, in pregnant and lactating women and for the elderly. Nutrient supplements should only be taken on the advice of nutritionists, dietitians and medical doctors.

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Appendices

Appendices

Table 1.3: Examples of vegetables equivalent to one serving

Groups of Vegetables	Serving size	(Weight)
Vegetables, cruciferous, cooked[a]	1/2 cup	(50 g)
Vegetables, green leafy vegetables with edible stem, cooked[b]	1/2 cup	(40 g)
Vegetables, fruit, cooked[c]	1/2 cup	(40 g)
Vegetables, leafy *ulam*, raw[d]	1 cup	(50 g)
Vegetables, beans, cooked[e]	1/2 cup	(50 g)
Vegetables, flowers, cooked[f]	1/2 cup	(50 g)
Vegetables, sprouting, cooked[g]	1/2 cup	(50 g)
Vegetables, starchy[h]	1/2 cup	(60 g)
Vegetable juice, with pulp, no sugar added	1/2 glass	(125 ml)
Other vegetables[i]:		
Mushroom (white/ brown/ shitaki/ enoki, erygii, button, oyster mushroom), fresh/ soaked, cooked	1/2 cup/ 6 pieces	(40 g)
Fungus (black fungus, white fungus), cooked	1/2 cup	(40 g)
Mixed vegetables, cooked[j]	1/2 cup	(50 g)
Wolfberry (Goji berry), dried	1 cup	(50 g)

Note:
* Serving size and food weight are measured in edible portions.
[a] Cruciferous such as cabbage, broccoli and cauliflower.
[b] Green leafy-vegetables with edible stem such as *kangkung, sawi, pucuk manis, bayam, sayur meranti, kau kee, daun keledek,* drumstick leaf, gongura, tropical amaranths, sessile joyweed, tong ho kalan and makchoi.
[c] Fruit vegetables such as brinjal, tomato, chayote *(fo shou gua),* capsicum, angled loofah (petola), bitter gourd, sour eggplant *(terung asam Dayak),* squash, snake gourd, pointed gourd *(parwal),* ridged gourd *(turai)* and bottle gourd.
[d] Leafy ulam such as pegaga, ulam raja, lettuce and garden salad.
[e] Vegetables, beans such as string bean, snow pea, lady fingers and French bean.
[f] Vegetables, flowers such as daylily (golden needles/ *jin zhen cai*) and asparagus.
[g] Vegetables, sprouting such as soya sprout, green bean sprout (taugeh), pea sprout *(dou miao)* and alfalfa.
[h] Vegetables, starchy such as carrot, radish, pumpkin, beet root, lotus root, yam bean *(sengkuang),* water chestnut *(sengkuang cina),* Chinese yam *(huai san)* and arrowroot *(fen ge).*
[i] Other vegetables such as mushroom, fungus and seaweed are rich sources of micronutrients such as iron, iodine and Vitamin B12 but low in fibre. Consume with other vegetable groups such as cruciferous, green leafy-vegetables and fruit vegetables to obtain optimum phytonutrients.
[j] Mixed vegetables refers to a combination of several types of vegetables such as cabbage + carrot + baby corn + French bean.

Table 1.4: Examples of fruits equivalent to one serving

Fruits	*Serving size (weight)	
Ambarella *(kedondong)*	6 whole medium sized	(200 g)
Guava	1 big slice	(110 g)
Banana, *berangan*	1 whole medium sized	(60 g)
Banana, Cavendish	1/2 whole medium sized	(60 g)
Banana, *mas*	2 whole medium sized	(60 g)
Ciku	1 whole medium sized	(80 g)
Dragon fruit, red	1 slice/ 1/3 whole medium sized	(135 g)
Langsat	20 whole fruits	(180 g)
Mango	1/2 whole large sized	(100 g)
Papaya	1 slice/ 1/4 whole medium sized	(110 g)
Pineapple	1 slice/ 1/4 whole medium sized	(150 g)
Water apple *(jambu air)*	10 whole fruits	(500 g)
Watermelon	1 big slice	(250 g)
Apple	1 whole medium sized	(110 g)
Durian (7 x 3 cm)	5 ulas	(40 g)
Grapes	8 small	(90 g)
Jackfruit *(cempedak)*	4 pieces	(60 g)
Jackfruit *(nangka)*	5 pieces	(190 g)
Pear, green	1/2 whole medium sized	(100 g)
Pear, yellow/ Orange	1 whole medium sized	(160 g)
Rambutan (4.5 X 3cm)	6 whole fruits	(110 g)
Orange (Limau manis)	1 whole, medium	(134 g)
Dates, pitted, dried	2 pieces	(20 g)
Raisin	1 heap dessert spoon	(20 g)
Prunes, pitted, dried	4 pieces	(20 g)
Figs, dried	3 pieces	(25 g)
Fruit juice, with pulp & without added sugar	1/2 glass	(125 ml)

Note:
*Serving size and food weight are measured in edible portions.

Table 1.5: Examples of rice, other cereals, whole grain cereal-based products and tubers equivalent to one serving

Rice, other cereals, whole grain cereals-based products and tubers	*Serving size (weight)	
Rice, brown/ multigrain/ unpolished/ parboiled/ white, cooked	1 cup/ 2 rice scoops	(100 g)
Noodles, *mee-hoon* made of brown/ white rice flour/ sago noodles *(tang-hoon),* soaked	1½ cups	(150 g)
Noodles, mee/ kuih-teow / laksa, wet	1 cup	(100 g)
Pasta/ spaghetti/ macaroni, cooked	1½ cups	(150 g)
Porridge, brown/ white rice, plain, cooked	2 cups	(330 g)
Corn, without skin and cob, cooked	1/3 medium ear	(40 g)
Corn kernel, without margarine, cooked	3 dessert spoons/ 1/3 commercial cup	(40 g)
Cornflake, without milk and added sugar	1 cup/ 8 dessert spoons	(30 g)
Bran, coarse, uncooked	1 cup/ 10 dessert spoons	(100 g)
Oats (rolled/ processed)/ wheat germ, uncooked	6 dessert spoons	(40 g)
Muesli, without milk	4 dessert spoons	(45 g)
Quinoa, cooked	1 cup/ 2 rice scoops	(150 g)
Wheat *(gandum)*/ barley, without gravy, cooked	12 dessert spoons/ 3/4 cup	(150 g)
Potatoes, without skin, raw	2 whole medium sized	(160 g)
Sweet potato/ yam (taro)/ tapioca, without skin, raw (1 cm cube)	1/2 cup/ 1/3 of a whole medium sized	(70 g)
Bread, wholemeal/ ryemeal/ white	2 square slices	(60 g)
Roti canai	1 piece	(95 g)
Bread, pita, wholemeal	1/2 piece	(40 g)
Bun[a]	1 rectangular bun/ 2 small buns	(50g)
Capati (D= 20cm)	1/2 piece	(50 g)
Dosai/ rawa dosai (D=20cm)	1 piece	(80 g)
Idli (D= 6cm)	2 small pieces	(110 g)
Pau, with filling	1/2 piece	(40 g)
Putu mayam	2 pieces	(100 g)
Biscuit, wholemeal crackers/ Marie/ milk[b]	5 pieces	(30 g)
Biscuits, plain/ cream crackers/ oatmeal[b]	4 pieces	(45 g)

Note:
* Serving size and food weight are measured in edible portion.
** Preferably choose wholegrain foods in your daily diet.
[a] Choose healthier bun such as less sweet, no cream or sweet filling, and fortified with micronutrients or healthy ingredients.
[b] Choose healthier biscuits such as low fat, sugar, no cream or sweet filling and low sodium.

Table 1.6: Examples of legumes, nuts and seeds equivalent to one serving

Legumes, nuts and seeds	Serving size (weight)	
Soya bean, yellow/ black, cooked	1 cup	(180 g)
Soya bean cake, fermented *(tempeh)*	2 rectangular pieces	(90 g)
Soya bean curd, tau-kua/ hard/ traditional/ fried tau-hoo, compressed tau-hoo *(dou fu gan)*, (6 x 6 cm)	1 1/2 pieces	(150 g)
Soya bean curd, soft tau-hoo *(tauhu lembut),* (18 x 5 cm)	1 box	(240 g)
Soya bean curd, *tau-hoo-pok,* (D= 3 cm)	4 round pieces	(60 g)
Egg tau-hoo *(tauhu telur)*	1 1/2 packet	(200 g)
Soya bean chip (dou bao), fresh (5 x5 cm)	5 pieces	(50 g)
Soya bean sheet (*fucok* sheets), dried, raw (42.5 x 14 cm)	1 sheet	(30 g)
Soy bean milk, fresh, unsweetened	1 1/2 glasses	(375 ml)
Soy bean dessert, tau-hoo-fah, unsweetened	2 containers	(700 g)
Gram, chickpeas/ black-eyed peas/ kidney beans, without gravy, cooked	1 cup	(180 g)
Gram, red beans/ mung beans, without gravy, cooked	1 1/2 cups	(260 g)
Dhal, various split pea/ lentils (chana dhal/ *kadalei,* red lentils/ *masoor*, green lentils, *urad*), cooked	1 cup	(180 g)
Baked beans/ green peas, beans only, canned	1 1/2 cups/ 1 whole medium canned	(400 g)
Lotus seeds[a]	1 cup	(120 g)
Nuts, peanuts/ almonds/ cashew nuts[b]	10 pcs/ 2 dessert spoons	(15 g)
Nuts, walnut[b]	1 pc	(15 g)
Seeds, chia seeds/ flax seeds/ pumpkin seeds/ sesame seeds/ watermelon seeds/ sunflower seeds[b]	2 dessert spoons	(15 g)
Seeds, *kuaci*[b]	10 pcs/ 2 dessert spoons	(15 g)

Note:
* Serving size and food weight are measured in edible portion.
[a] Lotus seeds are categorised as nuts and seeds group, but considering this food is a good source of protein and low in fat. Therefore, the serving size of lotus seed was calculated based on protein content instead of fat.
[b] Nuts and seeds were calculated based on fat exchange. 1 serving of nuts/ seeds = 5 g of fat.

Table 1.7: Examples of fish and seafood equivalent to one serving

Fish and seafood	Serving size (weight)	
Fish, mackerel, Indian, without head & entrails, raw[a]	1 whole medium sized	(70 g)
Fish, bream, African *(ikan tilapia),* without head & entrails, raw	1 whole medium sized	(90 g)
Fish, sardine/ tamban, without head & entrails, fresh, raw	2 whole small sized	(60 g)
Fish, scad, yellow tail *(ikan selar),* without head & entrails, raw[b]	2/3 of a whole medium sized	(70 g)
Fish cut, mackerel, Spanish *(Ikan tenggiri),* raw[c] (14 cm x 8 cm)	1 piece	(70 g)
Fish, sardine, canned	3 small pieces/ 2/3 of a small can	(90 g)
Anchovies, whole/ without head & entrails, dried	2/3 cup	(25 g)
Prawn, without head & shell, raw	12 pieces	(80 g)
Squid, without skin & entrails, raw	1 whole medium sized	(80 g)

Note:
* Serving size and food weight are measured in edible portion.
[a] Fish, mackerel Indian include *ikan kembong, pelaling, mabung* and *termenung.*
[b] Similar serving size and food weight for *ikan cincaru, Selayang, bawal (hitam, tambak, putih)* and *keli.*
[c] Similar serving size and food weight for barred Spannish *(ikan tenggiri batang),* sting ray *(ikan pari)* and salmon.

Table 1.8: Examples of poultry, meat and egg equivalent to one serving

Poultry, meat and egg	*Serving size (weight)	
Chicken, drumstick/ thigh, without bone, raw	1 piece	(100 g)
Chicken, breast, without skin, raw (14 x 7 x 1 cm)	1/2 medium sized piece	(70 g)
Chicken, cut into 12 pieces, raw	1 piece	(70 g)
Beef, lean (1 palm size), raw	1 piece	(60 g)
Egg, century/ duck	2 whole	(120 g)
Egg, hen, grade A, without shell	2 whole	(100 g)
Egg, quail, without shell	12 whole	(120 g)

Note:
* Serving size and food weight are measured in edible portion.

Table 1.9: Examples of milk & milk products equivalent to one serving

Milk & milk products	Serving size (weight)	
Milk, full cream/ fresh/ low fat	1 glass	(250 ml)
Milk, evaporated	1/2 glass	(125 ml)
Milk, powdered, full cream/ skimmed (heap)	4 heap dessert spoons	(30 g)
Cheese, cottage/ spread	3 heap dessert spoons	(40 g)
Cheese, processed, slice (8 x 8 cm)	2 square slices	(40 g)
Yoghurt, natural/ fat free/ low fat, plain	2 yoghurt pots	(270 g)
Yoghurt, Greek style	1 yoghurt pot	(135 g)

Standard household measurements used in this dietary guideline are as follows:

▪	1 rice scoop	= 50 g	▪	1 teaspoon (tsp)	= 5 ml
▪	1 tablespoon (tbsp)	= 15 ml	▪	1 glass	= 250 ml
▪	1 dessert spoon (dsp)	= 10 ml	▪	1 cup	= 200 ml

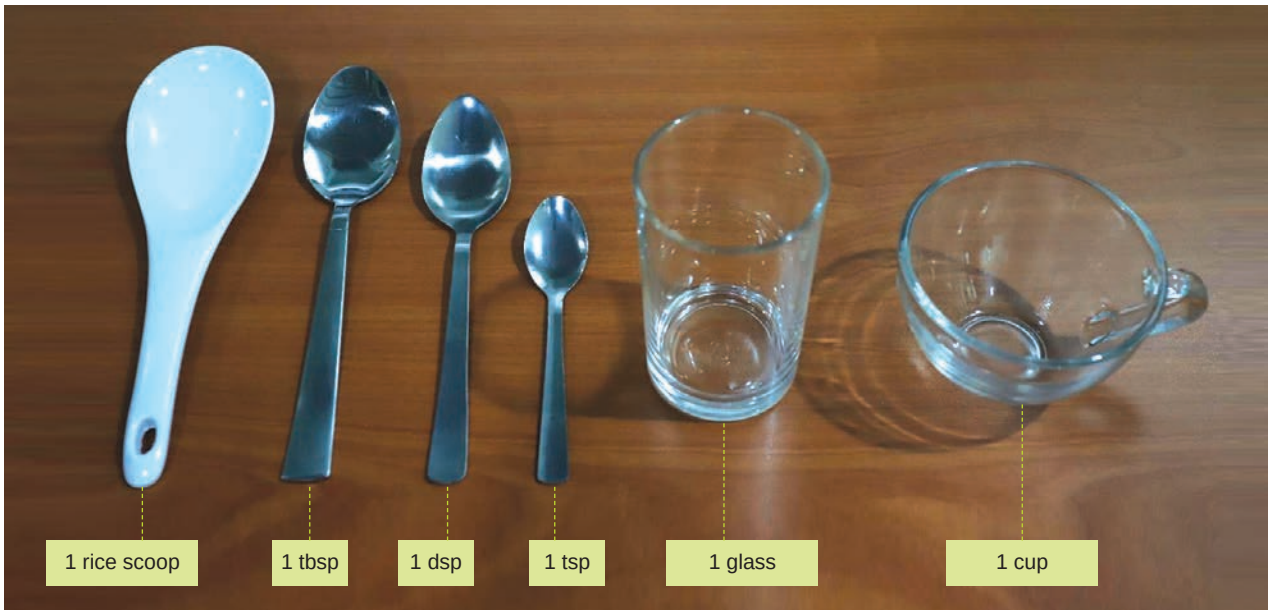
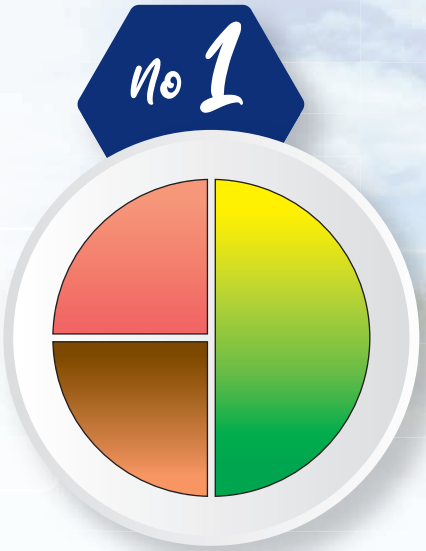


Figure 1.3: Standard household measurements used in this dietary guideline

In ensuring the intake of your main meals (breakfast, lunch and dinner) is healthy and in accordance with your daily requirement, the following are the steps on how to plan and take your main meal using the Malaysian Healthy Plate:

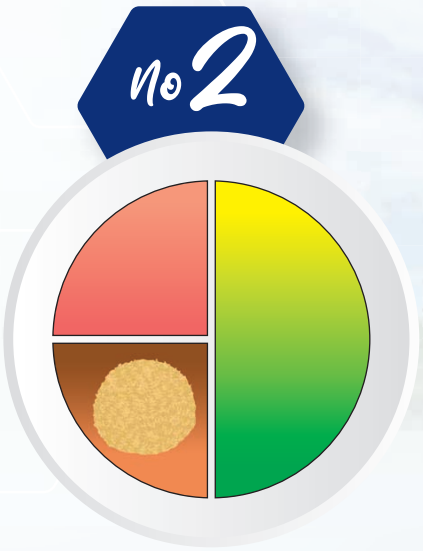


Step 1

Imagine of the three parts in a plate.

Explanation

- Use a round plate with 10 inches (25 cm) in diameter. Imagine there is a line at the middle of the plate. Then, on one half of the plate, divide it further into two parts: thus nabbed 3 parts on the plate.
- The foods and their serving size from each part are inter-changeable within same food group.



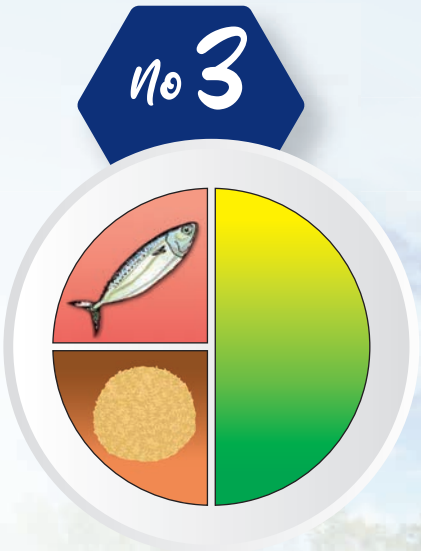
Step 2

Fill in the first quarter of your plate with rice/ other cereals (e.g: meehoon)/ wholegrain cereal-based products (e.g: wholegrain bread)/ tubers (e.g: sweet potato). It is recommended to fill in this first quarter with whole grains.

Explanation

- This food group is the major source of energy where rice is a staple food for Malaysians.
- The types of rice commonly consumed are brown/ white rice, and glutinous rice. Other grains and cereal products are noodles, pasta, breads, corns, barley and oats. Some examples of tubers are potatoes, sweet potatoes and cassava.
- Malaysians are encouraged to take whole grain to fill this quarter of this plate.
- Taking whole grain can help reduce constipation and increase the satiety that helps in weight management and reduces the risk of heart disease and diabetes.
- Whole grain is also an important source of fibres, vitamins and minerals.
- Examples of whole grain include brown rice, whole meal breads, whole grain noodles, whole grain pasta, whole grain biscuit, whole grain capati, oats, barley and corns.

Figure 1.4: How to plan and take your main meal using the Malaysian Healthy Plate

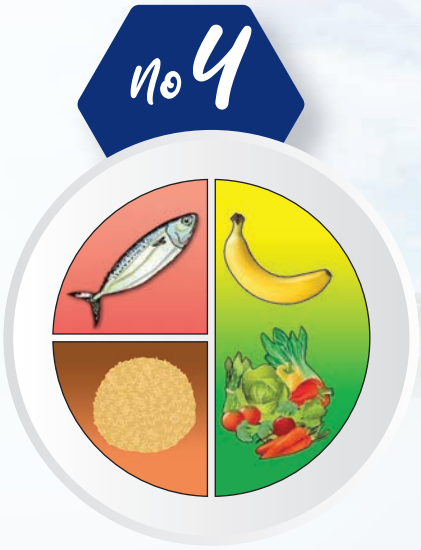


Step 3

Fill in the second quarter of your plate with fish/ poultry/ meat/ egg/ legumes (e.g: dhall, tempeh, soy beancurd)/ dairy products.

Explanation

- Protein in human diet comes from two main sources, namely animal protein (e.g., fish, meat, chicken, eggs) and plant protein such as legume (e.g. soya bean, tempeh), beans (e.g. green peas, baked beans) and lentils (e.g. chana dhal, green lentils).
- Protein is an important nutrient in building and restoring body tissues.
- It is recommended to eat fish more often in a week than other protein sources. Fish such as tuna, salmon, Indian mackerel (ikan kembung), Spanish mackerel (ikan tenggiri), contain omega 3 fatty acids that are important for a healthy heart.
- Choose chicken, mutton and meat with less fat to reduce the saturated fat intake and help maintain normal cholesterol levels.
- A diet with high saturated fat increases the risk of coronary heart diseases.
- Plant proteins including legumes (e.g., dal, bean, red beans, soya beans, almonds, walnut, pistachio) and seeds (sunflower seeds) are also encouraged as these foods are low in saturated fat and contain vitamins and minerals such as zinc, iron and magnesium.



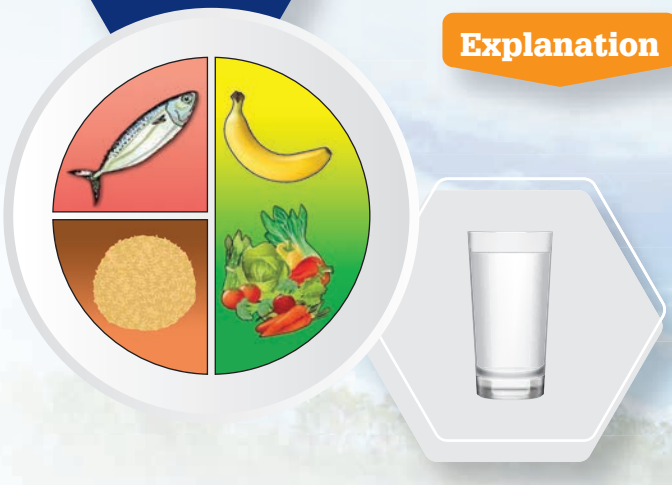
Step 4

Fill the other half of your plate dishes with vegetables and add fruits.

Explanation

- Vegetables that are encouraged to be taken are green leafy vegetables (e.g., spinach, green mustard and salad), coloured vegetables (e.g., red spinach, purple cabbage), fruit vegetables (e.g., capsicum, pumpkin, tomato and cucumber and beans (e.g., long beans and beans), ulam (e.g., pegaga and ulam raja) and edible vegetable stems (e.g., celery and asparagus).
- Prepare vegetables using healthy cooking methods such as steaming, blanching and stir frying.
- Fruit such as guava, kedondong, papaya, banana, melon and mango are encouraged to be taken in daily diet.
- Vegetables and fruits are rich in fibres, vitamin and minerals that are beneficial to health.
- A high fibre diet can reduce the risk of cardiovascular diseases, obesity and diabetes.

Figure 1.4: How to plan and take your main meal using the Malaysian Healthy Plate (cont...)



Step 5

To complete the plate, drink plain water or unsweetened beverages, milk or dairy products.

Explanation

- Plain water is encouraged to be taken to replace sugary drinks to help reduce calorie intake and control body weight and dental caries.
- Drink at least 6-8 glasses of plain water daily.
- Milk and milk products are an important source of calcium for healthy teeth and bones.
- Milk and milk product also an important source of protein, vitamin A, riboflavin (vitamin B2) and potassium.
- It is advisable to choose for fresh/ full cream milk and milk product. For those tend to losing weight or patients with hyperlipidemia, choose low fat or skim milk and milk product.
- Intake of unsweetened soya bean or soy products (tofu, tempe) also helps fulfill the calcium requirement.

Figure 1.4: How to plan and take your main meal using the Malaysian Healthy Plate (cont...)

Table 1.10: Example of one day menu and serving size of each food group for **1500 kcal**

Meal time	Example of one day menu
Breakfast	2 slices (60 g) of wholegrain bread
	1 glass of milk
Morning tea break	1-2 pots of plain yoghurt
Lunch	2 scoops of brown rice
	1 scoop (60 g) of stir-fried spinach with tauhu
	1 scoop (30 g) of string beans + brinjal
	1 piece of fried fish with chilli (80 g)
	1 whole medium apple
	1 glass of plain water
Afternoon tea break	1 glass of unsweetened soya milk
Dinner	2 scoops of brown rice
	1 scoop (60 g) of stir-fried kangkung
	1 bowl of (250 g) of chicken soup with carrot
	1 slice (159 g) of papaya medium size
	1 glass of plain water

Food group	*Total number of servings in a day
Vegetable	3 servings
Fruit	2 servings
Rice, other cereals, wholegrain cereal-based products, and tubers	3 servings
Poultry/ meat/ egg	1 serving
Fish	1 serving
Legumes	1 serving
Milk & milk products	2 servings
Fats/ oils	6 servings
Sugar	1 serving

Table 1.11: Example of one day menu and *serving size of each food group for **1800 kcal**

Meal time	Example of one day menu
Breakfast	2 slices (60 g) of wholegrain bread
	1 slice of cheese
	1 glass of milk
Morning tea break	1-2 pots of plain yoghurt
Lunch	2 scoops of brown rice
	1 scoop (60 g) of stir-fried spinach with tauhu
	1 scoop (30 g) of string beans + brinjal
	1 piece of fried fish with chilli (80 g)
	1 whole medium apple
	1 glass of plain water
Afternoon tea break	4 pieces of wholegrain crackers (20 g)
	1/2 cup of boiled chickpeas (80 g)
Dinner	2 scoops of brown rice
	1 scoop (60 g) of stir-fried kangkung
	1 bowl of (250 g) of chicken soup with carrot
	1/2 whole (159 g) of guava small size
	1 glass of plain water

Food group	*Total number of servings in a day
Vegetable	3 servings
Fruit	2 servings
Rice, other cereals, wholegrain cereal-based products, and tubers	4 servings
Poultry/ meat/ egg	1 serving
Fish	1 serving
Legumes	1 serving
Milk & milk products	2 servings
Fats/ oils	8 servings
Sugar	1 serving

Table 1.12: Example of one day menu and *serving size of each food group for **2000 kcal**

Meal time	Example of one day menu
Breakfast	2 slices (60 g) of wholegrain bread
	1 slice of cheese
	1 omelette
	1 glass of milk
Morning tea break	1 pot of plain yoghurt
	1 cup whole grain wheat breakfast cereal without added sugar
Lunch	2 scoops of brown rice
	1 scoop (60 g) of stir-fried spinach with tauhu
	1 scoop (30 g) of string beans + brinjal
	1 piece of fried fish with chilli (80 g)
	1 whole medium apple
	1 glass of plain water
Afternoon tea break	4 pieces of wholegrain crackers (20 g)
	1 1/2 pieces (158 g) of stuffed tauhu
Dinner	2 scoops of brown rice
	1 scoop (60 g) of stir-fried kangkung
	1 bowl (250 g) of chicken, taukua and carrot stew
	1/2 whole (80 g) of mango medium size
	1 glass of plain water

Food group	*Total number of servings in a day
Vegetable	3 servings
Fruit	2 servings
Rice, other cereals, wholegrain cereal-based products, and tubers	5 servings
Poultry/ meat/ egg	2 serving
Fish	1 serving
Legumes	1 serving
Milk & milk products	2 servings
Fats/ oils	9 servings
Sugar	2 servings

Achieve and maintain a healthy body weight

KEY MESSAGE

2

ACHIEVE AND MAINTAIN A HEALTHY BODY WEIGHT

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2.1 Terminology

Energy balance

Energy balance is achieved when calorie-intake (food intake) is balanced with calorie expenditure (physical activity). Individuals gain weight when calorie or energy intake exceeded energy expenditure while, individuals lose weight when the energy expenditure exceeded the energy intake over a period of time.

Body mass index (BMI)

BMI is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the body weight in kilograms divided by the square of the height in meters (kg/m^2). However, BMI has its limitation. It does not distinguish between weight associated with muscle mass and weight associated with fat mass. Hence, BMI is not a direct measure of body fat, but it is more accurate in approximating body fat than measuring body weight alone.

Waist circumference (WC)

The circumference around the waist is measured by placing a measuring tape around the trunk between the lower costal margin and the iliac crest. It is an indication of body fat located at the abdominal region and is an independent predictor of risk factors and morbidity of obesity-related diseases. Abdominal obesity is defined as WC ≥ 90 cm for males and ≥ 80 cm for females.

Body composition

Body composition measurements are objective methods of nutritional assessment. The assessment of body composition provides insights into both nutritional status and functional capacity of the human body that is useful in nutrition for describing growth and development from birth through to adulthood. Body composition is a method of describing what the body is made of that is fat, protein, minerals and water. It also describes body weight more accurately than BMI. Body composition analysis can accurately show changes in fat mass, muscle mass, and body fat percentage. A range of techniques [skin-folds,

bioelectrical impedance analysis (BIA), dual-energy X-ray absorptiometry (DEXA) and stable isotopes] allow for the measurement of fat, fat-free mass, bone mineral content, total body water, extracellular water, total adipose tissue and its sub-depots (visceral, subcutaneous, and inter-muscular), skeletal muscle, selected organs, and ectopic fat depots.

Healthy body weight

Healthy body weight refers to appropriate body weight in relation to height whereby BMI in the normal range category is between 18.5 to 24.9 kg/m^2.

Body image

Body image refers to the perception that a person has of their physical self, and the thoughts and feelings that result from that perception. An individual with negative body image may have body size dissatisfaction, have incorrect perception of body weight status, involve in body change strategies in order to achieve the ideal body image.

Nutrient-dense foods

Foods rich in nutrients but relatively low in calories/ energy. Nutrient-dense foods contain vitamins, minerals, complex carbohydrates, protein, and healthy fats. Examples includes fruits and vegetables, whole grains, fish/ seafood, lean meats, legumes, nuts and seeds.

Energy (calorie)-dense foods

Energy (calorie)-dense foods are usually processed foods, which are high in calories because they contain large amounts of fat or sugar. Examples include fast foods (fries, burger), cakes, chips and local *kuih*.

Eating disorders

Eating disorders are characterised by a persistent cognitive distortion related to food and body weight and disturbed eating patterns and is defined by the clinical criteria in Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (APA, 2013). The DSM-5 includes the following diagnostic categories: anorexia nervosa (AN), bulimia nervosa (BN), binge eating disorder (BED) and other specified feeding of eating disorder (OSFED).

Disordered eating

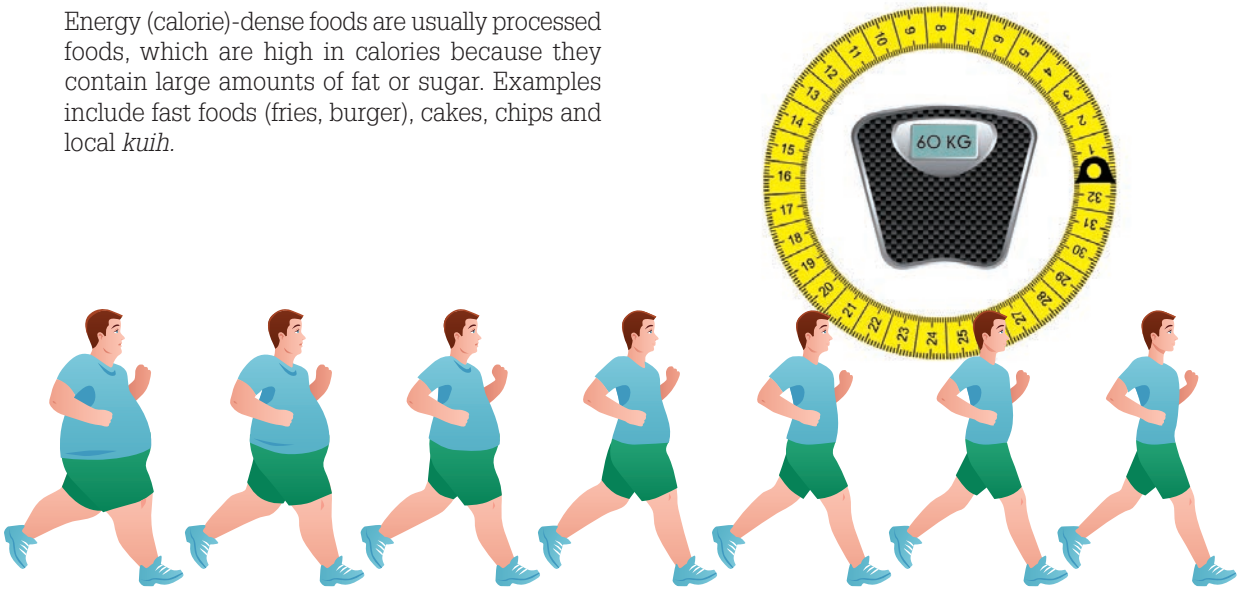
Disordered eating refers to a constellation of unhealthy eating and weight related attitudes and behaviours that do not meet the criteria for an eating disorder, but that have medical and/ or psychological consequences. Disordered eating includes restrained eating, binge eating, purgative practices and other unhealthy methods to lose or control weight.

Restrained eating

Restrained eating refers to the intention to control food intake for weight maintenance either weight gain or loss.

Fad diet

Fad diets are usually very-low-calorie diets and promote a single type of food that can lead to nutrient deficiencies. They can lead to quick weight loss and may also lead to quick weight re-gain.



2.2 Introduction

Body weight is an important anthropometric measurement to determine the nutritional risk and status of an individual. Unhealthy weight status is a form of malnutrition which comprises both underweight (UW) and overweight/ obesity (OW/ OB). Individual's weight status can be classified using body mass index (BMI). In addition, BMI is usually complemented together with waist circumference measurement, including body composition analysis of body fat percentage. Waist circumference is used as an indicator for abdominal obesity while BMI is often positively correlated with body fat percentage. Globally, there is approximately 2 billion OW/ OB adults compared to only 462 million UW adults (WHO, 2018). In Malaysia, the prevalence of overweight and obesity in adults is much higher that is 50.1% compared to the prevalence of underweight of 6.5% (IPH, 2020).

Body weight is regulated by the concept of energy input and energy output. Unhealthy weight status is usually described as the consequence of imbalance energy input from dietary intake and energy output/ energy expenditure via physical activity and exercise. When energy input/ calories (IN) consistently exceeds energy output/ calories (OUT) over a period of time, it will lead to weight gain contributing to OW/ OB; while the reverse, in which when energy output/ calories (OUT) exceeds energy input/ calories (IN), it will lead to weight loss contributing to UW (WHO, 1998).

Even though the energy imbalance concept may seem straightforward in describing unhealthy weight status, the aetiology contributing to OW/ OB and UW is rather complex, involving the interactions of various factors such as genetics, physiological and metabolism, psychological and behavioural including environmental factors (WHO, 1998).

The prevalence of UW or low body weight globally is shown to be lower compared to the extreme end of OW/ OB. However, it is still a nutritional problem which could affect the health status of individuals including mortality. The major consequence of UW is nutritional deficiencies such as energy, protein, iron, calcium, which could lead to poor growth and development and weaken immune system, including higher risk of clinical and chronic conditions/ diseases such as anaemia and osteopenia/ osteoporosis. In terms of the different stages of human life cycle, toddlers and teenagers/ young adults especially females could be more prone to the problem of UW. The possible reasons could be due to 'picky eating' which usually occurs during toddlerhood while in female teenagers and young adults, it could be due to the negative body image and disordered eating. When UW problem persists, this may also lead to eating disorders such as anorexia and bulimia nervosa, which could result to a far bigger problem to solve than just nutrient deficiencies because it involves mental health.

Overweight/ obesity is a global problem, which affects almost all stages of the human life cycle from infant to the older age population. OW/ OB is a risk factor for several chronic non-communicable diseases (NCDs) such as cardiovascular diseases, musculoskeletal disorders (e.g., osteoarthritis), some cancers (e.g., breast and colon cancers), and diabetes mellitus (WHO, 2018). James (2013) described obesity, a modern pandemic: the burden of disease and more recently, a position statement from the World Obesity Federation in 2017 has proposed obesity as a chronic relapsing progressive disease process (Bray, Kim & Wilding, 2017). With that, OB/ OW has contributed to an economic burden to the country due to the high healthcare costs associated with the management and treatment of this condition including its associated chronic NCDs and conditions. In Malaysia, the healthcare costs attributed from OW/ OB was estimated at USD 1.7 billion in 2017 (WHO, 2019). In addition, OW/ OB may contribute to low labour productivity due to absence from work including the development of mental health problems such as depression and anxiety, which will further burden the country in the terms of economic costs. Furthermore, people with obesity commonly face a pervasive, resilient form of social stigma (Rubino *et al.*, 2020).

According to WHO (2018), there are two main causes of OW/ OB, which are: 1) excessive intake of foods high in fat which are also energy-dense; and 2) sedentary lifestyle or low physical activity due to rapid urbanisation. Both of these causes are under behavioural and environmental factors. However, in Malaysia, the availability of foods at all times which promotes the eating out habit among Malaysians could be a possible factor related to food consumption/ environment factor, contributing to the positive energy balance. Fournier *et al.* (2016) reported BMI issue in Malaysia and investigated its relationships with the socio-demographic characteristics of the population, as well as their eating patterns using a Malaysian Food Barometer model. They found about 64% of Malaysians had at least one meal per day outside of home, 23.4% had meals at home, and 12.5% will eat at home with outside food. In terms of physical inactivity among Malaysian adults, the latest findings from NHMS 2019 indicated a prevalence of 25.1% (IPH, 2020) while the MANS 2014 reported a slightly higher prevalence of 37% for physical inactivity (IPH, 2014).

National surveys over the last two decades revealed a high prevalence of unhealthy weight status especially OW/ OB in Malaysian population; therefore, it is utmost important for Malaysians at all life stages to maintain body weight in a healthy range (NCCFN, 2010). This will reduce and prevent the increasing prevalence of diet-related chronic diseases in Malaysia. This key message is in line with the enabling strategy 4 of the current National Plan of Action for Nutrition of Malaysia (NPANM III), 2016-2025 that is, preventing and controlling obesity and other diet-related non-communicable diseases (NCCFN, 2016) and provides key recommendations including guidelines on how to achieve the recommendations for achieving and maintaining healthy body weight of Malaysians.

2.3 Scientific basis

An unhealthy weight is often seen as a result of individual choice on diet, exercise and lifestyle. Maintenance of normal body weight in the current obesogenic environment is challenging for many individuals. This is further illustrated in Figure 2.1 which describes the existence of a complex web involving societal and biological factors that have, in recent decades expose our inherent vulnerability to weight gain and obesity.

The risk of developing obesity-related co-morbidities rises exponentially with increasing BMI over 30 kg/m^2 as shown in Figure 2.2 (WHO, 2000). On the other hand, fat accumulation intra-abdominally and subcutaneously around the abdomen (central, abdominal, visceral, android, upper body or apple-shaped obesity) is also associated with higher risk for cardiometabolic diseases, independent of BMI (Cameron, Magliano & Soderberg, 2013). However, fat accumulation in the subcutaneous regions of hips, thighs and lower trunk (gluteo-femoral, peripheral, gynoid, lower body or pear-shaped obesity) is considered less harmful or even protective against cardiometabolic complications (Manolopoulos, Karpe & Frayn, 2010; Cameron, Magliano & Soderberg, 2013; Kwon, Kim & Kim, 2017)

The World Obesity Federation has declared that obesity is a disease (Bray, Kim & Wilding, 2017), while The Obesity Society has put a statement on obesity as a chronic disease (Jastreboff *et al.,* 2019). Notably, the chronic diseases have been shown to have strong correlations with BMI (WHO/ IASO/ IOTF, 2000), while Calle *et al.* (1999) have shown the correlation of BMI and mortality in Figure 2.2 (Kyrou *et al.,* 2018).

Figure 5.2: The full obesity system map with thematic clusters (see main text 5.1.2 for discussion) [17,18] Variables are represented by boxes, positive causal relationships are represented by solid arrows and negative relationships by dotted lines. The central engine is highlighted in orange at the centre of the map.

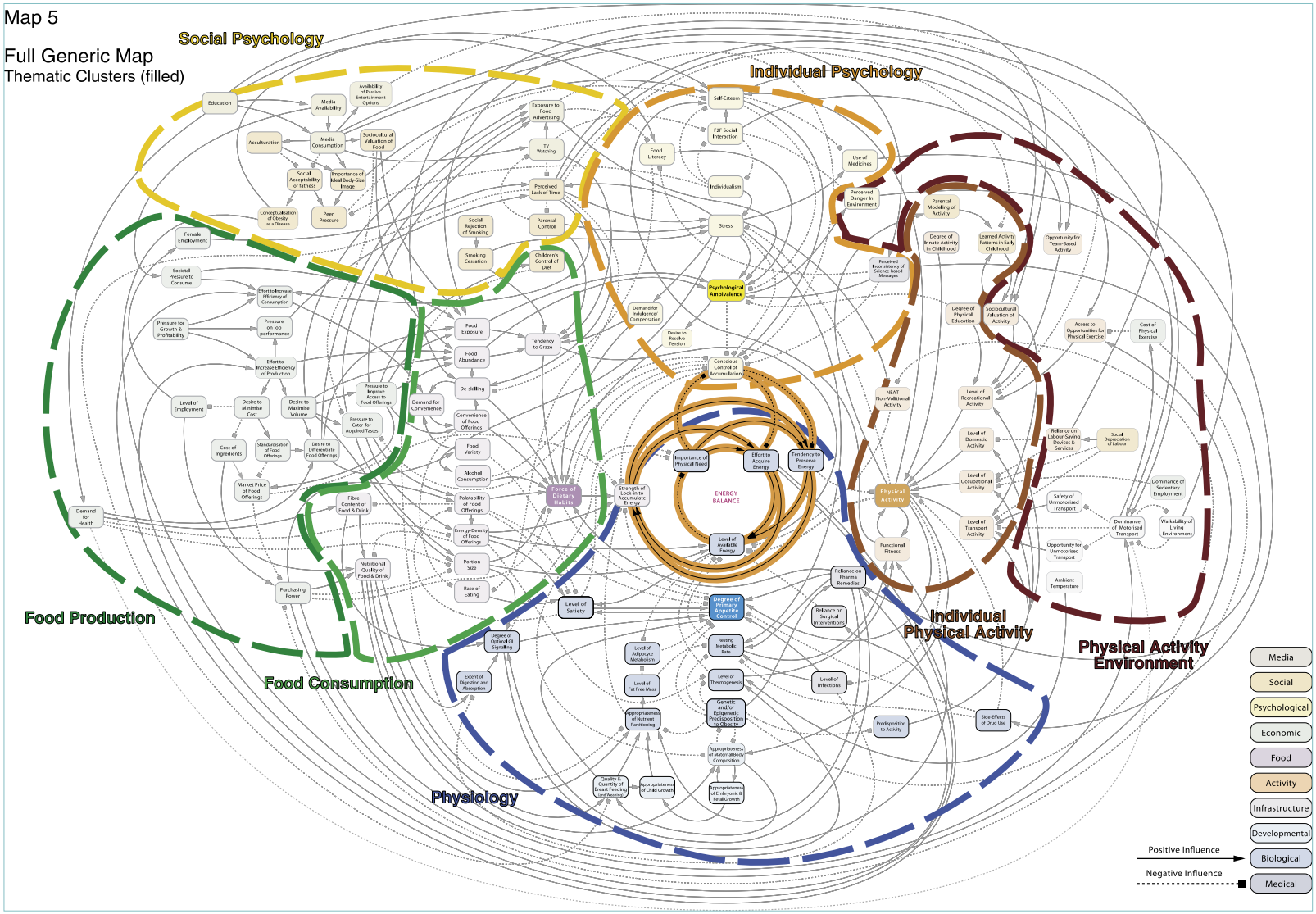


Figure 2.1: Tackling Obesities: Future Choices, Foresight Report
Source: Butland *et al.* (2007).

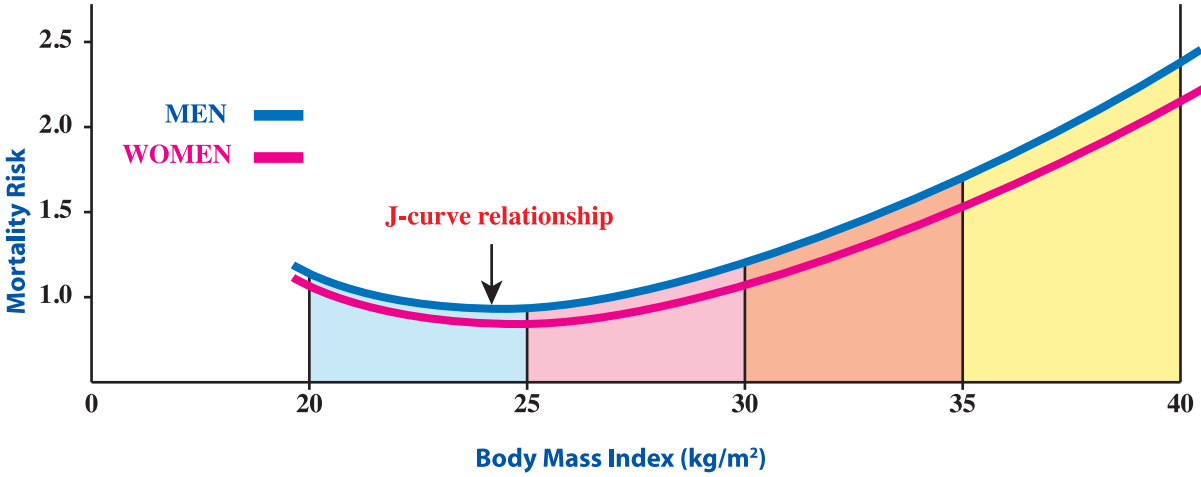


Figure 2.2: Relationships between Body Mass Index (BMI) and mortality
Source: Calle *et al.* (1999) & Kyrou *et al.* (2018)

The escalating pandemics of obesity and sedentary lifestyle leads to much higher risk of premature death and many serious disorders, including diabetes mellitus, hypertension, dyslipidaemia, cardiovascular disease, stroke, gallbladder disease, respiratory dysfunction, gout, osteoarthritis and certain types of cancer as shown in Figure 2.3 (Bray, Kim & Wilding, 2017).

Besides a major risk factor for chronic diet-related diseases or non-communicable diseases (NCDs) mentioned above, overweight and obesity may contribute as a risk factor for infectious diseases such as the current pandemic of COVID-19, which arose late in 2019 and increasing rapidly in the number of cases globally. This is shown from arising data which indicated an possible positive association between overweight and obese individuals including those with chronic NCDs with high risk of being infected by the COVID-19 virus (Ricardo et al., 2020; Popkin *et al.*, 2020). The possible reason is due to the weaker immune system in individuals who are overweight or obese and with chronic NCDs as compared to healthy individuals (Katzmarzyk *et al.*, 2020). Hence, obesity and other chronic diseases can influence the severity and mortality of COVID-19 patients admitted for treatment in the hospitals.

A systematic and appropriate weight management is required to attain and maintain healthy body weight for minimising the risk of developing chronic diseases in adults of any age. Maintaining a healthy weight throughout childhood may reduce the risk of becoming an OW/ OB adult. Adult individuals who are overweight or obese will benefit from modest amount of weight loss; therefore, prevention of further weight gain is important.

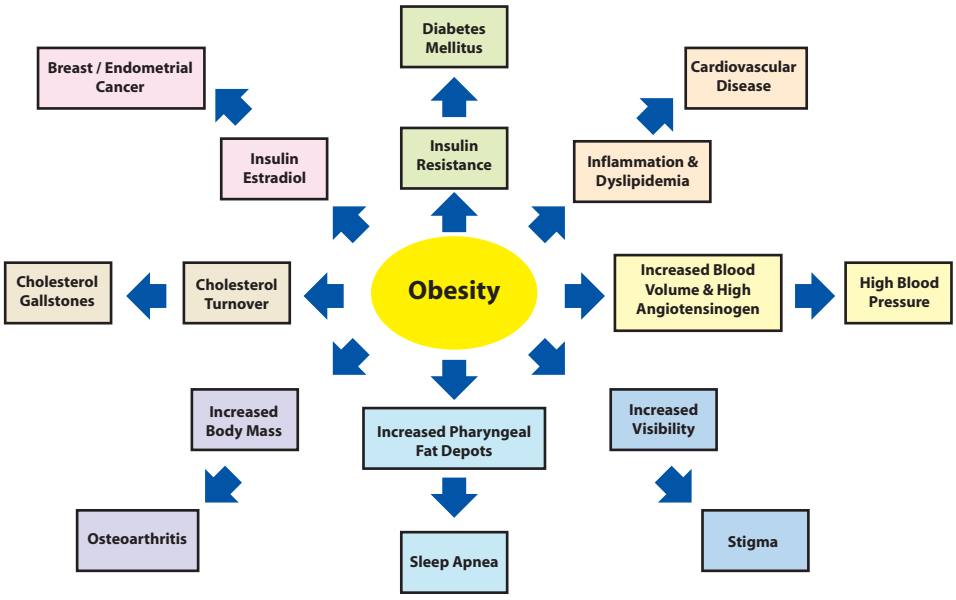


Figure 2.3: A model showing the relation of obesity in the centre and the diseases with which it is associated Source: Bray, Kim & Wilding (2017)

Ideally, weight management should start from childhood. However, for adults, weight loss, should be set realistically at 10% reduction from the baseline body weight within 6 months of intervention or treatment (MASO/ AAM/ MEMS, 2004). Weight loss is associated with improvement in related co-morbidities. Therefore, OW/ OB individual should set target for achieving healthy body weight goal with the support of health care professionals that includes nutritionist, dietitian, clinical psychologist, physician, and exercise therapist. Weight loss could be achieved with proper management of food intake (energy intake) and physical activity (energy expenditure).

Between the years 1994 to 2001, numerous studies related to basal metabolic rate (BMR), total daily energy expenditure (TDEE) and physical activity level (PAL) in various population groups of both sexes (adults, the Armed Forces and Elite athletes) were reported (Table 2.3). The overall results revealed that with the exception of the Armed Forces and Elite athletes, all other age-groups led a sedentary lifestyle with PAL values in males (1.50-1.68) and females (1.48-1.70) which did not meet the WHO recommended PAL values of 1.75 for moderate activity (Ismail, 2001).

2.3.1 Measures of body weight/ body fat

2.3.1.1 Body mass index

One of the most commonly used indices of relative weight is the body mass index (BMI). BMI is not a direct measure of body fat, but it is more accurate at approximating body fat than measuring body weight alone. BMI can be considered to provide the most useful, albeit crude, population-level measure of obesity.

Measuring body weight is important for assessing body composition and for monitoring the changes in weight either gain or loss. Calibration is needed for both the weighing scale and stadiometer when measuring BMI. Calibration of instruments is different from model to model and manufacturer to manufacturer. However, it is a simple procedure described in the user's manual which comes with the instrument. In order to calibrate the weighing scale for accuracy of weighing scale, it is recommended to test against a known object on the weighing scale.

A Technical Committee initiated by the Malaysian Association for the Study of Obesity (MASO, 2005) recommends retaining the current WHO classification of BMI (WHO, 1998) for adults and acknowledges the need to have the public health action points as recommended by WHO Expert Consultations 2004 (Table 2.1).

Table 2.1: Body weight classification of adults according to BMI and public health action for Malaysia

Body weight classification	BMI cut off points for definition[1] (kg/m^2)	Risk of co-morbidities	BMI cut-off points for public health action[2] (kg/m^2)
Underweight	<18.5		<18.5
Normal	18.5 to 24.9	Low	18.5 to 22.9
Overweight	≥ 25.0		23.0 to 27.4
Pre-obesity	25.0 to 29.9	Moderate	27.5 to 32.4
Obesity Class I	30.0 to 34.9	High	32.5 to 37.4
Obesity Class II	35.0 to 39.9	Very high	≥ 37.5
Obesity Class III	≥ 40.0		

Source: [1]WHO (1998), [2]WHO (2004)

Some scientific evidences suggest that Asian populations have different associations between BMI, percentage of body fat and health risks than do European populations (Ko *et al.,* 1999; Deurenberg *et al.,* 2001; Zhou, 2002). A WHO expert consultation had addressed the debate about interpretation of recommended body mass index (BMI) cut-off points for determining OW/ OB in Asian populations and considered whether population-specific cut-off points for BMI are necessary. The WHO consultation group agreed that the WHO BMI cut-off points should be retained as international classifications (WHO, 2004).

Reducing BMI cut-off values for action on OW/ OB would increase their prevalence rates overnight; and therefore, increase governmental and public awareness. However, such a change would require public health policies and clinical management guidelines to be changed and could lead to increased costs for governments (such as more treatment at lower thresholds).

The Committee (MASO, 2005) acknowledges the need to have additional trigger points for public health action. These were identified as 23 kg/m^2 or higher, representing increased risk and 27.5 kg/m^2 or higher representing high risk as recommended by the WHO consultation (WHO, 2004).

A low body weight (BMI < 18.5 kg/m^2) is associated with a low risk of chronic diseases. However, a low body weight is unhealthy because it increases the risk of other clinical conditions such as anaemia and low bone mass. It also leads to distortion of body image amongst teenagers and young adults and increased risk of eating disorders namely anorexia and bulimia. A low BMI is associated with greater mortality risk than that of normal individuals (Di Angelantonio *et al.,* 2016; Klatsky *et al.,* 2017). Hence, the healthy weight range for adults is defined as having a BMI range of 18.5 to 24.9 kg/m^2. The BMI however is not suitable for use in pregnant women.

2.3.1.2 Waist circumference

Body fat located at the abdominal region is associated with greater health risk than peripheral fat. Excess abdominal fat is an independent predictor of risk factors and morbidity of obesity-related diseases such as type 2 diabetes, hypertension, dyslipidaemia and cardiovascular diseases (WHO, 1998).

Waist circumference is positively correlated with abdominal fat. Waist circumference has been shown in large epidemiological studies to be strongly, significantly and independently correlated with blood pressure, dyslipidaemia, fasting plasma glucose, 2-hours plasma glucose and/ or diabetes (Zhou, 2002). Therefore, it is a valuable additional alternative method for identifying individuals at increased risk of chronic diseases.

Waist circumference is a convenient measurement which is unrelated to height and correlates with BMI. For Malaysians, MASO/ AMM/ MEMS (2004) proposed waist circumference cut-off points as recommended by the WHO/ IASO/ IOTF (2000) as shown in Table 2.2. Ideally, the goal for adults would be to maintain body weight within normal BMI and to have waist circumferences below the cut-off points recommended according to gender.

Table 2.2: Waist circumference cut-off points

	Men	Women
Waist circumference	≤ 90 cm (35 inches)	≤ 80 cm (32 inches)

Source: WHO/IASO/IOTF (2000)

2.3.1.3 Body composition

Despite the simplicity of the use of body mass index (BMI), there are limitations of BMI as indicators of cardiovascular disease risk. For instance, body weight is not suitable for the measure of ideal body composition when relating to fitness as increase in weight due to increase in fat-free mass (FFM) can be misinterpreted as increase in body fatness. With this reason, caution is needed when these indices are applied and used on athletes (Kruschitz *et al.,* 2013).

The rise in the prevalence of obesity across all ages in Malaysia (IPH, 2015; IPH 2017; IPH, 2020) highlights the importance of body composition assessment as indicators of cardiometabolic risk (Amato, Guarnotta & Giordano, 2013). The distribution of body fat and fat free mass (FFM) are associated with various health outcomes in infancy, childhood and later adulthood. Some of the measures of body composition include skinfold thickness (i.e., trunk, thighs, shoulder blade, and triceps), bioelectrical impedance, underwater weighing (densitometry) and dual energy x-ray absorptiometry (DXA) (Burkhauser & Cawley, 2008; Ozhan *et al.,* 2012; Wang, Chen & Eitzman, 2014). However, it is important to address the complexity and cost of the body composition assessment for the use of epidemiological studies (Wells & Fewtrell, 2006). Nevertheless, it is best to evaluate body composition for the monitoring of changes resulting from weight management interventions in this population.

2.3.2 Weight management strategies and concerns

2.3.2.1 Weight management

Weight management can be achieved when energy intake (food intake) is balanced with energy expenditure (physical activity). Obesity develops when energy intake exceeds energy expenditure over time; excess energy is stored in adipose tissue, and chronic excess leads to greater adiposity. The changes on body weight mass in accordance to the laws of thermodynamics and the preservation of energy, whereby even small but persistent deviations from energy balance, which may arise from altered energy expenditure or energy intake and which lead to sustained positive or negative energy balance states (Piaggi, 2019). It is also evident that metabolisable energy (feacal energy) can influence human body weight regulation (Lund, Gerhart-Hines & Clemmensen, 2020).

Balanced diet that meets nutrient needs is able to prevent weight gain and have a desirable body weight. The amount of calories consumed must be within the individual's requirement. Energy requirement is determined by age, gender and physical activity level. The Recommended Nutrient Intake (RNI) for Malaysia (NCCFN, 2017) has recommended intake of 50-65% energy from carbohydrates, 10-20% energy from proteins and limit energy from fats between 25-30% are able to reduce the risk of chronic disease, overweight and obesity.

Macronutrients (carbohydrates, proteins and fats) contribute to dietary energy intake. Fat contributes significantly to the caloric content of foods because it provides twice the calories per gram compared to carbohydrate and protein. High sugary foods also increase the calorie content of foods and drinks. Eating foods with lower calories may be helpful to reduce energy intake to maintain weight. Individuals should limit the portion size eaten, especially foods that are energy-dense to help control calorie intake. Besides diet, regular physical activity is important to maintain weight in the healthy range.

Combination of balanced diet and physical activity have better results in weight reduction. Moderate to vigorous intensity of physical activity or exercise preferably spread throughout the week, is good for weight management. For further information on the physical activity or exercise, please refer to Key Message 3 for the Malaysia Physical Activity Pyramid (pg 65).

2.3.2.2 Weight gain

In simple term, underweight refers to body weight that is too low for a normal healthy individual. Individuals who are severely underweight or have chronic energy deficiency (CED) often have a poor nutrition status and are prone to infections, anaemia, low immune status, low bone mass and difficulty to recover from illnesses. Weight gainers need to set realistic targets. However, the weight gain should not exceed the recommended healthy weight range according to their height (BMI 18.5 to 24.9 kg/m^2). Some individuals may gain weight faster than others, especially if there is a genetic predisposition to obesity. Underweight is unhealthy weight arising from unintentional weight loss from many causes especially poor food intake.

The principles of energy homeostasis explains that weight gain can only be achieved with a persistent state of positive energy balance, e.g., overeating sustained to a degree that constantly exceeds daily energy expenditure (Piaggi *et al.,* 2018). It is important to eat consistently and have more frequent meals. Eat at least three main meals and one to three additional snacks. Skipping meals will cause missing out of important calories and other nutrients needed to accomplish the goal.

High caloric and nutritious food and beverages fed in small portions, at a slow pace to avoid re-feeding syndrome is the best approach to reverse underweight (Uzogara, 2016). In addition to feeding, strength-training exercises that build muscle, frequent rest and good sleep, healthier lifestyle (cessation of smoking, alcohol) and behaviour modification also can help in underweight management (Uzogara, 2016).

Eating a larger than normal portion of food will help increase energy intake. For example, having a bigger bowl of breakfast cereal, two sandwiches instead of one for snacks, a bigger serving of rice at lunch or dinner, drinking a bigger glass of fruit juice or milk and eating a larger

piece of fruit. Individuals who wish to gain weight should select nutrient-rich and calorie-dense foods as shown in Table 2.4. Beverages such as juices and milk-based beverages are simple ways to increase caloric intake. One common misconception is that the best way to build muscle or *"bulk up"* is to eat a high-protein diet. Adequate protein intake is essential for muscle growth. However, most of the calories needed to fuel muscle growth come from carbohydrates and fat. Hence, eating a balanced proportion of macronutrients (carbohydrates, protein and fats) but at increased total calories with frequent meal is recommended for weight gain.

In recent years, a new public health nutrition strategy in maintaining healthy eating is avoiding the ultra-processed foods (Gibney, 2018). The high calories contributed from the ultra-processed foods has linked to NCDs (Machado *et al.,* 2019). In a systematic and meta-analysis review found that consumption of ultra-processed food was associated with increased risk of overweight, obesity, abdominal obesity, all-cause mortality, metabolic syndrome and depression in adults. In addition, consumption of ultra-processed food was associated with cardiometabolic diseases, frailty, irritable bowel syndrome, functional dyspepsia and cancer (breast and overall) in adults (Lane *et al,* 2020)

Strengthening exercises such as weight lifting, push-ups help to stimulate muscular development and increase weight gain (refer to Key Message 3 for Physical Activity Pyramid for strengthening exercises). Exercise tends to stimulate the appetite in the long term (Schubert *et al.,* 2014; Hunschede *et al.,* 2017) and increases thirst. This will help individuals to eat and drink more.

2.3.2.3 Weight reduction

There is strong evidence that weight loss promotes lower blood pressure, lipid levels and glucose levels in overweight and obese individuals with hypertension, dyslipidaemia or diabetes (Jensen *et al.,* 2014; Steinberg *et al.,* 2015; Painter *et al.,* 2017; CDC 2017; LeBlanc *et al.,* 2018).

Individuals who are overweight or obese should attempt to lose weight gradually by 5-10% of their initial body weight. The benefits of 10% weight loss are shown in Table 2.5. The therapeutic of weight loss on metabolic function in obesity individual are shown in the Figure 2.4. If able to reduce body weight, the individual can attempt for further weight loss; however, a body composition assessment is required.

A reasonable timeline for 5-10% weight loss is three to six months, with a safe weight loss of 1/2 to 1 kg per week has shown to improve health outcomes (Magkos *et al.,* 2016; Varkevisser *et al.,* 2019). This usually means a reduction of calorie intake by 500 to 1000 kcal/ day. A sound long-term weight loss plan includes a reduction in calorie intake, intake of the recommended amounts of nutrients and increased physical activity. A calorie-controlled and balanced diet, along with regular physical activity is the best choice for weight loss (Miller *et al.,* 2013; Annesi *et al.,* 2016; Villareal *et al.,* 2017). For further information of type of exercises and duration, please refer to Key Message 3 for Malaysia Physical Activity Pyramid (pg 65).

When it comes to weight loss diets, it is calories that count. A systematic review has shown the macronutrient of diets are not as important as overall calorie deficit (Bravata *et al.,* 2003) in inducing weight loss. The weight loss diet should have a balanced proportion of carbohydrates (50% to 65%), protein (10% to 20%) and fats (25% to 30%). Diets that provide very low or very high amounts of protein, carbohydrates or fat are likely to provide low amounts of some nutrients and are not advisable for long term use. Although these diets have been shown to result in weight reduction, the maintenance of the weight lost ultimately will depend on change in lifestyle.

Individuals on a weight loss diet should limit portion size of foods eaten, especially foods that are energy dense to help reduce calorie intake. Fats are the most concentrated source of energy, hence limiting high fat foods would help reduce calorie intake. A randomised study has demonstrated that moderate 5% weight loss improves metabolic function in multiple organs simultaneously, and progressive weight loss causes dose-dependent alterations in key adipose tissue biological pathways (Magkos *et al.,* 2016) (Figure 2.4).

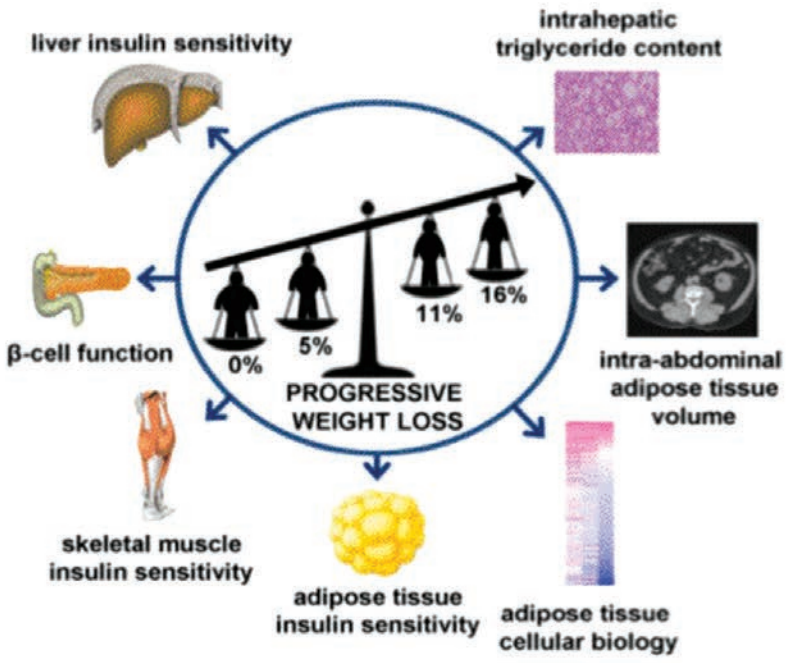


Figure 2.4: Therapeutic effects of weight loss on metabolic function
Source: Magkos *et al.* (2016)

Meta-analysis provides further evidence that whole grain intake is associated with a reduced risk of chronic diseases (Aune *et al.,* 2016) and these findings are in line with national dietary guidelines that promote and recommend increase intake of whole grains in order to prevent chronic diseases and weight management. Hence, intake of diet high in dietary fibre and low in fat such as whole grain cereals, vegetables and moderate amounts of fruits can help in preventing chronic diseases and weight management. Healthier cooking methods to reduce to fat such as steaming, grilling, stir-frying and clear soups, rather than deep-frying are also beneficial in weight reduction.

Besides a reduction in calorie intake, increasing physical activity is essential for successful weight loss and to avoid weight regain. Regular physical activity in combination of diet restriction can assist in weight maintenance. Energy intake influences energy expenditure in a dynamic way, whereby when a person's food intake is reduced for weight control, all components of energy expenditure change that includes the metabolic rate at rest (resting energy expenditure (REE), metabolic rate of exercise and adaptive thermogenesis (Yoo, 2018). However, exercise may not be the only method to control weight and manage obesity (King *et al.,* 2012).

2.3.2.4 Self-monitoring

Self-monitoring is an important behavioural approach towards better control of body weight. Self-monitoring is commonly used in weight-loss regimens to increase awareness of current and desired behaviours which incorporate self-monitoring technology through mobile phone apps, smart scales, and other wearable devices into their weight-loss programmes (Painter *et al.,* 2017). Overweight and obese individuals who practise daily self-weighing have been found to successfully lose weight and able to maintain the weight loss over a longer period of time compared to those who do not weigh themselves frequently (Carels *et al.,* 2008; Steinberg *et al.,* 2015).

Although there is emerging evidence that daily weighing can promote greater weight loss compared to less frequent weighing (Vanwormer *et al.,* 2008; Steinberg *et al.,* 2013), the mechanisms are unclear. Nevertheless, self-weighing helps the individual to adopt a lifestyle change in behaviour (diet and/ or exercise) mainly to prevent further weight gain or losses. Hence, adults should monitor and weigh themselves at least once a week to maintain a healthy body weight.

2.3.2.5 Fad diets

Fad diets are popular diet plans that claim to reduce one's weight rapidly in a short period of time. These diets are usually unhealthy and in long-term practice can likely contribute to side effects in the human health (Omar *et al.,* 2019). The rapid weight reduction is due to the loss of water and muscle instead of fat, while low calories intake may contribute to constipation, insufficient energy intake and nutrients, and fatigue (Khawandanah & Tewfik, 2016). Fad diets are typically based on two main characteristics - intake of macronutrients in particular percentage or omitting or taking in particular foods (Saltsman, Thomason & Roberts, 2001). Fad diets typically differ dramatically from the recommended intake of macronutrient as the source of energy in a diet which is approximately 50-65% from carbohydrates, 10-20% from protein and ≤ 30% from fat (NCCFN, 2017).

Numerous weight loss diet plans emerged in the past decade and can mainly be categorised as - Very low-calorie diet (VLCD), low fat diet, high fibre diet, high protein diet, and low carbohydrate diet. Some of these diet plans are similar in their compositions, largely made of a combination of high carbohydrates, low fat or moderate fat (Omar et al., 2019). The VLCD plan is defined as a diet plan that restrict energy intake to less than 800 kcal/day (Khawandanah & Tewfik, 2016). Examples of VLCD plan are Cambridge Diet, Rotation Diet, Liquid formula Diet (400 to 500 kcal/day), Grapefruit Diet (< 800 kcal/day) and the Human Chorionic Gonadotropin (HCG) Diet (500 kcal/day) (Navaro *et al.,* 2017). All these VLCD plans have to be practised with caution as the self-restriction of energy intake poses adverse effects to health, including anaemia, gallstone formation, decrease in lean body mass, ketosis, inadequacy of micronutrients, tiredness, and weakness as well as dizziness (Johansson *et al.,* 2013; Khawandanah & Tewfik, 2016). The formation of gallstone in VLCD individuals is three times higher than low-calorie diet counterparts (Gudzune *et al.,* 2015). Further, those on VLCD plan may face difficulties in getting back to regular and balanced diet (Bray *et al.,* 2018).

For very low-fat diet plans such as Pritikin Diet and Pasta Diet, the fat intake is ≤ 15% of total energy intake whereby saturated, monounsaturated, and polyunsaturated fatty acids are consumed in balance within the 15% of fat intake. The proteins account for 15% of the total energy intake while carbohydrates account for ≥ 70% of the calorie intake (Lichtenstein & Van Horn, 1998). As the fat intake is restricted, some of the very-low-fat diet plans may limit the consumption of seafood, low-fat dairy, and poultry which are considered as important sources of protein and calcium (Bray *et al.,* 2018). Pritikin Diet limits the fat intake to less than 10% of total energy intake and it is almost the lowest limit of the essential fatty acids daily requirement. As Pritikin Diet emphasised on the high carbohydrate intake, nutrient deficiencies such as fat-soluble vitamins and minerals such as calcium and zinc, as well as protein, may occur. In addition, the low-fat diet contributes to iron deficiency and further causes anaemia as well as amenorrhea (Khawandanah & Tewfik, 2016).

A low carbohydrate diet plan is defined as diet restrict to less than 130 g of carbohydrate intake per day or carbohydrate intake of less than 26% total energy expenditure. Moreover, a very low carbohydrate or ketogenic diet is defined as diet restrict to 20-50 g of carbohydrate intake per day or carbohydrate intake of less than or equal to 10% total energy expenditure (Dyson, 2015; Noakes & Windt, 2017). A low carbohydrate diet plan is usually high in fat and protein (Dyson, 2015; Oh & Uppaluri, 2020). For example, Atkins Diet, which restricts the carbohydrate intake with no limits on protein and fat intakes, is one of the most popular very low carbohydrate diet plans in weight management (Dyson, 2015; Khawandanah & Tewfik, 2016). Besides Atkins Diet, South Beach and the Zone diet plans are the examples of 'high-protein' diet, which differ in terms of carbohydrate and fat ratios (Atallah *et al.,* 2014). Recently, there is very low carbohydrate diet plan known as very low-calorie ketogenic (VLCK: 600-800 kcal/day) diet, which are low in carbohydrates (< 50 g daily from vegetables), and lipids (10 g/day of olive oil) (Muscogiuri *et al.,* 2019). The VLCK Diet preserves the body muscle and strength at the same time maintains the resting metabolic rate (RMR), while decreases the body fat mass in treating the obese patient (Gomez-Arbelaez *et al.,* 2018).

A low carbohydrate diet may lead to long term adverse health effects on renal function due to high protein intake, higher risk of osteoporosis due to ketosis that promotes urinary calcium loss, as well as micronutrients deficiency especially thiamine, folic acid, vitamin C, iron and magnesium (Dyson, 2015; Wyka *et al.,* 2015). In addition, low carbohydrate diets have higher risk for lower gastrointestinal disorder and CVD (Dyson, 2015), while high protein diets may cause formation of kidney stones and damage to blood vessels which could lead to arteriosclerosis (Wyka *et al.,* 2015).

Paleolithic Diet (Paleo diet) or Caveman Diet, or Stone-Age Diet is a high fibre diet plan based on foods consumed during the Old Stone Age (Konner & Eaton, 2010). In other words, Palaeolithic Diet is an ancestral way of eating that emphasised on foods such as nuts, roots, lean meat, organ meat and a high proportion of fruits and vegetables; however, it excludes grains, legumes and dairy products (Genoni *et al.,* 2019) as well as refined sugar, processed oil, and salt (Manousou *et al.,* 2017). The limitation of salt and dairy in Palaeolithic Diet increases the risk of iodine deficiency, including countries with salt iodisation program (Manousou *et al.,* 2017). Besides, the limitation of grains and dairy may limit the intake of nutrients such as fibre, vitamin D, calcium, thiamine, riboflavin and iron (Berggren *et al.,* 2018). A recent systematic review and meta-analysis by Ghaedi *et al.* (2019) revealed that a Palaeolithic Diet may be associated with preventing cardiovascular disease risks, but the evidence is not conclusive and more well-designed trials are still needed.

Studies showed that fad diet results in weight loss due to the restriction of calories intake instead of its functional food properties. Hence, more studies should be conducted in order to have a safe-to-consume and nutritional-sufficient dietary plan with the addition of bioactive ingredients that work on weight loss (Navaro *et al.,* 2017). In order to maintain body weight resulting from a weight loss regime, it is important for a person to combine both exercise and dietary intervention (Headland *et al.,* 2016).

2.3.2.6 Body image disturbance and disordered eating behaviours

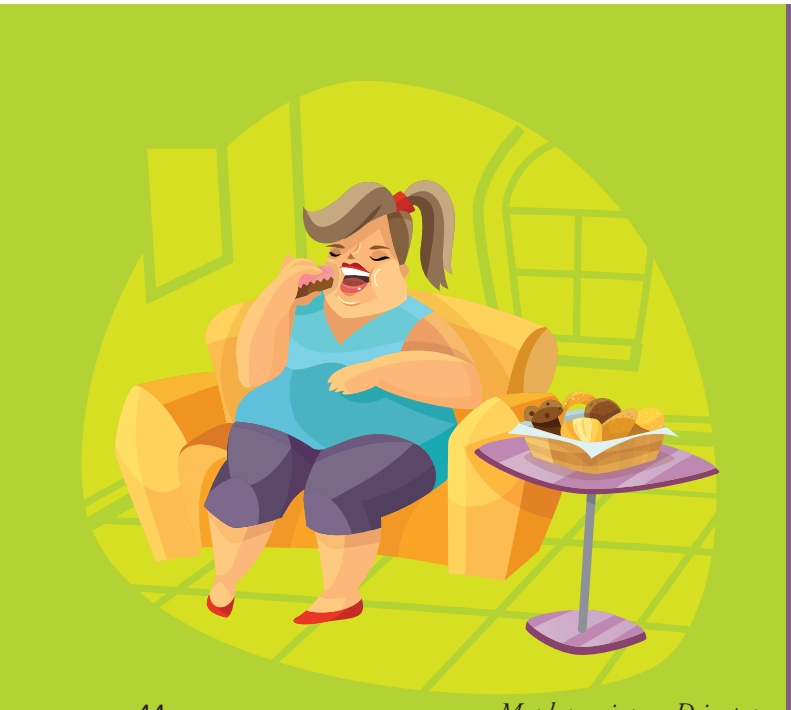
Body image is defined as the perception that a person has of their physical self, and the thoughts and feelings that result from that perception (Cash, 2004). Those who have negative body image are preoccupied with thinness, dissatisfied with various parts of their body parts, and/ or had perceived their body weight status incorrectly, as well as modifying their eating and exercise behaviours in order to achieve the ideal body image (Kamaria *et al.,* 2016; McGuinness & Taylor, 2016).

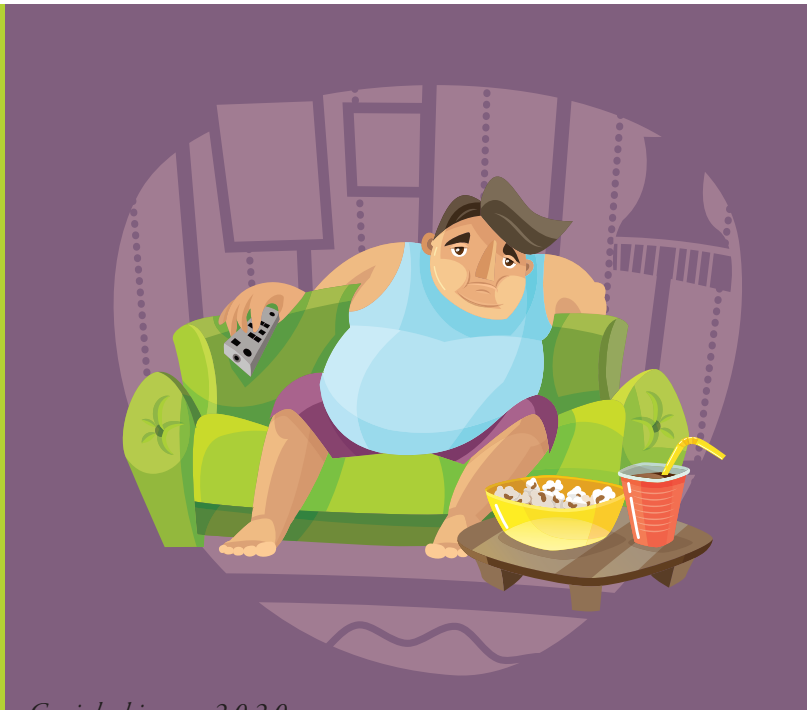
Disordered eating is referred to a constellation of unhealthy eating and weight related attitudes and behaviours that do not meet the criteria for an eating disorder, but have medical and/ or psychological consequences (Ackard, 2004). Disordered eating behaviours include dieting, severe food restriction, bingeing, purgative practices, and other unhealthy methods to lose or control weight (Pereira & Alvarenga, 2007; APA, 2013). Further, the co-existence of negative body image and disordered eating behaviours is reported in Malaysia, particularly during adolescence and young adulthood (Chong *et. al.,* 2017; Nur Nabilla *et al.,* 2019; Chin *et al.,* 2020) that may lead to adulthood.

The issues of negative body image and disordered eating behaviours are not limited to adolescents and young adults as studies have reported that midlife adults also do face body size dissatisfaction and disordered eating behaviours, whereby the issues were more common in females as compared to males (Forrester-Knauss & Zemp Stutz, 2012; McGuinness & Taylor, 2016). In addition, disordered eating behaviours predicts the development of a clinical eating disorder as well as weight gain over time which may lead to obesity (Nagata *et al.,* 2018). Evidences have reported that unhealthy dieting behaviours may result to 5- to 18-fold risk of developing eating disorders, while professionally administered weight loss programmes do not increase the risk or symptoms of eating disorders (Peckmezian & Hay, 2017). While the populations are getting fatter overtime, the beauty standards for females are focused on thinness and slim while muscular are appreciated by males. This is known as cultural discontent, whereby one's ideal beauty standard is inconsistent with his/ her actual body weight status. In order to achieve such ideal body image, one may develop negative body image such as body dissatisfaction and having incorrect perception of body weight status (Carraça *et al.,* 2011; Kamaria, Vikram & Ayiesah, 2016). Furthermore, those who have negative body image would engage in dieting and unhealthful weight control behaviours, and they would be at risk of having disordered eating behaviours and obesity problem (Neumark-Sztainer *et al.,* 2006).

Body weight status influences one's body image and eating behaviours. Overweight and obese adults were found to be more likely to have negative body image and disordered eating than their counterparts (Carraça et al., 2011; As-Sa'edi *et al.,* 2013; Kamaria, Vikram & Ayiesah, 2016; Sonneville *et al.,* 2016; Nagata *et al.,* 2018). For instance, overweight and obese individuals may engage in yo-yo dieting which also known as weight cycling, a pattern of losing weight and then regaining it back (Dulloo & Montani, 2015; Rhee, 2017). Yo-yo dieting is associated with an increased risk of eating disorders, obesity, and psychological problems such as anxiety and depression (Dulloo & Montani, 2015; Rhee, 2017; Quinn, Puhl & Reinka, 2020).

Indeed, "feel fat" or perceiving oneself as overweight or obese, irrespective of their actual weight status, is associated with the engagement of various weight control behaviours and disordered eating behaviours, such as dieting, fasting, taking diet pills or laxatives, self-induced vomiting, and binge eating (Sonneville *et al.,* 2016). In addition, self-perceived overweight was associated with more frequent weight loss attempts, but more likely to gain weight overtime (Robinson, Sutin & Daly, 2018).





2.4 Current Status

The unhealthy weight status of both underweight and overweight/ obesity still exists in Malaysian population with the latter being a far bigger problem compared to the former. In reference to the WHO (1998) classifications for BMI, the findings from the National Health and Morbidity Surveys (NHMS) in Malaysia for 2006, 2011, 2015, and 2019 have shown a slight decrease in the prevalence of underweight (BMI < 18.5 kg/m^2) in adults aged 18 years and above from 2006 (8.5%) to 2019 (6.5%) with an overall total of less than 10%. However, based on the same surveys, the prevalence of both overweight and obesity (BMI > 24.9 kg/m^2) have increased over the years with the current prevalence of 50.1% in 2019 for combined overweight and obesity (Figure 2.5).

In terms of risks based on socio-demographic properties such as gender, age, ethnicity, and locality, the following is current data from NHMS 2019.The prevalence of overweight was highest in males (30.8%) but the reverse was shown for obesity in which the prevalence for females was 24.7% (IPH, 2020). The middle age group of 45-49 years old had the highest prevalence for overweight (39.6%) while the age group of 35-39 years old had the highest prevalence for obesity, 25.3% (IPH 2020). In terms of ethnic group, the prevalence of overweight was highest in Bumiputra Sabah (35.3%) while for obesity, the highest was among Indians (29.3%). As for locality, the prevalence of overweight was higher in urban areas (30.6%) but for obesity it was higher in rural areas, 19.8% (IPH, 2020).

Besides weight status using BMI, it is also important to report on the current status for abdominal obesity, which correlates with body fat around the central and abdominal area of the human body. Based on NHMS 2019, the overall prevalence of abdominal obesity using the International Diabetes Institute/ Western Pacific World Health Organization/ International Association for the Study of Obesity/ International Obesity Task Force (WHO/ IASO/ IOTF, 2000) guidelines (waist circumference ≥ 90 cm for males and ≥ 80 cm for females) was 52.6% in Malaysian adults (IPH, 2020). The highest prevalence was found in females (64.8%), age group of 60-64 years old (71.5%), among Indians (68.3%) and in urban areas, 53.1% (IPH, 2020).

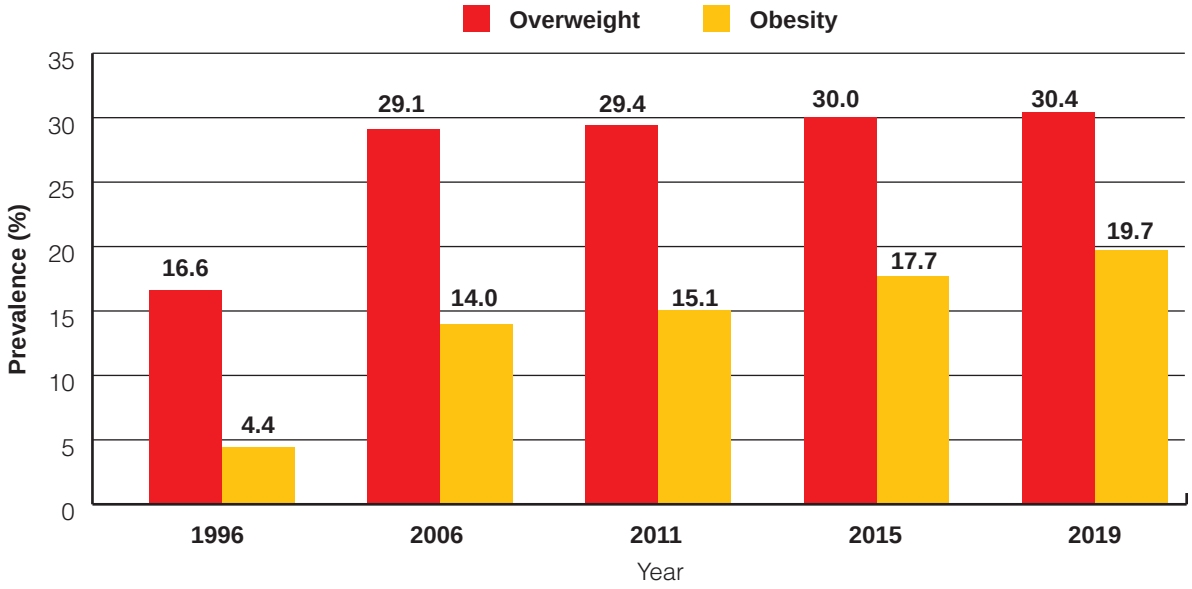


Figure 2.5: Prevalence of overweight and obesity in Malaysian adults based on NHMS 1996, 2006, 2011, 2015, and 2019
Source: Lim *et al.* (2000); IPH (2008, 2011, 2015 & 2020)

2.5 Key Recommendations

Key Recommendation 1

Weigh and measure yourself regularly to know your body weight and waist circumference status.

How to Achieve

1. Weigh yourself in light clothing and without shoes using the same weighing scale at least once a week, preferably before breakfast. Determine your BMI based on your weight (kg) and height (m) and ensure your BMI is within the normal range (BMI 18.5 to 24.9 kg/m^2).

2. Measure waist circumference using a measuring tape, at least once a month. The waist circumferences should be below the recommended cut-off points [male: ≤ 90 cm (35 inches); female: ≤ 80 cm (32 inches)].

Key Recommendation 2

Maintain healthy body weight by balancing calorie intake with physical activity.

How to Achieve

1. Eat according to calorie and serving size recommended based on age, sex and physical activity level.

2. Limit intake of ultra-processed foods in your daily diet.

3. Drink plain water instead of sugary drinks.

4. Exercise for at least 30 minutes daily and refer to the recommended physical activity pyramid (pg 65).

5. Prevent weight gain overtime.

Key Recommendation 3

If overweight or obese, aim for a safe and steady weight loss.

How to Achieve

1. Set a realistic goal and monitor weight loss of 0.5 to 1 kg per week.

2. Reduce your calorie intake from 500 kcal up to 1000 kcal per day by reducing serving size.

3. Use a smaller plate and eat slowly.

4. Limit intake of ultra-processed foods in your daily diet.

5. Avoid fad diets that promote fast weight loss in a short period of time.

6. Gradually increase physical exercise to 60 minutes per day (e.g., brisk walking, swimming and cycling) using the physical activity pyramid (pg 65) as a guide.

7. Seek advice of healthcare professional if you have chronic diseases.

Key Recommendation 4

If underweight, aim for steady weight gain.

How to Achieve

1. Eat three main meals (breakfast, lunch and dinner) including healthy snacks in between main meals every day.

2. Eat nutrient dense foods with high calorie content and limit intake of ultra-processed foods.

3. Engage in physical exercise for 30 minutes per day (e.g., brisk walking, swimming and slow jogging) using the physical activity pyramid (pg 65) as a guide. Do strength training exercise to increase the muscle mass.

4. Set a realistic goal and monitor weight increase of 0.5 to 1 kg per week.

Footnote:
Fad diets are popular diet plans that claim to reduce one's weight rapidly in a short period of time, however they are usually deficient in certain nutrients and very likely to have side-effects to human health in long-term practice.

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Appendices

Appendices

Table 2.3: Basal metabolic rate (MJ/day), total daily energy expenditure (MJ/day) and Physical Activity Level (PAL) of Malaysian

Subjects	Age (yr)	BMR	Male TDEE	PAL	BMR	Female TDEE	PAL
Adults	30-60	5.66	9.53	1.68	4.79	8.17	1.70
Armed Forces	20-30	5.74	12.08	2.10	NA	NA	NA
Elite Athlete	20-30	6.84	14.91	2.18	5.39	10.67	1.98

Moderately active-PAL = 1.75 (WHO, 1998);
PAL - physical activity level; TDEE - total daily energy expenditure; BMR - basal metabolic rate;
A compilation of numerous studies related to BMR, energy expenditure and PAL of Malaysians between 1994 to 2001;
Source: Ismail (2001)

Table 2.4: Examples of high calorie or energy-dense foods and lower calorie choices

High calorie or energy-dense foods	Calorie content per serving (kcal)	Lower calorie choices	Calorie content per serving (kcal)
Nasi briyani (rice only) 1 plate (245 g)	448	White rice 1 plate (159 g)	207
Fried chicken 1 piece (154 g)	436	Fish asam pedas 1 serving (55g)	122
Fried *kuetiau* 1 plate (380 g)	670	*Kuetiau* soup 1 bowl (360 g)	260
Fried *mee* 1 plate (300 g)	519	*Mee* soup 1 bowl (300 g)	204
Curry *mee* 1 bowl (520 g)	670	*Assam laksa* 1 bowl (680 g)	470
Roti canai 1 piece (84 g)	266	*Capati* 1 piece (64 g)	192
Popia goreng 1 piece (42 g)	113	*Popia basah* 1 piece (40 g)	74
Currypuff 1 piece (48 g)	153	Red bean dumpling 1 piece (50 g)	139
Teh tarik 1 mug (250 ml)	140	*Teh O* 1 mug (250 ml)	60
Carbonated drink 1 can (325 ml)	137	Plain water 1 glass (250 ml)	0

Source: NMM (2016); Suzana *et al.* (2015); Tee *et al.* (1997)

Table 2.5: Benefits of weight loss on health risks in obesity

Health risk	Benefits of 10 kg weight loss in a 100 kg person
Blood pressure	10 mmHg reduction in systolic blood pressure 20 mmHg reduction diastolic blood pressure Weight loss also reduces the need for medication in hypertensive patients
Blood Lipids	10% reduction in total cholesterol 15% reduction in LDL cholesterol 30% reduction in triglycerides 8% increase in HDL cholesterol
Diabetes	> 50% reduction in risk of developing DM 30-50% reduction in fasting glucose 15% reduction in HbA1c
Osteoarthritis	Decrease BMI >2 kg/m^2 associated with more than 50% decreased risk of developing osteoarthritis
Mortality	20-25% reduction in all-cause mortality 30-40% reduction in diabetes-related death 40-50% reduction in obesity-related cancer death

Source: SIGN (1996); MASO/ AAM/ MEMS (2004)

Be physically active every day

KEY MESSAGE

3

BE PHYSICALLY ACTIVE EVERY DAY

Prof. Dr. Poh Bee Koon, Assoc. Prof. Dr. Hazizi Abu Saad, Dr. Denise Koh Choon Lian, Dr. Wee Bee Suan, Ms. Inin Roslyza and Ms. Rosne Rafidah Abd Rani.

3.1 Terminology

Duration

Duration represents the temporal length of the activity, often quantified in minutes.

Frequency

Frequency represents the number of times a person engages in an activity over a pre-determined period, for example weekly.

Exercise

A subcategory of physical activity that is planned, structured, repetitive, and purposeful in the sense that the improvement or maintenance of one or more components of physical fitness is the objective. "Exercise" and "exercise training" frequently are used interchangeably and generally refer to physical activity performed during leisure time with the primary purpose of improving or maintaining physical fitness, physical performance, or health.

Health-enhancing physical activity

Health-enhancing physical activity (HEPA) refers to any form of physical activity that benefits health and functional capacity without undue harm or risk. Physical activity does not need to be strenuous to be effective, 30 minutes a day of moderate to vigorous intensity activity on five or more days a week, is considered sufficient for health benefit.

Intensity

Intensity refers to the degree of overload an activity imposes on physiological systems compared to resting states. The intensity of physical activity can be described as light, moderate or vigorous. These terms correlate to the absolute amount of energy expenditure or oxygen consumption associated with specific types of activity. Oxygen consumption is expressed in metabolic equivalents (METs), which are multiples of the resting rates of oxygen consumption during physical activity (Ainsworth *et al.*, 2011). One MET is defined as the amount of oxygen consumed while sitting at rest and is equal to 3.5 ml of oxygen per kg/minute. In general, **light intensity** activity is physical activity carried out at 1.0 to less than 3.0 METs; **moderate intensity** activity is defined as 3.0 to 6.0 METs; and more than 6.0 METs is categorized as **vigorous intensity** activity.

Muscle-strengthening activity

Physical activity and exercise that increase skeletal muscle strength, power, endurance, and mass (e.g., strength training, resistance training, or muscular strength and endurance exercises).

Physical activity

Physical activity is defined as any bodily movement produced by skeletal muscles that result in energy expenditure. Physical activity is a complex behaviour that involves many aspects. It can be described by four parameters: type, frequency, duration and intensity. It is closely related to, but distinct from, exercise and physical fitness. Exercise, on the other hand, means any planned, structured and repetitive bodily movements that are performed to improve physical fitness.

Physical activity has three main domains:

- **Occupational work**: activities undertaken during the course of work
- **Household and other chores**: activities undertaken as part of day-to-day living
- **Leisure-time physical activity**: activities undertaken during discretionary or free time. Activity is selected on the basis of personal needs and interest. It includes exercise and sports.

Physical activity level (PAL)

Physical activity level (PAL) is a method of quantifying or characterising physical activity, commonly according to its type, frequency, duration and intensity (Welk, 2002).

Physical fitness

A set of attributes or characteristics that people have or achieve that relates to the ability to perform physical activity (Caspersen, Powell & Christenson, 1985).

Screen time

Sedentary screen time is time spent passively watching screen-based entertainment, such as television, video, computer, electronic games, mobile devices or other visual devices. Sedentary screen time does not include active screen-based games where physical activity or movement is required.

Sedentary behaviour

Any waking behaviour characterized by an energy expenditure of 1.5 METS or lower while sitting, reclining, or lying. Most desk-based office work, driving a car, and watching television are examples of sedentary behaviours; these also apply to those unable to stand, such as wheelchair users. When operationalised, sedentary behaviour includes self-reported low movement sitting (leisure time, occupational, and total), television (TV viewing or screen time), and low levels of movement measured by devices that assess movement or posture.

Sport

Sport covers a range of activities performed within a set of rules and undertaken as part of leisure or competition. Sporting activities involve physical activity carried out by teams or individuals and may be supported by an institutional framework, such as a sporting agency.

3.2 Introduction

Physical activity is important for the health and well-being of people of all ages. It has long been recognised as an important factor in enhancing health and reducing the risk of various chronic diseases (DHHS, 2018). There is a dose-response relationship between physical activity and health status (Warburton & Bredin, 2017). People who are physically active tend to be healthier than their physically inactive counterparts; they experience less health problems, such as obesity, cardiovascular disease, type 2 diabetes mellitus, osteoporosis and cancer particularly colon, breast and prostate cancer (Wahid *et al.,* 2016; Lear *et al.,* 2017). Regular physical activity also appears to promote a sense of well-being (Wiese, Kuykendall & Tay, 2018) better health-related quality of life (Marker, Steele & Noser, 2018), helps in releasing tension, and decrease the likelihood of anxiety (Anderson & Shivakumar, 2013; Stonerock *et al.,* 2015), depression (Schuch *et al.,* 2018) and poor cognitive development (Gao *et al.,* 2018). Long term physical activity may also modify brain structure and functions, as reported in a recent study among young healthy twins in Finland (Tarkka *et al.,* 2019). The new WHO Guidelines on Physical Activity and Sedentary Behaviour also reaffirmed that physical activities confer benefits for various health outcomes, such as improved all-cause mortality, cardiovascular disease mortality, hypertension, site-specific cancers, type-2 diabetes, mental health (reduced symptoms of anxiety and depression); cognitive health, and sleep; and measures of adiposity (WHO, 2020a).

Globally, physical inactivity is rising in many countries, including in Malaysia, where only a small percentage of the population is involved in regular and adequate exercise (Chan *et al.,* 2017). General levels of physical activity have declined since the industrial revolution, where development of new technologies has enabled people to reduce the amount of physical labour needed to accomplish many tasks in their daily lives (Hallal *et al.,* 2012). Lack of physical activity is a global health hazard and is increasing rapidly in both developed and developing countries where 1 in 4 adults (1.4 billion worldwide) is not active enough while more than 80% of the world's adolescents is insufficiently physically active (WHO, 2018). Generally, physical inactivity is estimated to cause 5.0 million deaths globally. People who are insufficiently active have a 20 to 30% of increased risk of death compared to people who are sufficiently active (WHO, 2020b). About 30% of ischemic heart disease, 27% of diabetes mellitus, and 21 to 25% of breast and colon cancer burden reported yearly, are caused by physical inactivity (WHO, 2010). More recently, sedentary behaviour, such as prolonged sitting time, has been associated with higher risk of mortality from all causes (Patel *et al.*, 2018).

The bottom line is that physical activity brings health benefits that far outweigh the risks of adverse events (DHHS, 2018), hence it is vital to emphasise the importance of physical activity in order to encourage the nation and provide them with achievable steps of becoming more physically active.

3.3 Scientific basis

3.3.1 Physical activity and chronic disease prevention

3.3.1.1 Cardiovascular disease, diabetes, cancer and all-cause mortality

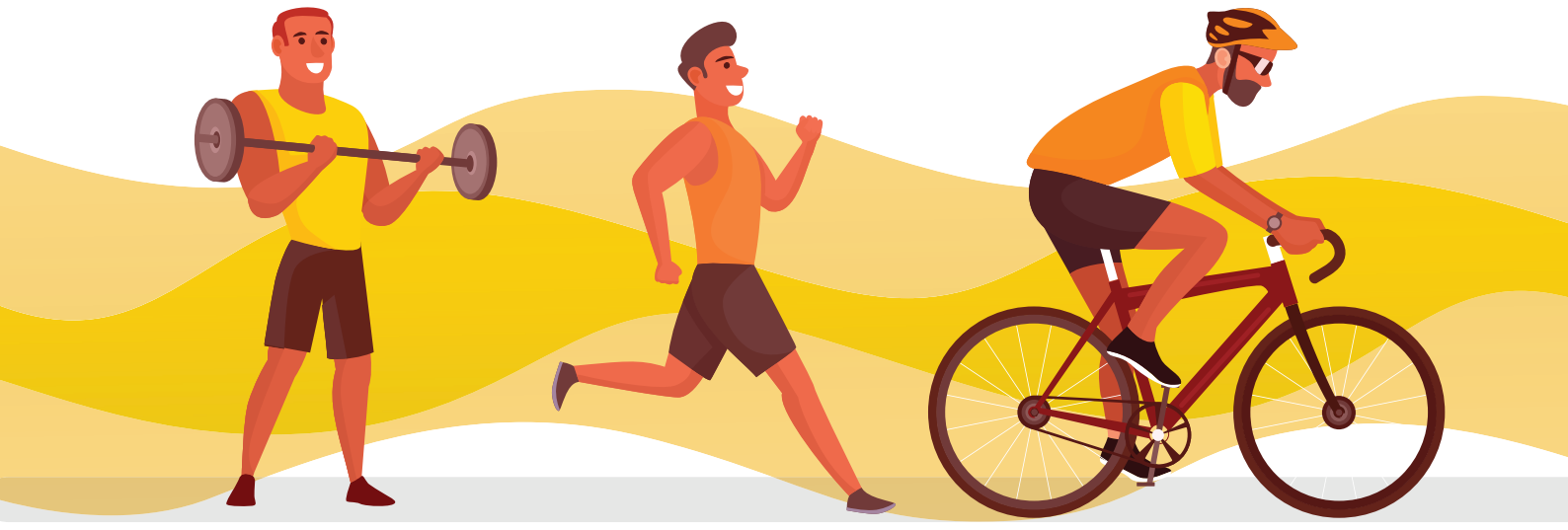
Physical activity contributes positively to human health. Many studies have shown significant and positive associations between physical activity with a number of adverse health outcomes. These include risk of type 2 diabetes mellitus (T2DM), cardiovascular disease (CVD), and several types of cancer as well as all-cause mortality.

A large prospective study of 17,265 men and 13,375 women aged 20 to 93 years in Copenhagen found that people who spent three hours a week commuting to work by bicycle had a substantial decrease in the risk of death compared to those who did not commute by bicycle (Andersen *et al.*, 2000). Blair (2007) concluded that there is sufficient evidence-base for understanding the benefits of physical activity and chronic disease prevention.

Wahid *et al.* (2016) in their meta-analysis of 33 studies concluded that those who increased their physical activity level from being inactive to achieving 150 minutes of moderate-intensity aerobic activity per week had decreased risk of CVD incidence [RR 0.83 (0.77-0.89)] and CVD mortality [RR 0.77 (0.77-0.89)]. They also indicated a decrease in risk of T2DM incidence by 26% for those who increase their physical activity from being inactive to achieving 150 minutes of moderate-intensity aerobic activity per week. Another systematic review and dose-response meta-analysis by Kyu *et al.* (2016) concluded that the risk for ischemic heart disease among individuals who are low active, moderately active, and highly active, was reduced by 16%, 23%, and 25%, as compared to inactive men and women. As for ischemic stroke, reduction of risk was as much as 16%, 19%, and 26% for the same categories of physical activity. Comparing individuals in different physical activity categories, the reductions in risk for diabetes is 14% for those in low active, 25% among moderately active, and 28% for highly active as compared to those in the inactive category (Kyu *et al.*, 2016).

There are multiple mechanisms through which physical exercise has the potential to reduce obesity, reduce inflammation, up-regulate mechanisms governing physiological antioxidant generation and drastically increase cellular sensitivity to endogenous, or exogenous insulin. Increased level of habitual physical activity in moderate measures has the potential to positively impact the health of those with T2DM, insulin resistance and pre-diabetes (Venkatasamy *et al.,* 2013).

A meta-analysis that analysed 19 studies on colon cancer and 35 studies on breast cancer reported reduction in risk of colon cancer by 10%, 17%, and 21%, while the reduction in risk of breast cancer was 3%, 6%, and 14%, respectively, among those who are low active, moderately active, and highly active, as compared to inactive individuals (Kyu *et al.*, 2016) while de Rezende *et al.* (2018) concluded that the association between physical activity and risk of breast and colon cancer were consistent. Leisure-time physical activity has been associated with lower risks of 13 cancers, namely esophageal adenocarcinoma, liver, lung, kidney, gastric cardia, endometrial, myeloid leukaemia, myeloma, colon, head and neck, rectal, bladder, and breast (Moore *et al.,* 2016). The World Cancer Research Fund and the American Institute for Cancer Research in their third report concluded that evidence for the protection of physical activity against colon cancer is convincing and probable against postmenopausal breast cancer and cancer of the endometrium. However, evidence suggesting that it protects against premenopausal breast cancer, cancers of the lung and pancreas is limited (WCRF/ AICR, 2018).



3.3.1.2 Obesity and weight management

Persistently higher PA level has been associated with decreased rate of weight gain even after controlling for genetic liability and childhood environment. There is also a wealth of evidence from controlled trials that exercise (or PA) carried out over long periods of time can generate energy deficit and thereby induce weight loss (Wiklund, 2016).

Regular physical activity can buffer the risks associated with being overweight or obese, independent of its effect on body weight. He and Baker (2004) described a prospective study with a large sample size documenting relationship between physical activity and health outcomes in middle-aged adults. They found that being overweight or obese was associated with declines in physical health and development of a new physical difficulty (such as mobility difficulties). However, physical activity, as defined by regular light or vigorous exercise or household chores, reduced the risk of declining physical health independently of the ability to achieve ideal body weight and other confounds (such as age, race, sex, socioeconomic status, smoking and alcohol use).

A positive and significant dose-response association is evident between siting time and physical inactivity with body weight status. As indicated by Kong *et al.* (2015) low physical activity status [adjusted odds ratios (AORs)= 1.03, 1.12] and long leisure sitting time and (AORs=1.15, 1.32) were positively associated with overweight and obese.

Weight management interventions to reduce body weight are usually more effective when the strategy involves a combination of diet and physical activity, as compared to diet or physical activity alone. In their critical review of the literature, Chin, Kahathuduwa and Binkx (2016) indicated that diet plus physical activity usually result in 8-11% weight loss after 6 months of intervention as compared to approximately 2-3% of weight loss after intervention using physical activity only strategy.

3.3.1.3 Bone, joint and muscle health and performance

Studies have reported positive effects of either a physically active lifestyle or exercise interventions on intermediate markers of bone health, such as bone mineral content (BMC) and bone mineral density (BMD) (Howe *et al.,* 2011). Four possible mechanisms that may explain the beneficial effects of physical activity in reducing the risk of osteoporosis are that it (1) increases bone mineral accrual during maturation, (2) attenuates the rate of bone mineral loss during aging, (3) enhances bone strength, and (4) reduces the risk of falls by improving muscle strength, flexibility, coordination and balance.

Literature has provided moderate to strong evidences on the importance of physical activity in optimising bone health during the developmental years. Even though the beneficial effects of physical activity in the long-term is not well known, observational studies suggest it plays a strong role in preventing fractures during adulthood. Exercise activities during growth and human development period can maximise peak bone mass and hence delay the onset of osteoporosis (Santos, Elliott-Sale & Sale, 2017). Lifelong exercise is important in the prevention and management of osteoporosis (Beck *et al.,* 2017). This is possibly due to the benefits of physical activity on BMD, as indicated by various randomised controlled trials. However, at this point in time, there is still a lack of information to claim a dose-response relationship between physical activity and bone health.

There is a wealth of evidence depicting the impact of high-intensity resistance exercise in inducing muscle hypertrophy, through the enhancement of muscle mass and strength. However, studies have shown little or no anabolic effects on muscle through aerobic exercise and have concluded that aerobic fitness does not have an impact on fat-free mass (Hawkins *et al.*, 2001).

There is moderate to strong evidence that physical activity plays an essential role in the maintenance of bone health, although information is lacking to define the type and dose of activity required to optimise the benefits. Physical activity has also successfully shown beneficial effects on pain and disability management in people with knee osteoarthritis (Iwamoto *et al.*, 2011). It is evident that strength training has the ability to preserve muscle mass with aging of an individual, whilst aerobic exercise exudes multiple favourable effects on muscle quality despite having little effect on the preservation of muscle mass.

3.3.1.4 Mental and neurological health

Multiple studies (Carek *et al.*, 2011; Chan *et al.*, 2019) indicate that physical activity improves mood and reduces symptoms of depression and anxiety, while aerobic-exercise intervention showed significant improvements in depression comparable to individuals receiving psychotropic treatment and individuals in the aerobic-exercise condition had significantly lower relapse than those in the medication group.

A systematic review by Lubans *et al.* (2016) highlighted that participation in physical activity can improve physical self-perceptions and enhance self-esteem in young people. However, more studies are needed since inconsistent findings had been reported on the relationship between physical activity, fitness, cognition, and academic achievement (Donnelly *et al.*, 2016).

3.3.2 Physical activity and sleep recommendations for general adult population

The World Health Organization (WHO, 2010; WHO, 2018; WHO, 2020b) recommends adults aged 18-64 years old to participate in physical activities that include leisure physical activity, active transportation (i.e., walking, cycling), occupational, household chores, play games, sports or planned exercise, in the context of daily, family and community activities.

The latest WHO recommendation advocates for adults to engage in 150 to 300 minutes of moderate-intensity aerobic physical activity; or do at least 75 to 150 minutes of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity activity, throughout the week, for substantial health benefits (WHO, 2020b). The recommendation also urged adults to undertake regular physical activities of any MVPA bouts of any duration as all physical activity is beneficial and every move count towards better health.

For additional health benefits, adults should increase their moderate-intensity aerobic physical activity to more than 300 minutes per week; or engage in more than 150 minutes equivalent combination of vigorous-intensity activity; or an equivalent combination throughout the week. Muscle strengthening activities involving major muscle groups at moderate or greater intensity should be done on at least two days a week (WHO, 2020; WHO, 2010; WHO, 2018).

For adults who are not active, or with disease limitations, reducing sedentary behaviour, by moving from the category of "no activity" to "some levels" of activity, has health benefits. Physical activity reduces the risk of all-cause mortality, cardiovascular disease incidence and mortality, high blood pressure; and also reduces the incidence of type 2 diabetes and some cancers, and depression. Physical activity is also associated with a higher level of cardiorespiratory and muscular fitness compared, and more likely to achieve weight maintenance, and have a healthier body mass and composition (WHO, 2018). It is recommended that adults should limit the time spent being sedentary, and sedentary time should be replaced with physical activity of any intensity (including light intensity) (WHO 2020).

Experts are in agreement that sleep is very important for optimal health. Sleep serves critical role in brain function, including neuro-behavioural, cognitive and safety-related performance (Maia *et al.*, 2013), memory consolidation (Tononi & Cirelli, 2014), mood regulation (Minkel *et al.*, 2012), nociception (Roehrs *et al.*, 2012), and clearance of brain metabolites (Xie *et al.*, 2013). Sleep is also involved in systematic physiology, including metabolism (Vgontzas *et al.*, 2014), appetite regulation (Speath, Dinges & Goel, 2013), immune and hormone function (Prather, 2012), and cardiovascular systems (Petrov *et al.*, 2014). Healthy sleep requires adequate duration, good quality, appropriate timing and regularity. The sleep environment contributes to a restful sleep. Sleep Council UK (2020) has recommended six elements that need to be considered to ensure quality sleep, including (i) comfortable bed, bedding, and pillows, (ii) suitable temperature, (iii) ambient lighting, (iv) sudden or continuous noise, (v) arousing stimuli, such as electronic devices, and (vi) bodily, mental, and behavioral factors.

Sleep duration is one of the most frequently investigated sleep measure in relation to health, thus, most sleep recommendation focuses on this parameter. Current evidence supports the general recommendation for obtaining 7 or more hours of sleep per night on a regular basis to promote optimal health among adults aged between 18 to 60 years old (Watson *et al.*, 2015). In general, there was consensus that 6 hours of sleep or less was inappropriate to support optimal health in adults, while the appropriateness of 9 or more hours of sleep on optimal adult health could not be ascertained with certainty. However, there may be individual variability on optimal sleep duration due to differences in genetics, behaviour, medical and environment.

3.3.3 Physical activity recommendations for specific groups

3.3.3.1 Pregnant women

According to the American College of Obstetricians and Gynaecologists (ACOG, 2020), regular physical activity in all phases of life, including pregnancy, promotes health benefits to the expectant mothers. Physical activity in pregnancy has minimal risks and has been shown to benefit most women, although some modification to exercise routine may be necessary because of normal anatomic and physiologic changes and foetal requirements. Therefore, women with uncomplicated pregnancies should be encouraged to engage in aerobic and strength conditioning exercise before, during and after pregnancy (ACOG, 2020).

The latest WHO Guidelines on Physical Activity and Sedentary Behaviours also stated that among pregnant and postpartum women, physical activity during pregnancy and the postpartum period confers benefits on the following maternal and fetal health benefits: decreased risk of pre-eclampsia, gestational hypertension, gestational diabetes, excessive gestational weight gain, delivery complications and postpartum depression, and fewer newborn complications. Participating in physical activity during pregnancy was also shown to have no adverse effects on birthweight and no increase in risk of stillbirth (WHO, 2020b). It is recommended that all pregnant and postpartum women without contraindication should undertake regular physical activity throughout pregnancy and the postpartum period.

Pregnant women should participate in at least 150 minutes a week of moderate intensity aerobic physical activity; and incorporate a variety of aerobic and muscle strengthening activities. Adding gentle stretching may also be beneficial. In addition, women who, before pregnancy, habitually engaged in vigorous intensity aerobic activity, or who were physically active, can continue these activities during pregnancy and the postpartum period (WHO, 2020b).

In the Physical Activity Guidelines for Americans (DHHS, 2018), recommendations for healthy pregnant mother, who are not already highly active or doing vigorous-intensity activity, is to get at least 150 minutes of moderate-intensity aerobic activity a week during pregnancy and in the postpartum period. Preferably, this activity should be spread throughout the week. On the other hand, pregnant women who habitually engage in vigorous-intensity aerobic activity or who are highly active can continue their physical activity during pregnancy and in the postpartum period provided that they remain healthy; and discuss with their healthcare provider how and when physical activity should be adjusted over time.

The New South Wales Government of Australia has suggested that staying active during pregnancy can help to maintain healthy weight (NSWA, 2016). Pregnant women are encouraged to aim for 30 minutes of moderate exercise, ideally walking or swimming, on most days of the week. Nevertheless, exercise that involve excessive stretching need to be done carefully as it could overstretch ligaments in the body, such as hips, knees, ankles or elbow joints, as ligaments tend to become looser during pregnancy and are therefore more prone to injury. High impact activity, such as jumping, or exercise which risks falling or injury to the abdomen, should be avoided. Besides, activities where oxygen supply is limited, such as scuba diving or mountain climbing, should also be avoided.

The 2018 Canadian Guideline for Physical Activity throughout Pregnancy (Mottola *et al.*, 2018) had recommended that all women without contraindications should remain physically active throughout pregnancy. According to the guidelines, pregnant women should accumulate at least 150 minutes of moderate intensity physical activity each week to achieve clinically meaningful health benefits and reductions in pregnancy complications; of which a minimum of three days per week of physical activity should be accumulated. However, pregnant women are encouraged to be physically active every day.

As for women with contraindications, safety precautions were suggested. Women with absolute contraindications, such as ruptured membrane, premature labour, unexplained persistent vaginal bleeding, placenta praevia after 28 weeks of gestation, pre-eclampsia, incompetent cervix, intrauterine growth restriction, high-ordered multiple pregnancy, uncontrolled type 1 diabetes, uncontrolled hypertension, uncontrolled thyroid disease, and other serious cardiovascular, respiratory or systemic disorder, may continue their usual activities of daily living but should not participate in more strenuous activities (ACOG, 2020; Mottola *et al.*, 2018).

On the other hand, women with relative contraindications, such as recurrent pregnancy loss, gestational hypertension, history of spontaneous preterm birth, mild or moderate cardiovascular disease or respiratory disease, symptomatic anaemia, malnutrition, eating disorder, twin pregnancy after the 28th week, and other significant medical conditions, should discuss with their obstetric care provider prior to participation in physical activity (Mottola *et al.*, 2018). In cases where the pregnant woman experiences vaginal bleeding, dizziness, shortness of breath before exercising, chest pain, headache, muscle weakness, calf pain or swelling, regular painful contractions of the uterus, decreased foetal movement, and amniotic fluid leakage, exercise should be immediately terminated (Kader & Naim-Shuchana, 2014).

3.3.3.2 Overweight/ obese

A consensus statement formed in 2002 by the International Association for the Study of Obesity (IASO) recommended approximately 45 to 60 minutes, or 1.7 PAL (Physical Activity Level) per day of moderate intensity activity to prevent the transition to overweight or obesity. National Institute of Health and Clinical Excellence recommended the same 45 to 60 minutes moderate activities each day for obesity prevention, in the absence of a reduction in energy intake (NICE, 2006). For preventing weight gain or regain in formerly obese individuals, 60 to 90 minutes of moderate intensity activity or lesser amounts of vigorous activity is required (Saris *et al.*, 2003). The same amount of time and intensity of activity is also recommended by NICE for prevention of obesity (NICE, 2014).

The American College of Sports Medicine Position Stand stated that overweight and obese individual should participate in at least 150 minutes of moderate intensity physical activity to elicit modest reduction in body weight (ACSM, 2009). Nevertheless, there is likely a dose effect of physical activity, with greater weight loss and enhance prevention of weight regained with doses of physical activity that approximate 250 to 300 minutes in a week (about 2000 kcal per week) of moderate intensity physical activity.

The 2018 Physical Activity Guidelines for Americans stated that moderate-intensity aerobic physical activity of more than 150 minutes a week is needed to achieve weight stability (DHHS, 2018). Besides, muscle strengthening activities may help promote weight maintenance, although not to the same extent as aerobic activities. Some overweight or obese individuals may require the equivalent of 300 or more minutes of moderate-intensity physical activity a week to lose substantial amount of weight (more than 5% of body weight) and to keep a significant amount of weight off once it has been lost. Muscle strengthening activities can also help maintain lean body mass during weight loss.

3.3.3.3 Exercising during airborne infectious pandemics

The recent COVID-19 pandemic has caused drastic changes to our lifestyle. Worldwide lockdown and physical distancing guidelines with varying degrees of strictness have been implemented throughout the world, and have impacted the physical activity behaviour of the population. As physical distancing is an important measure to reduce the spread of airborne infections, it is recommended that physical activities that involve body contact, such as team sports, should be avoided. Other measures recommended to maintain physical distancing when exercising are to: (i) choose non-crowded locations, (ii) keeping a distance of at least 2 meters apart from others when exercising outdoors, (iii) limit time spent exercising in indoor shared environments such as gyms or fitness centres, (iv) keeping a distance of 10 meters when exercising indoors, and (v) moderate intensity physical activity should be emphasised, rather than strenuous exercise. These measures can help to limit the dispersion and over-inhalation of respiratory droplets and thus decrease exposure to airborne viruses (Dominski & Brandt, 2020).

3.4 Current status

In Malaysia, the National Health and Morbidity Survey (NHMS) has been an important platform for monitoring the health of the population in Malaysia. The objectives of the NHMS are to provide community-based data on the pattern of common health problems, health service utilisation and health expenditure in the community. To determine the prevalence of physical activity in Malaysian adults, face-to-face interviews using the short version of International Physical Activity Questionnaire (IPAQ) has been impelemented in NHMS surveys since NHMS III in 2006 (IPH, 2008).

Statistics from NHMS show that physical activity among adults aged 18 years and older appear to have improved over a decade, with the prevalence of those considered physically active increasing from 63.3% in 2011, to 66.5% in 2015, to 74.9% in 2019 (IPH, 2020). Of the physically active adults reported in the 2015 survey, 25.4% had health-enhancing physical activity while 41.1% were minimally active (IPH, 2015).

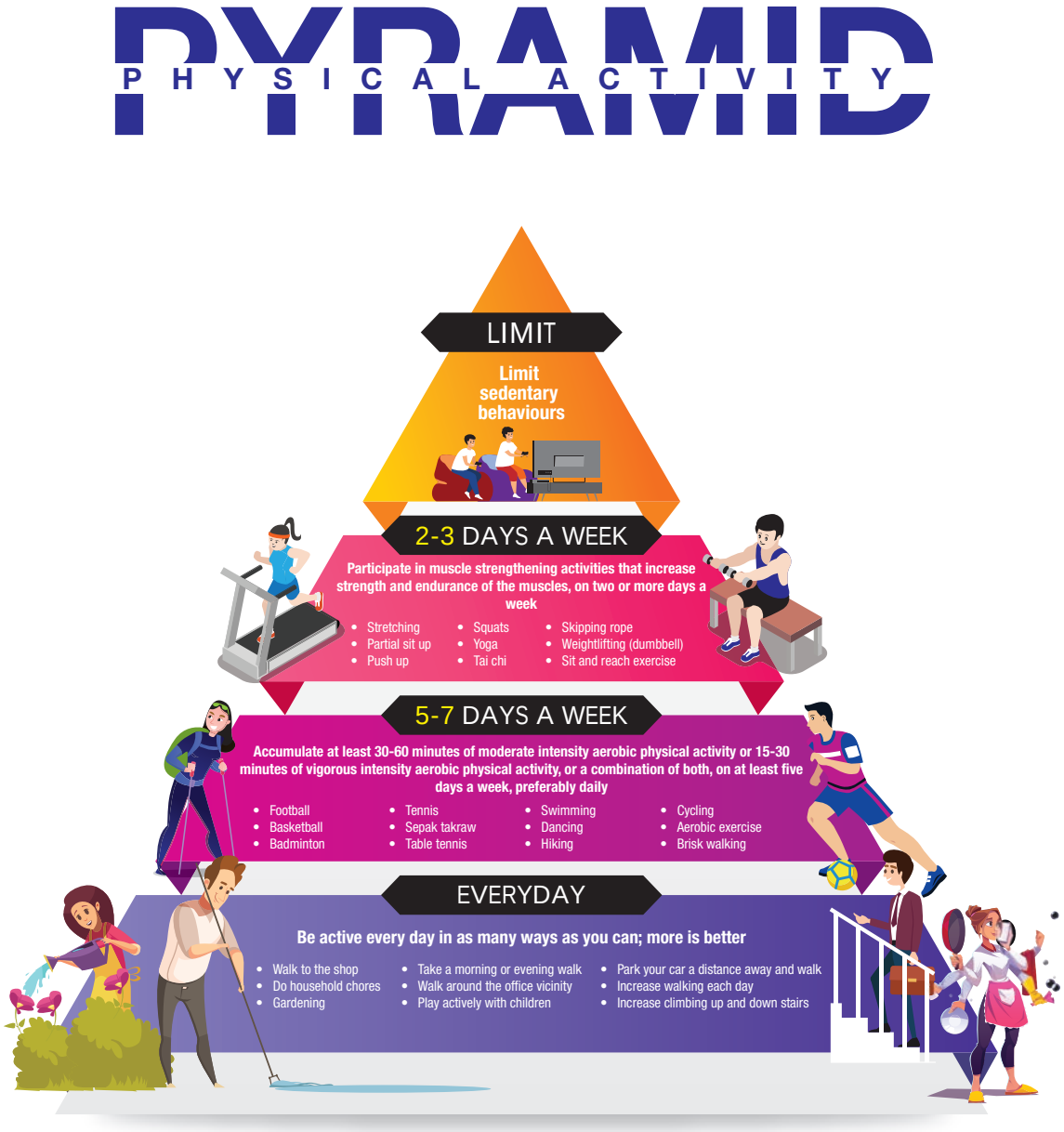
Compared to other countries that have used the IPAQ, the prevalence of physically active population in Malaysia is slightly higher than in Taiwan (57.7%) and Japan (56.7%) but considerably lower than in China (93.1%) and Australia (82.9%) (Bauman *et al.*, 2009). Despite increasing physical activity, Malaysia now ranked as Southeast Asia's fattest country according to recent reports by the WHO, with the percentages of overweight or obese men and women being 43.8% and 48.6%, respectively (Chan *et al.*, 2017).

In Malaysia, the NHMS conducted in year 2019 reported that some 25.1% of adults were physically inactive (IPH, 2020). There were significantly more women (28.2%) than men (22.1%) who reported being physically inactive. There was also significantly higher prevalence of those who were physically inactive in the urban (26.5%) compared to rural (20.3%) population. The level of physical activity decreased among older age groups and was most apparent in the elderly population.

Prior to that, the prevalence of physical inactivity was even higher; whereby the NHMS conducted in 2015 reported 33.5% of adults were physically inactive (IPH, 2015) and NHMS III conducted in year 2006 reported 43.7% of adult population were inactive (IPH, 2008). Women were significantly more inactive (2015 38.3% vs. 2006 50.5%) compared to men (2015 28.9% vs. 2006 35.3%). Significant differences between urban and rural populations were also observed, whereby urban adults were found to be more inactive (2015 35.0% vs. 2006 45.6%) as compared to rural adults (2015 28.7% vs. 2006 40.1%).

In view of the low levels of physical activity among Malaysians, it has been deemed important to include and highlight physical activity when revising the Malaysian Dietary Guidelines in 2010 as a measure to promote physical activity amongst our nation (NCCFN, 2010).

The Physical Activity Pyramid (Figure 3.1) is a simple and useful guide on how to be physically active every day. Activities listed at the base of the pyramid are activities that should be incorporated in daily life and what an individual should do most often. Activities listed at the top of the pyramid are activities that are sedentary, and an individual should limit these activities during waking hours. The following recommendations for physical activities are based on this physical activity pyramid.



Note:

- Sleep regularly for at least 7 hours every night.
- For activities to be done on 5-7 days a week, examples are listed according to intensity from vigorous at the top to moderate intensity at the bottom. An activity is considered moderate intensity when an individual is able to talk but cannot sing comfortably while doing the activity; vigorous intensity activity, on the other hand, makes an individual "huff and puff".

Figure 3.1. Physical Activity Pyramid

3.5 Key Recommendations

Key Recommendation 1

Be active every day in as many ways as you can; more is better.

How to Achieve

1. Always attempt to incorporate more physical activities in daily life, as a form of exercise. Think of each movement as an opportunity for improving health, rather than as an inconvenience.

2. Do these activities whenever possible so as to be more active:

    a) Choose to walk up the stairs, instead of taking the lift or escalator.

    b) Choose to walk or cycle to the shop, *surau* or other places of worship, instead of driving or riding a motorcycle.

    c) Do housework manually, such as sweeping and mopping the floor, washing the car and motorcycle.

    d) Park car a distance away and walk to intended destination.

    e) Do gardening, such as trimming plants or moving pots.

    f) Take a walk with children or pets.

3. Emerging technologies, such as activity or fitness tracker watches or step counters, can be used as a tool to increase physical activity and reduce sedentary behavior. Fitness or workout phone applications can also be used to track physical activity and fitness.

Key Recommendation 2

Accumulate at least 30-60 minutes of moderate intensity aerobic physical activity or 15-30 minutes of vigorous intensity aerobic physical activity, on at least five days a week, preferably daily. Alternatively, a combination of both moderate and vigorous intensity aerobic physical activities can be done throughout the week. When fitness improves, the intensity level and the amount of time spent on physical activity can be gradually increased for additional health benefits.

How to Achieve

1. Start off by doing moderate to vigorous intensity physical activities, such as playing badminton, brisk walking, aerobic exercise, cycling, swimming, hiking, jungle trekking, fun run or marathon. A moderate intensity activity is when an individual is able to talk but cannot sing comfortably while doing the activity.

2. Remember, moderate intensity activities can be incorporated into daily life, as part of work, transport (walking and cycling), sport and leisure, as well as household chores.

3. As fitness improves, aim for more than 60 minutes or more of moderate-intensity activities, or for more than 30 minutes or more of vigorous physical activity that makes you "huff and puff", such as brisk walking (faster pace), jogging, playing football, netball, basketball, squash or tennis, every day.

4. Participate in online exercise programs, follow along exercise videos, or workout using treadmill or stationary bicycle or other home gym equipment, when exercising outdoors is not possible.

For a more comprehensive list of moderate and vigorous-intensity activities, refer to Table 3.1.

Key Recommendation 3

Participate in muscle-strengthening activities that increase strength and endurance of the muscles, on two or more days a week.

How to Achieve

1. Perform exercises that improve muscle strength and endurance, using either machine, on two or more days a week, preferably on non-consecutive days.

2. Do exercises like squats, push-ups, sit-ups or lunges that use own body weight for resistance as muscular-strengthening activities.

3. If using machine or free weights, exercises to improve muscle strength should be performed in sets of 8 to 12 repetitions for at least 2 to 3 sets.

    Exercises to improve muscle endurance should be performed in sets of 15 to 25 repetitions for at least 2 to 3 sets.

    Perform different types of exercises that condition various major muscle groups. As muscle strength improves, the resistance can be increased accordingly.

4. Perform other muscular-strengthening activities around the house, such as heavy gardening like digging or shovelling, climbing stairs, cycling, lifting or carrying heavy loads.

For a more comprehensive list of muscle-strengthening activities, refer to Table 3.2.

For examples of weekly physical activity plan that incorporate moderate and vigorous intensity physical activity as well as muscle-strengthening exercises, refer to Table 3.3.

Key Recommendation 4

Limit sedentary behaviours.

How to Achieve

1. Limit sedentary screen time, particularly those for recreational purposes. For example, watching television, playing video games, or using the computer, smart phone, tablet or surfing the internet.

2. Break your sedentary time often with active movements, while at work or while engaged in other sedentary activities. Examples of sedentary break activities are simple stretching or walking.

Key Recommendation 5

Sleep regularly for at least 7 hours every night.

How to Achieve

1. Keep to a regular bedtime. Bedtime routines should be done in a conducive environment with comfortable temperature, suitable lighting and reduced noise.

2. Avoid screen time at least 30 minutes before bedtime. Do not use electronic devices in bed.

3. Avoid consumption of caffeinated sugary foods or drinks, such as coffee, at least four hours before bedtime.

Additional recommendations: Specific groups

Pregnant women

Pregnant women should accumulate at least 150 minutes of moderate-intensity physical activity each week over a minimum of 5 days per week, preferably every day. Activities that pregnant women can perform include aerobic (brisk walking, swimming and other suitable aqua activities) and resistance exercises (low resistance, yoga) and gentle stretching. Pelvic muscle training (e.g., Kegel exercises) is recommended to be performed on a daily basis to strengthen muscles that support bladder, uterus and bowels.

Pregnant women who are not used to exercising should begin with as little as 5 minutes a day and increase by 5 minutes per week until 30 minutes a day is reached. For women who are already active before pregnancy, it is possible to continue with pre-pregnancy routine, but with approval from a health care professional. Warning signs to terminate exercise during pregnancy are vaginal bleeding, dizziness, shortness of breath before exercising, chest pain, headache, muscle weakness, calf pain or swelling, regular painful contractions of the uterus, decreased foetal movement, and amniotic fluid leakage.

Overweight/ obese

For modest weight loss, those with previously sedentary lifestyle, a total of more than 30 minutes a day of moderate-intensity physical activity is suggested. For clinically significant weight loss, at least 45 minutes of moderate-intensity physical activity daily is recommended. To prevent the transition to overweight or obesity, approximately 45 to 60 minutes per day of moderate intensity physical activity is required, especially if there is no reduction in energy intake. For weight control and for preventing weight gain or regain among formerly obese individuals, a total of 60 to 90 minutes a day of moderate intensity activity is required. Additionally, strength training is also recommended.

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Appendices

Appendices

For second level of physical activity pyramid, examples of moderate and vigorous activities defined by level of intensity are as follows:

Table 3.1: Examples of moderate and vigorous activities defined by level of intensity

Moderate activity 3.0 to 6.0 METs (3.5 to 7 kcal/min)	**Vigorous activity** Greater than 6.0 METs (more than 7 kcal/min)
Aerobic activities:	**Aerobic activities:**
• Walking at a moderate or brisk pace of 80 to 100 m/min on firm and level surface indoor or outdoor • Walking while carrying an object or a child weighing around 7 kg on firm and level ground. • Walking while pushing a stroller with child or an adult in a wheelchair at 55-80 m/min • Running at a speed less than 100 m/min • Actively playing with children – walking, running, or climbing, playing active children games (hopscotch, dodgeball, t-ball) • Carrying an object or child weighing from 0.5-12 kg up a flight of stairs • Carrying an object or child weighing from 11-33 kg down a flight of stairs • Child care: Bathing, grooming, feeding, occasional lifting of child while standing, moderate effort • Elder care: Bathing, dressing, moving into and out of bed, a disabled adult • Pet care: Bathing, grooming a dog • House cleaning: Moderate to vigorous effort in household task (i.e., cleaning, sweeping, washing the car, washing the windows, washing dishes) • Playing Frisbee recreationally • Skateboarding moderate to vigorous effort • Ice skating less than 14 km/h • Bicycling 9 to 16 km/h, level terrain, or with few hills • Stationary bicycling – light to moderate effort between 30 to 89 watts • Step aerobics with less than 4-inch step • Ballroom dancing such as waltz, foxtrot, samba, tango, mamba, cha cha, slow dancing • Traditional dancing such as joget, mak yong • Ballet, modern dance and jazz rehearsal or class • Horseback riding – trotting, walking • Saddling or grooming a horse • Trampolining – recreational and competitive	• Race-walking and aerobic walking at 130 m/min or faster on a firm and level surface indoor or outdoor • Jogging while pushing a stroller designed for sport use • Jogging or running • Vigorously playing with children – running longer distances or playing strenuous games with children • Carrying an adult or a child up a flight of stairs • Standing or walking while carrying an adult or a child • Wheeling your wheelchair • Walking and climbing briskly up a hill • Roller skating or in-line skating at a brisk pace • Bicycling more than 16 km/h or bicycling on steep uphill terrain • Stationary bicycling – using vigorous effort • Stationary bicycling – moderate to vigorous effort between 90 to 270 watts • Aerobic exercise – high impact • Step aerobics with 6 to 12-inch step • Teaching an aerobic dance class • Professional ballroom dancing – energetically • Traditional dancing – such as *zapin, joget lambak, kuda kepang* • Modern dancing, disco – energetically • Ballroom dancing (i.e. line dancing, polka, folk, irish step dancing) • Ballet, modern dance and jazz performance, vigorous effort • Horseback riding – galloping or jumping • Polo, on horseback • Ice skating at a speed more than 14 km/h • In-line skating (rollerblading) at a speed 14 to 24 km/h

Table 3.1: Examples of moderate and vigorous activities defined by level of intensity (cont...)

Moderate activity 3.0 to 6.0 METs (3.5 to 7 kcal/min)	**Vigorous activity** Greater than 6.0 METs (more than 7 kcal/min)
Aerobic activities (games):	**Aerobic activities (games):**
• Table tennis • Tennis – doubles or hitting balls, non-game play, moderate effort • Golf, wheeling or carrying clubs • Softball – fast pitch or slow pitch • Basketball – shooting baskets • Volleyball – played on a hard court surface with 6 to 9 players • Netball – played on a hard court surface with 6 to 9 players • Cricket – batting, bowling, and fielding • Badminton singles or doubles played socially • Archery (non-hunting) • Fencing • Bowling • Gymnastics – general moves	• Most competitive sports • Tennis – singles • Football and futsal – competitive • Basketball – drills, practice, officiating • Wheelchair basketball • Hockey – ice and field • Beach volleyball – on sand court • Handball – general or team • Squash • Sepak takraw – competitive
Aerobic exercise (water activities):	**Aerobic exercise (water activities):**
• Water aerobics and water calisthenics • Swimming – recreational or in slow or moderate effort • Treading water – slowly, moderate effort • Diving – springboard or platform • Snorkelling • Canoeing or rowing a boat at a speed between 6 to 9 km/h, moderate effort • Whitewater rafting, kayaking, canoeing • Sailing – recreational or competition • Paddle boating • Kayaking – on a lake, calm water • Water walking – moderate effort, moderate pace	• Water jogging • Swimming – steady paced laps • Synchronised swimming • Treading water – fast, vigorous effort • Free diving • Scuba diving • Water polo • Canoeing, rowing or kayaking at a speed more than 9 km/h, vigorous effort • Water walking – vigorous effort, vigorous pace

Table 3.1 Examples of moderate and vigorous activities defined by level of intensity (cont...)

Moderate activity 3.0 to 6.0 METs (3.5 to 7 kcal/min)	**Vigorous activity** Greater than 6.0 METs (more than 7 kcal/min)
House Chores:	**House Chores:**
• General household tasks requiring considerable effort • Scrubbing the floor or bathtub while on hands and knees, hanging laundry on a clothesline, sweeping an outdoor area, cleaning out the storeroom, washing windows, moving light furniture, packing or unpacking boxes, walking and putting household items away, carrying out heavy bags of trash or recyclables (such as glass, newspapers, and plastics), or carrying water • Gardening and yard work: Raking the lawn, bagging grass or leaves, digging, hoeing, shovelling or weeding while standing or bending • Planting trees, trimming shrubs and trees, hauling branches, stacking wood • Home repair: Cleaning gutters, refinishing furniture, sanding floors with a power sander, or laying or removing carpet or tiles • General home construction work: Roofing, painting inside or outside of the house, wall papering, scraping, plastering, or remodelling • Automobile bodywork • Hand washing and waxing a car	• Heavy housework: Moving or pushing heavy furniture, carrying household items up a flight of stairs • Felling a large tree

Modified from: Ainsworth *et al.* (2011).

For the third level of physical activity pyramid, examples of flexibility and strength training activities defined by level of intensity are as follows:

Table 3.2: Examples of flexibility and strength training activities defined by level of intensity

Moderate activity 3.0 to 6.0 METs (3.5 to 7 kcal/min)	**Vigorous activity** Greater than 6.0 METs (more than 7 kcal/min)
Strength training:	**Strength training:**
• Putting groceries away – walking and carrying especially large or heavy items. • Resistance (weight) training such as squats, slow or explosive effort • Resistance (weight training) with 8-15 repetition at varied resistance	• Carrying several heavy bags of groceries at one time up a flight of stairs. • Grocery shopping while carrying young children and pushing a full grocery cart, or pushing two full grocery carts at once
Strength training (exercise & sports):	**Strength training (exercise & sports):**
• Weight training and bodybuilding using free weights or Universal-type weights • Boxing – punching bag	• Circuit weight training • Boxing – in the ring, sparring
Endurance training:	**Endurance training:**
• Resistance (weight training) with 15-25 repetition at low resistance (10-30% of maximum weight) • Using a stair climber machine at a light-to-moderate pace • Using a rowing machine – with moderate effort	• Resistance (weight training) with 15-25 repetition at high resistance (40-60% of maximum weight • Using a rowing machine – with vigorous effort • Using an arm cycling machine – with vigorous • Jump rope
Flexibility exercises:	**Flexibility exercises:**
• Stretching – lower hold duration (10-15 s) • Yoga – beginner poses and shorter holding duration • Tai chi, qi gong – moderate to vigorous effort • Gymnastics	• Stretching – higher hold duration (15-30 s) • Yoga – more difficult pose and longer holding duration • Tai chi, qi gong – vigorous effort

Modified from: Ainsworth *et al.* (2011).

Table 3.3: Examples of weekly physical activity plans for various population groups

Sample of weekly physical activity plan for Malaysians - Always warm-up sufficiently before exercise and cool-down with light stretches after each exercise session

Population \ Days	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Total amount of MVPA (minute)
Working Adults (150 minutes MPA/week)	■ 30 min	■ 30 min	○	■ 30 min	○	■ 30 min	■ 30 min	150 min
Working Adults (80 minutes VPA/week)	○	◆ 20 min	○	◆ 20 min	○	◆ 20 min	◆ 20 min	80 min
Working Adults (240 minutes MVPA/week)	◆ 30 min	■ 60 min	○	■ 60 min	◆ 30 min	■ 60 min	○	240 min
Housewife (150 minutes MVPA/week)	■ 30 min	○	■ 30 min	■ 30 min	○	■ 30 min	■ ○ 30 min	150 min
Pregnant Women (150 minutes MVPA/week)	■ ◆ ● ❖ 30 min	■ ◆ ● 30 min	◆ ● ❖	■ ◆ ● 30 min	■ ◆ ● ❖ 30 min	■ ◆ ● 30 min	◆ ●	150 min
Overweight/ Obese Adults (225 minutes MVPA)	■ 45 min	■ 45 min	○	■ 45 min	■ ○ 45 min	■ 45 min	○	225 min

TYPE OF ACTIVITIES

- ■ Moderate Aerobic Physical Activity
- ◆ Vigorous Aerobic Physical Activity
- ○ Muscle-strengthening Activity
- ◆ Kegel Exercises[1]
- ● Pregnancy safe Flexibility[2]
- ❖ Pregnancy safe Muscle Strength and Endurance Activity[3]

Note:

1. **Kegel Exercises -** Kegel exercises helps strengthen the pelvic floor muscle, which stretch during pregnancy and childbirth. Start with a hold of 3 to 5 seconds and relax 3 to 5 seconds, and complete 20 repetitions. Work towards holding for 5 to 10 seconds and relax for 5 to 10 seconds, completing 2-3 sets of 20 repetitions. For mid to late pregnancy, it is recommended to do Kegel exercise while on all fours or lying side-ways with a pillow underneath for support.

2. **Pregnancy Safe Flexibility -** Flexibility exercises can be done every day. Avoid deep back bend or other contortions like yoga and avoid lying on the back for extended periods.

3. **Pregnancy Safe Muscle Strength and Endurance Activity -** Muscle strengthening and endurance exercises can be done during pregnancy, but do not over-exert. Avoid weighted sit-up exercises, exercises that use heavy barbells behind the neck, abdominal rotation machines, circuit classes, and movements that may touch the baby bump. Not recommended to perform exercises with weights in late pregnancy, i.e. third trimester.

Cook nutritious foods at home more often and choose healthier options when eating out

KEY MESSAGE

4

COOK NUTRITIOUS FOODS AT HOME MORE OFTEN AND CHOOSE HEALTHIER OPTIONS WHEN EATING OUT

Ms. Siti Shuhailah Shaikh Abd Rahim, Ms. Ruhaya Salleh, Dr. Yang Wai Yew and Prof. Dr. Winnie Chee Siew Swee.

4.1 Terminology

Home cooked foods

Home cooked foods are defined as foods prepared at home using fresh and nutritious ingredients and healthy cooking methods.

Eating out

Eating out is defined as eating foods prepared outside from home by food vendors such as in food courts, *warung, mamak,* restaurants, western fast foods, food trucks, hawker stalls and other form of eateries. This includes ordering these foods for indoor, office or home consumption through take-away or delivery services.

Healthier options

Healthier options are defined as foods and beverages which contain less fat, sugars, sodium, saturated fat, free of trans fat, and/or higher in dietary fibre, wholegrains and rich in nutrients Healthier options include food choices which are prepared with low fat cooking methods such as steaming, roasting, baking, clear soups and stir-frying.

4.2 Introduction

Cooking more frequently may shift diets away from eating outside the home and depending on the cooking method and ingredients, cooking at home results in lower consumption of unhealthy foods that are strongly associated with poor diet and diet-related health outcomes (Wolfson, Leung & Richardson, 2020). Cooking at home can also provide more control over the precise ingredients used, which, depending on what and how a person cooks, could have a positive influence on dietary intake, diet quality scores and diet-related diseases such as obesity, diabetes and hypertension.

There is an increasing prevalent of eating out in Malaysia as indicated with the rise in food away from home expenditure to 11.2% in 2019 across all household income classes (Department of Statistics, Malaysia, 2019). Eating out has become more affordable and available (including 24 hours' restaurants) especially in urban settings. The rising demand for food away from home has stimulated the development of food catering and other industries and influenced the orientation of food producers, processors, and retailers towards food service industry and manufacturing (Tan 2010; Noraziah & Mohd Azlan, 2017). Online food ordering is the new eating out and according to Euromonitor (2015), the 100% home delivery market in Malaysia has a value of RM 253 million in 2014 and is expected to continue to grow at 11% per annum. It has been shown that online food consumption is driven by both convenience and hedonic motivations (Nejati & Moghaddam, 2013).

The practice of eating out in Malaysia are largely influenced by factors such as working away from home, working mothers, and food varieties (both local and international) served at many premises (Noraziah & Mohd Azlan, 2017). From a nutrition and health standpoint, the exposure to obesogenic environment within the nutrition transition in developing countries such as Malaysia include the increased access to unhealthy foods away from home (Popkin, Adair & Ng, 2012). The nature of the current Malaysian foods served at food premises – sweet, oily, fatty – are of good taste but can promote overeating, imbalanced diet and food safety issues.

Therefore, it is imperative that Malaysians are provided with guidelines on how to prepare home cooked meals more often and to choose healthier foods when eating out.

4.3 Scientific basis

An individual's nutrient intakes and overall health can be affected by what he or she eats at home. While research across all age-groups from children, adolescents to adults reported eat out has been linked to adverse health outcomes, eating foods cooked at home from basic ingredients has been linked to increased intake of fruits, vegetables, and whole grains, reduced BMI, and improved general health (McLaughlin, Tarasuk & Kreiger, 2003; Larson *et al.,* 2006 Laska *et al.,* 2012). A study of young adults found those that cooked more frequently were more likely to achieve nutrition guideline goals for fat, calcium, whole grain, fruit and vegetable intake (Larson *et al.*, 2006). Another study found cooking classes increased intake of fruit and vegetables and improved food safety behaviours (Brown & Hermann, 2005). A national survey in the United States have also shown that more frequent cooking at home is associated with better diet quality overall and among lower- and higher-income adults (Wolfson, Leung & Richardson, 2020).

A systematic review was conducted in 2011 to 2016 of 34 studies (mostly from Western countries, Indonesia, Japan and Hong Kong) on the impact of interventions for adults that included a cooking component on diet, health, and psychosocial outcomes (Reicks, Kocher & Reeder, 2018) showed improvements in fruit and/ or vegetable intake and weight. Most studies also showed positive dietary behaviour changes and improvements in cooking confidence and knowledge.

Several reviews on cooking intervention and outcomes have shown that common food skills needed include planning food shopping, as well as purchasing and shopping behaviours (Raber *et al.*, 2016; McGowan *et al.,* 2017). Raber *et al.* (2016) summarized the outcomes of 59 cooking interventions to prevent chronic disease within a conceptual framework involving 5 major constructs and a series of individual behaviours. The 5 major constructs included cooking frequency, skills and methods, minimal use of ingredients that guidelines suggested should be limited, ingredient additions and replacements, and flavoring. This is shown in Figure 4.1.

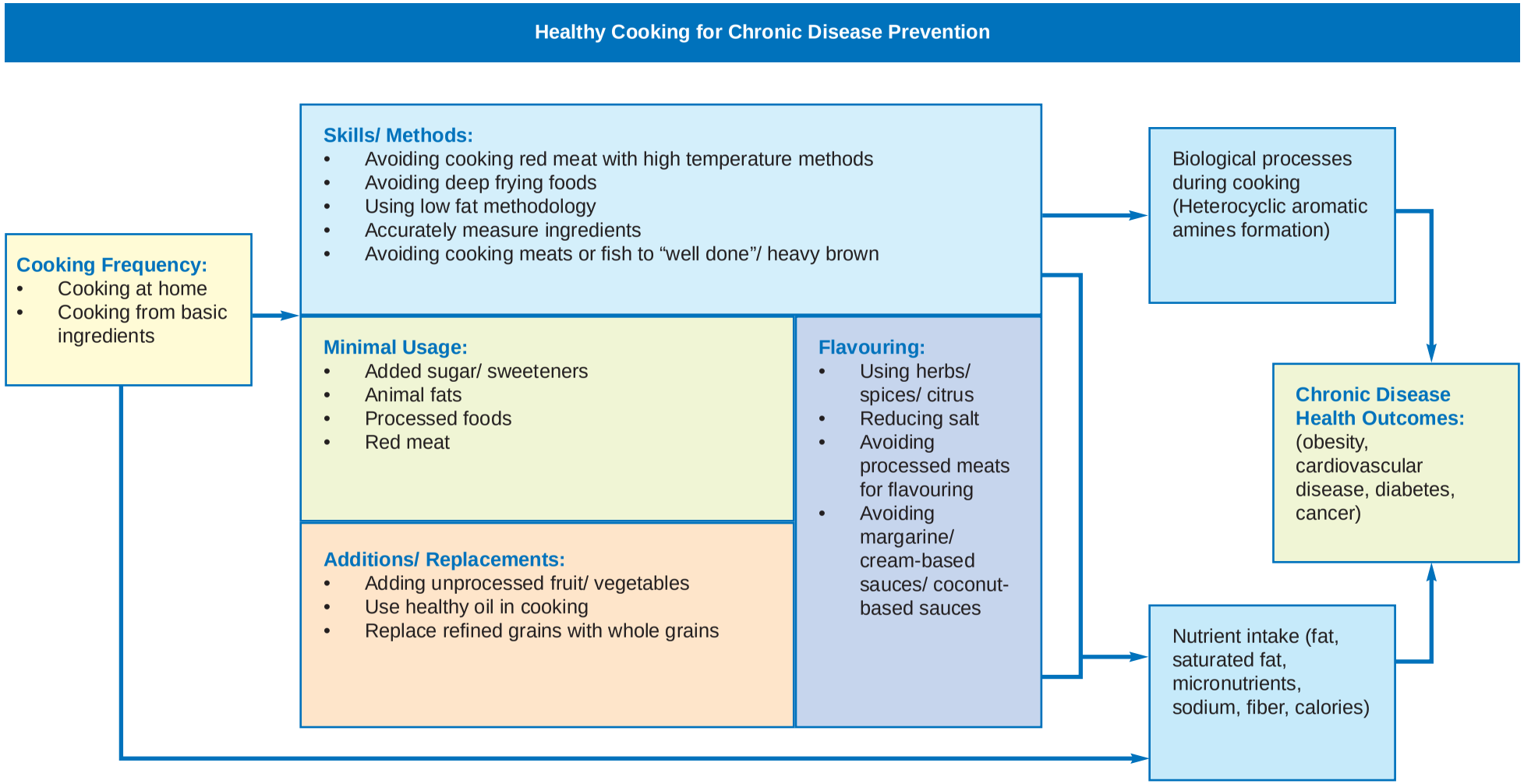

Figure 4.1. Conceptual model of healthy cooking: Scheme depicting the conceptual framework and the constructs that define healthy cooking in relation to chronic disease. This figure outlines the directionality of these constructs and how they inter-relate to influence dietary behaviours and health

Source: Adapted from Raber *et al.* (2016).

Among adolescents, the family meal is positively associated with intake of fruits, vegetables, dietary fibre and micronutrients while negatively associated with intake of soft drink, fried food, saturated and trans fat (Larson *et al.,* 2007). Home and family environments are essential in the development of children's and adolescents' food preferences and consumptions habits, and thus prevention of childhood obesity (Birch & Davison, 2001).

On the contrary, the exposure to obesogenic environment within the nutrition transition including increased access to unhealthy food away from home such as Western-style food, fast food and energy-dense foods would predispose a major risk of becoming overweight and obese (Wang & Lobstein, 2006; Swinburn *et al.,* 2011). There has been some concern in the scientific literature on eating out associated with larger portion sizes (Ledikwe, Ello-Martin & Rolls, 2005), higher energy densities (Prentice and Jebb, 2003) and lack of consumer information (Blumenthal & Volpp, 2010). A recent study investigating the relationship between the frequency of eating out and obesity among adults from the sixth Korean National Health and Nutrition Examination Survey (KNHANES VI) from 2013 to 2015 reported that the risk of obesity and unbalanced diets increased with the frequency of eating out (Dahye Kim & Byeong-il Ahn, 2020).

Two systematic reviews reported that eating out was identified as a risk factor for higher energy and fat intake and lower micronutrient intake with an increased risk of weight gain and obesity over time (Lachat *et al.,* 2012; Yang *et al.,* 2012). Lachat and colleagues found a substantial increase in the energy contribution from food away from home during the last decades (Lachat *et al.,* 2012), while within the Asian developing countries, three studies reported positive associations between eating out and increased risk of childhood overweight and obesity in India (Jeemon *et al.,* 2009) and China (Li *et al.*, 2010; Shan *et al.,* 2010). A nationwide survey in Brazil found that eating out was associated with overweight and obesity only among men, with the highest frequencies of consumption soft drinks and sit-down meals being reported (Bezerra & Sichieri, 2009). In Malaysia, a study from Kelantan amongst the adolescence revealed that eating out from home and fast food consumption were negatively associated with healthy-based food pattern, yet positively associated with Western-based food pattern (Nurul-Fadhilah, Teo & Foo, 2016).

Both socio-economic and demographic variables have differential impacts on the expenditure on food away from home. Yet, the demographic shifts have resulted in less time available for food preparation, with significant effects on the home food environment (Bowers, 2000). It has been established that households with higher disposable incomes are known to spend more on food outside (Kinsey, 1994). There are consistent positive associations between socioeconomic status and greater energy contribution from food away from home. Adults or children from higher socioeconomic strata, as measured by higher household income (van't Riet, den Hartog & van Staverev, 2002; Lachat *et al.,* 2009), or availability of pocket money (Lachat *et al.,* 2009), had a higher energy contribution from eating outside food. As for Malaysia, besides increased opportunities to eat out, the prices are sometimes lower than the cost of a homemade meal (Noraziah & Mohd Azlan, 2017), hence promoted the likelihood of eating out.

Patterns of eating in Malaysia have changed with social transformation vis-a vis urbanization and eating-out is a manifestation of the changes including both external forces in the urban environment and internal drive at homes (Noraziah & Mohd Azlan, 2017). Eating out at the individual level occurs during working days and at the family level occurs during weekends, as observed at food premises and feast held either at houses or offices (Noraziah & Mohd Azlan, 2017). Research has shown that amount of time spent on food preparation and cooking affected the diet quality. Those spending less than one hour per day on food preparation was associated with significantly more money spent on food away from home and higher fast food consumption (Monsivais, Aggarwal & Drewnoski, 2014).

Other potential threats implicated with eating out include issues of food quality which may predispose the population to food safety risk. In Malaysia, the hot and humid weather alongside the environmental pollutants when eating out in open spaces such as street foods provide a suitable ground for most bacterial growth (Abdul-Mutalib *et al.,* 2015). Food eateries with poor hygiene conditions are linked to contaminated and unsafe foods, hence causing food poisoning outbreaks. While diarrhoea is the most common symptom of foodborne illnesses, other serious consequences include kidney and liver failure, brain and neural disorders, and death. Hence, continuous exposure towards poor sanitary conditions will lead to serious health hazard (WHO, 2002).

4.4 Current status

Data on cooking at home and cooking skills among Malaysians is scarce compared to studies on food consumption away from home. Previous literature examining food consumption in Malaysia focuses primarily on Malaysia's household food demand. Generally, the trend of eating out in Malaysia is evident based on the monthly household expenditure pattern from 1993 to 2019 (Department of Statistics Malaysia, 2019). The expenditure for food and non-alcoholic beverages (indicator of food at home) had declined from 23.8% in 1993 to 18.0% in 2016. However, the expenditure for food away from home increased to 10.7%. On actual quantity, the food consumed at home had been substituted for food away from home, which was reflected in the reduced percentages of expenditure on food at home across all household income classes (2014 to 2016) (Department of Statistics, Malaysia, 2019). In the same survey, it was found that the B40 income group spent 11.4% on restaurant and hotels, as compared to 13.2% (T20) and 13.0% (M40), respectively (Noorhaslinda, Nor Fatimah & Nur Afifah, 2018; Department of Statistics Malaysia, 2019).

Recent studies such as the MANS 2014 (Institute for Public Health, 2014) and Malaysian Food Barometer Survey (Fournier *et al.,* 2016) have examined eating out closely. MANS 2014 found almost half of Malaysian adults obtain food outside home, higher among those live in Peninsular Malaysia and in urban areas. Specifically, the survey showed that only 50.7% of adults reported that their source of breakfast was home prepared, and the remaining (49.3%) were obtained outside; 24.9% (stall), 11.8% (cafeteria) and 10.1% (restaurant). Higher percentages were observed for lunch where 59.8% of adults reported that their source of lunch was home prepared, 17.5% obtained from restaurant, 14.2% from stall, while 11.3% from the cafeteria. The percentage of those who took dinner at home was significantly higher among the respondents in East Malaysia (93.7%) and rural areas (92.1%). While, 9.3% and 7.5% of adults in Peninsular Malaysia reported that their sources of dinner were obtained from restaurant and stall, respectively (Institute for Public Health, 2014). Findings from the Malaysian Food Barometer Survey were consistent with MANS 2014 with high prevalence of food away from home reported. About 64% of Malaysians had at least one meal per day outside of home, 23.4% had meals at home, and 12.5% will eat at home with outside food (Fournier *et al.,* 2016).

The new practices of eating out observed in Malaysia can be identified and categorised in terms of the place of eating, time of eating, food types and the food outlets. The place of eating is related to food businesses available in the urban environment with fast food restaurants being one of the common features. Besides the normal meal hours, the time of eating is no longer restricted to mealtime as food services is always available. The presence of 24-hour restaurants has encouraged teenagers, late sleepers or night workers to take their meal at late night or early mornings. Different food premises offer varieties of food to be chosen, therefore has driven the urban people to frequently patronising cafe, restaurants or stalls throughout the day (Noraziah & Mohd Azlan, 2017). However, there is increasing evidence suggesting that the nutritional profile of food offered outside determines the overall diet hence eating out can increase the probability of eating healthily provided healthy options are offered (Boo, Chan & Fatimah, 2008; Lachat *et al.*, 2012).

A study conducted at Selangor, it was found that majority (91.2%) of adolescents had family meals away from home at least once a week either at restaurants (53%), fast food outlets (41.6%), food courts in shopping complexes (40%) or food stalls (30.2%) (Lim, Mohd Sharif & Lim, 2013). In a study amongst Malaysian female university students, a high proportion of consumers were choosing chicken and fish items may be specific to the student population who generally understand that white meat (e.g., fish and chicken) was healthier than red meat (e.g., lamb and beef) (Boo, Chan & Fatimah, 2008). Nonetheless, the popularity of these two categories of food may be attributed to the unique multicultural background of Malaysia.

4.5 Key Recommendations

Key Recommendation 1

Make cooking habit as part of your healthy lifestyle daily.

How to Achieve

1. Plan your weekly menus to cook at home. This makes it easier to buy necessary groceries at least once a week.

2. Allocate time for nutritious food preparation and start with simple recipes.

3. Prepare ingredients such as onions, garlic, chilies and ginger beforehand, and refrigerate and cover in separate containers.

4. Learn basic cooking skills from attending basic cooking classes or from reliable online resources, videos or other website related to healthy cooking recipes.

Key Recommendation 2

Cook nutritious foods at home every day.

How to Achieve

1. Cook daily. If you can't, cook more portions on weekends and freeze them in batches for easy thawing.

2. Select simple recipes that you can handle. One-pot meals that contain grains, chicken/ fish/ meat and vegetables are easy to make and are rather balanced.

3. Replace instant spices with natural marinated recipes by using herbs, spices and natural flavours like lemon juice to add flavour to your dishes, with no additional salt, sugar and flavour enhancer.

Key Recommendation 3

Bring home-cooked foods daily to workplace, higher learning institutions and schools.

How to Achieve

1. Establish a new habit for all family members to bring home-cooked food to workplace, higher learning institutions and schools to save money and eat healthier and safe food.

2. Plan and prepare simple menu when bringing home-cooked foods for breakfast/ snack/ lunch/ dinner time for the whole week. Create a daily menu schedule because the same menu every day will be boring.

3. Prepare only for individual portion when bringing home-cooked foods to practice eating within the correct serving size daily.

4. Invite other co-worker, peers and friends to bring home-cooked food and exchange dishes like the 'pot luck' concept to make it more fun.

Key Recommendation 4

Choose healthier options daily when eating out or purchasing foods from outside.

How to Achieve

1. Eat or order food from eateries or online food deliveries that offer variety, safe and healthy food. Avoid eating or ordering foods late at night.

2. Choose clean and healthy eateries with grade A rating or eateries with Ministry of Health's initiative such as Healthy Cafeteria, BeSS or having menus with MyChoice logo.

3. Request for smaller portions or share foods with others if small portions are unavailable.

4. Use smaller plates to avoid overeating especially when eating in buffet-style or during open houses.

5. Portion meals according to the Malaysian Healthy Plate (MOH, 2016) recommendation of "quarter quarter half". Fill in the first quarter of your plate with rice/ other cereals (e.g: meehoon)/ wholegrain cereal-based products (e.g: wholegrain bread)/ tubers (e.g: sweet potato). It is recommended to fill in this first quarter with whole grains. Fill in the second quarter of your plate with fish/ poultry/ meat/ legumes (e.g: dhall, tempeh, soy beancurd)/ dairy products. Fill the other half of your plate with vegetables and fruits. Give priority to vegetable and fruits..

6. Request or choose foods that are cooked using healthier cooking methods such as grilled, steamed and baked. For example, choose plain rice instead of *nasi minyak* (*briyani*). Be cautious of the menu with wordings like 'golden', 'crunchy', 'crispy',' breaded', 'crumbed', 'batter-fried' and 'fried' as most of the cooking method involve deep-frying loaded with of cooking oil.

7. Limit high sodium content foods such as salted egg, salted fish, *sambal belacan*, *budu* and other preserved foods.

8. Request for plain water to go with your meals instead of sweet sugary drinks such as cordials, *Air Batu Campur* (ABC), carbonated sodas, *cendol*, drinks with whipped cream, milk shakes and bubble tea.

9. Request for unsweetened drinks or reduced sugar content ('*kurang manis*'). Substitute condensed milk with evaporated milk such as '*teh C*".

10. Drink Chinese tea, *teh 'O'*, or *teh 'O'* with lime juice without added sugar if you wish to have flavoured beverages.

11. Avoid misuse of free refill drinks that usually are sugar-laden drinks.

12. Limit adding condiments such as soy sauce, chilli sauce, monosodium glutamate and mayonnaise on to your food. This will increase your sodium intake.

13. Avoid foods which are added or coated with grated cheese, cheese sauce or chocolate. These foods contain high sodium, fat and sugar.

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Eat plenty of vegetables and fruits everyday

KEY MESSAGE

5

EAT PLENTY OF VEGETABLES AND FRUITS EVERYDAY

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5.1 Terminology

Fruits

The term fruit is generally used to describe the sweet, fleshy edible portion of a plant that arises from the base of the flower and surrounds the seeds. Examples of fruits are bananas, papayas, apples, oranges and others. Most fruits are eaten fresh and raw when they are ripe which give them a sweet taste. In some cases, they are consumed before the fruits ripen, usually with a spicy or savoury dip. Some ripe and unripe fruits are used in cooking or incorporated into salads which can offer a tasty alternative. Fruits can also be consumed as canned fruits, dried fruits and fruit juice, preferably without added sugar and preservatives. Concentrated fruit juice and fruit jam which are usually added with sugar during processing are excluded as they do not retain any nutritional values of the original food.

Plenty

Plenty is defined by frequency and quantity. By frequency, it means as often as possible, or eating at every meal. In terms of quantity, it implies at least three servings of vegetables and two servings of fruits every day. In practice, it means having vegetables and fruits during meal times as well as for snacks.

Vegetables

Vegetables refer to the edible portions of plants such as leaves, stems, tubers, roots, flowers and bulbs. Vegetables include all fresh, green leafy vegetables (such as spinach and lettuce), coloured vegetables (such as red spinach), fruit vegetables [also known as gourds or melons, such as pumpkin, loofah (*petola*) and cucumber], bean vegetables (such as long beans), cruciferous vegetables (such as cabbages and broccoli), *ulam-ulam* [such as *pegaga* (*Centella asiatica*) and *ulam raja (Cosmos caudataus*)] and edible plant stems (such as celery and asparagus). There are fruits, in a botanical sense, which are treated as vegetables in cooking, for example tomatoes and brinjals. This definition does not include tubers (such as potatoes, tapioca and yam) (WHO, 2003). Vegetables are also sometimes sold as canned or frozen. Some vegetables are eaten raw; others are cooked to make them more palatable and digestible, sometimes in combination with other food groups (such as eggs, meat, fish or legumes). Vegetables can also be consumed as juice, preferably without added sugar and/ or salt.

5.2 Introduction

It has always been widely accepted that vegetables and fruits are "good for you" and consistent scientific data point to a close association between fruit and vegetable consumption and various desirable health outcomes. A variety of vegetables and fruits should be consumed because no single vegetable or fruit contains all nutrients and bioactive substances. For example, green leafy vegetables are good sources of folate; yellow and orange fruit vegetables provide carotenoids; cruciferous vegetables are rich in dithiolethiones and isothiocyanates; fruits have bioflavonoids and citrus fruits have vitamin C. Carotenoids from consumption of vegetables and fruits have been shown to increase plasma concentrations of interferon, and decreased macrophage inflammatory protein and tumour necrosis (Jahns *et al.,* 20181}). In attacks from novel infections that compromise the inflammatory homeostasis, it is speculated that long term consumption of vegetables and fruits may confer beneficial anti-inflammatory and immunomodulatory effects (Zabetakis *et al.,* 2020). Vegetables and fruits are also good sources of dietary fibre (Dreher, 2018) and other yet unknown substances which are beneficial to health.

Preferably, vegetables should be consumed fresh, if possible. Antioxidant activity declines in stored vegetables at ambient or chill temperatures. Blanching and freezing, for example of peas and spinach, reduced water-soluble antioxidant acidity by 30 and 50% respectively. However, the antioxidant levels remained constant if stored at -20°C (Hunter & Fletcher, 2002). Frozen vegetables could also be used as considerable levels of nutrients are retained by freezing, particularly when they are frozen when fresh. Vitamin C, pro-vitamin A and total folate content in various frozen vegetables and fruits were more often better retained than in fresh vegetables and fruits which had been refrigerated for 5 days (Li *et al.,* 2017). For healthy populations, it is not advisable to replace vegetables and fruits with supplements.

Certain nutrients and phytochemicals in vegetables are damaged by cooking. Consumption of raw salads and *ulam-ulam* prevent such nutrient loss. When consumed raw, vegetables must always be washed properly. In some cases, cooking increases nutrient availability, for example, carotenoids from cooked tomatoes are absorbed better than from raw ones. When vegetables are cooked, they should not be overcooked since this will cause nutrient loss. Stir-frying using a small amount of oil is an effective method of cooking vegetables. It provides a tasty dish with good texture and most importantly it minimises nutrient loss. The small amount of oil used will enhance absorption of the fat-soluble vitamins (for example, vitamins A and E) and other fat-soluble dietary components such as carotenoids. Stir-frying should be the preferred cooking method compared to deep-frying and prolonged boiling of vegetables (Putriani *et al.,* 2020).

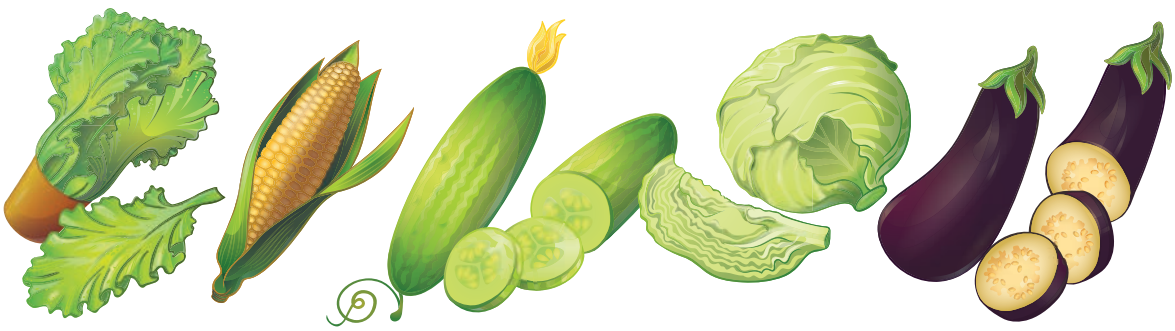
5.3 Scientific basis

5.3.1 Cardiovascular disease

Meta-analysis of prospective cohort studies suggested that dietary factors such as vegetable and fruit intake may have a protective effect against risk of cardiovascular diseases (Dauchet *et al.*, 2006; He *et al.*, 2007; Wang *et al.*, 2014; Zhan *et al.*, 2017) and with particular analyses for stroke (Dauchet, Amouyel & Dallongeville, 2005; He *et al.*, 2006; Hu *et al.*, 2014) and coronary heart disease (He *et al.*, 2007; Gan *et al.*, 2015). These studies showed that the risk of coronary heart disease (CHD) is significantly increased with lower intakes of vegetables and fruits. Cardiovascular diseases are the principal cause of death globally. The World Health Organization estimated that 17.9 million people died from CVDs in 2016, which represented 31% of all global deaths. Of these deaths, 85% were due to heart attack and stroke (WHO, 2017). Coronary heart disease (CHD) is the most important manifestation of arteriosclerosis and was regarded as a major cause of disease mortality worldwide, including in Malaysia. Ischaemic heart disease remained the principal cause of death in Malaysia; 15.6% of total deaths in 2018 were attributed to this (Department of Statistics, Malaysia, 2019).

Meta-analyses consistently showed evidence that an intake of > 400 g/day of vegetables and fruits could reduce risk of cardiovascular diseases. Aune *et al.* (2017) showed in their meta-analysis of 95 published prospective studies from across the world that the reduction in risk for coronary heart disease, stroke and cardiovascular disease were 16%, 28% and 22% for an intake of 500 g per day of vegetables and fruits. A further reduction in risk, of approximately 5 to 8% were reported for these three diseases for an intake of 800 g/day of vegetables and fruits. There was an approximately linear association between vegetable consumption and 28% reductions in relative risk at intakes of 600 g/day of vegetables. When consumption of vegetables and fruits were at 800 g/day, there was also a 28% reduction in relative risk; this association was not linear, with steeper inverse associations at lower levels of intake. There were significant dose-response associations between vegetable and fruit intakes and total reported cardiovascular deaths; whereby significant reductions in risk was observed when consumption of vegetables and fruits and were up to 800 g/day (Aune *et al.*, 2017; Aune, 2019). Based on these findings Aune (2019) suggested that recommendations for daily consumption of vegetables and fruits could be up to 800 g/day, or equivalent to ten servings of 80 g each as part of a healthy diet. Hu *et al.* (2014) in their meta-analysis of 20 prospective cohort studies showed a significant risk reduction of 21% among participants with the highest intake of vegetables and fruits compared to those at the lowest intake. They reported a linear dose-response relationship; the risk of stroke decreased by 11% and 32% for every 200 g/day increment in vegetable and fruit intake respectively. The RR (95% CI) of stroke was 0.97 (0.95-1.00) for 50 g/day of vegetable consumption compared to 0.80 (0.62-1.02) for 400 g/day. The RR (95% CI) of stroke was 0.90 (0.84-0.96) for 50 g/day of fruit consumption compared to 0.45 (0.28-0.74) for 400 g/day.

In a longitudinal study of Swedish adults, Larsson *et al.* (2013) reported significant inverse relationships between total vegetable and fruit intakes and the risk of stroke, cerebral infarction and haemorrhagic stroke. Those with the highest vegetable and fruit intake had a 13% lower risk of all causes stroke compared with those in the lowest intake group and the risk of stroke was significantly reduced with increasing consumption of vegetables and fruits of at least 5 servings a day. However, there remains uncertainty about the magnitude of the benefit of vegetable and fruit intake on the occurrence of CVD because evidence from randomised controlled trials were inconclusive. Part of this inconclusiveness could be attributable to confounding factors such as the manner in which vegetables and fruits were prepared and eaten, the large variety of vegetables and fruits consumed globally, the difference in their nutrient contents, and potential interactions with other dietary components (Alissa & Ferns, 2017).



Most studies have reported inverse association or no association between intake of various vegetable groups and CVD, atherosclerotic vascular diseases, CHD, heart disease and stroke. The vegetable groups were green leafy vegetables, cruciferous vegetables, allium vegetables, yellow-orange-red vegetables, legumes. These are summarised in a narrative review of recent prospective cohorts (Blekkenhorst *et al.*, 2018). Aune *et al.* (2017) showed that high vs low intake of apples/ pears, citrus fruits, carrots and non-cruciferous vegetables were inversely associated with risk of cardiovascular diseases, and canned fruits were positively associated. Hu *et al.* (2014) showed inverse association between the risk of stroke and citrus fruits [0.72 (0.59-0.88)], leafy vegetables [0.88 (0.79-0.98)], and apples/ pears [0.88 (0.81-0.97)], but not with cruciferous vegetables [0.85 (0.64-1.13)], onion/ leek/ garlic [0.89 (0.79-1.01)], root vegetables [1.04 (0.91-1.18)], and berries [1.05 (0.86-1.27)]. However, Gan *et al.* (2015) showed that the inverse associations between total vegetable and fruit, vegetable or fruit consumption were not observed in Asian countries. They suggested that Asian cooking which mostly boiled and steamed vegetables may lead to loss of water-soluble, heat sensitive and oxygen-labile nutrients, higher usage of salt may decrease the benefits of vegetables, and higher consumption of vegetables and fruits in the Western studies compared to Asian studies.

One prospective cohort study, the Prospective Urban Rural Epidemiology (PURE) with 135,335 individuals from across the world found that higher fruit consumption was associated with a lower risk of CVD, non-CVD and total mortality. Raw vegetable intake was strongly associated with a lower risk of total mortality, but the benefit was smaller for cooked vegetable intake (Miller *et al.*, 2017). Similar findings were observed in a population-based study in the Netherlands, where higher consumption of vegetables and fruits, either in raw or processed foods, exerted a protective effect against the incidence of CHD. About 34% lower risk of CHD incidence was seen among adults with high intake of total vegetables and fruits (> 475 g/d) compared to those with a low total vegetables and fruits consumption (≤ 241 g/d) (Griep *et al.*, 2010).

5.3.2 Hypertension

Hypertension continues to represent a growing public health concern nationwide and worldwide. High systolic blood pressure (SBP) was the leading risk factor, accounting for 10.4 million (95% uncertainty interval [UI] 9.39-11.5) deaths and 218 million Disability Adjusted Life-Years (DALYs) in the Global Burden of Disease 2017 risk factors. High SBP was the leading Level 4 risk factor for age-standardised DALY rates in Southeast Asia, as well as central Europe, eastern Europe, central Asia, north Africa and Middle East, south Asia, east Asia and Oceania (GBP 2017 Risk Factor Collaborators, 2018). In Malaysia, based on the NHMS 2019, the overall prevalence of hypertension was 30.0% (95% CI = 28.57, 31.50) (IPH, 2020).

Meta-analyses and systematic reviews have shown an inverse association between vegetable and fruit consumption and the risk of hypertension (Hartley *et al.*, 2013; Li *et al.*, 2016; Wu, Sun & He, 2016; Schwingshackl *et al.*, 2017). A meta-analysis (28 cohort studies) observed an inverse association for the risk of hypertension for 100 g of fruits daily by 3% (Schwingshackl *et al.*, 2017). Li *et al.* (2016) reported that the pooled relative risk (RR) of hypertension for the highest vs. the lowest consumption of vegetables and fruits was 0.81 (95% CI = 0.74-0.89). From their meta-analysis of 25 studies comprising of cross-sectional and case-control studies, Li *et al.* (2016) showed a significant inverse association between vegetable and fruit consumption and risk of hypertension (RR = 0.70, 95% CI = 0.61-0.79) (Li *et al.*, 2016). Wu, Su & He (2016) in their meta-analysis showed that the incidence risk of hypertension decreased by 1.9% for each serving of fruit consumption daily, and decreased by 1.2% for each serving of total vegetable and fruit consumption daily. A Cochrane systematic review found that the consumption of ≥ 5 servings of vegetables and fruits significantly reduced mean systolic BP by 3.0 mmHg compared to low vegetable and fruit intake (Hartley *et al.*, 2013).

Several cohort studies have proven the long-term effect of vegetables and fruits in reducing hypertension risk (Wang *et al.*, 2012; Borgi *et al.*, 2016; Liu *et al.*, 2018; Kim & Kim, 2018; Stefler *et al.*, 2019). The findings have generally shown an association between high consumption of vegetables and fruits and low risk of hypertension. Based on the findings from three large longitudinal cohort studies: Nurses' Health Study (n = 62,175), Nurses' Health Study II (n = 88,475), and Health Professionals Follow-up Study (n = 36,803), the pooled hazard ratios (HRs) for hypertension incidence among participants who consumed ≥ 4 servings/day of total whole fruits were 0.92 (95% CI = 0.87-0.97) and 0.95 (95% CI = 0.86-1.04) for total vegetable as compared to those who consumed ≤ 4 servings/day (Borgi *et al.*, 2016). When vegetables and fruits were combined into one intake category, higher consumption (≥ 6 servings/day) was associated with a lower risk of developing hypertension (HR = 0.89, 95% CI = 0.86-0.93) when compared to ≤ 1 serving/day. Specifically, higher intakes (≥ 4 servings/week as compared to < 1 serving/month) of raisins/ grapes, apples/ pears, blueberries, avocados, broccoli, carrots, and tofu/ soybeans were associated with a decreased risk of hypertension.

The Korean Genome and Epidemiology Study (KoGES) which was an 8-year follow up study found that a higher intake of fruits was prospectively associated with a lower risk of hypertension in middle-aged and older Korean adults regardless of sex, however, no association between vegetable consumption and risk of incident hypertension was reported (Kim & Kim, 2018). Similarly, the Women's Health Study (WHS) in Boston also showed that total fruits but not total vegetables significantly reduced the risk of hypertension after adjusting for lifestyle factors and other food intake (Wang *et al.*, 2012). In another longitudinal study, the China Health and Nutrition Survey,

fruit intake was more strongly and significantly associated with lowering BP than vegetable intake (Liu *et al.*, 2018). A 12-year follow-up of 8,997 men and women in the Health, Alcohol and Psychosocial Factors in Eastern Europe Prospective Cohort Study found that fruit intake was inversely related to both systolic and diastolic blood pressure at baseline (mean SBP and DBP was 3.5 mmHg and 1.4 mmHg lower in the highest compared to the lowest intake tertiles). However, it was not associated with blood pressure change over time. In addition, no significant association was found between vegetable intake and blood pressure, neither cross-sectionally nor longitudinally (Stefler *et al.*, 2019). One possible explanation for the non-association is the complicated processing involved in the preparation of vegetables for consumption. The added fats, salt and seasonings and the cooking method may have offset part of the beneficial effects of fresh vegetables (Wang *et al.*, 2012; Stefler *et al.*, 2019).

Findings from the National Health and Nutrition Examination Survey (NHANES) 2007-2014 among 18,433 US adults aged ≥ 18 years revealed that vegetable fibre intake was associated with a decreased risk of hypertension but not fruit fibre, in which 0.052 g/kg/day of vegetable fibre showed a positive effect on hypertension risk (OR = 0.76; 95% CI = 0.63-0.99) (Sun *et al.*, 2018). However, a systematic review and meta-analysis of randomised controlled trials found that viscous soluble fibre intake including fruit pectin significantly reduced the overall systolic BP by 1.6 mmHg and diastolic BP by 0.4 mmHg in all populations (Khan *et al.*, 2018).

The association between vegetable and fruit intake and blood pressure could probably be explained by the rich nutrient content of vegetables and fruits such as potassium, fibre, magnesium, folic acid, calcium and vitamin C which have been found to be associated with blood pressure lowering effects through various routes such as improving endothelial function, causing vasodilation, modulating baroreflex sensitivity and increasing antioxidant activity (Li *et al.*, 2016). Furthermore, increased vegetable and fruit consumption may increase the intake of dietary fibre and reduce the intake of fat, in which low fat intake has been found to be associated with reduced risk of hypertension (Nestel, 2019).

5.3.3 Cancers

Cancer is now known as one of the most common non-communicable diseases (NCD) worldwide. It has emerged as the second highest cause of death among Malaysians. The three most common cancers among men in Malaysia in 2018 were lung (16.6%), colorectum (16.2%), and prostate (8.8%); whilst the three most common cancers among women were breast (32.7%), colorectum (12%) and cervix uteri (7.2%) (IARC, 2020). The prevalence is expected to increase in the near future due to the increase in NCD risk factors and an aging population. Cancer risk factors are generally similar worldwide which commonly include smoking, insufficient physical activity, alcohol, diet, overweight and obesity, and infections. Nevertheless, the prevalence of risk factors may vary by region and country contributing to variation in overall cancer incidence rates including the most common types of cancer. Despite the risk factors, there are also factors that are linked with lower incidence or risk of cancer, which are known as protective factors.

The protective effects of vegetables and fruits against cancer have been shown since 1975 (Armstrong & Doll, 1975; Bjelke, 1975). Since then, many pooled studies continued to show this effect. A review of 156 studies showed that individuals with low fruit and vegetable intake have nearly twice the risk of cancer at any sites compared to those with a higher intake, after controlling for potential confounding factors (Block, Patterson & Subar, 1992). The protective effects of vegetables and fruits were linked with several plausible mechanisms such as reduced oxidative damage of DNA or increased enzyme activity to detoxify carcinogens (Steinmetz & Potter, 1991).

A meta-analysis showed an 8 to 18% reduction in lung cancer risk with higher intakes of vegetables and fruits, although the positive effect decreased when stratified by smoking status (Vieira *et al.*, 2016). A more recent study found that pre-diagnosis fruit intake was associated with borderline decrease in risk of total death from breast cancer among women, but not vegetables (He, Gu & Zhang, 2017). Similarly, a prospective cohort study involving > 500,000 participants from ten European countries concluded that the risk of cancers of the upper gastrointestinal tract was inversely associated with fruit intake only (Bradbury *et al.*, 2014). In contrast, the latest review indicated that low vegetable and fruit consumption was associated with 17.6% of oral cavity/ pharyngeal cancers, 17.4% of laryngeal cancers, and 8.9% of lung cancers (Islami *et al.*, 2018).

The protective effects of vegetables and fruits may be due to biologically active compounds such as flavonoids which contain antioxidants (Vieira *et al.*, 2016). Vegetables and fruits contain significant amounts of phytochemical compounds such as phenolics and triterpenoids, the anti-inflammatory properties which are beneficial to counter inflammatory response (Zhu, Du & Xu, 2018). Human studies are still needed to test the anti-inflammatory activity of these compounds in humans. In addition, other potential mechanisms related to protective effects of vegetables and fruits may be related to high intake of fibres, and micronutrients such as vitamins C, E, and folate (He, Gu & Zhang, 2017).

A healthy diet should consist of adequate amounts of vegetables and fruits due to its potential protective effects. Although, additional vegetable and fruit intake may not have much effect on cancer risks especially when confounded by smoking and alcohol intake, a moderate intake of vegetables and fruits may lower risk of many common cancers, especially of the digestive tract (Vieira *et al.*, 2016; Turati *et al.*, 2015). The WCRF/ AICR recommended that people should eat mostly foods from plant origin, which includes at least five portions/ servings a day of non-starchy unprocessed vegetables and fruits (Hastert & White 2016; Norat *et al.*, 2014). In agreement with that, another systematic review concluded that either combination or separate intake of vegetables and fruits (600 g/day) reduced the risk of total cancer (0.97, 95% CI = 0.95-0.99) (Aune *et al.*, 2017).

Consumption of pickled vegetables is associated with gastric cancer. A meta-analysis which combined the results of cohort studies showed a pooled relative risk of gastric cancer incidence of 1.15 (95% CI = 1.07-1.23) for 40 g/day increment in pickled vegetable intake in a dose-response manner (Yoo *et al.*, 2020). Other meta-analysis also reported an increased risk of gastric cancer associated with consumption of pickled vegetables (OR = 1.28, 95% CI = 1.09-1.51, Poorolajal *et al.,* 2020); OR = 1.28, 95% CI = 1.05-1.53, Jim *et al.,* 2010). Yoo *et al.* (2020) and Jim *et al.* (2010) proposed that the high sodium content in pickled vegetables to be the main reason, including possibly epithelial damage induced by high dietary salt intake. Most meta-analysis on pickled food and risk of gastric cancer had been done using East Asian case control and prospective studies. The findings on a dose-response relationship are equivocal (D'Elia *et al.,* 2012; Ren *et al.,* 2012). The latest nationally available data for Korea showed that average intake of kimchi in Korea was 1363.3 g/day for males and 88.8 g/day for females (Kim *et al.*, 2016), which was most probably far higher than intake levels in Malaysia. There are no published reports on amount of intake of pickled vegetables or kimchi for Malaysians. Izzah *et al.* (2012) reported that the frequency of consumption of pickled vegetables by Malaysians was very low.

However, there are notable health benefits, such as anti-atherosclerotic effects from *kimchi* (Kim, Noh & Sang, 2018). The possible mechanism could be the nutritional values of the pickled vegetables and the presence of lactic acid bacteria in the fermentation process (Behera *et al.,* 2020). Fermented cabbage contains lactobacilli, which are activators of the nuclear factor (erythroid-derived 2)-like (Nrf2). Nrft2 can block the angiotensin II receptor type 1 (AT_1R) axis which is associated with oxidative stress. Viruses such as the SARS-CoV-2 binds with the angiotensin-converting enzyme 2 (ACE2). Downregulation of ACE2 enhances AT_1R which causes oxidative stress that may lead to a poor prognosis (Bousquet *et al.,* 2020). Bosquet *et al.* proposed that fermented cabbage be considered as a proof-of-concept of dietary manipulation that may enhance Nrf2-associated antioxidant effects. Kim *et al.* (2016) noted that there was a downward trend of kimchi consumption among Koreans from 1998 to 2012, and concluded that there is need for development of low sodium kimchi as consumption of pickled vegetables contribute towards the achievement of 400 g/day of total vegetables and fruits, particularly in Korea. Pickled vegetables may also be a good way to preserve vegetables during pandemics where short-term shortages may occur. Ozer *et al.* (2019) reported that pickled cabbage contained 109.89 4.74 mg ascorbic acid/100 g d.w. and kimchi contained 77.43 2.87 ascorbic acid/100 g d.w. They also reported that *kimchi* and sauerkraut contained 869.64 70.16 and 438.257 25.05 mg gallic acid equivalents/100g fresh weight respectively. It would be better to drain any pickling liquids to limit consumption of salt.

5.3.4 Diabetes mellitus

The prevalence of diabetes mellitus in Malaysia has been increasing over the period of available nationally representative data: 8.3% in adults aged ≥ 30 years in NHMS 1996, 14.9% in adults aged ≥ 30 years in NHMS 2006 (IPH, 2008), 15.2% (95 CI = 14.3-16.1) in NHMS 2011 (IPH, 2011), and 18.3% (95% CI = 17.08-19.58) in NHMS 2019 (IPH, 2020). As insulin resistance is associated with dietary fibre intake, meta-analyses of prospective cohorts have consistently shown an inverse relationship between vegetable and fruit intake and risk of diabetes mellitus (Wang *et al.*, 2016; Wu *et al.*, 2015). Wu *et al.* (2015) showed that 2-3 servings/day of vegetables and 2 servings/day of fruits conferred a lower risk of diabetes mellitus than other levels of vegetable and fruit consumption. They standardized each serving as 106 g per portion. Wang *et al.* (2016) showed that a higher intake of fruit, particularly berries, and green leafy vegetables, yellow vegetables,

cruciferous vegetables, and fruit fibre were associated with a lower risk of diabetes mellitus. Findings from the DONALD cohort study which compared fasting blood sample provided in adulthood (18-39 years) and data on flavonoid intake from vegetables and fruits during adolescence (females: 9-15 years; males: 10-16 years) showed that higher flavonoid intake from vegetables and fruits were related to higher homeostasis model assessment insulin sensitivity (HOMA-2%S) among females (p_{trend} = 0.03) but not among males (Pensczynski *et al.*, 2019). They concluded that intake during adolescence is associated with a favourable risk profile for diabetes mellitus in early adulthood. A 5-year study which followed patients newly diagnosed with diabetes mellitus (n = 401) showed that increasing vegetable and fruit intake following that diagnosis were associated with lower cardiovascular risk factors (Lamb *et al.,* 2017).

Findings from a prospective cohort (n = 3,300) showed that fresh fruit intake was inversely associated with the risk of gestational diabetes mellitus (GDM) in Chinese pregnant women (Zhou *et al.*, 2019). Individuals in the highest quintile of total fruit consumption had an adjusted OR of 0.41 (0.27-0.62) compared to individuals in the lowest quintile who had an adjusted OR of 0.80 (0.56-1.12) (p_{trend} < 0.001). They reported that every 100 g of total fruit consumption was associated with a 14% (95% CI = 8-20) decrease in OR of GDM. Their evidence suggested that women with GDM risk should consume low glycaemic index and glycaemic load fresh fruits. Randomised control trials (n = 6,513) showed that pregnant women who were given daily intake of fruit (4-60 g of dried fruit) and green leafy vegetables (30 g fresh or 7.5g dried) had lower rates of GDM (7.3%) compared to women in the control group who were given potatoes and onions (12.4%), OR = 0.56 (95% CI = 0.36-0.86, p = 0.008) and the reduction in GDM remained significant after pre-pregnancy adiposity and fat or weight gained during pregnancy were adjusted for (Sahariah *et al.*, 2016).

This dietary guideline limits unsweetened fruit juice to one serving per day as part of the 'five per day' recommendation for vegetable and fruit intake. A systematic review and meta-analysis of 17 cohorts involving 38,254 cases/10,126,754 person years, showed that consumption of fruit juice was associated with 7% greater incidence of diabetes mellitus after adjustment for adiposity (Imamura *et al.,* 2015). However, consumption of fruit juice had a lower association with incidence of diabetes mellitus compared to consumption of sugar sweetened beverages, which was reported to be at 13% per one serving/day and artificially sweetened beverages at 8%, both after adjustment for adiposity (Imamura *et al.,* 2015). They however cautioned a potential bias, that is, the likelihood of misclassifying sugar sweetened fruit drinks such as fruit punch as fruit juice. Epidemiological evidence from the EPIC arm in Netherlands found no evidence for associations between pure fruit juice and fruit consumption and diabetes risk after adjusting for overall dietary quality (Scheffers *et al.,* 2020).

5.4 Current status

Despite desirable benefits from vegetable and fruit consumption, a high prevalence of inadequate consumption was reported among adults. Findings from the Prospective Urban Rural Epidemiology (PURE) study in 18 countries (including Malaysia) found that mean intake of vegetables and fruits was 3.76 servings per day (Miller *et al.*, 2016). Based on income levels, mean daily intake was 2.14 servings in low-income countries (Bangladesh, Pakistan, India, and Zimbabwe), 3.17 servings in lower-middle-income countries (China, Iran, Colombia, and Occupied Palestinian Territory), 4.31 servings in upper-middle-income countries (Malaysia, Argentina, Chile, Brazil, Turkey, Poland, and South Africa), and 5.42 servings in high-income countries (Canada, Sweden, and United Arab Emirates) (Miller *et al.*, 2016).

In Malaysia, the prevalence of inadequate vegetable and/or fruit intake had increased from 92.5% in 2011 (IPH, 2011) to 94.0% in 2015 (IPH, 2015) among adults in Malaysia. The latest NHMS 2019 (IPH, 2020) showed that 94.9% (95% CI = 93.82-95.79) of adults did not consume adequate vegetables and fruits, with more men [95.1% (95% CI = 93.14-96.50)] having inadequate intake of vegetables and fruits compared to women [94.7% (95% CI = 93.44-95.72)]. Only 10.0% of Malaysian adults consumed adequate vegetables (≥ 3 servings/day), and 9.4% consumed adequate fruits (≥ 2 servings/day) (IPH, 2020). By age group, adults aged 18-19 years old (98.9%) were reported to have the highest prevalence of inadequate intake of vegetables and/or fruits (IPH, 2020). In terms of amount consumed, women consumed 1.59 servings of vegetables/day compared to 1.61 servings/day for men. Women consumed 1.40 servings of fruit/day compared to 1.53 servings/day for men (IPH, 2014). Based on ethnicity, Chinese consumed more vegetables and fruits compared to other ethnic groups in the country (IPH, 2020). A small-scale study among adults aged 20-65 years in Penang and Kota Bharu found that adults consumed 1.3 ± 1.0 servings of vegetables daily and 0.7 ± 1.0 servings of fruits daily (Lee & Wan Abdul Manan, 2019). These intakes were much lower than the recommended daily intake of vegetables and fruits. In Selangor, a study on 348 adults reported that only a small proportion of respondents (3%) consumed at least five servings of vegetables and fruits daily. They consumed 0.7 serving of vegetable and 1 serving of fruit daily (Wong *et al.*, 2014).

Nurul Izzah *et al.* (2012) reported that among adults in Selangor, the most frequently consumed vegetables were spinach, Chinese mustard, cauliflower, celery, water spinach, French beans, long beans, potato, carrot, round cabbage, chilies, cucumber, tomato, and okra. The most consumed *ulam* and traditional vegetables were *petai*, sweet leaves (*cekur manis*) and Indian pennywort (*pegaga*). Shallots, onion, garlic, green bean sprout and curry leaves were also preferred by Malaysian adults. On the other hand, the most preferred fruits were apples and bananas. In terms of cooking method, Malays and Chinese consumed more boiled vegetables compared to Indians (Nurul Izzah *et al.*, 2012). Attitude, habit, social influences from family members and friends, and

availability of fruits at home and nearby areas were the factors found to be associated with the intention to consume vegetables and fruits among Malaysian adults (Khairunnisa Izzati *et al.*, 2012). A qualitative study reported that texture, taste, colour, odour and appearance were the main factors influencing the consumption of vegetables and fruits among Malay adults (Norsyahidah *et al.*, 2013).

In comparison, studies reported in the USA such as the Women's Health Study (WHS) in Boston showed that mean intake of vegetables and fruits was 6.1 ± 3.6 servings/day, of which 3.9 ± 2.6 servings/day were of vegetables and 2.2 ± 1.6 servings/day were of fruits (Wang *et al.*, 2012). The proportion of women who consumed ≥ 5 servings/day of total vegetables and fruits was 31.6% (Wang *et al.*, 2012). Another US study (n = 3,696,778 adults; mean age = 64.1 ± 10.2 years and 64.1% were female) found that daily consumption of ≥ 3 servings of vegetables and fruits was 29.2% (Heffron *et al.*, 2017). In the United States, consumers of frozen vegetables and fruits consumed significantly more total vegetables and fruits than non-consumers despite both groups not meeting their recommended daily servings of vegetables and fruits. Consumers of frozen vegetables and fruits had significantly higher intakes of dietary fibre, potassium, calcium and vitamin D and lower sodium intake (Storey & Anderson, 2018). American children and adults who consumed canned vegetables and fruits consumed more energy, and energy-adjusted dietary fibre, total sugar, choline, potassium, and less fat and saturated fat. Both child and adult consumers and non-consumers of canned vegetables and fruits had comparable energy adjusted sodium and added sugar intakes (Freedman & Fulgoni, 2016). These findings on frozen and canned vegetables and fruits were derived from secondary analysis of cross-sectional data from the U.S. National Health and Nutrition Examination Surveys. In the European Union, 65.7% of individuals aged ≥ 15 years consumed at least one portion/day of vegetables and fruits; only 14.1% consumed > 5 servings/day (Eurostat, 2018). In Kenya, a national cross-sectional study carried out in 2015 (n = 4,479 adults; aged 18-69 years) found that mean serving of vegetables and fruits was 2.09 serving/day, with 1.31 servings/day of vegetables and 0.78 servings/day of fruits. Only 12.4% of adults in Kenya had ≥ 2 servings/day of fruits, 7.4% had ≥ 3 servings/day of vegetables and 6.0% had ≥ 5 servings/day of vegetables and fruits (Pengpid & Peltzer, 2018). In Tanzania, a population-based survey found that 82% of the adults aged ≥15 years did not meet the daily recommended intake for vegetables and fruits (Msambichaka *et al.*, 2018).

In Asia, data from the 2013 China Chronic Disease Surveillance survey showed that 46.8% of Chinese adults did not meet the WHO recommendation of 400 g/day of vegetable and fruit intake, with mean vegetable intake at 350.6 g/day and mean fruit intake at 102.3 g/day (Li *et al.*, 2017). Data from the 2015 Vietnam National Survey revealed that mean serving/day of vegetables and fruits was 4.3 servings, with 3.0 servings of vegetables and 1.3 servings of fruits were recorded (Nguyen *et al.*, 2020). Findings also showed that women consumed more fruits than men, but vegetable intake was similar in men and women. Less than half of the adults (42.9%) met the WHO recommendations for total consumption of vegetables and fruits, with more women met the recommendation as compared to men (Nguyen *et al.*, 2020). In Laos, a national cross-sectional survey conducted in 2013 found that mean servings/day of vegetables and fruits was 2.32; with 1.33 servings/day of vegetables and 0.99 servings/day of fruits among adults aged 18-64 years. Only 8.7% of the adults had ≥ 3 servings/day of vegetables, 18.9% of the adults had ≥ 2 servings/day of fruits, and 5.3% had ≥ 5 servings/day of vegetables and fruits (Pengpid *et al.*, 2019). The Thailand National Health Examination Survey III demonstrated that mean servings of vegetables and fruits was 3.24 serving/day, with 1.78 servings/day of vegetables and 1.46 servings/day of fruits (Satheannoppakao *et al.*, 2009). The Bangladesh Non-communicable Disease Risk Factor Survey 2010 showed that the prevalence of inadequacy of vegetable and fruit intake (< 5 servings/day) was 82.8% (Karim *et al.*, 2017).

5.5 Key Recommendations

Key Recommendation 1

Eat at least five servings of vegetables and fruits everyday.

How to Achieve

1. Eat at least three servings of vegetables a day, and two servings of fruits a day.
2. Eat at least one serving of vegetables at every main meal.
3. Consume fruit as snack if you not consume it with your main meal.

Key Recommendation 2

Eat a variety of vegetables everyday.

How to Achieve

1. Eat green leafy vegetables such as *sawi* and *bayam* and their edible stems everyday.
2. Eat different coloured vegetables at every main meal.
3. Eat fruit vegetables such as brinjal (eggplant), tomato, *peria* and *petola* several times a week.
4. Vegetable can be fresh green leafy vegetables, other fresh vegetables including various coloured vegetables, fruit vegetables, bean vegetables, *ulam*, canned and frozen vegetables. Drain and rinse canned vegetables to reduce salt.
5. Choose a variety of vegetables as snacks such as cucumber slices, tomatoes and carrot sticks.
6. Prepare vegetable juices such as cucumber juice without added sugar and seasonings.
7. Eat under-utilise vegetables such as *cekor*, *terung pipit*, *midin*, and drumstick *(moringa)* leaves.

Key Recommendation 3

Eat a variety of fruits everyday.

How to Achieve

1. Eat different type of fruits daily, if possible.
2. Choose a variety of fruits as snacks such as bananas and guava, without added sugar, salt or flavourings.
3. If you choose dried fruits, select unsweetened or unsalted varieties.
4. If you choose canned fruits, serve without syrup.
5. If you choose fruit juices (without added sugar), limit to once a day. Fresh whole fruits are preferable over fruit juices.

5.6 References

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Eat adequate amounts of rice, other cereals, whole grain cereal-based products and tubers

KEY MESSAGE

6

EAT ADEQUATE AMOUNTS OF RICE, OTHER CEREALS, WHOLE GRAIN CEREAL-BASED PRODUCTS AND TUBERS

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6.1 Terminology

Breads

Breads refer to leavened or unleavened dough prepared from flour or meal, or a combination of these with water and baked or steamed. Among examples of breads are white or wholemeal bread, bun, pita bread, *roti canai, roti arab*, *capati*, tortilla, bagel and steamed bun or *pau* (MOH, 1985).

Carbohydrate

Carbohydrates are polyhydroxy aldehydes, ketones, alcohols, acids, their simple derivatives and their polymers having linkages of the acetal type (FAO/ WHO, 1998).

One of the macronutrients and a source of energy. Carbohydrates are the least concentrated form of energy providing 4 kcal per gram (NHMRC, 2013). They include sugars, starches, and fibre (USDHHS & USDA, 2015).

Fibre

Total fibre is the sum of dietary fibre and functional fibre. Dietary fibre consists of nondigestible carbohydrates and lignin that are intrinsic and intact in plants (i.e., the fibre naturally occurring in foods). Functional fibre consists of isolated, nondigestible carbohydrates that have beneficial physiological effects in humans. Functional fibres are either extracted from natural sources or are synthetically manufactured and added to foods, beverages and supplements (USDHHS & USDA, 2015).

Starches

Many glucose units linked together into long chains. Examples of foods containing starch include vegetables (e.g., potatoes, carrots), grains (e.g., brown rice, oats, wheat, barley, corn), and legumes (beans and peas; e.g., kidney beans, garbanzo beans, lentils, split peas) (USDHHS & USDA, 2015).

Sugars

Composed of one unit (monosaccharide, such as glucose or fructose) or two joined units (disaccharide, such as lactose or sucrose). Sugars include those occurring naturally in foods and beverages, those added to foods and beverages during processing and preparation, and those consumed separately (USDHHS & USDA, 2015). Other terminologies for sugars which include total sugars, free sugars, added sugars and hidden sugars can be found in Key Message 11.

Cereals

Cereals are the edible seeds known as kernel or grains of the grass family, *Gramineae* or *Poaceae* (Frølich & Aman, 2010). True cereal grains include wheat, oat, rice, corn, barley, rye, kamut, triticale, sorghum, fonio, millet, teff, and canary seed (AACCI, 2006). All cereal grains have three anatomical components: the bran, endosperm, and germ. Each component contributes to a different nutritional composition. Bran consists primarily of the main outer layers of the grain which is rich in dietary fiber, vitamins, minerals, and phytochemicals (Seal *et al.*, 2016). The endosperm constitutes about 60-85% of the grain, comprised mainly of carbohydrates in the form of starches with some protein and B vitamins (Frølich & Aman, 2010). The germ is the smallest fraction (2.5-3%) of the grain, containing a high lipid and protein content and some vitamins and minerals (Mathews & Chu, 2020).

Cereal-based products

Cereal products mostly made from a variety of grains including rice, wheat, maize, oats, rye, barley, millet, quinoa, and sorghum derive either from the processing of grain through one or more mechanical or chemical operations, or from the processing of flour, meal or starch (FAO, 1996).

Dietary fibre

Dietary fiber is the edible parts of plants or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine with complete or partial fermentation in the large intestine. Dietary fiber includes polysaccharides, oligosaccharides, lignin, and associated plant substances. Dietary fibers promote beneficial physiological effects including laxation, and/ or blood cholesterol attenuation, and/ or blood glucose attenuation (AACC, 2001),

Glycemic index (GI)

A way to classify carbohydrate-containing foods based on the ability of different types of carbohydrate-containing foods to raise the blood glucose level. GI is defined as the incremental area under the blood glucose response curve elicited by a 50 g available carbohydrate portion of a food expressed as a percentage of the response to 50 g anhydrous glucose taken by an individual (Wolever, 2013).

Glycemic load (GL)

The GL refers to the cumulative exposure to postprandial glycemia, as a measure of insulin demand, over a specified period of time (Salmeron *et al.*, 1997). It does not take into account the pattern of loading within the specified time e.g., few high – glycemic impact meals versus frequent meals of low glycemic impact. It is calculated indirectly as the product of the average GI of carbohydrate foods consumed and the total carbohydrate intake over a specified time period (Jenkins *et al.*, 1981).

Noodles and pasta

Products such as *mee, bihun, laksa,* macaroni and spaghetti that are obtained by extruding or moulding units of dough made of cereal flour (MOH, 1985).

Rice

Grains of *Oryza sativa* from which the husk has been removed. White rice are rice grains that have been milled and polished to remove the husk, bran and germ. Among different varieties of rice include brown, wild, basmati, parboiled and fragrant rice (MOH, 1985).

Refined Grains

Refined grains and grain products refer to highly processed grain (cereal) foods where the outer layer of the grain is lost during processing (NHMRC, 2013). Many refined grains are low in fiber but enriched with thiamin, riboflavin, niacin, and iron, and fortified with folic acid (USDHHS & USDA, 2015). These also include cereal or grain-based products with a significant amount of added fat and sugar, such as cakes, pastries, and biscuits (NHMRC, 2013).

Snacks

A snack is composed of solid food with or without a beverage that occurs between habitual meal occasions for the individual, is not a substitute for a meal, and provides substantially fewer calories than would be consumed in a typical meal (Johnson & Anderson, 2010).

Tubers

Root plants that store carbohydrates. These include potatoes, sweet potatoes, tapioca (cassava), yam, lotus root, ginger root and sweet turnip (*sengkuang*) (MOH, 1985).

Whole grain

Whole grains consist of the intact, ground, cracked or flaked caryopsis, whose principal anatomical components are the starchy endosperm, germ, and bran, which are present in the same relative proportions as they exist in the intact caryopsis (AACCI, 1999; Jones, 2010).

Whole grain products

Food products made with at least one whole grain ingredient (AACC, 2000). The food contains 100% whole grain ingredients for wheat flour, rice flour, rice and grains; a minimum of 60% whole grain ingredients for bread; and a minimum of 25% or 8 g per serving whole grain ingredients for other products (MOH, 2020).

6.2 Introduction

Cereals and cereal products are the basis of diets in many different cultures and cuisines in both developed and developing countries, providing a major proportion of dietary energy and nutrients (Laskowski *et al.,* 2019). They are composed of approximately 75% carbohydrates, mainly starches and about 6-15% protein, contributing in global terms more than 50% of energy supply (WHO, 2003).

Among the types of cereals broadly consumed worldwide include wheat, maize, rice, barley, sorghum, oats, rye and millet. Cereals and cereal based products are the most consumed staple accounting for the highest food supply, providing a major source of energy in the form of carbohydrate and protein. In Malaysia, rice is the main cereal and staple consumed due to its cultural importance for all major ethnic groups, palatability and ease of preparation. Rice is easily available and accessible in the country as its production is subsidized and supply is assured by means of various policies. This is followed by wheat and wheat based products which include noodles, breads and pastas (Sundaram & Tan, 2019).

Other than being an exceptional sources of energy and plant based protein, whole grain cereals have been acknowledged as an important source of fibre, minerals, trace elements, vitamins, carotenoids, polyphenols and numerous bioactive compounds with antioxidant and anti-carcinogenic properties (Gani *et al.,* 2012). These properties are all essentials to promote and maintain health. Research findings have shown that intake of whole grain cereals as potential protection against obesity, diabetes, CVD and cancers (McKeown *et al.,* 2013).

6.3 Scientific basis

6.3.1 Importance of carbohydrate in a diet

The importance of carbohydrates in human nutrition cannot be underestimated. Dietary carbohydrate is the primary source of energy in the human diet (SACN *et al.*, 2015; NCCFN, 2017). Besides, intake of dietary carbohydrate from a variety of sources is beneficial. It provides various micronutrients and phytochemicals including fibre which are necessary for optimal health (Chambers, Byrne & Frost, 2019). Also, an adequate amount of carbohydrate is required to maintain glucose homeostasis and gastrointestinal functions (Ludwig *et al.*, 2018). Therefore, eating an adequate amount of rice, other cereals, cereal-based products, and tubers help to achieve a sufficient amount of carbohydrates as dietary energy and nutrient adequacy.

The optimal proportion of carbohydrate (including starches and sugars) is essential in reducing chronic disease risk (Chambers, Byrne & Frost, 2019). The estimated Acceptable Macronutrient Distribution Ranges (AMDR) related to reducing the risk of chronic disease for carbohydrate is 45-65% total energy intake (TEI) (IOM, 2002). As for the Malaysian adult population, the Technical Scientific Committee (TSC) of RNI 2017 recommends the carbohydrate intakes of 50-65% TEI (NCCFN, 2017) with the optimal proportion should be between 50 and 55% TEI (Seidelman *et al.*, 2018).

Nonetheless, the Prospective Urban Rural Epidemiology (PURE) study observed that high carbohydrate intake of > 60% of TEI was associated with an adverse impact on total mortality and non-cardiovascular disease mortality, with moderate consumption (e.g., 50-55%) were likely to be more appropriate than very high or very low carbohydrate intakes (Dehghan *et al.*, 2017). The PURE study is a large prospective cohort involving 18 countries in five continents from low and middle-income countries, including Malaysia. The high carbohydrate intake, especially from refined sources (such as white rice and white bread) may explain the increased risk of total mortality and cardiovascular events (Dehghan *et al.*, 2017).

A similar finding was also observed in the recent meta-analyses of prospective cohort study involving 15428 adults in four communities who were enrolled in the Atherosclerosis Risk in Communities (ARIC) study (Seidelman *et al.*, 2018). In this meta-analysis, both high and low proportions of carbohydrate diets were associated with increased mortality, with minimal risk observed at a 50-55% carbohydrate intake (Seidelman *et al.*, 2018). The relationship between carbohydrate intake and the risk of mortality was non-linear. Both PURE and ARIC cohort studies suggested a U-shaped association, with the lowest observed risk associated with carbohydrate consumption of 50-55% of TEI (Figure 6.1) (Dehghan *et al.*, 2017; Seidelman *et al.*, 2018). The data also indicate that the source of carbohydrate, as well as the source of the protein and fat substituted for carbohydrates in the diet, might modify the relationship between carbohydrate intake and mortality (Seidelman *et al.*, 2018).

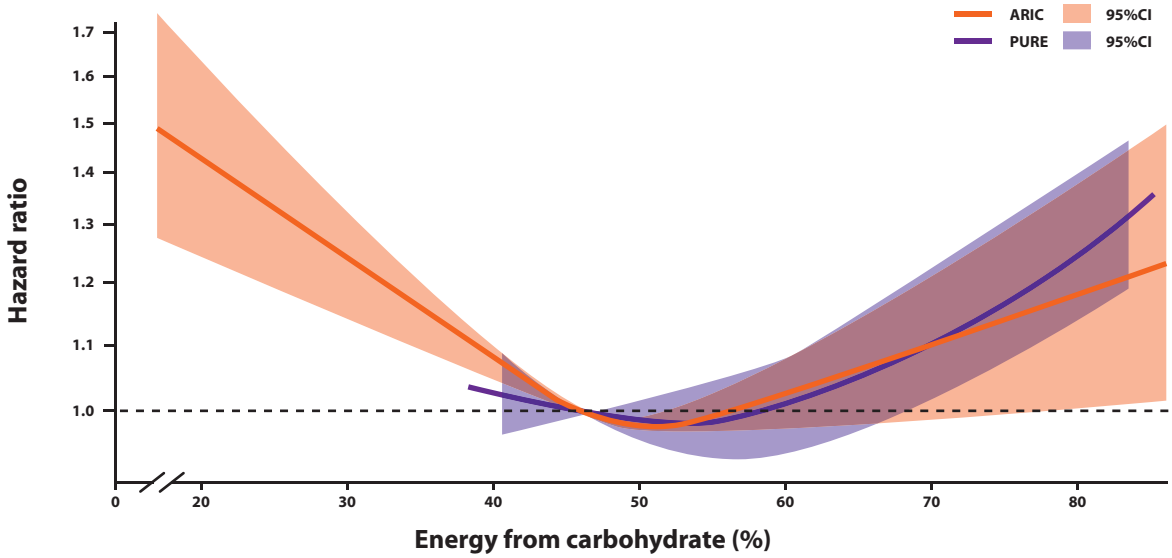

Figure 6.1: U-shaped association between the percentage of energy from carbohydrate and all-cause mortality in ARIC and PURE cohort studies
Source: Seidelman *et al.* (2018) and Dehghan *et al.* (2017)

6.3.2 Role of dietary fibre in a diet

Eating adequate amounts of rice, other cereals, cereal-based products and tubers ensures that one obtains sufficient carbohydrate as dietary energy in the diet. Besides getting adequate carbohydrate in terms of quantity, it is equally important to choose quality carbohydrate choices. Dietary fibre, whole grains, dietary glycaemic index (GI), glycaemic loads (GL), and total sugars are among common indicators of carbohydrate quality (Reynolds *et al.,* 2019).

Dietary fibre are edible carbohydrate polymers with three or more monomeric units that are resistant to digestion and absorption in the human small intestines (Joint FAO, 2010). These include edible carbohydrates naturally found in cereals, especially whole grains, tubers, fruits, vegetables and legumes. It is well documented that dietary fibre, depending on its water solubility, viscosity and fermentability, may exert different beneficial effects on the human body. These include fecal bulking effect, delaying post-prandial glucose and lipid metabolism and promoting healthy gut microbiota which is increasingly recognised to protect against non-communicable disease risks and mortality (Makki *et al.,* 2018).

As concluded in the recent series of systematic reviews and meta-analyses of prospective studies and clinical trials (Reynolds *et al.,* 2019), a higher intake of dietary fibre or whole grains are associated with a reduction in mortality risk and NCD incidences. For instance, higher intake of dietary fibre is associated with a 15-31% reduction in all-cause mortality, risks of coronary heart disease, stroke, type 2 diabetes and colon cancer. More importantly, there is a clear dose-response relationship between dietary fibre and health outcomes. Consuming 25-29 g dietary fibre per day confers greatest benefits compared to lower consumption of dietary fibre (15-19 g or 20-24 g). The findings also concluded that additional benefits are likely to accrue with more than 30 g intake of dietary fibre daily.

Whole grains are useful means of increasing dietary fibre intake. Many whole grains are good sources of dietary fibre while most refined grains contain little or no fibre. It is therefore not surprising that similar reductions in all critical health outcomes (13-33%) were also observed for whole grain intakes in prospective studies and intervention trials (Reynolds *et al.,* 2019). The reported benefits of dietary fibres were likely attributed to fibre-rich foods such as wholegrains, fruits and vegetables, due to the fact that synthetic and extracted fibre were not widely used when the contained studies were undertaken. Existing data suggest that dietary fibre and whole grains are complementary in reducing disease risk in the population.

Whole grain products are defined by the quantity (percentage or specific amount) of whole grain ingredients incorporated into a food. In Malaysia, a whole grain product should contain 100% whole grain ingredients for wheat flour, rice flour, rice and grains; at least 60% whole grain ingredients for bread; and 25% whole grain ingredients or 8 g per serving for other products (MOH, 2020). However, there is currently no universally accepted definition of whole grain and whole grain products that can be used to provide quantity recommendations for consumers (Van Der Kamp *et al.,* 2014; Seal *et al.,* 2016; Mathew & Chu, 2020). As a result, dietary guidelines for whole grain consumption of many countries remain non-quantitative (Herforth *et al.,* 2019), e.g., enjoy grain (cereal) foods, mostly whole grain and/ or increase cereal fibre varieties (NHMRC, 2013), diversification of the diet to provide increasing amounts of whole grains, pulses, fruits and vegetables is encouraged (SACN, 2015). Given the protective roles of whole grains and dietary fibre in disease risks, MDG 2020 focuses on increasing dietary fibre and replacing refined grains with whole grains.

6.3.3 Glycaemic index and glycaemic load

Glycaemic index (GI) and glycaemic load (GL) are two empirical metrics that rank carbohydrate-containing foods based on their physiological effects on blood glucose upon consumption. There are evidences from prospective cohort studies that diets lower in overall GI or GL are protective of coronary heart disease and type 2 diabetes development (Livesey & Livesey, 2019; Livesey *et al.,* 2019), but their influence on body weight and CVD risks have been inconsistent in intervention trials (Vega-Lopez, Venn & Slavin, 2018; Reynolds *et al.,* 2019). Concurring with dietary guidelines of other countries (Buyken *et al.,* 2018; Herforth *et al.,* 2019), the current MDG 2020 does not have explicit recommendations based on GI or GL due to inclusive or insufficient evidence linking GI/ GL in disease risk reduction. Future studies are warranted to consider GI/ GL as a relevant measure of carbohydrate quality, along with dietary fibre and whole grains when addressing the health aspects and impact of carbohydrate quality (Brand-Miller & Buyken, 2020).

6.3.4 Limit intake of refined carbohydrate

Refined carbohydrates are present in the form of refined grains and refined sugars. Diet that is high in processed foods, added sugars and other refined carbohydrates are among the driving factors for the growing epidemics of many non-communicable diseases. Plain sugars are refined forms of carbohydrate and generally refer to monosaccharides and disaccharides naturally present in foods or added to food products. The term 'free sugar' differs from 'added sugar', as it also includes naturally present sugars in fruit juices, syrups and honey (Buyken *et al.*, 2018). A growing body of evidence suggests restricting the intake of free sugars in adults and children to reduce the risk of NCDs (WHO, 2015), principally via prevention and control of unhealthy weight gain and dental caries, which is explained in more details in Key Message 11.

Compared to refined grains, whole grain contains higher amounts of magnesium, dietary fiber, phytochemicals and other functional compounds (Benisi-Kohansai *et al.,* 2016). It is clear that increased intake of whole grain by only 2-3 servings per day may reduce the risk of type 2 diabetes, cardiovascular disease and all-cause mortality, hence the recommendation of balancing the whole and refined grains would require increasing the whole-grain intake and simultaneously reducing refined grains intake (Gaesser, 2019).

Several prospective cohort studies have identified whole grain food sources association with lowered risk of CVD. Findings from large, population-based, prospective studies and clinical trials have consistently observed a dose-response relation between whole-grain intake and disease risk, with health benefits proportional to the amount of whole grain consumed (Ye *et al.,* 2012; Benisi-Kohansai *et al.*, 2016; Reynolds *et al.*, 2019). Whole grain exert health benefits by supporting the maintenance of glucose and insulin homeostasis, lowering of serum cholesterol and LDL-cholesterol concentrations and reducing inflammation and oxidative stress (Ye *et al.*, 2012).

6.4 Current status

FAO food balance data showed that carbohydrate foods supplied approximately 63% of the total per capita energy supply (Shahar *et al.,* 2018). The trend in total rice supply reflects the trend in cereals, as rice is the main contributor and the food for the Malaysian population. Rice supply gradually decreased from 763 kcal/capita/day in 2013 to 680 kcal/capita/day in 2014 whereas in 2017 this value has increased to 748 kcal/capita/day (FAOSTAT, 2017). On the other hand, wheat, maize, barley, oats, cereals and other per capita consumption steadily increased from 2014 onwards (FAOSTAT, 2017).

In Malaysian Adult Nutrition Survey 2014 (MANS, 2014), the mean carbohydrate intakes was 273 g/day, contributing to 53% of total energy intake. In comparison to MANS (2003) study, the daily intake of carbohydrates has decreased slightly over the years but the proportions of energy derived from carbohydrate is still within the recommendations (NCCFN, 2017). The majority of Malaysians achieved adequate daily energy contribution from carbohydrates (Zainuddin *et al.,* 2019). However, it should be noted that carbohydrates were consumed mostly in refined forms such as white rice and biscuits (Kasim *et al.,* 2018). Despite the lack of national data on whole grains and whole grain products consumption among adults, it appears that whole grains are consumed infrequently in Malaysian diets. Local data of school children observed that only 25% of primary school children and 19% of adolescents consumed whole grains daily. The children and adolescents consumed wheat (77.7%) followed by oats (13.7%), corn/maize (7.4%) and rice (1.2%) as their main types of whole grains. Ready-to-eat breakfast cereals and hot cereals were the two major food sources contributing to total whole grain intake. Almost all the children and adolescents (97.7 %) did not meet the Malaysian recommendation for whole grain intake of 2–4 servings per day (Norimah *et al.,* 2015).

6.5 Key Recommendations

Key Recommendation 1

Eat 3-5 servings of cereals, cereal-based products and tubers daily according to your energy needs and physical activity level.

How to Achieve

1. Include at least one serving of cereal grains in every main meal.

2. Include a serving of snack food (light meal in between breakfast, lunch or dinner) based on tuber, wholegrain cereals or products if your energy need is more than 1500 kcal/day.

Key Recommendation 2

Choose at least half of your cereals and cereal-based products from whole grains.

How to Achieve

1. Cook white rice mixed with whole grains such as brown rice, hulled barley, oats and corn.

2. Choose whole grain alternatives for noodles and pasta, bread, breakfast cereals, cakes, biscuits and other cereal based products.

3. Add whole grains such as corn, hulled barley and oats to soups (e.g., mushroom soup or beef stew).

4. Choose whole-meal bread, whole-wheat *capati*, *putu mayam ragi* (string hoppers), *ragi* noodles, thosai or porridges over similar refined products.

5. Read the ingredients list of cereal-based product labels. Choose products with higher percentages of whole grains (refer KM14).

Key Recommendation 3

Choose cereal-based products that are high in fibre, low in fat, sugar and salt.

How to Achieve

1. Read the nutrition information panel and look for the fibre content, as well as look for claims of 'high in fibre' on the label.

2. Choose cereal based products labelled as high fibre and low in fat, sugar and salt content.

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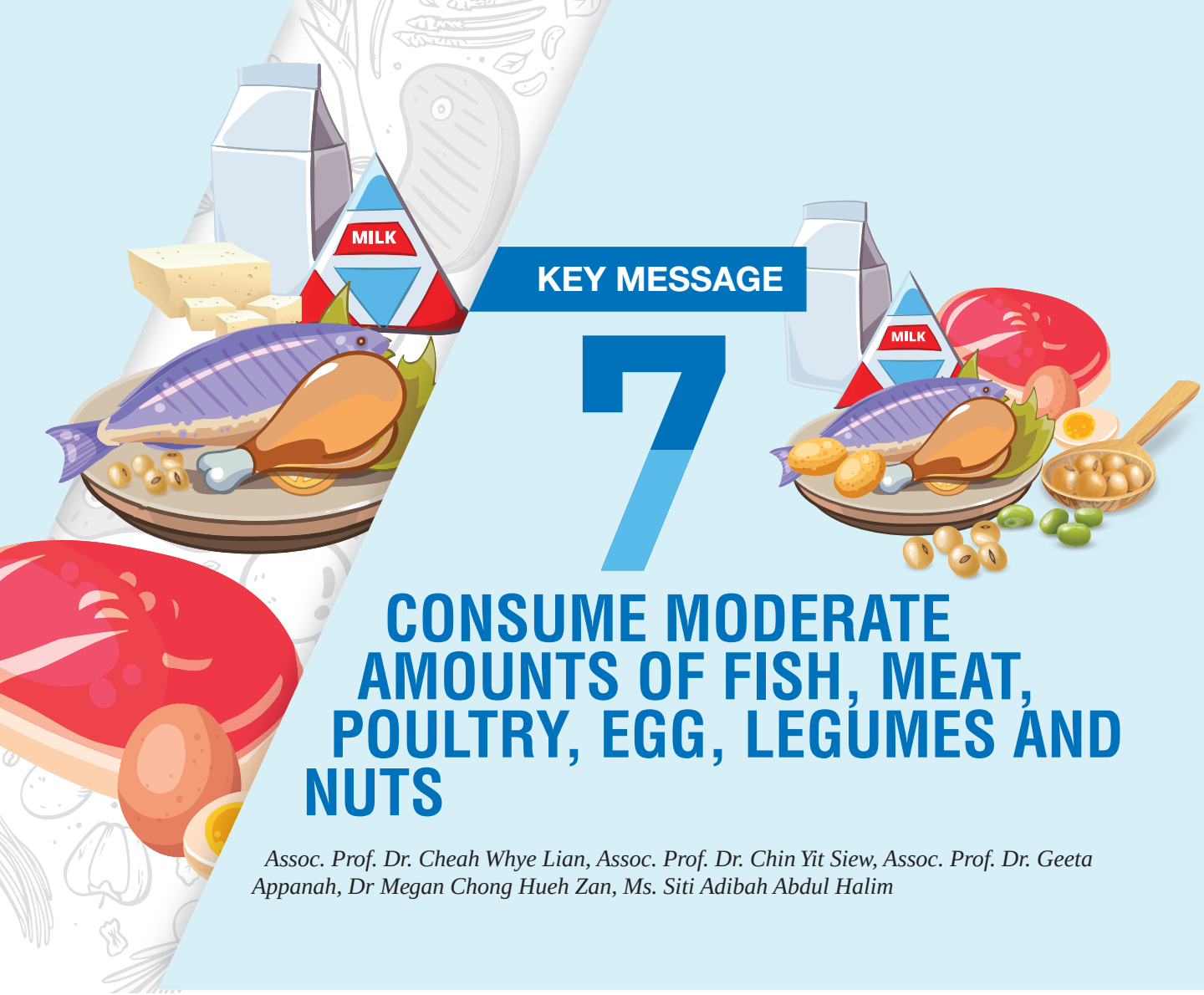
MILK

Consume moderate amounts of fish, meat, poultry, egg, legumes and nuts



KEY MESSAGE

7

CONSUME MODERATE AMOUNTS OF FISH, MEAT, POULTRY, EGG, LEGUMES AND NUTS

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7.1 Terminology

Egg

Egg usually refers to chicken egg but can also include eggs from other birds, for instance duck and quail.

Fish

Fish is any aquatic vertebrate animal that is covered with scales, and equipped with two sets of paired fins and several unpaired fins. The term includes all marine and fresh water fishes. It does not include shellfish.

Legumes

Legumes are plants that belong to the family of Leguminosae or known as Fabaceae, which include pulses and lentils. They are in the form of fruit or seeds of a plant, which are grow within a pod. Groundnuts or peanuts, and monkey nuts are classified under legumes although being called as nuts. Common type of legumes consumed are baked beans, kidney beans, soya beans, pinto beans, black-eyed peas or garden peas, and different color of lentils.

Meat

Meat is defined as skeletal muscle and associated tissues derived from commonly farmed and/ or harvested mammals. It includes part of all the carcass muscle component of animals such as cattle, sheep, goat, buffalo, deer, pig or rabbit. Meat ranges from raw fresh cuts to those made using advanced processing methods. However, it does not include organs and glands such as liver, kidney, brain and heart.

Nuts

Nuts are obtained from seeds or fruits of some plants. Chestnuts and hazelnuts are nuts obtained from fruits that have a hard shell. Where else almonds, cashew nuts, walnuts, pistachios, pecans and Brazil nuts are dried seeds. It is important to note that not all seeds are nuts but all nuts are seeds. In botanical term, nuts are referred as fruits that composed of inedible hard shell and seed that are generally edible, which explained why many nuts used in cooking such as almonds, pecans, walnuts are not classified as nuts in botanical term.

Poultry

Poultry is defined as domestic fowls which include chicken, duck, goose, turkey, quail and other avian foods raised for production of meat. It excludes egg.

Processed meat

Processed meat refers to meat that has been transformed through salting, curing, fermentation, smoking or other processes to enhance flavor or improve preservation.

Shellfish

Shellfish, any aquatic invertebrate animal having a shell and belonging to the phylum Mollusca (i.e., oysters, mussels, scallops and clams), the class Crustacea (i.e., shrimp, prawn, crab and lobster) or the phylum Echinodermata (i.e., sea urchins and sea cucumber).

7.2 Introduction

Protein is needed in the forming of new cells and repairing of old cells in our body, as part of growth and maintenance of human body. In addition, it also forms enzymes and hormones and provides energy. In situation where supply of energy from carbohydrate and fats is insufficient, protein will be used. Protein can be obtained from animal and plant sources. However, lysine, methionine, cystine, threonine, tryptophan and leucine are not synthesized by human body, therefore they have to be consumed through food. Methionine and lysine are needed for the endogenous synthesis of carnitine that plays a crucial role in energy production (Krajcovicova-Kudlackova *et al.*, 2000). Tryptophan is involved in the production of the neurotransmitter serotonin.

A protein that provides all essential amino acids and some non-essential amino acids is considered as complete protein. Samples of complete protein are meat, poultry, fish, and eggs. Plant protein on the other hand is often classified as incomplete protein, with exception of soy protein. However, if plant protein is consumed appropriately, it can meet the energy needs. Sources of plant proteins are legumes, pulses, seeds, nuts, beans and soy products.

For adults, to achieve optimal health, Malaysian Recommended Nutrient Intake RNI 2017 (NCCFN, 2017) has recommended at 1.00 g protein/kg body weight. This amount was higher than previous recommendation of 0.83 g/kg body weight/day by WHO (2007) because it was broadly agreed that the previous recommendation may be sufficient for prevention of deficiency but not for optimal health.

7.3 Scientific basis

Fish (including shellfish), meat, poultry, eggs, legumes, and nuts are rich in protein and good source of nutrients such as iron, zinc, iodine, omega-3 fatty acids and vitamins (B-group vitamins). All these are important to maintain good health and functioning of the body.

7.3.1 Fish

Fish is a good source of high-quality proteins. Fish proteins are notable for its unique amino acids profile and high biological value (Weichselbaum *et al.,* 2013). Fish is also a leaner choice of animal protein, having the least saturated fat than meat and poultry (FAO & WHO, 2010). Additionally, fish also provides other micronutrients including iodine, iron, zinc, magnesium, selenium, potassium, and B□vitamins (Fernandes *et al.*, 2012; Nurnadia *et al.,* 2013; Tørris, Smastuen & Molin, 2018).

Some fish (such as salmon, trout, and herring) are high in a type of polyunsaturated fatty acids (PUFA) called "omega-3 fatty acids" or n-3 fatty acids (Calder, 2014). These fatty acids are critical for brain development and prevention of allergies in children (Bernstein, Osken & Ferranti, 2019). Omega-3 fatty acids from fish have been shown to provide specific health benefits, notably in relation to cardiovascular health (Chowdhury *et al.,* 2012; Endo & Arita, 2016, Del Gobbo *et al.,* 2016; Alexander *et al.,* 2017) as well as supportive roles in cognition and brain ageing (Raji *et al.,* 2014; Zhang *et al.,* 2016)).

Small fish consumed with edible bones such as anchovies (*ikan bilis*) are good sources of calcium (Henry *et al.,* 2016). These can help to contribute to dietary calcium intake, especially for individuals who do not consume milk.

7.3.2 Shellfish

Shellfish such as clams, crabs, lobsters, mussels, oysters, scallops and shrimps are generally low in calories and rich in lean protein, healthy fats and many micronutrients (Table 7.1). Most number of shellfish contains omega-3 fatty acids and therefore offer a range of health benefits including those brain and heart health (Mozaffarian & Wu, 2011). The omega-3 fatty acids found in seafood are derived from phytoplankton, the small aquatic plant cells that are a source of food for many aquatic organisms (USDA, 2018). Shellfish are also rich in iron, magnesium and vitamin B_{12} – all of which have essential contributions in the body (USDA, 2018).

Table 7.1: Nutrition comparison of 85 gram servings of different types of shellfish

Shellfish	Calories (kcal)	Protein (grams)	Fat (grams)
Shrimp	72	17	0.43
Crayfish	65	14	0.81
Crab	74	15	0.92
Lobster	64	14	0.64
Clams	73	12	0.82
Scallops	59	10	0.42
Oysters	69	8	2.00
Mussels	73	10	1.90

Source: USDA (2018)

Shellfish are most nutritious when steamed, grilled or baked. Breaded or deep fried shellfish may contain extra calories, refined carbohydrates, added salt and other preservatives. Shellfish may contain heavy metals such as mercury and cadmium, however, it is generally lower compared to larger fishes.

7.3.3 Lean meat and poultry

Meats and poultry are valuable source of dietary protein and are considered as complete protein containing all essential amino acids, which play important role in growth and development. The bioavailability of its minerals and vitamins, such as vitamin B_{12}, iron, iodine, and zinc are high as well (FAO, 2019). Meats and poultry vary in its' fat content, and providing little amount of carbohydrates. Lean meat and poultry does not include offal such as liver and kidneys, heart, gizzard and visceral organs.

Lean meat refers to the 100 g of meat that contains less than 10 g of fat, 4.5 g or less of saturated fats, and less than 95 mg of cholesterol (USDHHS & USDA, 2015). Based on FAO (2015), the lean cuts of the meat generally have a higher composition of water which is more than 70% per 100 g, followed by the protein and lastly the fat composition. Examples of lean meat and lean poultry include skinless chicken breast, beef or pork tenderloin, and skinless turkey breast. Lean meats and lean poultry may provide important nutrients that body needs when consumed in recommended amounts in healthy eating patterns (USDHHS & USDA, 2015). Studies reveals that consumption of a heart-healthy diet that includes lean red meat has no detrimental effects on blood lipids and has shown to reduce major CVD risk factors (McNeill, 2014).

When considering the health outcomes, meat can be further categorized into either red or white meat. The classification of the red and white meats are based on their myoglobin or heme iron concentration, muscle fiber physiology, lipid profile, fatty acid composition, and cholesterol content (Cobos & Diaz, 2015; Keeton & Dikeman, 2017). Some physiological changes in meat color and texture are in response to an animal's genetic, dietary regimen and/ or handling practices prior to slaughter that can alter the muscle pH endpoint and result in pale, soft, exudative or dark, firm, dry muscle (Keeton & Dikeman, 2017). Red meat normally refers to beef, lamb, and pork based on properties such as red color before cook, dark color after cook, high myoglobin content, high lipid, protein and iron content; while white meat with a higher proportion of white muscle fiber has lighter colored meat, such as poultry and fish (Seman *et al.,* 2018). A meta-analysis reported that consumption of unprocessed "red" meat (beef, lamb, or pork) was not associated with risk of all-cause mortality (Wang *et al.,* 2016).

7.3.4 Processed meat

Processed meat refers to meat that has been transformed through salting, curing, fermentation, smoking or other processes to enhance flavor or improve preservation (IARC, 2015). It also may contain preservatives. Processed meat include bacon, chicken or fish nugget, red meat sausage, poultry sausage, luncheon meats (red and white meat), cold cuts (red and white meat), ham, regular hot dogs and low fat hot dogs made from poultry.

Preservatives are used in processed meats for food safety, shelf life and food technology reasons. Sodium nitrite or potassium nitrite play a key role in the safety of processed meats. Nitrites, or in slow cured meats sodium or potassium nitrates which are gradually converted to nitrites, are the key ingredients in meat cures. They provide excellent protection against botulism in processed meats. At the same time their use results in the characteristic colour and flavour of cured meats. Other preservatives inhibit the growth of microorganisms. The sulphites, sources of sulphur dioxide, also inhibit the growth of microorganisms while retaining the bloom (fresh colour and appearance) of red meat (NSWFA, 2009)

However, the processed meats and processed poultry are normally contained high salts, fats and carcinogenic compounds such as nitrosamines and nitrate (WCRF/AICR, 2018). Some of these preservatives can have adverse effects on health. The levels of nitrates and nitrites in meat are restricted because they can be converted in the stomach or during high temperature frying to chemicals understood to cause cancer. Sulphur dioxide exposure causes breathing difficulties in some people. Other preservatives can have adverse effects if consumption limits are exceeded.

Processed meat has been linked to coronary heart disease. Reports from systematic review and meta-analysis had concluded that consumption of processed meats has strong association with higher incidence of coronary heart disease (Micha *et al.*, 2013)

7.3.5 Eggs

Egg is an important source of protein and relatively less expensive compared to other animal-derived protein. An average large egg (50-60 g) contains about 6 grams of protein, slightly lower protein content than meat. Quality of egg protein is however excellent. Egg protein is considered complete as it contains all nine essential amino acids required by the human body (Miranda *et al.,* 2015).

Besides protein, eggs are good source of other nutrients including vitamins A, E and B_{12}, carotenoids (lutein, and zeaxanthin) and provide substantial amounts of choline, selenium, iron and zinc (Miranda *et al.*, 2015). Egg yolk is a rich source of polyunsaturated fatty acids including palmitic acid, stearic acid and provides variable amount of n-3 fatty acids (Shinn, Proctor & Baum, 2018). Since dietary cholesterol from eggs is a minor determinant of blood cholesterol level and due to its' high nutritional value (Kuang *et al.*, 2018; Soliman, 2018), eggs should be recommended for consumption by all healthy individuals (Clayton, Fusco & Kern, 2017; Wang, Wong & Kim, 2019). For healthy adults, egg can be part of their daily intake although some limitation remains prudent. Thus, for adults with Type II Diabetes (Fuller *et al.*, 2015; Richard *et al.,* 2017)) and dyslipidemia (Shin *et al.*, 2013; Rong *et al.,* 2013) a healthy diet would be to limit to three eggs per week (Li *et al.*, 2013; Díez-Espino *et al.*, 2017).

7.3.6 Legumes

Besides animal protein, plant protein such as legumes are generally good source of good quality protein with 20-45% protein and generally rich in the essential amino acid lysine (Maphosa & Jideani, 2017). However, except for soy protein, legumes are considered to be an incomplete source of protein because they are low in essential sulphur-containing amino acids (SCAA), methionine, cysteine, cystine and tryptophan (Kouris-Blazos & Belski, 2016).

Legumes are generally low in fat (with ±5% energy from fat, with exception of peanuts, chickpeas and soybeans), high in dietary fibre (5-37%), almost free of saturated fats, contain no cholesterol and have about twice the protein content of cereal grains, and with low glycemic index rating (Leonard, 2012; Messina, 2016; Kouris-Blazos & Belski, 2016; FAO, 2016, Maphosa & Jideani, 2017). The fat in legumes is mainly from mono- and polyunsaturated fatty acids (PUFA) (Kouris-Blazos & Belski, 2016).

Legumes are a good source of B-group vitamins (such as folate, thiamine and riboflavin), iron, zinc, calcium and magnesium but not fat soluble vitamins and vitamin C (Brigide, Guidolin & Oliveira, 2014; Kouris-Blazos & Belski, 2016). Although high in iron content, the bioavailability of iron in legume is poor, therefore it is encouraged to consume legumes with vitamin C rich foods to increase the absorption of iron (Messina, 2016).

Research has shown that legumes contain non-nutrient bioactive compound such as phytochemicals and antioxidants, which help in the prevention of certain cancers, heart diseases, osteoporosis and chronic degenerative diseases (Bouchenak & Lamri-Senhadji, 2013; Messina, 2016).

Legumes are a good source of inexpensive and sustainable protein which provide many health benefits. Therefore, consumption of legumes such as beans, peas should be recommended for everyone as part of a healthy diet.

7.3.7 Nuts

Nuts are nutrient dense foods, with high amounts of vegetable protein, fat (mostly unsaturated fatty acids), phytochemicals and antioxidants (Mohammadifard *et al.,* 2015; Rusu *et al.,* 2019). Due to the high energy density of nuts, it was recommended that its consumption to be controlled to prevent weight gain. However, such assumption has been debated as the ingestion of nuts helps to control the satiety, leading to strong compensatory dietary responses (de Souza *et al.*, 2017).

Except for chestnuts with little fat, most nuts have a high total fat content, ranging from 46 to 76% that provide energy of 20 to 30 kJ/g (Emilio, 2010). However, the fatty acid content of nuts is good for health because the saturated fatty acid (SFA) is low, and nearly half of the fat content is from unsaturated fat, monounsaturated fatty acid (MUFA) and polyunsaturated fatty acids (PUFA), namely oleic acid and linoleic acid.

Nuts are also rich in bioactive macronutrients such as L-arginine that help in improving vascular reactivity (Mohammadifard *et al.,* 2015; Rusu *et al.,* 2019). Besides that, nuts also provide 4-5 g per 100 g of dietary fiber (Sugizaki & Naves, 2018). In terms of micronutrients, nuts contain folate and antioxidant vitamins (e.g., tocopherols). Although nuts are cholesterol-free but their chemical compound consist of plant sterols or phytosterols which help in lower blood cholesterol when present in sufficient amounts (Plat *et al.,* 2019).

In terms of mineral, nuts have optimal nutritional density to contribute to bone health such as calcium, magnesium and potassium (Orchard *et al.,* 2014; Kong *et al.,* 2017). However, it is important to note that this is only applied if the nuts are consumed without sodium added.

As nuts are getting popular in cooking dishes and baking, and as snacks, they can make a healthy meal as plant-based alternatives to animal protein such as meat, poultry and fish.

7.3.8 Soybean foods

In general, soybean foods can be classified into two categories based on its fermentation process (Yang *et al.,* 2011). Fermented soybean foods include fermented tofu, miso, natto, soy sauces, and tempeh, while non-fermented soybean foods include fresh soybeans, dehydrated soybeans, soy sprouts, soy flour, soymilk and its products such as tofu (soybean curd), okara and yuba (Yang *et al.,* (2011). Some of soybean foods are produced as traditional Asian foods, while some of them are produced via modern processing techniques by food industries (Chen *et al.,* 2012). Tofu, soymilk, tempeh, and meat analogues are popular soybean products.

Although soybeans is under the plant-based protein source, it is considered as one of the excellent complete protein sources (Bolla, 2015; Rizzo & Baroni, 2018). Soybean foods are one of the most widely consumed legumes, and many of these products are consumed in various ways. Soybean foods are rich in protein, dietary fiber, unsaturated fat, vitamins (A, B_6, B_{12}, C and K) and minerals and various phytochemical such as isoflavones, anthocyanin, saponins, phytates, phytosterols, phenolic acids and trypsin inhibitors (Chen *et al.,* 2012; Zhou, Cai & Xu., 2017; Tahir *et al.,* 2018; Alghamdia *et al.,* 2018). Health benefits of consuming soybean foods include risk reduction of cardiovascular diseases, prevention of cancers (prostate and breast cancers), protection against osteoporosis and relieving premenstrual syndrome (PMS) and menopausal symptoms (Tahir *et al.,* 2018; Blanco Mejia *et al.,* 2019).

Type of soybean foods:

i. Tofu, also known as soybean curd, is made by coagulating soymilk with coagulant. There are two types of coagulant which are 'salt' coagulant (calcium sulphate and magnesium chloride) and 'acid' coagulant (glucono delta-lactone) (Jooyandeh, 2011; Wong, 2017). The 'acid' coagulant is used to produce a softer version of tofu or known as 'silken' tofu. The precipitate is then pressed into solid, then dried, frozen or fried. Tofu has a bland taste with smooth and soft texture, creamy white appearance and pleasant mouthfeel (Maurya, Shukla & Gour, 2018). Other soybean curd foods that are commonly consumed include *taukua* and *fucuk*. Besides a good source of complete protein, tofu is rich source of calcium, iron, manganese, selenium, phosphorus, copper, zinc, magnesium and vitamin B_1 (Wong, 2017; Eze *et al.,* 2018).

ii. Soymilk is made from soaked soybeans by grinding, heating and filtering. It is the biggest soy bean product consumed in the world as it is a plant-based milk alternative (Ma *et al.,* 2016). Generally, consumers takes soymilk due to medical reasons such as lactose-intolerance and cow milk allergy; in addition, they consume due to lifestyle choices such as vegan and vegetarian diet as well as concerns related to cholesterol in cow milk (Ma *et al.,* 2016; Jeske, Zannini & Arendt, 2016; Vanga & Raghavan, 2018). Soymilk is an important source of protein especially for those following vegetarian diet. To dates, soymilk is the only plant-based milk alternative that have similar protein content with the cow's milk when compared to almond milk and rice milk (Jeske, Zannini & Arendt, 2016; Vanga & Raghavan, 2018). Soy milk is a rich source of protein, unsaturated fat and other micronutrients such as magnesium, phosphorus and potassium (Vanga & Raghavan, 2018). The concerns of soymilk are soy intolerance and contamination of soymilk due to *Lactobacillus*. The recommendation is that the best shelf life of commercial soya milk is less than 8 hours at room temperature (Ma *et al.,* 2016).

iii. Tempeh is known as one of the popular traditional soybean foods. It is produced by the fermentation of soybean with a mold of *Rhizopus oligosporus* to form a dense, chewy cake. Tempeh is high in

protein, phosphorus, vitamin B_{12}, and magnesium, while low in fats (Tahir *et al.,* 2018).

iv. Meat analogue is processed foods that are made to mimic the aesthetic qualities and chemical characteristic of meat, including it's' texture, colour, or taste. One of the main ingredients in meat analogue is textured soy protein (TSP) also known as textured vegetable protein (TVP), whereby TSP is made from soybeans and contains at least 52% protein on a dry basis (USAID, 2016). Examples of meat analogue are vegetarian chicken, fish, goose, and slice meat. However, some of the meat analogues do not contains TSP, and they are made from konjac, mushrooms and wheat flour.

7.3.9 Vegetarian

About 2 million of Malaysians described themselves as vegetarian or vegan, including of those seasonal vegetarians (Vythilingam, 2016). Vegetarian diets are defined as diets that exclude meat including of that poultry and animal by-products such as gelatine. Types of other vegetarian diet are as the following:

i. Lacto-ovo-vegetarians – eat both dairy products and eggs (this is the most common type of vegetarian diet)

ii. Lacto-vegetarians – eat dairy products but not eggs

iii. Ovo-vegetarians – eat eggs but not dairy products

iv. Partial-vegetarians – eat seafood including freshwater saltwater fish and shellfish (pesco-vegetarian) or poultry (pollo-vegetarian)

v. Vegan – eat only plant foods

Vegetarian diets are recognized for their health enhancing properties as they are usually higher in fibre, antioxidants, phytochemicals, caretonoids, plant protein and lower in saturated fat than non-vegetarian diets (Satija & Hu, 2018). Pooled analysis of prospective cohort studies and randomized controlled trials reported that greater adherence to vegetarian diets were associated with reduced risk of coronary heart disease (CHD) (Dinu *et al.,* 2017) and improved cardiometabolic risk factors (Yokoyama *et al.,* 2014; Yokoyama, Levin & Barnard, 2017; Viguiliouk *et al.*, 2019), respectively. Despite the health promoting properties, vegetarian diets are commonly associated with vitamin and mineral deficiencies, particularly protein, iron, calcium, zinc, omega-3 fatty acids and vitamin B_{12}. Well planned vegetarian diets can provide all the nutrients recommended for an individual. Therefore, it is important that vegetarians consume a variety of foods such as whole grains, legumes, nuts and seeds and the right amount of foods to meet the nutrient needs.

7.3.10 Deficiencies

7.3.10.1 Protein deficiency

Protein deficiency can occur at any age due to illness or poor diets, and is frequently exacerbated by inadequate energy intake. Dietary protein deficiency not only contributes to poor growth, cardiovascular dysfunction, and high risk of infectious disease, but also exacerbates the deficiency of other nutrients (including vitamin A and iron) and worsens metabolic profiles (e.g., dyslipidemia and hyperglycemia) in humans (Wu, 2016).

Inadequate protein intake during gestation and early childhood has far-reaching adverse consequences. Protein undernutrition resulted in impaired growth of fetuses and stunting in children (Semba *et al.,* 2016).

Among the older adults, protein undernutrition is associated with larger loss of lean body mass (Deer & Volpi, 2015) which will exacerbate sarcopenia and further compromise skeletal-muscle functions. Protein undernutrition is also an established underlying factor for osteoporotic fractures and increased risk of injury in this population age group (Amarya, Singh & Sabharwal, 2015).

7.3.10.2 Iron deficiency and iron deficiency anaemia

Iron deficiency refers to a condition wherein iron stores in the body is reduced. Iron-deficiency anaemia is a more severe condition in which low levels of iron are associated with decreased quantity of red blood cells and presence of microcytic hypochromic red cells (Camaschella, 2015). Iron deficiency anaemia is the most prevalent anaemia worldwide. (WHO/ UNICEF/ UNU, 2001; Kassebaum *et al.,* 2014). Among other underlying factors resulting in iron deficiency anaemia, insufficient dietary iron intake is the most common cause.

Iron deficiency anaemia has a detrimental effect across all age group. It is associated with impairment on cognitive development in children, poorer physical performance and work productivity in adults and unfavorable maternal and fetal outcomes (Camaschella, 2015; Di Renzo *et al.,* 2015; Auerbach & Adamson, 2016). Furthermore, anaemia is positively associated with global cognitive decline and incidence of dementia among the older adults (Lopez *et al.,* 2016).

7.3.11 Excessive intake

Animal foods such as meat and fish may be processed before consumption by smoking, curing, salting or by adding preservatives. Meat and fish are also often cooked using very high temperature during frying, grilling (broiling) or barbecuing (charbroiling). These methods of processing and preparation may affect chemical composition as well as the nutritional value of animal foods (WCRF/ AICR, 2018). High consumption of these foods may associate with some health risk, such as cancers, CVD and diabetes.

7.3.11.1 Cancer risk

Consistent evidence showing that consumption of red meat and processed meat increases the risk of colorectal cancer, with an updated cancer report summarized that red meat and processed meat to be "convincing" factors contributed to colorectal cancer (Zhao *et al.*, 2017; WCRF/ AICR, 2018). Further, a consumption of Cantonese-style salted fish is probably a cause of nasopharyngeal cancer (Salehiniya *et al.,* 2018; WCRF/ AICR, 2018).

7.3.11.2 CVD, diabetes and mortality risks

A recent study found that red and processed meat consumption in a low meat intake population was found to have moderately higher risks of all-cause and CVD mortality (Alshahrani *et al.,* 2019). Similarly, two meta-analysis on prospective cohorts, reported that a higher consumption of total red meat and processed meat is associated with increased risk of total mortality as well as cardiovascular and cancer mortality (Larsson & Orsini, 2014; Wang *et al.,* 2016). Another systematic review and meta-analysis of observational studies reported that the intake of processed meat was associated with higher risk of coronary heart disease (CHD) and diabetes mellitus (Micha, Michas & Mozaffarian, 2012; Micha *et al.*, 2013).

These data indicate the urgency to monitor the red meat and proceeds meat consumption among the community.

7.4 Current status

Based on the Malaysian Adult Nutrition Survey (MANS) conducted among Malaysian adults aged 18-59 years old in 2003 and 2014, Malaysian adults tend to consume adequate to high levels of protein (80% to over 100% RNI). In the MANS 2014 report itself, about half of the adults (50.7%) were found to have exceeded the recommended protein contribution to total energy intake (10-20%) based on RNI 2017 (NCCFN, 2017). In terms of median protein intake, there was an increase of median protein intake of Malaysian adults from 55.3 g/day (14.3% of total energy intake) in 2003 to 56.7 g/day (16% of total energy intake) in 2014.

Based on the MANS 2014 report, Ahmad Ali *et al.* (2014) reported that the protein source foods consumed daily by most adults were marine fish and hen egg. Marine fish ranked the fourth highest among 10 protein source foods that were most commonly consumed daily by Malaysian followed by hen egg at the ninth ranked.

For a weekly basis consumption, it was reported that hen eggs were the leading food consumed with the consumption frequency of 3 pieces each time, followed by chicken, marine fish and other types of legumes [long bean, French bean and winged bean (*kacang botol*)]. Nuts on the other hand were found to be less consumed by the respondents as these foods were not feature in the top 10 daily or weekly consumed items (Ahmad Ali *et al.*, 2014).

In term of assessment of how many Malaysian adults met the recommendation of the Malaysian Food Pyramid, Mohamad Hasnan *et al.* (2015) in his study reported that 66.8% of Malaysian adults met the recommended serving per day for food category of meat, poultry and egg followed by 31.3% for fish and fish product and 17.1% for legumes and nut. Fish (38.6%), and meat, poultry and egg (13.1%) were amongst the top three food groups consumed over the recommended serving per day. Legumes and nuts consistently were not the favorite protein sources for Malaysian as the consumption was below the recommended serving per day.

7.5 Key Recommendations

Key Recommendation 1

Consume fish everyday.

How to Achieve

1. Consume a serving of fish daily.
2. Choose a variety of fish or shellfish, either from marine or freshwater.

Key Recommendation 2

Consume lean meat or poultry or eggs daily.

How to Achieve

1. Consume a variety of dishes from lean meat or poultry or egg as recommended.
2. Limit intake of organ meats (liver, spleen and kidney).
3. Limit intake of processed meats. Processed meat or poultry such as luncheon meats, nuggets, sausages, burgers and fish balls are generally higher in fat, salt and preservatives (e.g., nitrates).

Key Recommendation 3

Practice healthy food preparation and cooking methods for fish, meat, poultry and egg dishes.

How to Achieve

1. Choose lean cuts of meat and poultry to minimize the intake of saturated fat. Trim away as much as possible the visible fat before cooking.
2. Choose skinless chicken parts or remove the skin before cooking. Skinless chicken breasts are the leanest poultry choices.
3. Limit deep-frying methods as deep – frying add fat and calorie to these dishes.
4. Use healthier cooking methods such as steaming, stewing, braising, boiling, poaching, microwaving, grilling, roasting (allowing the fat to drip off) and air frying.
5. Limit breading and battering as this adds fat and calories that will cause the food to soak up more fat or oil during frying.
6. Use herbs and spices, lime or lemon to season and flavour dishes instead of salt, flavour enhancer or rich sauces (e.g., mayonnaise, oyster sauce, chilli or tomato sauce).

Key Recommendation 4

Consume legumes daily.

How to Achieve

1. Consume a serving of legumes daily.
2. Choose a variety of different types of legumes (dhal, tempe and tauhu) to prepare dishes.
3. Consume legumes as snacks or add to the dishes.
4. Consume nuts in small handful (at least 4 times a week) because they are high in calories.
5. Consume one serving of legumes (dhal, tempeh, tauhu and etc.) as part of your daily protein intakes.

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Consume adequate amounts of milk and milk products

KEY MESSAGE

8

CONSUME ADEQUATE AMOUNTS OF MILK AND MILK PRODUCTS

Prof. Dr. Hamid Jan Jan Mohamed, Prof. Dr. Winnie Chee Siew Swee, Assoc. Prof. Dr. Satvinder Kaur and Ms. Nur Shafawati Mohd Ghazali

8.1 Terminology

Raw or fresh milk and processed milk

Milk, raw milk or fresh milk means the normal, clean, fresh mammary secretion of healthy cow, buffalo, goat or sheep that is properly fed and kept, excluding that obtained during the four days immediately following calving. Fresh milk generally contains about 3% of milk fat. Unless it is pasteurised, it is best to boil fresh milk before consumption.

Pasteurised milk is milk that has been efficiently heat-treated by the holding method or by the high temperature short time (HTST) method.

Sterilized milk is milk which has been filtered, homogenized and thereafter heated to and maintained at a temperature of not less than 100°C for length to time sufficient.

Ultra-high temperature (UHT) milk is milk which has been subjected to heat treatment by being retained at a temperature of not less than 135°C for at least two seconds to render it commercially sterile and immediately aseptically packed in sterile containers.

Recombined milk is the product prepared from the constituents of milk combined with water or milk or both and has been subjected to pasteurisation, sterilisation or UHT.

Flavoured milk is milk or recombined milk to which permitted flavouring substance has been added and may contain sugar or salt or both. It shall have been heat-treated such as pasteurisation or UHT.

Full cream milk powder or dried full cream milk is milk or recombined milk from which the water has been removed. Full cream milk powder contains more than 26% of milk fat.

Skimmed/ non-fat milk is milk from which milk fat has been removed but with most of the other essential nutrients intact. It is useful for those who want to limit their intake of energy, fat and cholesterol.

Low fat milk is milk which contains not more than 1.5 g of fat per 100 ml of milk.

Reconstituted milk is the liquid product prepared by the addition of water to full cream milk powder and shall be subjected to pasteurisation, sterilisation or UHT.

Evaporated milk or unsweetened condensed milk is the product obtained by evaporating from milk, a portion of its water or by recombining of milk constituents and part evaporation.

Filled milk is the product where the milk fat has been replaced wholly or partly by an equivalent amount of edible vegetable oil or edible vegetable fat or a combination of these, such as palm oil.

Fermented milk or cultured milk is the product prepared by culturing pasteurized milk, sterilised milk, recombined milk, pasteurised cream or reduced cream with suitable lactic acid bacteria and include yoghurt, cultured cream and *lassi*.

Condensed milk or sweetened condensed milk is the product obtained by evaporating from milk, a portion of its water or by recombining milk constituents and adding sugar to the remainder. Condensed milk or sweetened condensed milk contains more than 8% of milk fat.

Milk products

Milk products include any product prepared from milk as main ingredient and includes the food or which a standard is prescribed in regulations such as yoghurt and cheese.

8.2 Introduction

Milk is one of the most complete of all foods, containing nearly all the constituents of nutritional importance to humans. Milk and milk products are the richest source of calcium in the diet that is readily absorbed. These foods are also important contributors of protein, vitamin A, vitamin D, riboflavin, vitamin B_{12} and zinc to the diet. In contrast, plant-based milk beverages such as soy milk and almond milk contains a lower level of essential nutrients such as protein and vitamin D which are important for bone health. Furthermore, the bioavailability of calcium and iron from plant-based milk is lower compared to animal milk. This is due to considerable amount of mineral inhibitory substances such as oxalate and phytates which chelates to calcium and iron to form insoluble salt compound (Walters, Esfandi & Tsopmo, 2018). Hence, among healthy individuals, replacing animal-based milk with plant-based milk is not recommended (Keller *et al.,* 2012).

Sweetened condensed milk and sweetened condensed filled milk are highly evaporated milk to which sugar has been added. Its high sugar content (up to 40% sugar) gives it a long shelf life even without refrigeration. It is not recommended for feeding infants and young children because after dilution, its nutrient content is very low. It is more often used in baking and the preparation of desserts. A non-dairy creamer, commonly used as tea or coffee whitener is a liquid or granular substance made of oil, corn syrup and sodium caseinate. It should not be considered as milk.

Milk products can be made from cow's milk or any other milk producing animals such as goat, buffalo, sheep and camel. Milk products include food products made from milk as a main ingredient such as yoghurt and cheese. Yoghurt is described as fermented milk with lactic acid bacteria. Cheese is the product derived from milk and produced by coagulation of the milk with casein. The solids (curd) are separated from the liquid (whey) and pressed into final form of cheese. Butter is also an example of milk products but it is not described here as due to its high fat content (approximately 80% butterfat), it is described in the fat section.

There are various types of milk. The main differences being the process used to produce the final product (MOH, 1985). Consumers should read the label of milk packages to identify the types of milk.

8.3 Scientific basis

Milk contains essential nutrients including fat, carbohydrate (lactose), protein, calcium, phosphorous, magnesium, and several trace elements and vitamins like thiamine, riboflavin, niacin and vitamin A. Calcium content from milk has the highest amount of absorbable calcium per serving compared to other calcium-rich plant foods (Hodges *et al.,* 2019). Thus, adding milk and milk products such as yoghurt and cheese in an individual's diet makes meeting calcium requirements easier.

There has been some scientific debate lately on the health benefits of milk and milk products. Nevertheless, most meta-analyses of observational studies and randomised controlled trials support the evidence that dairy intake not only contributes to meet nutrient recommendations but may also protect against the most prevalent chronic diseases (Thorning *et al.*, 2016). Milk and dairy products are evidenced to contain nutrients that are required for skeletal growth and bone maintenance during adulthood with the aim to reduce osteoporosis and bone fractures in older age (Rizzoli, 2014). Milk contains substantial amount of proteins, calcium, magnesium, phosphorous and may be fortified with vitamins D and K that support skeletal health compared to other foods.

There is some concern also that milk and milk products contain saturated fats and cholesterol and excessive consumption can have negative effects on health. Although some types of milk and milk products may be high in fat and saturated fats, the overall evidence from meta-analysis indicated that intake of milk and dairy products around 1 serving of 200-300 ml/day did not increase the risk of cardiovascular disease (Alexander *et al.,* 2016). There is also low fat or skimmed milk and low fat milk products which are suitable for individuals with cardiovascular risk factors. Low-fat, calcium-rich dairy products may lower blood pressure whereas no such association was found with intake of high-fat dairy products (Hu *et al.*, 2014; de Goede *et al.*, 2016).

Meta-analyses also support that in adults, dairy products facilitate weight loss and improve body composition by reducing body fat mass and preserving lean body mass during energy restriction and in short-term studies (Booth *et al.*, 2015). There is increasing evidence suggesting that fermented milk products, cheese and yoghurt, are associated with a reduced risk of type 2 diabetes possibly due to their effect on the gut microbiota (Zheng *et al.*, 2015). The World Cancer Research Fund (WCRF) and the latest meta-analyses reported that consumption of milk and milk products may protect against several types of cancers including colorectal and breast cancers (WCRF/ AICR, 2011; Ralston *et al.*, 2014). Additionally, the highest level of milk product consumption among Asians (400-600 g/day) was associated with a reduced risk of breast cancer by 6-10% compared to intakes of < 400 g/day (Zang *et al.,* 2015)

8.4. Current status

Milk consumption in developing countries have been changing over the years. Countries like China and India, which are with large populations, have seen an increase trend of milk intake from 1970s to 2008 (Wiley, 2011). In India, milk and dairy products are the second most consumed based on the consumer food expenditure. Similar trend was observed in China, whereby with rising income, demand for dairy products continues to rise (Ohlan, 2016). However, while the trend is increasing, based on their country guidelines, recommendations are still not met. On the other hand, European countries and the United States of America showed that their population were able to fulfill the required recommendations.

In Malaysia, Malaysian Adult Nutrition Survey (MANS, 2014) reported food consumption using a semi-quantitative food frequency questionnaire (FFQ) that consist of 126 food items (IPH, 2014). It was reported that only 24% of adults met the recommendation for milk and dairy products intake daily (Mohamad Hasnan *et al.,* 2015). Although there is an increase compared to MANS 2003, milk consumption was not listed in the top ten beverage consumed daily in the recent MANS study (2014). However, condensed milk was ranked sixth in the top ten list as most consumed foods. In a span of 11 years, there appears a drop in powdered milk consumption from 17% to 10% (Kasim *et al.*, 2018). Prevalence of the consumption of milk and its products is highest with commercial milk (29.6%), followed by powder milk (19.8%), yoghurt (17.1%) and finally, fresh milk (7.2%). Condensed milk had the highest prevalence (51%), however, this is not considered milk intake as condensed milk is added with high sugar levels and used alternatively for sugar in dessert, beverage or food preparation. In terms of quantity of consumption per day, the average intake was highest in commercial milk with 26.79 g/day. Yoghurt, fresh milk and powdered milk had an average consumption of 6.6 g/day, 5.2 g/day and 2.8 g/day, respectively.

Meanwhile for children, SEANUTS study reported that children aged 7-12 years old did not meet daily dietary intake of milk/ dairy products (Koo *et al.,* 2016). It is especially important to establish the habit of drinking milk in young children, as those who consume milk at an early age are more likely to do so as adults.

8.5 Key Recommendations

Key Recommendation 1

Consume milk and milk products daily.

How to Achieve

1. Consume 1 to 2 servings of milk and milk products daily.
2. Drink milk at breakfast and/ or before bedtime.
3. Drink unflavored milk instead of flavored milk.
4. Consume milk or milk products between main meals.
5. Drink skimmed milk or low fat milk if you need to reduce calorie intake.

Key Recommendation 2

Replace sweetened condensed milk, sweetened condensed filled milk and sweetened creamer with plain milk liquid or powdered milk or evaporated milk in beverages and cooking.

How to Achieve

1. Use plain milk (liquid or powdered milk) instead of sweetened condensed milk.
2. Replace sweetened non-milk sources with plain milk or milk powder in beverages, eg., *teh tarik*, coffee and malt drinks.
3. Use milk or milk products as part of ingredients of dishes and beverages.
4. Add milk or milk products to meals like oatmeal, cereal and puddings.

Additional recommendation: Lactose intolerance

Lactose intolerance persons may also derive the health benefits associated with milk and milk products by consuming lactose-free predigested milk. They can choose predigested milk products such as yoghurt and consume more calcium fortified or enriched milk products to meet their calcium requirement.

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Reduce intake of foods high in fat and limit saturated fat intake

KEY MESSAGE

9

REDUCE INTAKE OF FOODS HIGH IN FAT AND LIMIT SATURATED FAT INTAKE

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9.1 Terminology

Dietary fat classification

Chemically, dietary fats are composed of 3 fatty acids attached to a glycerol backbone. These fatty acids are built on carbon chains (C) of varying length with either shared bonding (unsaturation) denoted chemically as CX: 1/2/3 or single-bonding (saturation) denoted chemically as CX: 0.

Natural vegetable-based oils and fats and animal-based fats contain varying proportions of saturated (SFA), polyunsaturated (PUFA) and monounsaturated (MUFA) fatty acids.

Oils and fats

Humans consume fats as visible and invisible fats. Visible fats come from cooking oils that are plant-based (vegetable oils) and table spreads, which may be either plant- (margarine) or animal- (butter) based fats. Invisible fats are natural constituents of foods ranging from cereals, vegetables, fruits, pulses, nuts and oilseeds, dairy products, meat, eggs or fish.

Saturated fatty acids

Saturated fatty acids (SFAs) common to the human diet are built of 12 to 18 carbon-chain lengths, namely lauric acid (C12:0), myristic acid (C14:0), palmitic acid (C16:0) and stearic acid (C18:0).

Unsaturated fatty acids

There are two types of unsaturated fatty acids, namely monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA). The predominant MUFA in the diet is oleic acid (C18:1) whilst the PUFA consists of two groups, the omega-3 fatty acid [e.g., alpha-linolenic acid (ALA, C18:3), eicosapentaenoic acid (EPA, C20:5) and docosahexaenoic acid (DHA, C22:6)] and the omega-6 fatty acid [e.g., linoleic acid (LA, C18:2) and arachidonic acid (AA, C20:4)]. LA and ALA are known as essential fatty acids (EFA) as they cannot be synthesised by humans and therefore must be included in the diet.

Trans fatty acids

Trans fatty acids (TFAs) are produced industrially through partial hydrogenation of liquid plant oils to become solid fats. Elaidic acid (C18:1 *trans*-9), a common industrial TFA is produced during formulation of margarines, *vanaspati* (vegetable ghee), shortenings and bakery products. Naturally occurring TFAs also occur as vaccenic acid (C18:1 *trans*-11) in the stomach of dairy cattle.

Thermally oxidised fats

Lipid oxidation occurs when cooking oils are repeatedly reheated for deep-frying of foods. High temperature cooking of reused oil generates lipid peroxidation products.

Blended oils

Blending of two oils to achieve SFA:PUFA balance requires mixing proportionate volumes of palm oil and a LA-rich oil such as corn oil, soybean oil or sunflower oil.

9.2 Introduction

Fat is an essential nutrient in the human diet because of its energy density, as well as its requirement for physiological function, growth and development. Firstly, one gram of any fat yields 9 kcal which is double the yield of one gram of protein or carbohydrate. The second aspect, and crucial to domestic and commercial utilization, is that fat imparts taste, flavour and texture to food. At a deeper level, dietary fat aids the digestion, absorption and transport of fat-soluble vitamins and fat-soluble phytonutrients, such as carotenoids and lycopenes. During digestion, dietary fat depresses gastric secretions, slows gastric emptying and stimulates biliary and pancreatic secretions, thereby aiding the digestive process. Excess fat is stored as adipose tissue, which enables human survival during limited food availability. Fat also functions structurally to support organs in position and insulate nerves, protect the body from mechanical pressure and insulate the body to preserve body heat and temperature.

Vegetable-based oils and fats, and animal-based fats such as butter contain varying proportions of saturated (SFA), polyunsaturated (PUFA) and monounsaturated (MUFA) fatty acids, either naturally occurring or as commercially blended oils and fats (Karupaiah, Noor & Sundram, 2005). Palm oil or palm olein has an almost equal amount of saturated and unsaturated fatty acids as indicated by 40% of palmitic acid (C16:0), 4% of stearic acid (C18:0) and 43% of oleic acid (C18:1). Coconut oil is one of the major sources of SFA in the Malaysian diet as *santan* is commonly used in preparing meals. For instance, *nasi lemak, curry, masak lemak, kuih-muih* and *cendol* are traditionally consumed foods that use *santan*. *Santan* contains 92% of SFA with the major fatty acids being lauric acid (C12:0) and myristic acid (C14:0). Soybean, corn, sunflower and safflower oils are the main sources of the omega-6 fatty acids, namely LA (C18:2). Omega-3 fatty acids include the marine-based fatty acids such as eicosapentaenoic (EPA, C20:5) and docosahexaenoic (DHA, C22:6) acids as well as plant-based alpha-linolenic acid (ALA, C18:3). The types of fish rich in EPA and DHA commonly consumed by Malaysians are Indian mackerel (*kembung*), anchovies (*bilis*), yellow-tail and yellow-stripe scards (*pelata*), tuna (*tongkol*), sardines (*sardin*), torpedo scads (*cencaru*), Indian and short-fin scads (*selayang*), pomfret (*bawal*), red snapper (*merah*), king mackerel (*tenggiri*), marine catfish (*jahan*) and stingray (*pari*) (Ahmad *et al.*, 2016). ALA is found in soybean and canola oils; seeds and nuts such as flaxseed, chia, and walnuts; and some green leafy vegetables such as kale and spinach. Oleic acid (C18:1) is the main MUFA and found mainly in olive, peanut, canola and palm oil/ olein.

The fatty acid composition of various dietary fats and oils is provided in Table 9.1. Significant fat content distribution of various food categories in terms of total fat and fatty acid classes are provided in Table 9.2 and Table 9.3 provides the overall varying distribution of total fat in local fish with omega-3 fatty acid distribution.

9.3 Scientific basis

The fat guideline for a population is related to the risk associated with excessive consumption. Firstly, cardiovascular disease (CVD) constitutes the largest contributor to non-communicable disease-linked mortality in Malaysia. In 2016 alone, 74% of premature mortality (n = 113,400 cases) in Malaysia was attributed to non-communicable diseases with a proportional mortality of 35% alone contributed by CVD (WHO, 2018). Large population surveys, the Malaysian Cohort and the National Health and Morbidity Survey (NHMS) 2019 indicate between 38.1 to 47.7% of Malaysian adults were hypercholesterolemic (Jamal *et al.,* 2014; IPH, 2020). Hypercholesterolemia is a strong risk factor in the aetiology of CVD via atherogenesis, and diets high in saturated fats are causative of high blood cholesterol levels.

Secondly, obesity is a concern in the Malaysian adult population and excess consumption of calories from energy-dense foods is a dietary risk factor. According to the NHMS 2019, obese Malaysians make up 19.7% of the population while those categorised as overweight make up 30.4% (IPH, 2020). Despite the overwhelming tendency to associate obesity with higher fat intake, conclusive association between obesity and fat intake in the Malaysian population is not evident. The recent Malaysia Lipid Study data provided evidence that there is risk to cardiometabolic health associated with consumption of a high carbohydrate with high fat diet (Karupaiah *et al.,* 2019).

The diversity and functionality of fats depends on fatty acids that are either saturated or unsaturated, and this nature together with carbon chain length determines health risk (Karupaiah, Noor & Sundram, 2005). SFAs are hypercholesterolaemic whilst PUFAs when substituted for SFAs are effective in lowering blood cholesterol levels (Mensink, 2016).

9.3.1 Total daily fat recommendation

Total daily dietary fat intake for Malaysians (n = 2973) indicates median consumption levels below 30% TEI (IPH, 2014). Subset of this data (n = 1080) removing under and over reporters indicated 31% TEI with fat consumption (Zainuddin *et al.,* 2019). In line with this and global recommendations (FAO/ WHO, 2008), the Recommended Nutrient Intake (RNI) 2017 has set fat intake for Malaysians from 25 to 30% TEI with an upper limit of 35% TEI for active adults (NCCFN, 2017). Limiting dietary fat intake below 25% TEI would be likely to increase the carbohydrate load (Appel *et al.,* 2005; Siri-Tarino *et al.,* 2010) which increases CVD risk.

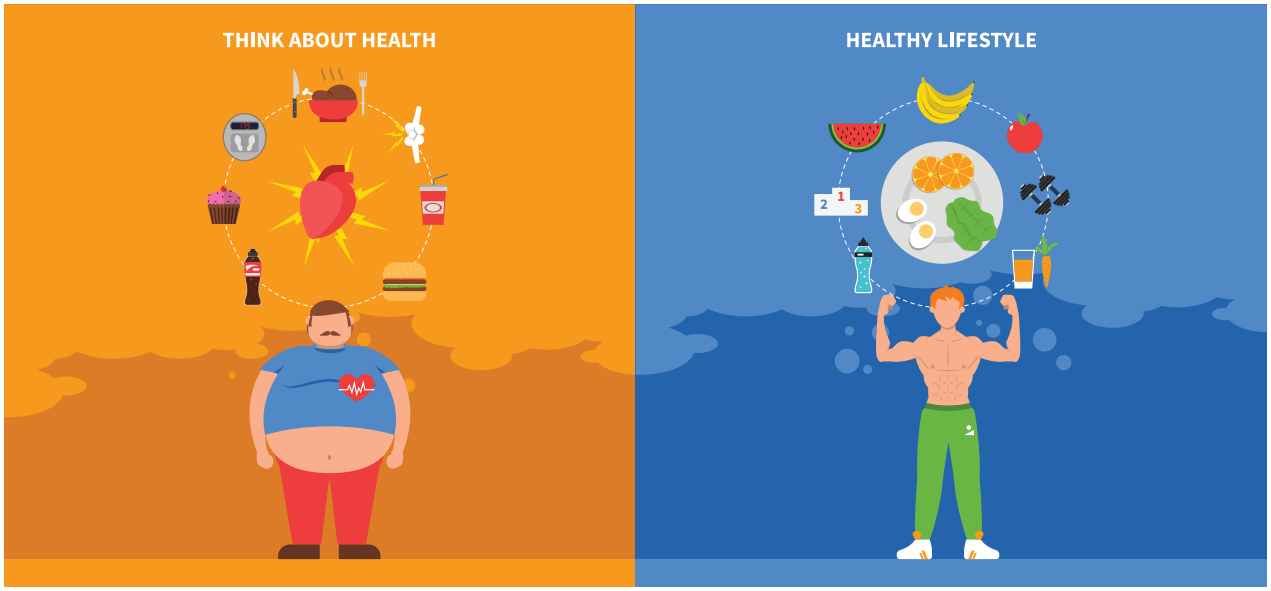
Epidemiological data suggests that there is no positive association between total dietary fat intake and CVD risk (Zhu, Bo & Liu, 2019). A reduction of total fat intake had no effect on CVD risk (Skeaff & Miller, 2009). Lowering fat intake and increasing carbohydrate intake also increases coronary events (Jakobsen *et al.,* 2009).

9.3.1.1 Practice implications to diet

Fat is an essential nutrient and its dietary level should not fall too low. Otherwise the prepared diet becomes monotonous, has low palatability, low energy density and the amount of essential fatty acid (EFA) can become limiting for health. However, the quality of fat in the diet bears different health implications which will be addressed separately in the following sections.

9.3.2 Rationale to limit SFA consumption

Saturated fatty acids (SFA) are hypercholesterolaemic (Mensink, 2016). The rationale to limit SFA intake is primarily based on the evidence that SFA increases blood LDL-cholesterol (LDL-C) levels and high LDL-C has been associated with increased CVD risk (Ference *et al.,* 2017). Reduction of SFA to < 10% TEI in the diet has been recommended for the Malaysian population (NCCFN, 2017) and requires replacement with PUFA and MUFA.



Nevertheless, the role of SFA in view of CVD risk remains inconclusive. A higher SFA intake is not found to be significantly associated with increased CVD risk as shown in meta-analyses (Mente *et al.,* 2009; Siri-Tarino *et al.,* 2010; Chowdhury *et al.,* 2014; de Souza *et al.*, 2015). Mente et *al.* (2009) found a marginally significant association between SFA intake and CVD risk when including both genders in the analysis, whereas SFA consumption within populations irrespective of gender have not been associated with CVD risk in another meta-analyses (Chowdhury *et al.,* 2014). It is also noted that no association with all cause CVD incidence and mortality has been linked to SFA intake (de Souza *et al.,* 2015). Contrarily, a meta-analysis of randomized controlled trials showed that SFA reduction lowered the risk of combined CVD events by 21% (Hooper *et al.,* 2020). Despite the inconsistent evidence on the association between SFA and CVD risk, it is recognized that healthy dietary patterns that are associated with lower CVD risk are typically not high in SFA content (< 10% TEI) (Krauss & Kris-Etherton, 2020). An urban population study in the Klang Valley showed that for this predominantly palm oil consuming adults (83.9%) daily SFA intake was reaching 14.1% TEI (Karupaiah *et al.,* 2019). However a dietary pattern analyses for this population revealed atherogenic risk was least with adults consuming healthy dietary patterns despite majorly (83.9%) consuming palm oil (Balasubramaniam *et al.,* 2020).

In the context of palm oil consumption link to risk of CVD outcomes or mortality, Ismail *et al.* (2018) could not establish strong evidence in a systematic review. A recent network meta-analysis comparing the effects of different oils and solid fats on blood lipids concluded that unsaturated fatty rich oils such as safflower, sunflower, corn, olive, soybean, palm and coconut oils were more effective in reducing LDL-C than highly saturated solid fats such as butter or lard (Schwingshackl *et al.,* 2018).

9.3.2.1 Practice implications to diet

The recommendation to limit SFAs are in view of its LDL-C raising effects. Animal fat and full cream dairy products contain substantial amount of SFA and therefore should be targeted for reduction along with replacing some SFA calories with PUFA by blending palm oil with a omega-6 PUFA oil.

9.3.3 Rationale to increase PUFA consumption

There is ample evidence to show that partially replacing SFA calories with PUFA is associated with reduced risk of CVD (Li *et al.,* 2015; Sacks *et al.,* 2017). The favourable effects of PUFA consumption on blood lipid profile are viewed as a benefit in CVD risk reduction (NCCFN, 2017; Sacks *et al.,* 2017). The omega-6 PUFA, mainly LA, is hypocholesterolaemic (Karupaiah, Noor & Sundram, 2005) while the omega-3 PUFA family has a hypotriglyceridemic effect, which is useful to offset dyslipidaemia in a metabolic syndrome-prone population.

Omega-6 fatty acids

Safflower, sunflower, corn and soybean oils have a pronounced effect on LDL-C reduction compared to olive and palm oils (Schwingshackl *et al.,* 2018). Based on a meta-analysis (cohort = 6; total *n* = 169,935) by Chowdhury *et al.* (2014), total dietary omega-6 fatty acid intake was not associated with CVD risk. However, another meta-analysis (cohort = 13; total n = 310,602) by Farvid *et al.* (2014) showed that greater dietary LA was associated with lower risk of CVD events and death. In terms of the effect of dietary omega-6 fatty acid and stroke risk, two prospective cohorts reported that dietary PUFA intake was not associated with development of stroke (Gillman *et al.,* 1997; He *et al.,* 2003).

Omega-3 fatty acids

The evidence on ALA intake and CVD risk remains inconsistent as two meta-analyses showed that dietary ALA intakes were not associated with CVD risk (Mente *et al.,* 2009; Chowdhury *et al.,* 2014), while another meta-analysis found that higher dietary ALA intake reduced CVD mortality but had no effect on CVD events (Pan *et al.,* 2012). Contrarily, robust findings have been reported for dietary marine omega-3 PUFA, namely EPA and DHA. Three meta-analyses have consistently shown that higher dietary marine omega-3 fatty acid intakes reduced CVD risk (Mente *et al.,* 2009; Chowdhury *et al.,* 2014; Alexander *et al.,* 2017).

Although the meta-analysis by Chowdhury *et al.* (2012) also reported lack of association between marine omega-3 fatty acid intakes and stroke risk, it was observed that fish consumption of 2 to 4 servings a week was associated with lower risk of stroke.

9.3.3.1 Practice implications to diet

High LA concentrations are found in specific vegetable oils whereas omega-3 PUFA is mainly from fish in the Malaysian diet (Tables 9.1 and 9.3).

9.3.4 EFAs and minimum requirement

The human body cannot synthesize LA and ALA, and minimum levels of these fatty acids are essential to prevent deficiency. The minimum requirement for EFA to prevent deficiency is about 3% TEI (2.5% TEI from LA + 0.5% TEI from ALA) as per the FAO and RNI recommendations (FAO, 2010; NCCFN, 2017). Clinical symptoms of EFA (LA and ALA) deficiency include growth retardation, skin lesions, reproductive failure, and fatty liver. EFA deficiency is rare and usually occurs in individuals with liver disease or malnutrition related to chronic disease conditions where blood levels of EFAs are low (Jeejeebhoy, Detsky & Baker, 1990). Fat-free diets are noted to lead to clinical EFA deficiency symptoms such as marked weight loss, dryness of the skin and atopic eczema and eventually death (Guarnieri & Johnson, 1970; Holman, 1971).

9.3.4.1 Practice implications to diet

Achieving a minimum 3% TEI for a 2000 kcal diet requires 5 to 6 g of LA and 1 g of ALA. Plant-based foods and seed oils contain both LA and ALA such as canola oil, soybean, soybean oil, safflower and sunflower oil (Table 1). In addition, salad dressings and spreads made from PUFA-rich oil can also be a source of both ALA and LA (Indahl *et al.,* 1999; Karupaiah *et al.,* 2016).

9.3.5 Maintain MUFA intake

MUFA intake as it has a neutral effect on blood cholesterol levels (Mensink *et al.,* 2003) and therefore the recommendation for Malaysians is to maintain MUFA intake. A network meta-analyses comparative found olive oil and palm oil to have equal treatment effects on LDL-C lowering (Schwingshackl *et al.,* 2018). A meta-analysis by Chowdhury *et al.* (2014) indicated that MUFA intake did not affect CVD outcomes. In contrast, the Mente *et al.* (2009) meta-analysis found a significant inverse association between MUFA intake and CVD risk in men, but not in women. A systematic review and meta-analysis of 32 cohort studies (n = 841,211 subjects) (Schwingshackl & Hoffmann, 2014) comparing the highest to the lowest tertiles of MUFA consumption from olive oil with determined oleic acid as well as MUFA:SFA ratio, concluded that increased MUFA intake resulted in a significant risk reduction for CVD mortality, CVD events and stroke. Subgroup analyses showed that only olive oil had a significant inverse correlation with CVD events and stroke, whereas oleic acid or increased MUFA:SFA ratio carried no observed effect on CVD events and stroke.

9.3.5.1 Practice implications to diet

MUFA intake is not a critical issue in the Malaysian diet as palm oil contains MUFA.

9.3.6 Rationale to exclude TFA from the diet

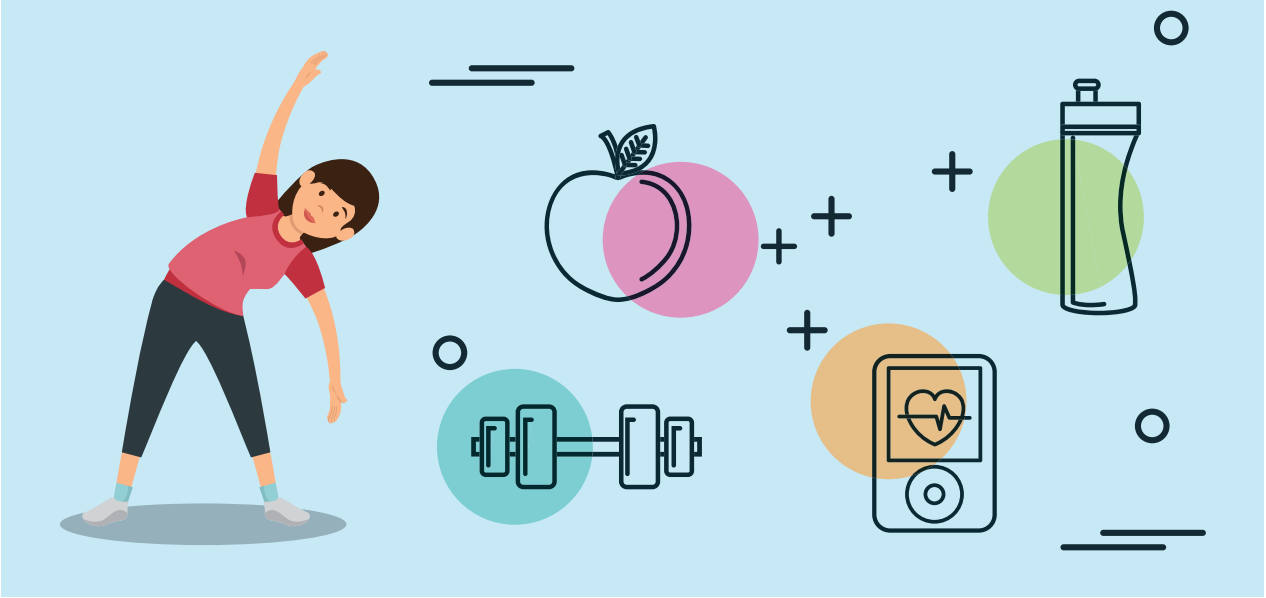
Major industrially produced TFAs in the food supply are elaidic acid isomers and this type of TFA is associated with CVD risk and mortality (Brouwer, 2016). The meta-analysis by Chowdhury *et al.* (2014) which pooled 5 observational studies on the effect of TFA on CVD risk, showed that total TFA intake was positively correlated with increased risk of CHD, and resulted in a 16% increased CVD risk. Another meta-analysis of 6 prospective cohorts (total n = 230,135) by de Souza *et al.* (2015) found that an additional 2% TEI derived from TFA was associated with a 25% increased risk of CHD and 31% increase in CHD mortality. Pooled relative risk estimates in a meta-analysis of 7 cohort studies, comparing extreme quintiles of total-TFA intake (intake TFA ranging from 2.8 to ~10 g/day) were 1.22 for CHD events and 1.24 for fatal CHD (Bendsen *et al.,* 2011).

The association of TFA consumption with stroke is not known for population wide studies (de Souza *et al.,* 2015) but a gender effect is noted only with men (Kiage *et al.,* 2014) but not women (Yaemsiri *et al.,* 2012; Kiage *et al.,* 2014).

The WHO Expert Consultation (WHO, 2003) and the United States Institute of Medicine (IOM, 2005) recommended that the TFA content in the diet should not exceed 1% kcal. This upper limit for TFA in the diet was adopted in the RNI (NCCFN, 2017).

9.3.6.1 Practice implications to diet

The consumption of TFA is a public health concern, particularly when commercially hydrogenated fats contribute to the bulk of dietary fat. Even then TFA intake will be low as palm oil is the most common edible oil used commercially and at home. Commercial foods are likely sources of trans fats, if they are imported. These may be stick margarines, *vanaspati* (vegetable ghee), partially hydrogenated edible oils, bakery products containing partially hydrogenated fats (pastries and cake) and cookies and biscuits (Table 9.2).



9.3.7 Dietary cholesterol

Past dietary guidelines focused on the reduction of dietary cholesterol intake as a strategy in reducing CVD risk (NCEP, 2002; USDA, 2010). These guidelines were based on a positive association between high plasma total cholesterol and increased CVD risk, which formed the basis to recommend reduced dietary cholesterol consumption (Goodman, 1991). Nevertheless, the Finnish Alpha-Tocopherol, Beta-Carotene Cancer Prevention Study reported that a higher dietary cholesterol intake did not associate with higher rates of CHD events and CHD mortality when comparing the highest (median = 768 mg) with the lowest (median = 390 mg) quintiles of cholesterol intake (Pietinen *et al.,* 1997).

The yolk of eggs is cholesterol-rich. Egg consumption is perceived as a health risk (NCEP, 2002; NCCFN, 2010) based on greater consumption been linked to higher CVD risk (Mann *et al.,* 1997; Nakamura *et al.,* 2004). An early meta-analysis of 22 prospective cohorts (n = 558,700 subjects), followed between 6 to 20 years (Shin *et al.,* 2013), did not establish any association between egg consumption and CVD in a healthy population. Consumption was assessed in terms of ≥ 1 egg per day compared to < 1 egg per week. A combined prospective cohort study of 17 years suggested higher consumption of dietary cholesterol or eggs (additional 300 mg daily beyond 3 to 4 eggs per week) among US adults was significantly associated with higher risk of incident CVD and all-cause mortality in a dose-response manner (Zhong *et al.,* 2019). A meta-analysis based on US, European, and Asian cohorts showed that moderate egg consumption (up to one egg per day) was not associated with CVD risk (Drouin-Chartier *et al.,* 2020). For patients with diabetes, a significant effect was noted with consuming ≥ 1 egg per day with increased risk of CVD compared to those consuming < 1 egg per week (HR = 1.69, 95% CI = 1.09-2.62) (Shin *et al.*, 2013). Another meta-analysis associated consumption of ≥ 3 eggs per week with a significantly higher risk for Type-2 diabetes in US studies, but this effect was not evident for non-US studies (Djousse, Khawaja & Gaziano, 2016). Based on the American Heart Association Guidelines 2020, healthy adults should be able to consume eggs with yolk in moderation with consumption up to one egg a day (Carson *et al.,* 2020).

Due to the lack of evidence from clinical studies showing a benefit from dietary cholesterol reduction, the expert group for the 2015-2020 USDA dietary guideline removed the reduction of dietary cholesterol advisory that was in the previous guideline (USDA 2015). In contrast, the IOM advisory still advise individual to eat as little dietary cholesterol as possible (IOM, 2002). It is important to highlight that this guidelines are meant for a healthy population. The RNI 2017 recommends removing the restriction on dietary cholesterol intake for a healthy population but at the same time cautions against excessive consumption (NCCFN, 2017). It must be cautioned that dietary cholesterol-rich foods such as red meat mutton, lamb, beef and pork also carry significant content of SFA, which are known to increase LDL-C levels. Cholesterol, SFA, animal protein, and sodium coexist in foods. Dietary cholesterol content of commonly Malaysian foods is indicated in Figure 9.1.

Practice implication

Exceeding one egg a day could lead to excessive dietary cholesterol consumption. It must be cautioned that dietary cholesterol-rich foods such as red meat mutton, lamb, beef and pork also carry significant content of SFA, which are known to increase LDL-C levels. Cholesterol, SFA, animal protein, and sodium coexist in foods. Dietary cholesterol content of commonly Malaysian foods is indicated in Figure 9.1.

9.4 Current status

Visible fat consumption by Malaysians is mainly palm oil for cooking, as this country is a primary producer of palm oil. The intake of SFA for our population is expected to be high from palm oil consumption. Current consumption of palm oil is 18.5 g/capita/day (FAO, 2013). On the other hand, it is estimated that human consumption of LA is insufficient (Jakobsen *et al.,* 2009) and therefore the public health approach is to encourage increasing LA consumption (USDA 2015; NCCFN 2017).

The largest evidence on current status of fat intake comes from the Malaysian Adults Nutrition Survey (MANS) 2014, a nationwide extensive food consumption survey estimating the median fat intake to be 46g/day or 29% TEI (IPH, 2014). This intake varies between urban (median = 49 g/day) and rural (median = 44 g/day) populations as well as between ethnic groups, with Chinese (median = 53 g/day) having the highest fat intake compared to Malays (median = 45 g/day) and Indians (median = 47 g/day). Fat intake is representative of various geographical regions in Malaysia. .

In comparison with MANS data, total fat consumption in relation to TEI is also reported by many small population subgroups (Shahar *et al.,* 2018). However due to heterogeneity of subject groups as per sampling, age, gender and dietary assessment methods, conclusive understanding of fat TEIs is not possible. In addition, reporting the distribution of SFA, PUFA and MUFA intakes for Malaysian healthy adults is severely limited by the lack of laboratory validated fatty acid compositional data of food intakes. However, it is noteworthy to look at a recent data from an urban population in Kuala Lumpur which reports that the intake of fat TEIs is 31.6% and this was distributed to SFA (14.1%), MUFA (12.6%) and PUFA (4.8%) (Karupaiah *et al.,* 2019). The actual trans fat intake in Malaysians does not exceed the 1% TEI limitation because palm oil is the major edible oil used commercially and domestically. It was reported that 83.9% of this urban population uses palm oil while the remaining small proportion are non-users (Karupaiah *et al.,* 2019). The percentage of palm oil users are expected to be higher in rural areas.

Amongst the top ten food items by Malaysian adults (IPH, 2014) it appears that 3.11 numbers of eggs are consumed weekly indicating that egg consumption is not excessive in the Malaysian population unlike the United States (Zhong *et al.,* 2019). Consumption of marine fish is 3.16 (medium) servings per week.

Cooking oils should ideally be consumed fresh, as repeated heating of these oils will generate thermally oxidized products (Oboh, Falade & Ademiluyi, 2014). Unfortunately, it is a common practice in the Malaysian households, as well as in commercial food production to use the same frying oil repeatedly to save cost (Azman *et al.,* 2012). Their study found that more than half of the 100 night-market food outlet operators in Kuala Lumpur (63.0%) admitted using cooking oil repeatedly for deep frying food and 7 of them re-used cooking oil up to four times or more. Another study found 43% of food operators in Pulau Pinang repeatedly heating cooking oil more than 5 times or more (Aziz, Elias & Sabran, 2018). Due to repeated heating, the quality, colour, smell and taste of cooking oil changes along with oxidation of lipid content to lipid peroxidation products. Lipid oxidation is casually linked to a high risk for the development of CVD (Falade, Oboh & Okoh, 2017).

9.5 Key Recommendations

Key Recommendation 1

Maintain total fat intake as recommended.

How to Achieve

1. Reduce consumption of both deep-fried (e.g., *keropok, vadai, yue char kuay, keropok lekor*) and batter-fried (e.g., *pisang goreng*, fish fillet) foods.

2. Use low-fat cooking methods such as stir-frying, grilling, pan-frying, and air-frying.

3. Modify recipes to reduce excessive use of oils and fats and replace it with ingredients with lesser fat. For example, replace *santan* with low-fat milk to prepare *nasi lemak* or reduce ghee in preparation of *nasi biriyani*.

4. Remove excessive oil after cooking once the dishes are cooled to room temperature. For example, remove visible fat that floats in soup or sambals.

5. Consume less gravy that is high in fat and oil such as curry with coconut milk or *masak lemak*.

6. Trim all visible fat of meats and remove chicken skin from poultry before cooking.

Key Recommendation 2

Reduce intake of foods high in saturated fats[1] such as butter, fatty meat, full cream milk, coconut milk, and coconut oil.

How to Achieve

1. Blend equal amount of palm oil with any polyunsaturated fat-rich oil (e.g., corn oil, soya bean oil, and sunflower oil) and use it for all types of cooking except deep-frying.

2. Reduce consumption of *santan*-based foods (e.g., *cendol* and curry laksa) and food prepared with animal-based fat such as butter, lard, and ghee.

3. Reduce consumption of full cream dairy products (e.g., cheese, ice cream, cream).

4. Reduce consumption of processed meats such as nuggets, luncheon meat, and sausages.

Key Recommendation 3

Increase the intake of omega-6 polyunsaturated fatty acid-rich oils (i.e., corn oil, soya bean oil, sunflower oil) and omega-3 polyunsaturated fatty acid-rich foods (i.e., *siakap*, *cencaru*, *kembung*, nuts, and seeds).

How to Achieve

1. Blend an equal amount of palm oil with any omega-6 polyunsaturated fat-rich oil (e.g., corn oil, soya bean oil, and sunflower oil) and use it for all types of cooking except deep-frying.

2. Encourage consumption of nuts (e.g., walnut, cashew nut, and pistachio), seeds (e.g., flaxseed, chia seed, and sesame), and legumes (e.g., soybean) within the amount recommended.

3. Consume at least 3 to 4 servings per week of fish high in omega-3 fatty acids such as *siakap, kembung*, anchovies, *tenggiri,* or sardines. Canned sources of fish (with low sodium) such as tuna and sardines may also be consumed.

Key Recommendation 4

Limit intake of trans fatty acids[2].

How to Achieve

1. Limit intake of shortenings and margarines[3] that are partially hydrogenated[4].

2. Read the nutritional information panel of processed foods for ingredients that may indicate trans-fat. Check the label for how much trans fat is stated in a product. Avoid a product with "partially hydrogenated fats/ oils" or "shortening" stated on the ingredient listing.

3. Limit intake of foods made with ingredients high in trans fat such as shortening, *vanaspati*, or partially dehydrogenated margarine:

    i. Western: French fries, fast foods, and bakery products.

    ii. Local: *roti canai, paratha*, curry puff, doughnuts.

Key Recommendation 5

Do not reuse cooking oil more than twice.

How to Achieve

1. At home, oils for deep-frying are not encouraged to be reused more than two times.

2. Avoid purchasing deep-fried foods from outside food vendors use cooking oil repeatedly.

3. Dispose household cooking oil for recycling purposes such as bio-fuels.

Footnote:

[1] Foods high in saturated fat such as butter, full cream dairies, animal fat, and coconut milk.
[2] Trans fatty acids are produced through an industrial process that makes vegetable oils to become solid at room temperature.
[3] Shortening refers to fat that is solid at room temperature, which is commonly made from partially hydrogenation of vegetable oils.
[4] Partial hydrogenation is a chemical process of turning liquid oils into a solid form.

Table 9.1: Fatty acid composition of selected dietary fats and oils

Types of fats and oils	SFA						MUFA			PUFA			Others	P/S ratio
	< 12:0	Lauric acid (C12:0)	Myristic acid (C14:0)	Palmitic acid (C16:0)	Stearic acid (C18:0)	Total SFA	Palmitoleic acid (C16:1n7)	Oleic acid (C18:1)	Total MUFA	Linoleic acid (C18:2)	alpha-linolenic acid (C18:3)	Total PUFA		
Coconut oil	14.90	48.50	17.60	8.40	2.5	91.90	-	6.50	6.50	1.50	-	1.50	0.10	0.02
Palm kernel oil	8.20	49.60	16.00	8.00	2.40	84.20	-	13.70	13.70	2.00	-	2.00	0.10	0.02
Cocoa butter	-	-	0.10	25.80	34.50	60.40	0.30	35.30	35.60	2.90	-	2.90	1.10	0.05
Beef fat	0.10	0.10	3.30	25.50	21.60	50.60	3.40	38.70	42.10	2.20	0.60	2.80	4.60	0.06
Shea butter	-	-	-	5.00	41.00	46.00	-	48.00	48.00	5.10	-	5.10	0.90	0.11
Palm oil	-	0.30	0.80	39.50	4.30	44.90	0.30	43.10	43.40	10.50	0.30	10.80	0.50	0.24
Palm olein	-	0.20	0.80	37.20	4.20	42.40	0.40	43.60	44.00	11.50	0.30	11.80	0.30	0.28
Lard	0.10	0.10	1.40	24.80	12.30	38.70	3.10	45.10	48.20	9.90	1.10	11.00	3.00	0.28
Olive oil	-	-	-	16.50	2.30	18.80	1.80	66.40	68.20	13.00	1.60	14.60	0.00	0.78
Groundnut oil	-	-	0.04	7.50	2.10	9.60	0.10	71.10	71.20	18.20	-	18.20	0.90	1.89
Corn oil	-	-	-	12.30	1.90	14.20	0.10	27.70	27.80	56.10	1.00	57.10	0.90	4.02
Soybean oil	-	-	0.10	10.80	3.90	14.80	0.20	23.90	24.10	52.10	7.80	59.90	1.20	4.05
Canola oil	-	-	-	5.60	1.80	7.40	-	56.00	56.00	25.80	9.80	35.60	1.00	4.81
Sunflower oil	-	0.02	0.09	6.20	2.80	9.10	0.12	28.00	28.10	62.20	0.16	62.40	0.40	6.85
Safflower oil	-	-	0.10	6.70	2.40	9.20	0.10	11.50	11.60	79.00	0.15	79.20	0.10	8.60

Notes: values represent %/100 g edible fat.
Sources: Kris-Etherton et al. (1988); Grundy & Denke (1990); Karupaiah, Noor & Sundram (2005); Dubois *et al.* (2007); Gunstone, Harwood & Dijkstra (2007) & Orsavova *et al.* (2015).

Table 9.2: Malaysian foods with significant content of dietary fat (g/100 g)

Food	Total fat	SFA	MUFA	PUFA	TFA*
Fishes					
Black pomfret *(bawal hitam)*	1.79	0.94	0.14	0.71	N/A
Giant seaperch *(siakap)*	2.43	1.27	0.23	0.93	N/A
Golden snapper *(jenahak)*	1.02	0.42	0.09	0.51	N/A
Indian Mackerel *(kembung)*	1.08	0.59	0.30	0.19	N/A
Silver Pomfret *(bawal putih)*	1.60	0.88	0.15	0.57	N/A
Yellow stripe scad *(selar kuning)*	2.54	0.83	0.29	1.42	N/A
Shellfish					
Cockles *(kerang)*	1.65	0.64	0.40	0.61	N/A
Cuttlefish *(sotong)*	1.18	0.57	0.11	0.50	N/A
Oyster *(tiram)*	0.98	0.56	0.08	0.34	N/A
Prawn *(udang)*	0.88	0.31	0.11	0.46	N/A
Nuts and seeds					
Almond	48.80	4.50	33.10	11.10	N/A
Hazelnut	61.20	4.80	50.90	5.50	N/A
Peanut	41.80	7.60	20.70	12.90	N/A
Walnut	53.60	7.90	0.20	45.00	N/A
Confectionary					
Chocolate wafer	27.30	17.00	7.60	1.70	0.74
Cooking chocolate	33.10	26.70	5.20	0.70	0.42
Fats, oils, spreads and dressing					
Butter	80.60	46.60	25.60	4.80	1.06
Fat spread	73.40	26.60	28.90	17.00	0.16
Ghee	99.80	61.50	29.70	3.30	1.04
Margarine	77.00	35.80	28.00	12.90	0.28
Peanut butter	42.00	8.50	20.40	11.30	0.22
Salad dressing	45.00	6.50	10.20	27.50	0.08
Shortening	99.80	57.00	33.60	8.80	0.20
Vanaspati	99.80	50.60	37.90	10.70	0.43
Dairy-based products					
Adult milk powder	25.60	15.10	7.90	1.30	0.42
Cheese	21.50	12.90	6.80	1.00	0.17
Ice cream	11.00	7.50	2.60	0.50	0.23
Soups					
Soup, canned	45.80	4.90	25.00	14.80	0.04
Soup, concentrates	17.00	8.80	6.20	1.50	0.33

Table 9.2: Malaysian foods with significant content of dietary fat (g/100 g) (cont...)

Food	Total fat	SFA	MUFA	PUFA	TFA*
Snacks					
French fried	2.55	1.30	0.90	0.30	0.01
Frozen *chappati/ paratha*	9.10	4.70	3.10	1.10	0.06
Frozen dough	5.50	2.70	2.10	0.70	0.02
Potato chips	32.7	12.50	14.80	4.90	0.08
Meat and meat products					
Beef lean	1.10	0.60	0.40	0.00	N/A
Burger patties	13.00	5.30	5.60	1.60	0.01
Chicken meat	19.00	5.70	9.20	4.10	N/A
Hen egg	8.10	2.60	4.70	0.80	N/A
Mutton	4.60	2.00	2.40	0.20	N/A
Nuggets	15.00	6.50	6.30	2.00	0.01
Pork fat	89.30	37.80	45.90	5.50	N/A
Pork lean	21.00	7.90	11.00	2.10	N/A
Prawn	0.30	0.10	0.10	0.10	N/A
Sausages	13.80	4.30	6.30	2.90	0.02
Popular street foods					
Char siew pau	15.4	7.20	7.00	1.20	N/A
Chicken rice	4.60	1.80	2.10	0.70	N/A
Curry *laksa*	6.40	4.40	1.40	0.60	N/A
Dosai	0.70	0.40	0.20	0.00	N/A
Fried *kueh tiau*	9.70	3.90	4.50	1.30	N/A
Fried mee – *Hokkien*	6.60	2.70	3.00	0.90	N/A
Fried mee – Indian style	9.00	5.60	2.30	1.10	N/A
Lor mai kai	5.00	1.90	2.40	0.70	N/A
Nasi goreng cina	13.20	5.30	6.50	1.40	N/A
Nasi lemak	3.60	2.00	1.10	0.50	N/A
Satay	10.80	3.60	4.60	2.60	N/A

*relates to total TFA content as a sum of 18:1 n9t; 18:2 n6t; cis-9 t-12; t-9, cis-12; 18:3t1; 18:3t2; 18:3t4; and 18:3t5 excluding natural isomers of conjugated linoleic acid (cis-9,t-11);
N/A = not available;
Sources: Tee *et al.* (1997); Alasalvar *et al.* (2003); Dubois et al. (2007); Abd. Aziz *et al.* (2013); Karupaiah *et al.* (2014) & Orsavova *et al.* (2015).

Table 9.3: Marine omega-3 fatty acid content in Malaysian fishes

Fish species	Fat (g per 100 g)	EPA (mg per 100 g)	DHA (mg per 100 g)
High fat fish (> 3 g fat per 100 g)			
Red pomfret *(bawal merah)*	34.0	2.0	1.0
Toli shad *(terubuk)*	13.8	137.0	35.0
Freshwater eel *(belut air tawar)*	10.7	37.0	9.0
Jelawat *(jelawat)*	7.9	1.0	6.0
Silver carp *(kap perak)*	7.1	2.0	6.0
Black siapkap *(siakap hitam)*	6.5	3.0	25.0
Eel *(belut)*	6.3	17.0	1.0
Catfish *(patin)*	6.2	9.0	1.0
Indonesian carp *(tebal sisik)*	5.2	1.0	0.0
Indian mackeral *(kembung)*	4.5	48.0	22.0
Wild sepat *(sepat ronggeng)*	4.5	2.0	7.0
River catfish *(keli bunga)*	4.4	0.0	2.0
Catfish *(keli)*	4.3	3.0	0.0
Snakehead *(haruan)*	3.3	3.0	1.0
Moderate fat fish (1-3 g fat per 100 g)			
Anchovies *(bilis)*	2.4	11.0	25.0
African bream *(tilapia)*	2.8	2.0	0.0
Red African bream *(tilapia merah)*	2.4	1.0	0.0
Catla *(catla)*	1.9	1.0	0.0
Big head carp *(kap kepala besar)*	1.8	0.0	0.0
Rohu *(rohu)*	1.3	2.0	0.0
Seamese sepat *(sepat siam)*	1.2	1.0	2.0

Sources: Rahman *et al.* (1995); Muhammad & Mohamad (2012).

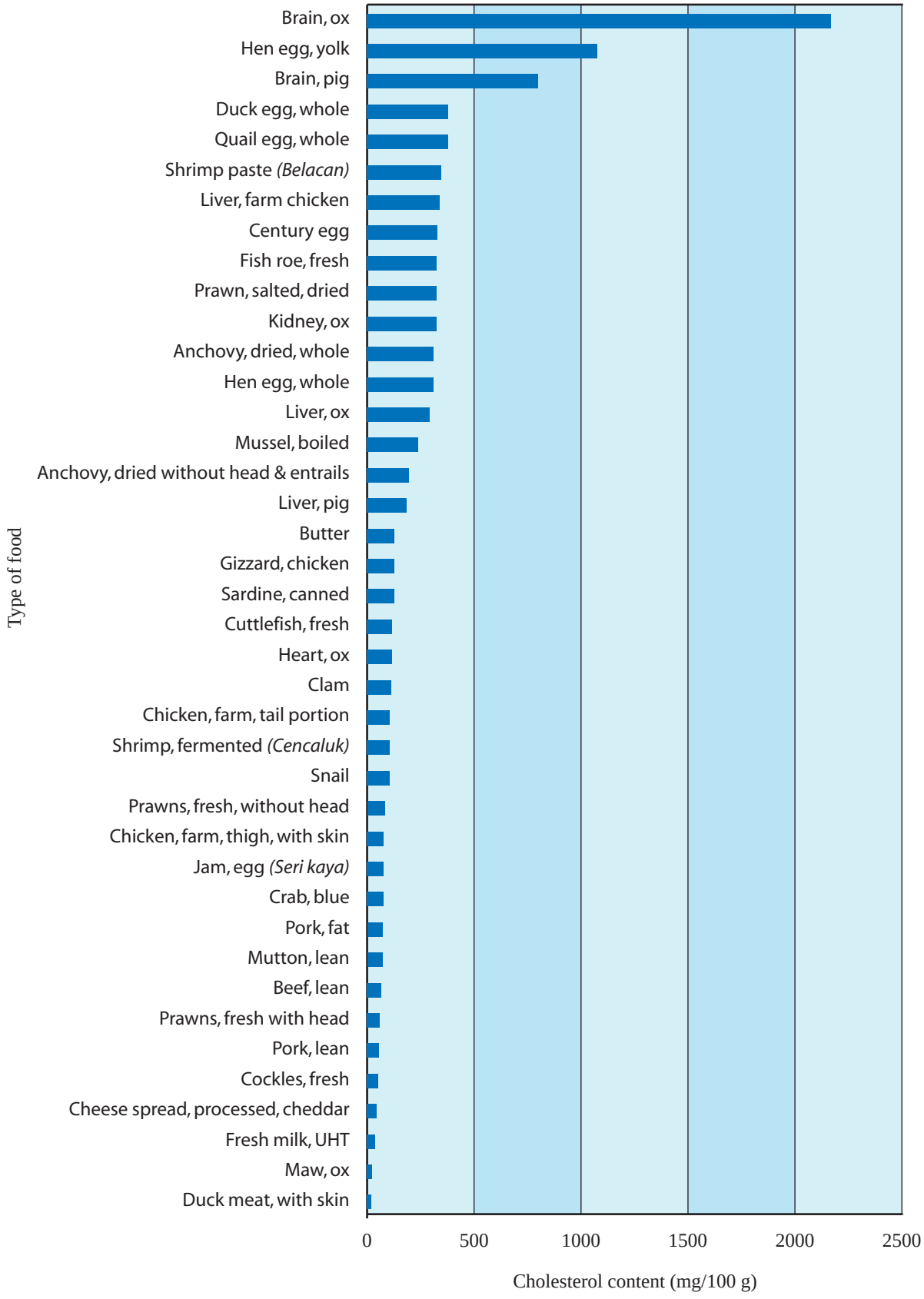


Figure 9.1. Cholesterol content of common foods
Source: Tee *et al*. (1997)

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Choose and prepare foods with less salt, sauces and flavour enhancers

KEY MESSAGE

10

CHOOSE AND PREPARE FOODS WITH LESS SALT, SAUCES AND FLAVOUR ENHANCERS

Prof. Dr. Suzana Shahar, Assoc. Prof. Dr. Zahara Abdul Manaf, Ms. Viola Michael and Ms. Ainan Nasrina Ismail

10.1 Terminology

Commercial edible salt

There is a wide range of commercial edible salts in the market, i.e., sea salt, rock salt, bamboo salt and pan salt. These commercial edible salts have different mineralities depending on their source, giving each one a unique flavour. However, their sodium content is as high as the table salt, they should be used with cautious similarly with the table salt and not exciding the daily recommended intake.

Flavour enhancer

Flavour enhancer means any substance that, when added to food, is capable of enhancing or improving the flavour of that food (MOH, 1985).

Hidden salt in food

A significant amount of salt in Malaysian's diet is from the processed foods even if they don't taste salty. Several food additives such as sodium nitrate, sodium bicarbonate and sodium bisulfate are the contributors for the salt sodium content in processed foods.

Iodised salt

It is a form of salt that has been fortified with iodine. It shall contain not less than 25 mg/kg and not more than 40 mg/kg of iodide (MOH, 1985).

Low sodium food

Low sodium food is defined as a food with a sodium concentration not more than 0.12 g/100 g (solid) or 0.06 g/100 ml (liquid) (FSQD, 2010).

Natural food enhancer

Any substance such as herbs and condiments, i.e., garlic, onion, curry spices, white pepper, lemon grass, vinegar and lemon; added during food preparation to enhance the flavour of food.

Flavor enhancer

Flavor enhancer means any substance that, when added to food, is capable of enhancing or improving the flavor of that food (MOH, 1985).

Very low sodium food

Very low sodium food is defined as a food with a sodium concentration not more than 0.04 g/100 g (solid) or 0.02 g/100 ml (liquid) (FSQD, 2010).

Salt and sodium

Salt is an inorganic compound consisting of sodium and chloride ions i.e., NaCl. 1 g sodium is equivalent to 2.55 mg NaCl whilst 1 mmol Na is equivalent to 23 mg Na (NaCl consists of Na at 40%). Thus, 1 teaspoon or 5 g salt provides 2000 mg or 88 mmol sodium. In addition to NaCl, sodium may also be present in other forms, such as monosodium glutamate, sodium nitrate and sodium benzoate.

Salt substitutes

It is referred to as light salts, typically replace all or some of the sodium with another mineral, such as potassium or magnesium.

Sauce

A sauce is liquid or sometimes semi solid food served on food as a relish (served as an accompaniment to food) or used as a flavourful seasoning in preparing other foods. This includes soya sauce (fermented soya beans), oyster sauce, tomato and chilli sauces, fish sauce (made from fermented fish), prawn sauce (*cencaluk*), *kicap sotong*, teriyaki sauce and Worchester sauce.

Sodium free food

Sodium free food is defined as a food with a sodium concentration not more than 0.005 g/100 g (solid) or /100 ml (liquid) (FSQD, 2010).

Table salt

It is a fine-grained salt that often contains an anti-caking ingredient, such as calcium silicate, to keep it free-flowing. It is available iodised or non-iodised. This type of salt is mainly used in cooking and at the table.

Processed Food

Processed food includes food that has been cooked, canned, frozen, packaged or changed in nutritional composition with fortifying, preserving or preparing in different ways.

Healthier Choice Logo (HCL)

Healthier Choice Logo (HCL) is given to a food/ beverage product which has fulfilled the nutrient criteria set by the Ministry of Health Malaysia in April 2017. This logo means the product is healthier compared with the other products in the same category (MOH, 2019).

10.2 Introduction

The prevalence of high blood pressure has remained constant in the country in the past decades. Results from the National Health Morbidity Survey, indicated that the prevalence of hypertension among adults aged ≥ 18 years old and more than 30 years old increased from 32.2% and 42.6% in 2006 (IPH, 2008) to 32.7% and 43.5% in 2011, respectively (IPH, 2015). However, latest findings from NHMS 2019 (IPH, 2020) showed a reduction in the prevelance of hypertension; with 30% of adults aged 18 years and above reported with raised blood pressure. Even though there were declining trend of the prevelance as compared to 2011, hypertension has been known as a major risk factor for cardiovascular disease and premature death. Heart diseases and diseases of pulmonary circulation and cerebrovascular diseases (23.5%) are the major cause of deaths in Ministry of Health hospitals. Based on Malaysia's latest Burden of Disease Study, high blood pressure is estimated to cause 42.2% of deaths and 21.6 % of disability-adjusted life years (DALY), the largest contributor for both men and women (MOH, 2015).

Dietary salt has been associated with high blood pressure and its related co-morbidity. Therefore, reducing the average salt intake of the population is likely to decrease the health burden associated with high blood pressure and improve public health**.** Excess salt and sodium intake globally is associated with heart disease, stroke and kidney disease, and also risk of stomach cancer, osteoporosis and obesity (Brown *et al.,* 2009; He, Jenner & Macgregor, 2010).

Sodium is an essential mineral that is required daily in a minute amount approximately at 500 mg/day (22 mmol/day) for adults. However, excessive intake or more than the Tolerable Upper Intake Level (UL) (2300 mg sodium/day or 101 mmol/day) can increase risk of adverse effects (IOM, 2006). Salt is the major source of sodium in the Malaysian diet. One teaspoon or 5 g salt provides 2000 mg (88 mmol) sodium. However, the WHO (2012) has not clearly defined the recommendation based on age range.

Recommended Nutrient Intake for Malaysia, 2017 (NCCFN, 2017) is in agreement with the current recommendation by WHO (WHO, 2012) with a maximum level of 2 g/day sodium for adult. The recommendation for children should be adjusted downward based on the energy requirement. Adequate Intake (AI) as suggested by IOM (IOM, 2006) could be referred for age specific guideline. The present document has been prepared to review the recommendation made in the year 2010, taking into consideration recent evidences or recommendations on salt intakes in the population, for the prevention and control of non-communicable diseases.

10.3 Scientific basis

As early as the year 1994, the evidence of an association between dietary salt intakes and blood pressure has increased, with the greatest reductions in blood pressure observed when a diet rich in fruits, vegetables and low fat dairy foods and reduced in saturated and total fat, is combined with a low salt diet (SACN, 2003).

High salt intake is associated with an increased risk of high blood pressure, as evidenced by a number of epidemiological studies. For example, the INTERSALT study involving 52 communities (INTERSALT Cooperative Group, 1988), reported a positive relationship between salt intake and blood pressure. The efficacy of reduced sodium intake in lowering blood pressure is also well established. A systematic review and dose-response meta-analysis study by Wang *et al.* (2020) has found that the the risk of cardiovascular disease increased up to 6% for every 1 g increase in dietary sodium.

In a Cochrane systematic review, a modest reduction in salt intake for four weeks or more among individuals with normal or elevated blood pressure had a significant effect on blood pressure (He & MacGregor, 2004). A systematic review and meta-analysis of randomised trials by Huang *et al.* (2020) on the effect of dose and duration of reduction in dietary sodium on blood pressure levels showed that " in trials of less than 15 days' duration, each 50 mmol reduction in 24 hour urinary sodium excretion was associated with a 1.05 mmHg (0.40 to 1.70; P = 0.002) SBP fall, less than half the effect observed in studies of longer duration (2.13 mmHg; 0.85 to 3.40; P = 0.002). Otherwise, there was no association between trial duration and SBP reduction. The magnitude of blood pressure lowering achieved with sodium reduction showed a dose-response relation and was greater for older populations, non-white populations, and those with higher blood pressure. Another earlier meta-analyses by Aburto, Li & Macgregor (2013) involving thirty six RCTs found that a reduction in sodium intake significantly reduced resting SBP by 3.39 mmHg and resting DBP by 1.54 mmHg. When sodium intake was < 5 g of salt (sodium 2000 mg) per 24 hours, compared with > 5 g of salt (sodium 2000 mg) per 24 hours, SBP was decreased by 3.47 mmHg and DBP by 1.81 mmHg. Another systematic review by Johnson *et al.* (2015) also confirmed a causal relationship between increasing dietary salt and increased blood pressure and an association between several adverse health outcomes and increased dietary salt. Further, an association between salt intake and renal cell cancer was also found. Although the understanding of long term effects of reducing dietary salt intake on cardiovascular morbidity and mortality can be improved by further studies, the available scientific evidence is strong enough to justify reducing sodium intake in the whole population through cost-effective public health approaches (WHO, 2007). Excessive sodium intake (exceeding 5 g/day) has also been associated with increased cardiovascular diseases other than raised blood pressure (O'Donnell *et al.,* 2020). Interconnected physiological mechanisms are associated with increased intake of dietary salt, including fluid homeostasis, hormonal and inflammatory pathway, as well as immune response and the gut microbiome (He *et al.,* 2020). High salt intake has been associated with the gut-immune axis, thus the gut microbiome as a potential therapeutic target to counteract salt-sensitive conditions. High salt intake affects the gut microbiome in mice, particularly by depleting *Lactobacillus murinus*. Consequently, treatment of mice with *L.murinus* prevented salt-induced aggravation of actively induced experimental autoimmune encephalomyelitis and salt-sensitive hypertension by modulating T_H17 cells. Further, a moderate high-salt challenge in a pilot study in humans

reduced intestinal survival of *Lactobacillus spp.*, increased T_H17 cells and increased blood pressure (Wilck *et al.*, 2017).

The Institute of Medicine (IOM, 2006) stated an Adequate Intake and Tolerable Upper Level for sodium for adults aged 19 to 50 years as 1500 mg and 2300 mg, respectively. A lower recommendation but similar TUL was outlined for older individuals (Table 10.1). The recommendation by WHO (2012) of 2000 mg sodium or less than one teaspoon or 5 g salt or sodium chloride is adopted as a population nutrient intake goal for Malaysians. Although it is important to advise people to consume less salt and to choose low salt foods, the widespread use of salt in processed food and food prepared away from home or eaten outside is a major barrier to achieving any meaningful reduction in dietary sodium intake. Therefore, there is a need to reduce the salt content of processed food and drinks, with the co-operation of food manufacturers, retailers and caterers. Reformulation of foods high in sodium or salt has been emphasized as effective public health strategies to reduce salt consumption of the population. More recently, evidence on the positive effects of reformulation on consumption and health was found to be stronger for sodium interventions, less conclusive for sugar and fats (Federici *et al.*, 2019).

Table 10.1: Dietary reference intakes of sodium for adults

Age group	Adequate Intake (AI) (milligrams/ day)[1]	Tolerable Upper Intake Level (UL) (milligrams/ day)[2]
19-50 years	1.5	2.3
51-70 years	1.3	2.3
> 70 years	1.2	2.3

[1] AI = Adequate Intake; [2] UL = Tolerable Upper Intake Level. Unless otherwise specified, the UL represents total intake from food, water, and supplements.
Source: IOM (2006)

Consumer should also be encouraged and educated to read food label and the manufacturers themselves should produced a consumer-friendly labelling showing the sodium content of food. Information on sodium content is now included on food labels (in terms of density or standard serve), but it is easy to confuse salt and sodium and consumers may not be aware of the definition of a low salt food. The Malaysian Food Labelling Act defines a low salt food as a food with a sodium concentration of up to 120 milligrams per 100 grams (MOH, 2006).

In older adults, salt has many detrimental effects on health by causing a rise in blood pressure, the consequence of which is cardiovascular disease (CVD), including strokes, heart attacks and heart failure. The risk of having these diseases is significantly increases with age. Furthermore, with increasing age there is also an increased salt sensitivity meaning that salt has a greater effect on blood pressure. Therefore, a reduction in salt is particularly important for older people even for older adults without high blood pressure. Osteoporosis has been associated with a high salt intake (Heaney, 2006). A high salt intake can cause calcium losses through the urine which can lead to bone demineralisation. It is believed that patients with high blood pressure excrete more calcium in the urine and are therefore at higher risk of osteoporosis. Normative changes in salt taste occur with aging resulting in higher thresholds of salt sensitivity and salt taste affinity that predispose older adults to high salt intake (Wessler, Hummel & Maurer, 2014).

10.4 Current status

The prevalence of hypertension among Malaysian remain 30% over the last 15 years since 2006 (IPH, 2008, 2011, 2015 & 2020). Based on the age-standardised adjusted estimated published by WHO, Malaysia's prevalence of high BP is higher compared to neighbouring countries in South East Asia, ie., Singapore and Thailand. In the Burden of Disease Study (2014), high blood pressure is estimated to cause 42.2% of deaths and 21.6% of disability-adjusted life years (DALY) for both men and women (MOH, 2015).

Ministry of Health Malaysia recommends that 2000 mg sodium per day (or 1 teaspoon or 5 g sodium chloride) as a population nutrient intake goal for Malaysians. This level was inline with the recommendation by the World Health Organization (WHO, 2007 & 2012). In the year 2010, it was estimated that 99.2% of the world adult population consumed excessive amount of sodium as compared to WHO recommendation (Powles *et al.*, 2013). On the other hand, a study conducted in Southeast Asia countries in 2010 found that sodium intake among adults in Southeast Asian countries exceeded 3 g/day. Thailand showed the highest sodium intake among the Southeast Asian countries, whilst Indonesia is the lowest. Meanwhile, Malaysia was ranked at number 8 among all Southeast Asian countries. Based on gender, adult men have higher intake of sodium than women (Ammara & Khor, 2015).

A cross-sectional population-based household survey, namely the Malaysian Community Salt Survey (MyCoSS) has been conducted in 2018 using 24 hours urinary sodium to estimate sodium intake among 960 adults aged 18 years and above. Based on this study, it was found that 79% of Malaysian adults consumed high sodium in their diet, with higher proportion of men compared to women. The mean 24-hour urinary sodium intake was 3167 mg/day (95% CI = 2987-3346), which corresponds to 138 mmol/day or 7.9 gram of salt or 1.6 teaspoon of salt (IPH, 2019). The data from MyCoSS is higher than an early study among health staff in Malaysia (MySALT) that reported mean sodium intake of 2860 mg/day as assessed using similar method, i.e., 24 hours urinary sodium excretion (IPH, 2016). Data obtained from dietary survey i.e., Malaysian Adult Nutrition Survey (MANS) showed a lower values, i.e., 2575 mg/day in the year 2008 and 1935 mg/day in 2014 (Mirnalini *et al.,* 2008; IPH, 2014). This data could be under reported as the gold standard for estimation of sodium or salt intake is the 24 hour urinary sodium excretion.

Modern processed western foods has been introduced as a result of urbanisation. This has led to the increasing demand on salt and sodium utilisation in food supply in Southeast Asia countries. Sodium-containing compounds such as sodium benzoate, sodium nitrate and sodium ascorbate are being used in proccessed food (IOM, 2010). In both MySALT studies in 2012 and 2015, sodium intake among health staff found that light soya sauce was the most popular seasoning consumed daily which contributed to the highest daily sodium intake (IPH, 2015). The Malaysian Adult Nutrition survey (MANS) showed that foods sources of high sodium content mostly came from local kuih (79%), breads (76.9%), *bihun*, *kueyteow*, laksa, *laksam*, *loh si fun* (76%), ketchup (75.6%) and followed by mee (75.2%) (IPH, 2014). Recent findings from MyCoSS (IPH, 2019) reported that top 10 high sodium food most consumed by Malaysian adults were fried vegetables, white/ wholemeal bread, omelette, fried chicken with spice, fried rice, *nasi lemak*, *roti canai*, fried *bihun*, fried noodle and chicken curry. Further, the top 10 food items that contributed to highest sodium proportion intake were mee *kolok*/ Kampua, light soya sauce, curry noodle, vegetable with salted fish, fried vegetables, *roti canai* and fried rice.

It is important to note that the increased of urbanization is not necessarily accompanied by a shift in preference from traditional to western foods. It was reported that both home-cooked foods and foods eaten away from home contributed to increased sodium intake in Southeast Asia countries (Brown *et al.,* 2009). For example, in Vietnam, consumption of streets foods showed a higher percentage to daily sodium intake among urban adolescents compared with rural adolescents (33.1 ± 2.1% vs. 12.1 ± 2.1%, respectively). However, rural adolescents had higher total sodium intakes compared with urban adolescents (1643.2 ± 124.8 mg Na vs. 1500.7 ± 124.8 mg NA, respectively) (Lachat *et al.*, 2009). Whilst, findings from the Singapore Chinese Health Study found that respondents reporting frequent intake of Western-style fast food items (≥ 2 times per week) consumed more *dim sum*, noodles and sugar-sweetened beverages, and greater amounts of sodium (864 mg NA/1000 kcal) compared with those who did not eat fast food (651.7 mg Na/1000 kcal) (Odegaard *et al.,* 2012).

There is also a concern about consumption of processed and ultra processed foods among Asian population. Processed and ultra-processed foods still have a lower contribution to energy and nutrient intake in Jakarta than non processed foods and processed ingredients. Based on the Jakarta Individual Food Consumption Survey 2014 (Setyowati et al. 2018), processed and ultra-processed foods still have a lower contribution to energy and nutrient intake than non-processed foods and processed ingredients. However, with respect to sodium, ultra-processed foods contributed to the second highest percentage at 18.4%, after processed ingredients at 68.9%, as compared to non processed foods of 7.9% and processed foods at 4.8%. In Malaysia, an attempt has been conducted to determine the contribution of ultra-processed foods on the diet of adults in Terengganu. It was found that the ultra processed food contributed the highest to sucrose (63%), followed by sodium (26%) and energy (24%) (Asma' et al. 2019).

Southeast Asian countries has been known to be the 'heaven' of variety of foods. Salted and fermented foods has been part of the traditional food culture in most Southeast Asian countries and they are widely consumed, particularly among the low-income groups (Ang *et al.,* 1999). The process of fermentation requires large amounts of salt to prevent putrefaction (Lee & Kim, 2013). Fermented fish sauces and pastes (such as *belacan*) are prepared from different kinds of fish, shrimp and shellfish. Salt is added and mixed, ranging from 20 to 40% for fish sauce and 15 to 25% for fish pastes (Ang *et al.,* 1999). Asian countries are also the largest producers and consumers of monosodium glutamate (Nguyen *et al.,* 2020), which is a flavour enhancer containing salt (sodium). Recently, it has been observed that Malaysians also favour foods from other countries such as Korean and Japanese foods, known to be high in salt, such as Ramen and dishes using salted eggs (Cho, 2010). The shift of dietary pattern from consuming traditional food such as rice with dishes to bread and pastries could also increased the level of sodium or salt consumption of the population, as evidenced in findings from the recent MyCoSS study (IPH, 2019).

In the local market, there are various types of salt been sold. It is important to note that a new Consensus Action on Salt and Health (CASH) in UK survey has reported that all variety of salt sold in the market, either in crystals or grains, from the sea or from the Himalayas; contain and equally high sodium chloride content as table and cooking salt (WASH, 2017). Salt substitutes containing potassium chloride can be one way of reducing sodium intake. However, these substitutes may be harmful to some people with certain medical conditions such as kidney and heart problems. These individuals should consult a medical doctor before trying such salt substitutes. Iodised salt is one way that has been used in iodine deficiency disorder (IDD) prevention programme. However, the consumption of iodised salt should also be consumed less than one (1) level teaspoon daily.

Though mandatory labelling of sodium has been gazetted on the 21 July 2020, and to be enforced by July 2022, industries should be begin to comply to the regulation since recent surveys indicated that almost half of one of the top sources of sodium in Malaysian diet, i.e., sauces did not include sodium content information on the nutrient information panel (Shahar *et al.,* 2019). Similar trend was noted for instant noodles, of which only 62% of instant noodles displayed the salt content on their food label. Further, salt content in instant noodles is very high, with 90% exceeding the daily salt intake recommended by WHO (Tan *et al.,* 2019). Among those processed foods sold in Malaysian supermarkets with sodium or salt labelling, the highest average salt content was gravy and sauce (3.97 g/100 g), followed by soup (2.95 g/100 g), cheese (2.14 g/100 g), meat (1.37 g/ 100 g), fish (1.25 g/100 g), chicken (1.20 g/100 g), vegetables (1.18 g/100 g), cheese (2.14 g/100 g), butter and margerine (1.13 g/100 g), breakfast cereals (0.94 g/100 g), savoury snacks (0.90 g/100g), flatbread (0.86 g/100 g), sweet snacks (0.30 g/100 g) and potato (0.29 g/100 g). Most processed food products available in supermarkets were high in salt content and 76.5% of unlabeled processed food products were made in Malaysia, whilst 23.5% were imported (Haron *et al.,* 2020).

Sodium target has been identified through the Healthier Choice Logo (HCL) guideline, however, less than one-fifth of the sauces products surveyed had salt content below the target for sodium of less than 4.5 g/100 g or salt of less than and equal to 4500 mg/100 g (Shahar *et al.*, 2019). Prompt action from regulatory and health authorities is needed to reduce the salt content in these types of foods. Integrative approaches including nutrition labelling, voluntary or mandatory reformulation or sodium reduction programmes in processed food and legislative sodium reduction programmes are essential to reduce the sodium intake in the population and further reduce the risk of cardiovascular disease (Hyseni *et al.,* 2017).

10.5 Key Recommendations

Key Recommendation 1

Limit salt intake in daily meals.

How to Achieve

1. Learn to enjoy natural flavour of foods with lower level of saltiness without salt (including asam boi) and sauces (such as soya sauce, oyster sauce, tomato sauce).

2. Limit the amount of salt, sauces and flavour enhancer [such as monosodium glutamate (MSG), ready-to-use paste, cubes and powder] in cooking.

3. Limit intake of ultra-processed foods such as instant noodles, chicken nuggets, burgers, hot dogs.

4. Enhance the flavour of food using natural herbs and condiments such as garlic, onion, curry spices, white pepper, lemon grass, vinegar and lemon.

5. Reduce the amount of gravy in your meal. For example, consume only 2 dessert spoons of curry, instead of 4 dessert spoons of curry.

6. Request for low or no added salt and sauces dishes when eating out.

7. Inculcate low saltiness taste of food since childhood.

Key Recommendation 2

Limit consumption of salty foods.

How to Achieve

1. Limit intake of preserved food with high-salt content (such as salted fish, salted egg, salted vegetables and fruits pickles), high-salt snacks (such as salted nuts, potato crisps and fish chips), processed foods (such as sardines, sausages, chicken nuggets, meatball and burger), fast foods, instant noodles, instant soup and other types of highly seasoned foods (such as dishes made from salted egg powder).

2. Choose foods with low salt or sodium content instead of medium and high sodium content within the same food group. For example, choose fresh fruits and vegetables instead of preserved and processed foods. Avoid consuming fruits with flavour enhancer (such as *asam boi)* and dipping (such as soya sauce). Refer Table 10.2 as a guide.

3. Soak preserved foods such as dried anchovies and dried prawns in water to reduce salt content.

4. In the Nutrition Information Panel of food labelling, salt is being referred as sodium. Note the sodium content of a food in the Nutrition Information Panel, compare with other available brands of the same product and choose the one with the lower sodium content.

5. Choose brands with "low" or "lower" or "less" salt claims on the label, if available. Use Healthier Choice Logo (HCL) as a guide, if available.

6. Read the ingredients list on the food label and take note of all sources of salt, such as sodium chloride (NaCl), monosodium glutamate (MSG), sodium nitrate, sodium benzoate. Identify the position of sodium in the list (from the high to the lowest) and read the total sodium from the Nutrition Information Panel.

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Appendices

Table 10.2: Sources and content of sodium in selected foods

LOW (< 120 mg Na per standard serving)	**MODERATE** (120-360 mg Na per standard serving)	**HIGH** (> 360 mg Na per standard serving)
Cereal & cereal products		
• Rice, plain, cooked 1 cup – 8 mg Na • Rice, husked, unpolished 1 cup – 100 mg Na	• Rice porridge, instant 1 packet – 294 mg Na	
	• Noodle, rice 1 flat piece (1/2 cup) – 138 mg Na • Noodle, wet 1 cup – 177 mg Na • Noodle snack, flavoured 1 medium packet – 184 mg	• Noodle, instant 1 packet – 1340 mg Na • Noodle, dry 1 round piece (11 x 3.5 cm) – 431 mg Na
• Bread, white 1 slice (10.5 x 9.3 x 1.1) – 64 mg Na • Bread, wholemeal 1 slice – 78 mg Na		
• Biscuit, cream crakers (6.5 x 6.5 x 0.5 cm) < 10 square pieces – 104 mg Na • Crackers, low-salt 1 piece – 19 mg Na	• Biscuit, soda/ plain (6.5 x 6.5 x 0.5 cm) 5 square pieces – 206 mg Na	
• Cookies, sesame seed (6.0 x 5.5 x 0.5cm) 5 pieces – 6 mg	• Cookies, oats (6.0 x 1.0 cm) 5 round pieces – 218 mg Na	
Starchy roots, tubers & products		
• Potato 1 whole large, oval (8.5 x 4.5 cm) – 55 mg Na	• Potato chips 1 small packet – 128 mg Na	• Potato chip 1 big packet – 655 mg Na
Legumes & legumes product		
• Soya bean, white 1 cup – 81 mg Na • Soya bean cake, fermented *(tempeh)* 1 rectangular piece (12.0 x 9.0 x 0.5 cm) – 5 mg Na • Soya bean curd, sheet/ film 1 cup – 11 mg Na	• Soya bean paste, fermented *(tau-ceo)* 1 tablespoon – 341 mg Na • Soya bean curd, strands *(fucok)* 1 cup – 188 mg Na • Soya bean noodle 1 piece (11.5 x 6 cm) – 127 mg Na • Appalam (8.5 x 0.2 cm) 5 pieces – 349 mg Na	• Soya sauce "thick" 1 tablespoon – 564 mg Na • Soya sauce "thin" 1 tablespoon – 1255 mg Na • Baked bean, canned 1/2 cup (beans only) – 365 mg Na
Nuts, seeds & products		
• Mixed nuts, without salt added 1 cup – 16 mg Na	• Peanut butter 3 tablespoon – 177 mg Na • Watermelon seeds, dried, black 3 cups – 168 mg Na	• Mixed nuts, salt added 1 cup – 917 mg Na

Table 10.2: Sources and content of sodium in selected foods (cont...)

LOW (< 120 mg Na per standard serving)	**MODERATE** (120-360 mg Na per standard serving)	**HIGH** (> 360 mg Na per standard serving)
	Vegetable & Vegetable Products	
• Fresh vegetables	• Chilli sauce, bottle 1 tablespoon – 224 mg Na	• Canned vegetables 1 cup – 777 mg Na • Pickeled vegetables 1 cup – 938 mg Na • Cabbage, Chinese, salted *(hum-choy)* 1 cup (chopped) – 2763 mg Na
	• Tomato juice, canned 1/2 cup – 226 mg Na • Tomato ketchup (sos tomato) 1 tablespoon – 171 mg Na	• Tomato soup, canned 1/2 cup – 804 mg Na
	• Seaweed, dried (hai-tai) 1/2 cup – 308 mg Na	• Peas, salted, fried 1 cup – 402 mg Na
	Fruits & Fruits Products	
• Fresh fruits	• Guava, with *"asam buoy"* (12.0 x 8.0 x 1.5cm) 2 slice without skin & seeds – 184 mg Na	• Banana, smoked 100g – 840 mg Na
• Fruit cocktail in syrup, canned 1 tin (450 ml) – 19 mg Na		• Fruit, mixed, spicy pickled 100 g – 1480 mg Na
• Durian cake *(lempuk)* 1 cylindrical piece (17.0 x 2.5 cm) – 20 mg Na	• Durian, fermented *(tempoyak)* 2 tablespoon – 178 mg	
	Meat and poultry products	
• Chicken, breast meat 1/2 cup (131 g) – 55 mg Na • Chicken, thigh 1 medium (12.5 x 11.3 x 3.2cm) – 71 mg Na	• Chicken, fried 1 piece (90 g) – 145 mg Na • Chicken burger patty 1 round piece – 185 mg Na • Chicken frankfurter ("frankfurter" *daging ayam*) (12.0 x 1.5 cm) 2 pieces, 4 inch long – 186 mg Na	• Chicken, fried, fast food franchise 1 piece (140 g) – 664 mg Na • Chicken curry, canned 1 can – 385 mg Na • Chicken, broth cubes, proprietary brand *(pati ayam)* 1 cube – 1152 mg Na
• Beef, lean 1/2 cup (122.8 g) – 82 mg Na	• Beef burger patty 1 round piece – 309 mg Na • Beef frankfurter (12.0 x 2.0 cm) 2 long piece – 186 mg Na • Beef, extract, proprietary brand *(pati daging lembu)* 1 teaspoon – 337 mg Na	• Beef, corned, canned 1/2 cup – 777 mg Na • Beef *rendang*, canned 1 can – 862 mg Na • Beef burger 1 whole – 554 mg Na • Beef, broth cubes, proprietary brand 1 cube – 864 mg Na

Table 10.2: Sources and content of sodium in selected foods (cont...)

LOW (< 120 mg Na per standard serving)	MODERATE (120-360 mg Na per standard serving)	HIGH (> 360 mg Na per standard serving)
• Goat meat, lean 1 cup (223 g) – 110 mg Na	• Mutton, lean 1 cup (198.6 g) – 180 mg Na	• Mutton curry, canned 1 can (167 g) – 708 mg Na
• Fresh rabbit, duck (100 g) – 46 mg Na	• Pork *(khinzir)* 1 bowl (410 g) – 189 mg Na • Pork, medium fat • 1 cup (205.8 g) – 195 mg Na	
Eggs		
• Hen egg, 1 whole 56 mg Na	• Duck egg, salted, whole 249 mg Na	
Fish, shellfish & products		
• Fresh fish (except stated in moderate column)	• Fish ball *(bebola ikan)* (D, 2 cm) 5 whole, small – 296 mg Na • Bream, threadfin, Japanese *(kerisi)* 1 whole, medium (22.0 x 8.0 x 2.5 cm) – 179 mg Na • Carp, big head 1 slice (11.8 x 6.4 x 8.2 cm) – 151 mg Na • Carp, common *(lee koh)* 1 slice (10.5 x 5 x 11.6 cm) – 134 mg Na • Mackerel, Spanish 1 slice (8.0 x 2.0 x 15 cm) – 155 mg Na • Snapper, red 1 slice (6.0 x 2.0 x 15.0 cm) – 128 mg Na • Fish crackers, fried (15.0 x 7.5 x 0.2 cm) 5 oval piece – 241 mg Na	• Fish ball *(bebola ikan)* (D, 3 cm) 2 whole, large – 378 mg Na • Fish, unspecified, dried, salted 1 piece (7.0 x 3.5 x 0.4 cm) – 433 mg Na • Scad, hairtail, dried *(cencaru, kering)* 1 piece, tail portion – 889 mg Na • Trevally, yellow-banded, dried *(selar kuning, kering)* 1 whole medium (16.0 x 4.5 x 1.5 cm) – 1113 mg Na • Fish curry, canned *(kari ikan dalam tin)* 1 tin – 1056 mg Na • Fish "satay" snack *("satay" ikan)* 5 sticks – 380 mg Na • Fish sauce *(budu)* 1 tablespoon – 1032 mg Na • Anchovy, dried, without head and entrails • 1/2 cup – 758 mg Na
• Sardine (18.0 x 3.5 x 2.0 cm) 2 whole, small – 60 mg Na		• Sardine, canned 1 small can – 476 mg Na
• Prawn, pink (11.0 x 1.4 cm) 5 whole, medium – 34 mg Na	• Prawn, salted, dried 1 tablespoon – 255 mg Na • Prawn crackers 1 small packet – 187 mg Na • Prawn paste (hay-ko) 1 tablespoon – 286 mg Na	• Shrimp, fermented 1 tablespoon – 897 mg Na • Shrimp paste 1 piece (3.5 x 3.2 x 3.0 cm) – 629 mg Na
• Cuttlefish, fresh 1 whole, medium (12.5 x 6.0 cm) – 78 mg Na	• Cuttlefish, dried 1 whole, small (14.5 x 9.5 x 0.5 cm) – 314 mg Na	• Cuttlefish crackers 1 large packet – 421 mg Na

Table 10.2: Sources and content of sodium in selected foods (cont...)

LOW (< 120 mg Na per standard serving)	MODERATE (120-360 mg Na per standard serving)	HIGH (> 360 mg Na per standard serving)
	• Clam *(lala)* 10 clam – 121 mg Na • Crab, swimming/ live crab, 1 whole (g) – 392 mg Na • Oyster, sauce 1 tablespoon – 779 mg Na	• Crab, blue/ sea crab 1 whole (128 g) – 377 mg Na
Milk & milk products		
• Low sodium cheese, cheddar • 1 slice – 21 mg Na	• Cheese, processed, cheddar 1 slice – 261 mg Na	• Cheese burger 1 whole – 864 mg Na
Oils & fats		
• Margarine, without salt 0 mg Na	• Margarine 3 tablespoon – 153 mg Na • Butter 2 tablespoon – 172 mg Na	
Beverages		
• Carbonates beverage, cream soda 1 bottle (500 ml) – 59 mg Na • Carbonated beverage, isotonic sports drink 1 bottle (500 ml) – 105 mg Na	• Carbonated beverage, isotonic sports drink 1 bottle (1500 ml) – 315 mg Na	
Condiments & spices		
• All natural condiments (eg: cloves, cinnamon, anise seeds, cumin seeds, *asam gelugor*, cardamom, chilli dried etc.)		• All types of instant flavouring or seasoning $\geq 1^1/_2$ teaspoon - > 360 mg Na or • $\geq$ 1/4 cube - > 360 mg Na • Tamarind, paste 1 tablespoon – 599 mg Na

Sources: Tee *et al,* (1997); Holland *et al*. (1992); USDA and Agricultural Research Service (2009).


SUGAR

Limit sugar intake in foods and beverages

KEY MESSAGE

11

LIMIT SUGAR INTAKE IN FOODS AND BEVERAGES

Prof. Dr. Ruzita Abd. Talib, Assist. Prof. Dr. Hanapi Mat Jusoh, Dr. Siti Sabariah Buhari and Ms. Tan Yen Nee

11.1 Terminology

Total sugars

Total sugars comprise all mono- and disaccharides. Derived from any source including naturally occurring and free sugars. These include sucrose (table sugar), fructose, glucose (dextrose), and lactose (milk sugar). (Erickson & Slavin, 2015; David & Elizabeth, 2018).

Free sugars

Free sugars include all sugars added by the manufacturer, cook, or the consumer as well as sugars that are naturally present in honey, syrups, fruit/ vegetable juices and fruit/ vegetable juice concentrates. These exclude sugar which is present in whole (intact, cooked, or dried) fruit and vegetables or dairy products (Erickson & Slavin, 2015; WHO, 2015).

Added sugars

Added sugars are sugars that are not naturally found in the food product and are added to foods during processing, culinary preparation, or during meals. These include brown sugar, corn sweeteners, corn syrup, dextrose, fructose, glucose, sucrose, high-fructose corn syrup, honey, invert sugar, lactose, maltose, malt syrup, molasses, and raw sugar (Erickson & Slavin, 2015). In the pre-packaged foods, no added sugar does not mean that no sugar is present, it just means that no sugars have been added during the manufacturing process, since most foods contain sugars in some form (Rachel *et al.*, 2017).

Hidden sugar

Hidden sugars are the ingredients in foods and drinks, although they are not seen as 'sugar'. The hidden sugars can be identified by reading the food label. Some foods may not have the word 'sugar' in the ingredients list on the food and beverages products packaging, but the products still have sugar with labeled in a different name such as sucrose, dextrose, maltose, fructose, lactose, glucose and honey (US FDA, 2014). Major sources of hidden sugar are soft drinks, sweets and candies, cakes, fruit drinks and juices (not homemade), flavoured waters, dairy desserts and several milk products, soups and sauces (not homemade), processed breakfast foods and smoothies, tea and coffee drinks, canned vegetables, industrial breads, hamburger buns, salad dressings, noodles and some alcoholic beverages (Marí, 2017).

Sugar Sweetened Beverages (SSBs)

Sugar-sweetened beverages (regular soft drinks) include carbonated and noncarbonated beverages, which are usually sweetened with HFCS or sucrose. These beverages have relatively high calorie and sugar contents, but no or a very small amount of other nutrients (Chen, 2013).

Artificial Sweeteners

Artificial sweeteners also known as non-nutritive sweeteners are defined as food additives that when added to food can impart a sweet taste (Yebra-Biurrun, 2005). The permitted artificial sweeteners include saccharin (2-sulphobenzoic imide), sodium saccharin (sodium salt of 2–selphobenzoic imide), acesulfame potassium, neotame and aspartame which contain low or no calorie (MOH, 1985).

11.2 Introduction

Sugars are a type of carbohydrate which provide energy. Sugar are commonly used in food and beverages to enhance the taste. However, excessive sugar intake can lead to health problems, such as increasing the risk of weight gain, diabetes, dental caries, and an increased risk of non-communicable diseases (NCDs) or metabolic diseases. In addition, overconsumption of added sugar can result in a poor diet quality (Fidler, Kobe & Štimec, 2012).

On average, Malaysian Adults consumed about 18.5 g or 4 teaspoons of sugar per day (IPH, 2014). The sources of sugar were sweetened beverages and local *kuih*. The WHO (2015) guidelines recommends that free sugars intake should not exceed 10% of total energy intake which equals to 50 g of sugar per day for the average adult (at a calorie intake of 2000 kcal).

Therefore, recently the government introduced sugar sweetened beverage tax, to encourage foods and beverages industries to reformulate their products into less sugar content. On top of that, the industries are mandatory to declare total sugars on the nutrition information panel (NIP) of their food products. The NIP may increase awareness of consumers about sugar content in the products (James *et al.,* 2013)

11.3 Scientific basis

The focus of scientific evidence on sugars guidelines in relation to health revolves around three main health issues: Sugar is the main cause of dental caries and that a lower absolute sugar intake would result in an appreciable decrease in caries incidence. Sugar increases overall energy intake, leading to an unhealthy diet and may cause weight gain and increased risk of NCDs or metabolic diseases such as cardiovascular disease (CVD), type 2 diabetes (T2DM), and non-alcoholic fatty liver disease (NAFLD). Finally, overconsumption of sugar may reduce the intake of foods containing more nutritionally adequate calories and could displace micronutrient-dense foods from the diet, resulting in a poor diet quality.

In addition to the above, this section also discusses the benefit of artificial sweeteners or artificial sweeteners on health. Foods and beverages containing artificial sweeteners become more popular because of their calorie-free sweet taste and the current need to substitute sugar as a strategy in weight and T2DM management.

11.3.1 Dental caries

Dental caries is the most prevalent non-communicable chronic disease worldwide and affects all age groups from infants to older adults (Moynihan, 2016). Undeniably, it is also a continuing public health problem in Malaysia. The National Oral Health Survey of Adults (NOHSA) 2010 showed that nine in ten of Malaysian adults experienced dental caries and it was significantly higher in rural areas (OHD, 2013). Dental caries prevalence among 12-year-old school children was 33.3% in 2017 as compared to 41.5% in 2007 (OHD, 2017a). The same trend was observed among the preschoolers where 71.3% experienced dental caries in 2015, while in 2005 it was 76.2% (OHD, 2017b). Although there was a declined trend of dental caries observed throughout the years, however it showed slow reduction for all target groups. Among adults, dental caries severity as measured by mean DMFT was 11.66 and was significantly higher among females and those in rural (OHD, 2013).

Untreated dental caries may cause severe pain and infection, which affects children's school attendance and performance and adult's productivity at work (Kaussebum, 2015). Higher oral health impacts were found among adults with dental caries as compared to caries free adults (OHD, 2013). In addition, dental caries is costly to health care systems and is a lifelong progressive and cumulative disease that tracks to adulthood, even with exposure to fluoride through water or mouth-care products (Bernabé & Sheiham, 2014).

Free sugars are the essential dietary factor in the development of dental caries because dental caries do not occur in the absence of dietary sugars. Dental caries develops when bacteria in the mouth metabolize sugars to produce acid that demineralizes the hard tissues of the teeth (enamel and dentine) (WHO, 2017). The consumption of sugar containing foods imposes a risk on the dental caries. The actual risk of a certain food is modulated by many factors that are divided in food-related factors such as the release of the sugars, the stickiness of the product, the type and concentration of the sugar and consumer-related factors such as the frequency of sugar consumption, the drinking and chewing habits, the chewing and swallowing efficiency, salivary flow and composition, the presence of cariogenic dental plaque and the use of fluorides (Van Loveren, 2019).

Both the amount of sugars and the frequency with which they are consumed is a risk factor for the development of dental caries. Limiting free sugars intake to less than 10% of total energy intake and ideally even further, to less than 5% may minimizes the risk of dental caries throughout the life course (WHO, 2017).

11.3.2 Obesity

The global prevalence of obesity has increased significantly over the past 40 years. Worldwide, obesity has nearly tripled since 1975 where 39% of adults aged 18 years and above were overweight and 13% were obese in 2016 (Jaacks *et al.,* 2019). Malaysia is no exception to that, with rising obesity rates and about one in two adults in Malaysia were overweight or obese, Malaysia is now the most overweight and obese nation in the south-east Asian region (Mariapun, Ng & Hairi, 2018; IPH, 2020). This is alarming because overweight or obesity increases the risk of major chronic diseases such as cardiometabolic diseases and cancers (Ryan *et al.,* 2016). While complex interactions of genetic, metabolic, cultural, environmental, socioeconomic and behavioural factors contribute to obesity, dietary factors remain as major determinants of obesity (Hruby & Hu, 2015). An excessive energy intake, the frequency of daily meals, eating alone and snack and beverage consumption were associated with obesity (Taillie *et al.,* 2015).

Along with the rapid economic development, food and the Malaysian's eating culture has undergone some form of transformation. The practice of eating-out and preferences to Western diet which is higher in sugar from processed foods had become a trend (Noraziah & Azlan, 2012; Lipoeto, Khor & Angeles-Agdeppa, 2013). Sugar-containing foods that contributed most to energy intakes of Malaysian adults were added sugars from beverages (i.e., cordial syrup, tea, coffee, chocolate flavoured beverages), condensed milk (added to beverages) and local *kuih* (starchy traditional cakes). Less than 1.2% of the daily caloric intake was obtained from jam, carbonated drinks, and "ABC ice" (shaved ice topped with syrup, nuts and beans). On average, Malaysians consumed 30 g (3 dessert spoon) of sweetened condensed milk (equivalent to approximately 16 g sugar), and 21 g (4 teaspoons) of table sugar which were habitually added to beverages such as *teh tarik*, *kopi*, and chocolate flavoured beverages (Amarra, Khor & Chan, 2016).

Several studies investigated the association of sugar intake with weight gain or obesity. Studies proved that regular sugar sweetened beverages (SSB) consumption has been positively associated with increased body weight and risk of obesity (Hu, 2013). Based on a systematic review of 32 experimental studies published until December 2013 in peer-reviewed journals shows that the majority of studies with strong methodology indicated a positive association between SSB consumption and risk of obesity or obesity, especially among overweight children (Della Torre *et al.,* 2016). Besides, a review of thirteen reviews and meta-analyses concluded that there was a direct association between SSB consumption and weight gain, overweight, and obesity in children and adolescents (Keller & Bucher Della Torre, 2015). Besides, consumption of high-sugary snacks has been associated with weight gain (Romieu *et al.,* 2017).

A systematic review and meta-analysis investigated the association between consumption of ultra-processed food and noncommunicable disease risk, morbidity and mortality. Forty-three observational studies were included (N = 891,723) demonstrated consumption of ultra-processed food was associated with increased risk of overweight, obesity, abdominal obesity, all-cause mortality, metabolic syndrome and depression in adults as well as wheezing but not asthma in adolescents. In addition, consumption of ultra-processed food was associated with cardiometabolic diseases, frailty, irritable bowel syndrome, functional dyspepsia and cancer (breast and overall) in adults while also being associated with metabolic syndrome in adolescents and dyslipidaemia in children (Lane *et al,* 2020).

11.3.3 Diabetes

Evidence is still inconclusive on the association between sugar consumption *per se* and T2DM. There is evidence to suggest that diets high in added sugar promote directly and indirectly the development of T2DM. Directly, the fructose component of sugar causes dysregulation of lipid and carbohydrate metabolism. Indirectly, sugar promotes positive energy balance, thus body weight and fat gain, which also cause dysregulation of lipid and carbohydrate metabolism. Due to the direct and indirect pathway, Stanhope, Schwarz & Havel (2013) have suggested that risk for T2DM is increased when added sugar is consumed with diets that allow for body weight and fat gain.

However, Tsilas *et al.* (2017) conducted a systematic review and meta-analysis of prospective cohort studies of the relation between intake of sugars and incident T2DM. The analyses showed that intakes of total sugars and fructose were not associated with T2DM, but intake of sucrose was associated with an 11% decrease in T2DM. The systematic reviews and meta-analyses also failed to show that sugar-sweetened beverages are associated with an increase in the risk of T2DM.

11.3.4 Cardiovascular disease and other metabolic diseases

Too much added sugar can be one of the greatest threats to cardiovascular diseases and other metabolic diseases including non-alcoholic fatty liver disease. The data reported by Yang *et al.* (2014) suggested that the higher the intake of added sugar, the greater the risk of CVD. They also show that the average level of added sugar consumption in 15% of daily calories, is associated with an 18% increase in risk for CVD mortality. Recent study showed that risk of death increased among adults who consumed more sugary drinks. Sugary drinks were also associated with higher mortality rates from cardiovascular disease (CVD), as well as higher cancer rates (Malik *et al.*, 2019).

The meta-analyses conclude that fructose and/ or sugar consumption increase total and LDL-C (Zhang *et al.,* 2013), TG, total and LDL-C, and blood pressure (TeMorenga *et al.,* 2014), and have significant effects on most components of metabolic syndrome (increased systolic blood pressure, fasting glucose and TG, decreased HDL) (Kelishadi, Mansourian & Heidari-Beni, 2014). Another meta-analysis concludes that the available evidence is not sufficiently robust to draw conclusions regarding the effects of fructose, high fructose corn syrup (HFCS), or sucrose consumption on NAFLD (Chung *et al.,* 2014). In addition, Wang *et al.* (2012 & 2014) concluded that there were no relationships between fructose consumption and levels of uric acid or postprandial triglycerides.

11.3.5 Behaviour and cognitive function

The association between sugar intake and hyperactivity was suggested to be based on two hypotheses. The first was a possible allergic response. The second was that hyperactive children might experience functional reactive hypoglycemia (Howard & Wylie-Rosett, 2002). However, a meta-analysis of 16 randomized trials in hyperactive children found that reducing sugar content of the diet did not reduce the degree of hyperactivity (Wolraich, Wilson & White, 1995).

The recent meta-analysis suggests that an unhealthy diet can increase the risk of attention deficit hyperactivity disorder (ADHD), whereas a healthy diet, would protect against these outcomes. The unhealthy dietary pattern, characterized by the consumption of saturated fat and refined sugar was associated with the risk of hyperactivity or ADHD occurrence (Del- Ponte *et al.,* 2019).

11.3.6 Poor dietary quality

Diet high in sugar may affect the intake of micronutrients. A high-sugar content of food/ beverages was found to contribute significantly to the total caloric intake, but it does not satisfy nutrient requirements (Fidler, Kobe & Štimec, 2012). The intake of sugar displaces foods that are rich in micronutrients. Therefore, diets that are rich in sugar may be poorer in micronutrients. Foods high in added sugar tend to have lower nutrient densities, and thus, provide little nutritional value. By contrast, foods with naturally occurring sugars tend to be higher in nutrients (Langlois & Garriguet, 2011).

11.3.7 Relationship between artificial sweeteners consumption and health outcomes

Foods and beverages containing artificial sweeteners become more popular in recent years especially due to their calorie-free sweet taste and the current need to substitute sugar as a strategy to tackle weight gain and other health problems. There are a number of artificial sweeteners that are deemed to be permitted according to Malaysian Food Regulation 1985 (MOH, 1985). While these can be consumed, their potential health benefits and adverse health effects, including risk for cancer, diabetes, dental caries and obesity should also be evaluated.

Based on a systematic review that analyzed the relationship between artificial sweetener consumption and cancer involving 599,741 participants, no conclusive evidence to suggest artificial sweeteners cause cancer (Mishra *et al.,* 2015). In another scoping review, it was concluded that in healthy subjects, there is also inconclusive evidence for beneficial and harmful effects of artificial sweeteners and the risk for cancer, diabetes, dental caries, weight gain and obesity (Lohner, Toews *&* Meerpohl, 2017).

Recently, a more comprehensive systematic review was published investigating the association between intake of non-sugar sweeteners (NSS) and various health outcomes. In this review, it was indicated that intake of NSS in adults had a small beneficial effect on body mass index and fasting blood glucose. However, this evidence is considered very low and low certainty of evidence from a limited number of small studies. On the contrary, no differences were found on oral health, mood, behaviour, cancer and kidney disease when comparing between intake or no intake as well as between lower and high doses of NSS (Toews *et al.*, 2019).

In essence, there is no sound scientific evidence 1 to date that suggests the use of permitted artificial sweeteners are not safe. While this could be true, the potential future risk may not be entirely excluded. There is a need for both further primary research and high quality comprehensive systematic reviews including meta-analyses to inform future recommendations about the health benefits and risks of artificial sweeteners.

11.4 Current status

The cultivation of sugarcane in Malaysia has significantly declined over the past 20 years and in such a situation, the country has to depend on imports for two-thirds of its requirements. In 2018, Malaysia had imported 2.1 million tonnes of sugar of which mainly from Brazil (76%), Australia (14%) and Thailand (5%) (GAIN, 2017). In terms of consumption, sugar consumption per capita among Malaysian has increased from 38.5 kg in 1991 to 51.8 kg in 2012, which was among the highest within the neighbouring countries (Figure 11.1). The overall domestic consumption of sugar in Malaysia has also increased from 1.7 million tonnes in the year 2014/2015 to 2 million tonnes as of May 2019/2020 (Figure 11.2).

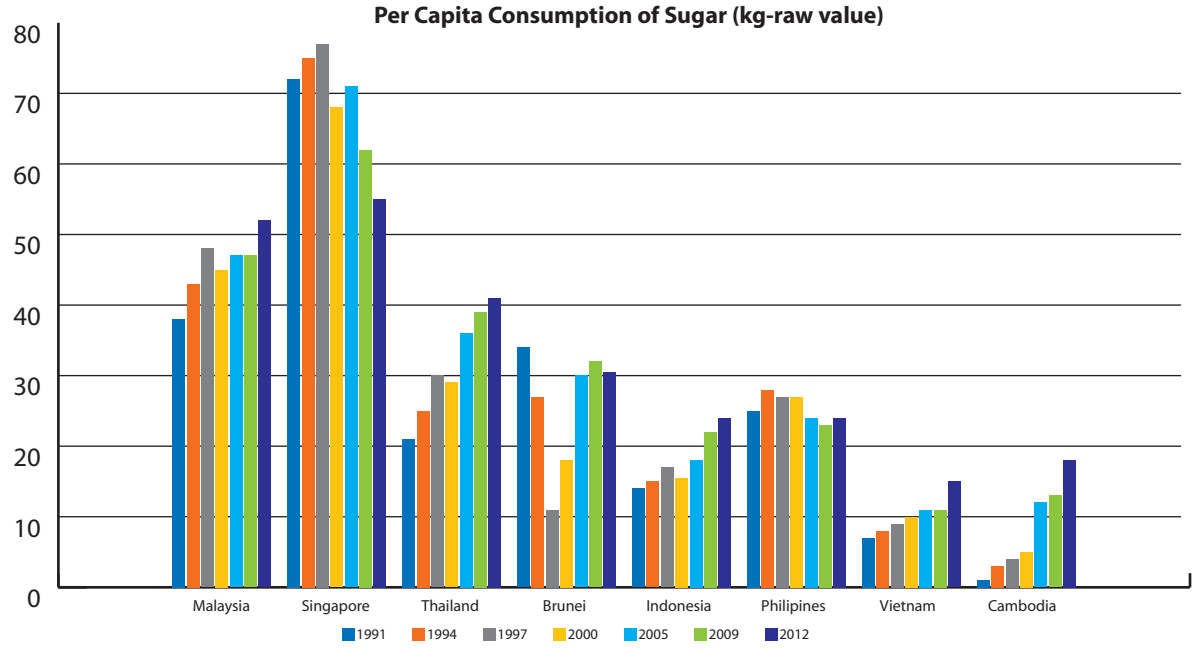


Figure 11.1. Per capita consumption of sugar (kg-raw value) in Asian countries
Source: Malmö University (n.d)

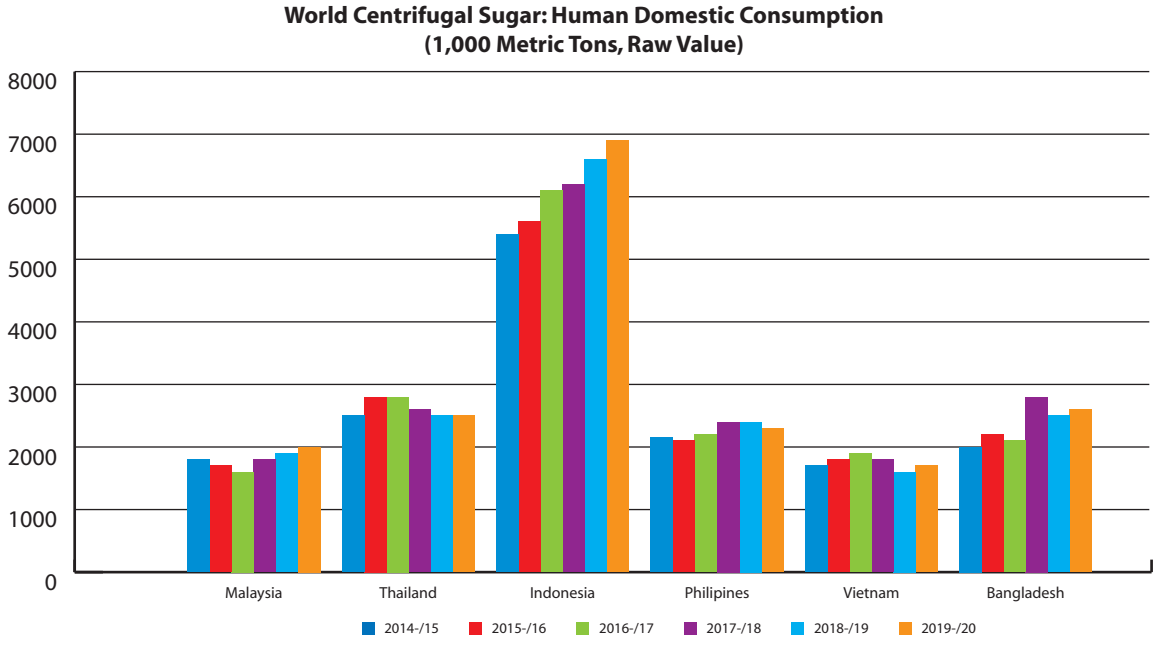


Figure 11.2: World centrifugal sugar: Human domestic consumption (1,000 metric tonnes, raw value)
Source: USDA Foreign Agriculture Service (2019)

According to Malaysian Adults Nutrition Survey (MANS) 2014, approximately 55.9% of the population consumed sugar (white, brown and palm sugar) daily while the mean sugar intake was about 18.5 g or 3.7 teaspoons per day (Noraida, 2018). MANS 2014 also indicated that the consumption of sugar was higher in rural areas (68.1% consumed daily, 4 teaspoons per day) and in men (58.2% consumed daily, 4 teaspoons per day) compared to urban areas (50.5% consumed daily, 3.4 teaspoons per day) and women (53.3% consumed daily, 3.2 teaspoons per day), respectively. In addition, approximately 23.5% of the population consumed sweetened condensed milk/ creamer daily amounting 24.3 g per day. Men appeared to have consumed more servings of sweetened condensed milk compared to their women counterparts (Noraida, 2018).

It can be concluded that the mean added sugar intake based on MANS 2014 (IPH, 2014) was about 31.5 g per day (taking into account that 24.3 g condensed milk contains about 13 g sugar). However, it is important to note that the data of sugar mentioned above is the sugar that is usually added to beverages such as tea, coffee and chocolate-based drinks. Sugar added into carbonated beverages and local *kuih* as well as natural sugar in fruits and vegetables were not quantified which could result in underreporting in total daily sugar intake. The list of commonly consumed beverages by Malaysian adults is shown in Table 11.1(IPH, 2014).

Table 11.1: Percentage and mean intake of top ten beverages consumed daily among Malaysian adult population

No.	Beverages	Percentage (%)	ml/day	No. of servings (cup)/day
1.	Tea	70.30	326	1.81
2.	Malted drink (Milo, Horlick, etc.)	59.10	315	1.57
3.	Coffee	53.20	357	1.78
4.	Soya milk	51.40	274	1.36
5.	Carbonated drink	45.70	186	0.93
6.	Fruit juice	41.10	273	1.36
7.	Cordial syrup	34.40	153	0.76
8.	Ready to drink beverage	30.80	287	1.43
9.	Pre-mixed drink (3 in 1)	28.80	315	1.57
10.	Energy drink	12.60	680	3.48

Source: IPH (2014)

Surprisingly, the sugar intakes among Malaysians based on two other studies were much higher than those reported in MANS 2014 (IPH, 2014). A study conducted by Nik Shanita, Norimah & Abu Hanifah (2012) found that mean intake of added sugar of adults in Klang Valley was approximately 44.2 g per day or 9 teaspoons/day. In a more recent and relatively large study, total sugar intake among Malaysian senior citizen aged 60 years and above who live in Johor, Perak, Kelantan and Selangor was 40.5 g per day (8 teaspoons/day) from which added sugar intake was 33 g per day (6 teaspoons/day) (NurZetty *et al.*, 2018). The sources of sugar that were most consumed among them were sweetened beverages which included added sugar and sweetened condensed milk that were mixed in tea or coffee and also in local *kuih* (NurZetty *et al.*, 2018).

As mentioned earlier, the new WHO (2015) guidelines recommends that free sugars intake should not exceed 10% of total energy intake. Based on findings from MANS 2014 (IPH, 2014) and Nik Shanita, Norimah & Abu Hanifah (2012), the sugar intake among Malaysians were within the recommended range at 8.6% and 9.4%, respectively. Nevertheless, it is strongly recommended that free sugar intake should remain below 10% of total energy intake to prevent excess of calories intake which may lead to obesity and NCDs. However, WHO (2015) recommend the intake ideally less than 5% which would provide additional health benefits in the form of reduced dental caries.

Information about sugar content of foods commonly consumed by Malaysians is rather limited. In fact, the national nutrient database, the Malaysian Food Composition Database (MyFCD), first published by Tee *et al* (1997), has yet to publish a sugar database. Hence, the sugar content of selected foods and beverages presented in Table 11.2 to Table 11.6 were obtained from recently published local articles (Sabeetha, Amin & Barakatun Nisak, 2017; Norhayati *et al.,* 2018; Rosmawati *et al.*, 2018; Chong *et al.*, 2019).

11.5 Key Recommendations

Key Recommendation 1

Limit intake of sugar in foods.

How to Achieve

1. Choose or prepare kuih, cookies and cakes with less sugar.
2. Replace desserts such as sweet puddings, cookies and cakes with fresh fruits.
3. Reduce the frequency of consuming food containing sugar.
4. Avoid adding sugar while cooking or to your meal.
5. Limit intake of ultra-processed foods such as sweet, candies, breads and buns, cookies, biscuits, pastries and cakes.
6. Avoid consuming sugary foods during morning and afternoon snacks and close to bedtime
7. Read food labels to choose low in sugar - food.
8. Limit intake of foods that sugar is listed as the first ingredient in the ingredient list on the food label.

Key Recommendation 2

Limit intake of sugar in beverages.

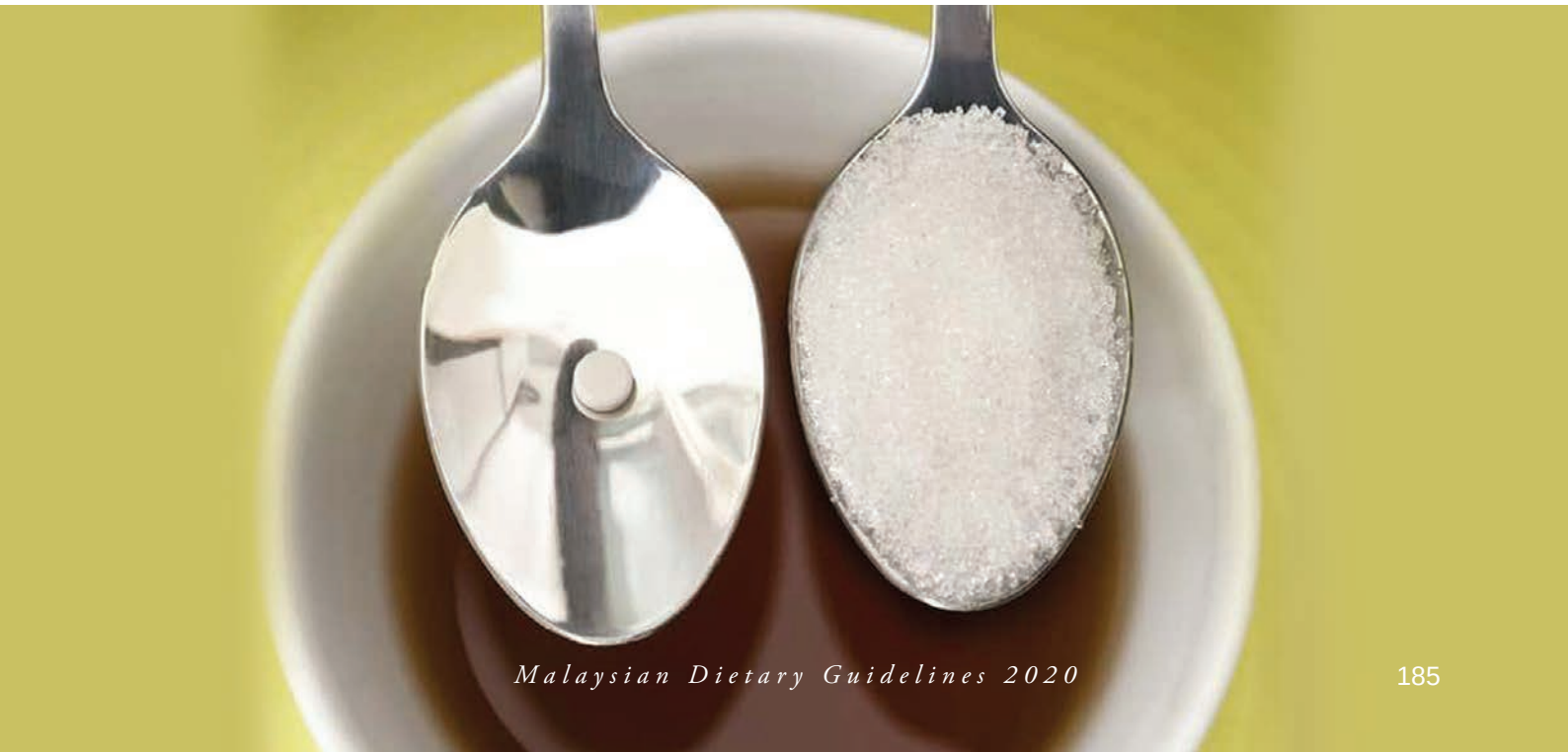
How to Achieve

1. Always choose plain water.
2. Limit intake of ultra-processed beverages such as carbonated and non-carbonated sugar-sweetened beverages (soft drink, syrup and cordial).
3. Limit intake of beverages with added sugar and sweetened condensed milk (*teh tarik,* coffee, *air batu campur, cendol,* bubble tea) and premix beverages.
4. Avoid consuming sugary beverages during morning and afternoon snack and close to bedtime.
5. Read food labels to choose low in sugar - beverages.
6. Limit intake of beverages that sugar is listed as the first ingredient in the ingredient list on the food label.

Additional recommendation: Artificial sweetener

Special consideration when consuming artificial sweeteners:

1. Use artificial sweeteners in moderation and those approved by the Food Regulation of Malaysia 1985.
2. Intake of artificial sweeteners should not become the sole and primary approach in obesity and diabetes management.



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Appendices

Appendices

Table 11.2: Total sugar contents in selected local *kuih*

Type of food	Total sugar (g/100g)	Household measurement equivalent (teaspoon)	Type of food	Total sugar (g/100g)	Household measurement equivalent (teaspoon)
Kuih keria	24.80	4.96	*Putu piring*	12.70	2.54
Bingka ubi	21.50	4.30	*Kuih koci*	12.10	2.42
Cekodok pisang	21.10	4.22	*Cucur badak*	11.90	2.38
Pau kaya	19.20	3.84	*Kuih tepung pelita*	11.40	2.28
Kuih peneram	18.60	3.72	*Pengat pisang*	11.30	2.26
Cek Mek Molek	17.50	3.50	*Kuih akok*	10.10	2.02
Kuih apam	17.20	3.44	*Putu mayam*	9.90	1.98
Kuih kasturi	16.90	3.38	*Pengat ubi keledek*	9.50	1.90
Kuih bakar	16.20	3.24	*Buah melaka*	8.90	1.78
Kuih apam balik	16.00	3.20	*Kuih ketayap*	8.70	1.74
Lepat ubi	15.80	3.16	*Kuih talam*	8.30	1.66
Kuih sagu	15.80	3.16	*Pau ayam*	7.00	1.40
Kuih kasui	14.80	2.96	*Kuih lopes*	5.50	1.10
Pau kacang merah	14.80	2.96	*Cucur bilis*	4.70	0.94
Pau kelapa	14.30	2.86	*Cucur bawang*	3.80	0.76
Pau goreng	14.20	2.84	*Pulut panggang*	2.20	0.44
Kuih lapis	13.70	2.74	*Cakoi*	1.20	0.24
Lepat pisang	13.50	2.70	*Ketupat*	0.50	0.10
Kuih sri muka	13.30	2.66			

Source: Chong *et al.* (2019)

Table 11.3: Total sugar contents in selected local cooked dishes

Type of food	Total sugar (g/100g)	Household measurement equivalent (teaspoon)	Type of food	Total sugar (g/100g)	Household measurement equivalent (teaspoon)
Mee rebus	6.20	1.24	*Mee-hoon goreng*	2.40	0.48
Roti canai	4.60	0.92	*Kuey teow goreng*	2.10	0.42
Mee bandung	4.00	0.80	*Nasi ayam*	1.90	0.38
Capati	3.30	0.66	*Nasi lemak*	1.50	0.30
Roti telur	3.10	0.62	*Lontong*	1.20	0.24
Murtabak	30.00	0.60	*Idli*	1.10	0.22
Mee goreng	2.70	0.54	*Tosai*	1.10	0.22
Mee Kari	2.60	0.52	*Kuey teow sup*	1.10	0.22
Lempeng	2.60	0.52	*Mee sup*	0.90	0.18

Source: Chong *et al.* (2019)

Table 11.4: Total sugar contents in selected cereal, starchy & tuber, legume, nut & seed and other processed products

Type of food	Total sugar (g/100g)	Household measurement equivalent (teaspoon)	Type of food	Total sugar (g/100g)	Household measurement equivalent (teaspoon)
Cereal products					
Wafer, chocolate, full coated	39.13	7.83	#Bun, red bean filling	14.4	2.88
Biscuit, cream filled	25.65	5.13	Biscuit, corn	14.02	2.80
Biscuit, raisin	24.56	4.91	Bun, potato	13.55	2.71
Biscuit, chocolate chip	24.17	4.83	#Bun, corn cream filling	12.5	2.50
#Cake, banana	24.00	4.8	Biscuit, crackers, vegetable flavour	9.72	1.94
Bun, kaya	22.82	4.56			
Cookies, butter	21.62	4.32	Corn flakes	8.58	1.72
Biscuit, milk	19.06	3.81	*Bun, plain	6.80	1.36
Muesli	18.75	3.75	*Bread, white	4.40	0.88
Biscuit, shortbread	17.80	3.56	*Bread, wholemeal	3.70	0.74
Biscuit, oatmeal	16.43	3.29	*Instant noodles, curry	2.30	0.46
Biscuit, cracker with sugar	14.92	2.98	*Biscuit, cream cracker	2.10	0.42
#Bun, coconut filling	14.9	2.98	Oatmeal cereal, dry	1.20	0.24
#Bun, chocolate filling	14.6	2.92			

Table 11.4: Total sugar contents in selected cereal, starchy & tuber, legume, nut & seed and other processed products (cont...)

Type of food	Total sugar (g/100g)	Household measurement equivalent (teaspoon)
Starchy root & tuber products		
Tapioca chips, spicy	12.64	2.53
Tapioca chips, plain, unsalted	7.61	1.52
Sweet potato, red, chips	5.09	1.02
Tapioca chips, black pepper	4.92	0.98
Potato chips, spicy	2.75	0.55
Legume, nut & seed products		
Soya sauce, sweet	42.23	8.45
Peanut, crush	40.97	8.19
Peanut/ groundnut, flour coated	8.06	1.61
Pistachio nut	6.41	1.28
Soya flour	6.33	1.27
Macadamia nut	4.28	0.86
Sunflower seed	2.38	0.48
Hazelnut	1.72	0.34
Flaxseed	1.69	0.34
Pumpkin seed	1.10	0.22
Other processed products		
[1]Palm sugar	86.70	17.34
[1]Seri kaya	47.30	9.46
[2]Sweetened creamer	45.90	9.18
[2]Chili, sauce	27.90	5.58
[2]Tomato, sauce	20.50	4.10
Thousand island, sauce	15.47	3.09
[1]Peanut butter	12.20	2.44
Mayonnaise	8.59	1.72

Source: Norhayati *et al.* (2018); [1]Rosmawati *et al* (2018); [2]Chong *et al.* (2019)

Table 11.5: Total sugar contents in selected sugar & syrup products and beverages

Type of food	Total sugar (g/100g)	Household measurement equivalent (teaspoon)
Sugar & syrup products		
Cordial, pineapple	65.52	13.10
Cordial, guava	64.63	12.93
Jam, blueberry	54.78	10.96
Jam, apricot	53.65	10.73
Jam, strawberry	52.67	10.53
Jam, grape	52.43	10.49
Cordial, roselle	51.03	10.20
Cordial, soursop	45.39	9.08
Cordial, mango	43.46	8.69
Cordial, orange	41.41	8.28
Cordial, grape	34.90	6.98
Cordial, sarsi	32.91	6.58
Cordial, lime	31.22	6.24
Cordial root beer	15.00	3.00
Powdered Beverages		
[1]Pre-mix coffee, powder	48.6	9.72
[1]Pre-mixed cocoa, powder	46.40	9.28
[1]Malted milk, powder	44.80	8.96
[1]Full cream milk, powder	40.70	8.14
[1]Low fat milk, powder	39.90	7.98

Type of food	Total sugar (g/100g)	Household measurement equivalent (teaspoon)
Ready-to-drink Beverages		
[1]Cocoa flavoured drink with sweetened creamer	10.70	2.14
[1]Coffee with sweetened creamer	9.00	1.8
[1]Tea with sweetened creamer	8.80	1.76
[1]Orange flavoured cordial drink	7.70	1.54
[1]Orange juice, fresh	7.60	1.52
[1]Soymilk, fresh	7.00	1.4
[1]Coffee with sugar	6.90	1.38
[1]Barley drink, fresh	6.60	1.32
[1]Chrysanthemum tea, fresh	5.70	1.14
	Total Sugar (g/500ml)	
[2]Bubble milk tea	102.5	20.5
[2]Brown sugar	92.5	18.5
Boba milk tea		

Source: Norhayati *et al.* (2018); [1]Chong *et al.* (2019); [2]Channel News Asia (n.d.)

Table 11.6: Total sugar contents in selected fruits

Type of food	Total sugar (g/100g)	Household measurement equivalent (teaspoon)	Type of food	Total sugar (g/100g)	Household measurement equivalent (teaspoon)
[3]*Pisang berangan*	20.40	4.08	Green pear	10.10	2.02
Rambutan	17.90	3.58	[3]Soursop	9.20	1.84
[3]*Ciku*	17.10	3.42	[3]Pineapple	8.60	1.72
Longan	16.70	3.34	[2]Dragon fruit, white	8.50	1.70
Mangosteen	15.10	3.02	[2]Dragon fruit, red	8.40	1.68
Langsat	14.10	2.82	[3]Papaya	7.80	1.56
[3]*Durian*	13.90	2.78	Yellow pear	7.70	1.54
[1]Watermelon, red, seeded	11.40	2.28	Tangerine	7.10	1.42
			[3]Mandarin orange	7.00	1.40
[2]Pomegranate	10.70	2.14	[3]Guava	6.70	1.34
[1]Watermelon, Yellow	10.10	2.01			

Source: [1]Sabeetha *et al.* (2017), [2]Norhayati *et al.* (2018), Rosmawati *et al.* (2018); [3]Chong *et al.* (2019).

Drink plenty of water daily

KEY MESSAGE

12

DRINK PLENTY OF WATER DAILY

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12.1 Terminology

Alcoholic beverage

An alcoholic beverage is a drink containing more than 2 percent volume per volume (2% by volume) of ethanol or commonly known as alcohol (MOH, 1985). Type of alcohol beverages includes shandy (alcohol content less than 2%), beer (lager, ale, or stout, with alcohol content less than 9%), wine (cider, champagne, peri, *tuak*, *tuak kelapa*, *lihing* or *todi*, with alcohol content between 10 to 25%) and brandy (rum, whisky, vodka, gin, *samsu*, *samcheng*, *montoku* or *langkau* with alcohol content more than 30%).

Alkaline water

Water that had a higher pH than normal drinking water (pH 8 or 9) and also contain alkaline minerals and negative oxidation redution potential.

Beverage

A beverage refers to any one of various liquids suitable for drinking, excluding plain water. This may include tea, coffee, liquids, beer, milk or soft drinks.

Dehydration

Dehydration is excessive loss of body water. There are a number of causes of dehydration including heat exposure, prolonged vigorous exercise, vomiting, diarrhoea, kidney disease, and medications (diuretics).

Hydration

Hydration is a process of providing an adequate amount of liquid to body tissues.

Oxygenated water

Drinking water that contained extra dissolved oxygen (from 30 to 120 mg/L)

Reverse osmosis (RO) water

Water that uses purification methodology that removes ions, molecules and other larger particles from drinking water using a semipermeable membrane and pressure in order to reverse the natural flow of water.

Total body water (TBW)

Total body water (TBW) comprises extracellular fluid (ECF) and intracellular fluid (ICF); averages approximately 60% of body weight, with a range of approximately 45 to 75%. Variability in TBW is primarily due to differences in body composition.

Water

Water is a substance with chemical formula H_2O: one molecule of water has two hydrogen atoms covalently bonded to a single oxygen atom. Water is a tasteless, odourless liquid at room temperature and pressure and appears colourless.

12.2 Introduction

Water is the principal chemical constituent of human body with the formula H_2O. Its molecule contains one oxygen and two hydrogen atoms connected by covalent bonds. Water is a clear, odourless, tasteless liquid at room temperature and pressure that is essential for most animal and plant life and is an excellent solvent for many substances. Sources of water include boiled tap water, bottled mineral water, RO water, drinking water, alkaline water, oxygenated water, beverages, soups and alcoholic beverages. Water undergoes continuous recycling and is the matrix which supports digestion, metabolism, nutrient transport, cardiovascular function, and temperature regulation.

Overall, homeostatic systems in the body generally ensure that body water balance is maintained by regulating sensations of thirst (water intake) and the quantity of urine excreted. In most healthy people, this results in a very precise control of water balance, and it is estimated that changes are maintained within 0.2% of body mass over 24 hours (Grandjean, Reimers & Buyckx, 2003). Several of these processes are regulated by the central nervous system (CNS) variables as shown in Figure 12.1. Each of these variables is simultaneously maintained at a specific set point and constantly changing throughout the human life span in response to water and food intake, urine production, and non-renal water losses. Due of these fluctuations, human body water regulation is also dynamic (Amstrong & Johnson, 2018).

Dietary Intake

Water
Beverages
Food moisture
Sodium
Total solutes

Fluid-Electrolvte Variables

Total body water

Extracellular Na+, Volume, & Concentration

Intracellular K+, Volume, & Concentration

Blood pressure

Plasma volume

Excretion

Urine
Sweat
Transdermal water
Respiratory water
Stool water

Figure 12.1: Variables that are regulated as part of body water homeostasis
Source: Amstrong & Johnson (2018)

If water loss is not sufficiently balanced by fluid intake from food and drinks, then dehydration cannot be prevented. Deficits in body water may affect the ability of the body to maintain homeostasis, while excess in body water could result in low sodium concentration in the blood and cellular oedema. Therefore, failure to maintain adequate hydration status leads to a variety of adverse consequences, both physiological and psychological. Despite the importance of adequate water intake, there is confusion among the general public and health care providers on the amount of water that should be consumed.

12.3 Scientific basis

Normal water needs range widely due to numerous factors. These includes environmental factors (physical activity and climate), dietary factors and physiological factors.

12.3.1 Environmental factors

Hot weather can cause higher non-renal water loss, through mostly sweating, even at increased water intake and low physical activity level (Mora-Rodriguez *et al.,* 2016). As a tropical country, Malaysia has a steady temperature all year round, ranging between 23°C and 33°C (Daud, Sarker & Talib, 2000). With average humidity from 60 to 80%, it makes Malaysian weather hotter and discomfort (Makaremi *et al.*, 2012). Some people who have to engage and expose directly to sunshine, such as construction workers, are riskier to dehydration than those working indoors. Direct exposure to sun heat may increase body temperature by 1°C per hour (Parsons, 2002). Individuals are advised to learn the risk of dehydration when they are engaged in outdoor activities, especially under hot and humid condition. If a person becomes dehydrated and cannot sweat enough to cool his or her body, his or her internal temperature may rise to dangerously high levels. This could cause heatstroke. Heatstroke is a condition caused by the body overheating, usually as a result of prolonged exposure to or physical exertion in high temperatures (Leon & Bauchama, 2015). This most serious form of heat injury, heatstroke, can occur if the body temperature rises to 40 °C or higher.

Physical activity results in increased water requirements that parallel sweat losses for evaporative heat exchange (Sawka, Wenger & Pandolf, 1996). Survey data of individuals reporting five or more days of leisure time activity per week show higher median water intakes on the order of 0.5 L/d compared with their less-active counterparts (FNB, 2004). The same activities in warmer environments would exacerbate the outcome. Figure 12.1 depicts generalized modeling approximations for daily sweating rates as a function of daily metabolic rate (activity level) and air temperature. Water requirements can increase 2- to 6-fold from baseline by simple manipulation of either variable. For example, daily water requirements for any given energy expenditure in temperate climates (20°C) can triple in very hot weather (40°C) (Figure 12.2). In addition to air temperature, other environmental factors also modify sweat losses; these include relative humidity, air motion, solar load, and choice of clothing for protection against environmental elements. Therefore, it is expected that water losses, and therefore water needs, will vary considerably among moderately active people based on changing extraneous influences.

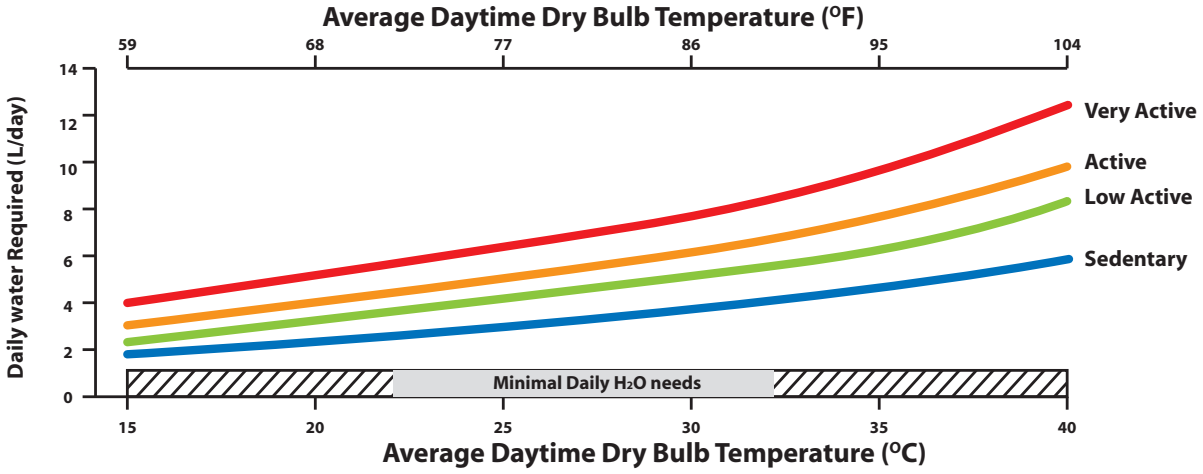

Figure 12.2: Water needs estimated from sweat loss predictions due to changes in physical activity and air temperature
Source: FNB (2004)

12.3.2 Dietary factors

12.3.2.1 Caffeine

Caffeine is a natural alkaloid or xanthine alkaloid found in coffee beans, tea leaves, cocoa beans, cola nuts and other plants. It is one of the most widely used pharmacological substances in the world. Important sources of caffeine such as coffee, tea, cocoa, caffeinated soda and energy drinks are taken into the body by drinking and each of them has unique nutritional properties . It has long been thought that consumption of caffeinated beverages, because of the diuretic effect of caffeine on reabsorption of water in the kidney, can lead to loss of body water. Caffeinated foods and beverages can have a diuretic effect by inhibiting the release off arginine vasopressin (Fredholm, 1984). Intake of < 250-300 mg of caffeine in acute doses (short-term high-level dose) is unlikely to have a measurable effect on urine output. However, side effects can be seen when ingestion exceeds more than 300 mg (Maughan & Griffin, 2003). A clinical trial by Maughan *et al.* (2016) also confirmed that there are no effects of moderate caffeine intake (96-212 mg) on net fluid balance.

In the review of coffee intake and its resources, Verster & Koenig (2018) reported that total daily caffeine intake has remained stable in the last 10-15 years, and coffee, tea and soft drinks are the most important caffeine sources. Consistently, according to data from National Health and Nutrition Examination Survey (NHANES) for 2007-2010, coffee remains main source of caffeine in adults. Meanwhile, based on NHMS (2014), as plain water was the most consumed daily beverage item among majority of Malaysian adults (98.2%), tea (0.7 times/day) and coffee (0.5 times/day) were the second and third most consumed beverages (IPH, 2015). Therefore, it can be concluded that tea and coffee are main sources of caffeine among Malaysian adults. The highest potential for reducing daily caffeine intake is by limiting coffee consumption, and in some countries and age groups, by reducing tea and soft drink consumption (Verster & Koenig, 2018).

Several countries such as Denmark, United Kingdom, Portugal, Canada, and United State of America (USA) advise to limit caffeine intake to 300 or 400 mg/day. In addition, food based dietary guidelines for Australia, Indonesia, New Zealand, Denmark, Hungary, Malta, Colombia, USA, and Canada state specific concerns for energy drinks, generally defined as any drink with > 150 mg of caffeine/litter, but often contain other bioactive ingredients and sugar (McLellan & Lieberman, 2012; Rosenfeld & Mihalov, 2014). The European Food Safety Authority (EFSA) limit caffeine intake of 400 mg per day for adult because adult's habitual caffeine consumption up to 400 mg per day does not give rise to safety concerns (EFSA, 2015).

12.3.2.2 Alcohol

Alcohol is not a nutrient but does provide energy to the body. One gram of alcohol contains approximately 7 kcal or 29 kJ per g (Wardlaw & Hampl, 2007). Therefore, alcohol consumption has the potential to affect dietary intakes of nutrients.

According to the recent NHMS 2019 (IPH, 2020), the current alcohol consumers make up 11.8% of the adult Malaysian population, which showed a slight increase in the prevalence of current drinkers compared to data from 2015 (8.4%) (IPH, 2015). The proportion of binge drinking (six or more standard alcoholic drinks in one sitting) among current drinkers in Malaysia was 45.8%. In addition, 10% of those who regularly consume alcoholic beverages in Malaysia practice heavy episodic drinking (HED), which is defined as consuming six or more standard alcoholic drinks in one sitting every week (IPH, 2020).

Alcohol, the active ingredient in alcoholic drinks has a diuretic effect that will increase fluid loss through urination. The mechanisms that explain alcohol effects diuresis are still not completely clear. Arginine vasopressine (AVP) plays an important role in hydration status by preventing swings in fluid balance to avoid dehydration and hyperhydration. In dehydrated state, AVP increases, triggered by increasing blood osmolality. Alcohol suppress AVP, independently of osmolality, resulting in an increased urine output (Eggleton, 1942; Saini *et al.*, 1995).

Therefore, for individuals who suffer from incontinene or need to pass urine frequently, it is recommended to avoid alcoholic beverages. Because of its diuretic effect, alcoholic beverages are not recommended to satisfy thirst or to be consumed as a rehydration fluid. A study, which examined the effects of alcohol on hydration, has revealed that consumption of alcoholic beverages after physical exercise delays the normal return of plasma viscosity and this might be linked with the alcohol induced dehydration property (El-Sayed, 2001). Alcoholic beverages especially those containing 4% alcohol tend to delay the restoration of fluid balance after exercise-induced dehydration (Shirreffs & Maughan, 1997). Therefore, alcoholic beverages should be completely avoided until one is fully hydrated from the dehydration state.

12.3.2.3 Sodium intake

Sodium is the principal cation in extracellular fluid in the body and is an essential nutrient necessary for maintenance of plasma volume, acid-base balance, transmission of nerve impulses and normal cell function (WHO, 2012). Sodium is the most important cation in regulation of fluid and electrolyte balance in the body due to its abundance and osmotic pressure. Since all body fluids are in chemical equilibrium, any change in sodium levels causes a compensatory shift in water, affecting plasma volume, blood pressure and intracellular and interstitial volumes.

Total body water depends on the amount of sodium present in the extracellular space and the appropriate volume of water required to achieve isotonicity. As such, sodium ingestion is required for proper hydration and fluid balance. It should be noted that when salty foods or fluids are freely available, humans spontaneously exhibit a baseline level of sodium intake in excess of any immediate need. This elevated baseline salt ingestion is adequate for maintaining fluid balance under normal conditions, i.e., in the absence of significant sodium or fluid loss (Stanhewicz & Kenney, 2015).

Changes in sodium intake can influence serum or plasma levels of sodium, but the changes are relatively small and do not lead to pathological conditions, such as hyponatremia. When observed, hyponatremia is often caused by excessive sodium loss from the body, which occurs with impaired renal function, increased vasopressin release, or excessive consumption of water (Adrogué & Madias, 2012).

12.3.3 Physiological factors

There are several methods to establish water recommendations among populations. Based on reviewed by Vivanti (2012), water requirement estimations including ml/kg body weight, estimation by 10 kg weight categories, ml/kcal (1 ml/kcal or 1.5 ml/kcal), surface area (ml/m^2) and percent of body weight. The earliest recommendation (RDA) for water came in the 1945 prescription by the Food and Nutrition Board (FNB) of the United States National Research Council. It was based on research at the time suggesting an intake of 1 ml of water for each calorie eaten (FNB, 1940). The RDA for water is a recommendation calculated to meet the needs of nearly all healthy individuals of each gender and life stage group. The RDAs are determined by using the Estimated Average Requirement (EAR) value and using the variability in the requirements among individuals to increase it to an amount that meets the needs of 97 to 98% of healthy individuals.

Then the RDA was expanded and was later known as Dietary Reference Intakes (DRI). The development of DRIs expands on the periodic reports of RDA, published from 1941 to 1989 by the National Academy of Sciences. Age and gender specific AI for water were established in 2004 (FNB, 2004). In the judgment of the Standing Committee of the Scientific Evaluation of DRI, the adequate intake (AI) is expected to meet or exceed the amount needed to maintain a defined nutritional state or criterion of adequacy in essentially all members of a specific, apparently healthy, population. Examples of defined nutritional states include normal growth, maintenance of normal circulating nutrient values, or other aspects of nutritional well-being or general health.

Instead of ml/kcal, Holliday and Segar (1957) established formula of 35-45 ml/kg/day to estimate adult water requirements. They converted water requirement from ml/kcal into ml/kg for ease of use occurred for adults. This range is based on gender-specific estimated requirements rather than greater or lesser water need because of

environmental or other factors. Chernoff (1994) used additional formula proposing 30 ml/kg with a minimum of 1500 ml, but no source is provided for the reference. The figure of 35 ml/kg was sourced to Zeman (1991), where 35 ml/kg is stated as the low end of the range for active young adults (35-40 ml/kg) and the high end of the range for average adults (30-35 ml/kg), but original sources are not offered (Vivanti, 2012).

Together with the available data on energy requirement in the Malaysian RNI 2017 (NCCFN, 2017) and the recommendation by the Food and Nutrition Board of the National Research Council (1945) which is 1 ml of water for each calorie eaten, the recommendation for water requirement for Malaysian could be established (Table 12.1).

Table 12.1: Calculation of water requirement according to RNI for adults

		RNI 2017 (Energy[1])	FNB 1945 (1 ml/kcal)	Glass[2]/day
Men	19-29 years	1960-2240	1960-2240	7.8-8.9
	30-59 years	1920-2190	1920-2190	7.7-8.8
Women	19-29 years	1610-1840	1610-1840	6.4-7.4
	30-59 years	1660-1900	1660-1900	6.6-7.6

[1] Energy requirement calculated based on RNI 2017 for Malaysia at PAL 1.4 and PAL 1.6;
[2] 1 glass = 250 ml;
Sources: FNB (1945); NCCFN (2017).

Intake of water for adults in certain conditions such as temperature and exercise needs to be considered. Before the 1970s, athletes were advised not to drink during competitive events. However, research was published that focused on dehydration and stated that exercise weight loss greater than 2% could impair performance. Thus, drinking guideline was developed to prevent thirst, minimize weight loss and maintain performance (Roy, 2013). According to Convertino *et al.* (1996), it is recommended that individuals drink about 500 ml (2 glasses) of fluid about two hours before exercise to promote adequate hydration and allow time for excretion of excess ingested water. It is plausible to recommend a standardized fluid replacement protocol for all people because numerous variables involved such as types of exercise, individual variability as well as environment. Therefore, Roy, (2013) had summarized and provided general principle in developing an individualized fluid replacement strategy.

1. Before exercise, make sure adequately hydrated:
    a. Beverage consumption with meals will enhance fluid replacement and pre exercise/ event hydration.
    b. Recovery from the previous exercise session should be 8 to 12 hours or more to enhance fluid replacement.
    c. Tracking daily weight is helpful in evaluating hydration status because post exercise and day-to-day variations are likely from fluid loss. Consider drinking 16 to 20 fluid oz. (450 ml to 600 ml) 4 hours before exercise, especially if pre exercise weight is reduced.
2. During exercise, drink according to your thirst sensation; no more or no less.
    a. Drinking more than 800 ml per hour is not recommended and may increase the risk for developing dilution hyponatremia.
    b. During extreme weather conditions, fluid intake and pace may require additional adjustment.
    c. For prolonged exercise (> 60 minutes), beverages containing 6 to 8% carbohydrate may provide additional benefit.
3. After exercise:
    a. Drink 16 to 24 oz. (450 to 720 ml) of fluid for every pound (0.5 kg) lost.
    b. Post exercise meals should include fluid intake.

12.4 Current status

The Malaysian Adult Nutrition Survey (MANS) 2014 measured daily consumption of plain water and they reported that Malaysian consistently reached 6.7-7.3 servings or glasses (1 glass = 250 ml) per day (IPH, 2014). Meanwhile, the NHMS 2015 reported that the percentage of adequate plain water intake (≥ 6 glasses per day) among Malaysian adults was 72.9% (IPH, 2015). However, NHMS 2019 reported that adequate plain water intake was increased to 74.2% (IPH, 2020). For other beverages, tea (70.3%) remained as the most consumed, followed by malted drink 59.1% and coffee 53.2% (Noraida *et al.*, 2015).

In small scale study by Azlan *et al.* (2012) found that 79% of their subjects drank 5 to 12 glasses of water a day. Among the subjects, 73%, 14.8%, and 11.9% consumed tap water, bottled mineral water, and bottled drinking water, respectively. The reasons for consuming bottled water include safety, health, quality, and taste. The results also showed that the subjects perceived low to acceptable qualities for tap water, while bottled drinking water and mineral were perceived as having relatively higher quality.

12. 5 Key Recommendations

Key Recommendation 1

Drink six to eight glasses (1.5-2.0 liter) of plain water daily.

How to Achieve

1. Drink one to two glasses of plain water during and between main meals.
2. Drink plain water at all the times even when you are not thirsty.
3. Drink additional two glasses of plain water when engaging with physical activity or in hot and humid environments.
4. If you are fasting, drink two glasses of plain water during sahur, two glasses while breaking fast and another two to four glasses along the night.

Key Recommendation 2

Maintain fluid intake from other food sources.

How to Achieve

1. Continue intake of other fluid sources such as soups, beverages and juices, preferably low in sugar, salt and fat.
2. Reduce intake of caffeinated beverage.
3. Avoid taking alcoholic drink as source of water.

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Consume safe and clean foods and beverages

KEY MESSAGE

13

CONSUME SAFE AND CLEAN FOODS AND BEVERAGES

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13.1 Terminology

Clean foods and beverages

Clean foods and beverages are food and water that are free from dirt, stains or impurities; unsoiled, free from foreign matter or pollution; unadulterated and not infected.

Cross contamination

Cross contamination is the transfer of harmful microorganisms from one item of food to another via a non-food surface such as human hands, equipment or utensils. It may also be a direct transfer from raw food to cooked food.

Food and water borne diseases

Food and water borne diseases are any diseases resulting from the consumption of contaminated food and drinking water. Most cases are actually food infection caused by a variety of food borne pathogenic bacteria, viruses and parasites.

Food poisonings

Food poisonings are syndromes acquired as a result of ingesting contaminated foods, which are foods that contain infectious, toxigenic microorganisms or noxious elements.

Fresh foods

Fresh foods are raw food that have not changed colour, do not have unpleasant odour, not withered and texture remain unchanged.

Safe foods and beverages

Safe foods and beverages is an assurance of the food and water against chemical, biological or physical conditions, which may expose the user to food borne illnesses.

Potentially hazardous foods

Potentially hazardous foods are generally moist, nutrient-rich foods with a neutral pH. Examples of foods that are normally considered potentially hazardous include raw and undercooked poultry or other products of animal origin, eggs, dairy products and fresh fruits and vegetables.

13.2. Introduction

Food borne diseases are defined as diseases, usually either infectious or toxic in nature, caused by hazards that enter the body through the ingestion of food. These include biological hazards such as infectious bacteria, toxin producing organism, moulds, parasites and viruses, chemical hazard such as natural toxins, food additives, pesticide residues, veterinary drug residues, environmental contaminants and allergens as well as physical hazard such as metal, glass, stone and bone chips (WHO, 2020). The contamination of food may occur at any stage in the process from the food production to consumption. It can also result from environmental contamination including pollution of water, soil and air. These diseases are cholera, typhoid fever, hepatitis A, dysentery and food poisoning and mainly related to poor sanitation. It may lead to permanent health problems and disability (Sharifa Ezat, Neety & Sangaran, 2013). Definitions of each food borne disease are simplified in Table 13.1.

Food borne diseases remain a real and formidable problem in both developed and developing countries, causing great human suffering and impede socioeconomic development by straining health care systems, and harming national economies, tourism and trade (WHO, 2020). The report by WHO global burden on food borne diseases stated that diarrhoeal disease agents were the most frequent causes of food borne diseases, particularly Norovirus and *Campylobacter spp.* Food borne diarrhoeal disease agents caused 230,000 deaths, particularly non-typhoidal *Salmonella enterica*, which causes diarrhoeal and invasive disease (WHO, 2015). Pathogens such as rotavirus, Shigella, Shiga-toxin producing *E. coli* and Cryptosporidium contribute to most of the burden of diarrhoea in developing countries (Kotloff, 2017). Other major causes of food borne deaths were *Salmonella typhi, Taenia solium*, hepatitis A virus, and aflatoxin (WHO, 2015).

Table 13.1: Definition of each food borne disease

Types food borne disease	Definition
Food poisoning	Acute onset of vomiting and/ or diarrhoea and/ or other symptoms associated with ingestion of food. May also presented with neurological symptoms such as paraesthesia, motor weakness and cranial nerve palsies.
Cholera	Acute severe watery diarrhoea with or without vomiting.
Typhoid/ paratyphoid	An illness with prolonged fever, constitutional symptoms (malaise, headache, anorexia) and hepatosplenomegaly.
Hepatitis A	Acute illness typically including acute jaundice, dark urine, anorexia, malaise and extreme fatigue.
Dysentery	Acute diarrhoea with visible blood in the stool.

Adapted from 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD 10)
Source: WHO (2004)

In Malaysia, the food borne cases are underestimated because most of the incidences were not reported and a lot of procedures are required before the case can be brought to the authority (Soon, Singh & Baines, 2011). Not all the food borne disease victims seek treatment at hospitals or clinics. Therefore, only part of them receive appropriate medical treatment and are reported by public health authorities. The main contributing factor to food borne diseases in Malaysia was identified as unsanitary food handling procedures which accounted for more than 50% of the poisoning episodes (Salleh *et al.,* 2017).

There were 60 episodes of food poisoning from 2,325 cases reported with 47 of the food poisoning episodes involving schools and institutions under the Ministry of Education. Food poisoning incidents at schools have increased 57% from 30 in 2015 to 45 in 2016 (MOH, 2017). Most of the incidences involved the school canteens and kitchens. Factors that contributed to the food poisoning were contaminated raw materials, cross contamination during handling, food that was prepared too early before serving as well as temperature abuse during processing, transportation, sales and storage (Salleh *et al.,* 2017). Apart from that, urbanisation has increased urban population and changed the lifestyles of the population. Eating out trend has become something common to the Malaysian population. Many of the food premises use roads outside their premises as eating areas at night despite the food cleanliness issue (Ali & Abdullah, 2012). As the diversity of immigrant workers have increased and more numbers of ethnic restaurants have newly operated, the correct food handling practices must be practiced to ensure the food consumed is safe (Rajagopal, 2013).

Food handlers are the most common source of contamination because they can spread harmful organisms by means of faecal-oral route or skin lesions, as well as unclean kitchen utensils or kitchen counters (Linscott, 2011). They play a major role in the prevention of food poisoning during food preparation; hence, food handler training is seen as one of the main strategies to increase food safety practices (Soon, Singh & Baines, 2011). It is important to continuously inform food handlers about good hygiene practices at all stages of the production chain.

It is also important to educate consumers to consume safe and clean food and beverages. Sometimes consumers give prioritisation on the low price of the food that they purchased instead of the hygiene level of the food premises. This will convince food handlers that as long as the price for their meal is cheap, they do not have to be concerned about food safety. Consumers could always avoid getting food borne illness by choosing the right food and the right place to dine. Grades of food premises will help consumers by giving an overview of the level of hygiene and sanitation of the food premise (Abdul Mutalib *et al.,* 2015).

Food Regulations 1985 have been published in Malaysia to protect the public against health hazards and fraud in the preparation and sale. This act and regulations help to ensure safe food and beverage consumption in food outlets and premises. The Ministry of Health Malaysia has also established the Food Handlers' Training Programme since 1996 as to increase the knowledge on food hygiene. This knowledge is very useful to ensure the handling, preparation and sales of food have been done in

appropriate ways. Thus, to ensure the training is effective and has the long term effect and impact, continuous improvement is needed. Malaysia authority classifies food premises according to their level of cleanliness. Grades like A, B, C and D or "no grade" have been applied to categorize food premises based on their level of sanitation. Several aspects that determine the grades including location, water supply, pest control, ventilation, food storage, toilet room, food handlers' clothing and health condition, food preparation, temperature, and so forth (MOH, 2009).

In terms of the intervention strategies for food safety in Malaysia, the National Food Safety and Nutrition Council was established and approved on the 21st March 2001. It provides the advice related to food safety and nutrition in the country. The Food Safety and Quality Division (FSQD) has been established to plan, implement, monitor and evaluate all the food safety and quality programmes at all levels that include national, state, districts, entry points and local authorities. For the surveillance purpose, the analysis of the related food samples are carried out by the Food Laboratory Section, a programme under FQSD, MOH. Other activities that strengthen the surveillance system are the Food Safety Information System of Malaysia (FOSIM) that functions in managing food safety surveillance that ensures imported foods can be eaten safely (Salleh *et al.,* 2017).

There are many reasons for the lack of impact of training initiatives and the implementation of safe food handling practices within the food service industry. The possible factors such as; the staff high revenue, the staff small wages, the staff position, more part-time staff working, the low language level and/ or educational level of the staff, less awareness on quality assurance, lot of complicated meals served, fulfilling high demands and short period of serving/ preparing most of the foods at mealtimes, culinary requirements for the current trend, the high quantity of vulnerable consumers been provisioned, less knowledge on food safety, inappropriate placement of equipment and the rotation of staff. The positive impact from the training can be enhanced by monitoring the food handlers that are involved in their contributions in decreasing the food borne outbreaks incidence rate (Soon *et al.*, 2011).

While education and regulation are crucial for continuous food safety, ignoring an inadequate infrastructure can undermine public health initiatives. The basic infrastructure for maintaining food safety should include proper access to waste facilities and water supply, presence of sanitary and proper waste management, and regular monitoring and supervision by authorities (Cortese *et al.,* 2015). It is recommended that in order to prevent and control food borne disease, inter-agency involvement, in particular agencies are responsible for the provision of basic environmental facilities, and local authorities need to play an important role in enforcing laws related to establishment and operations of food outlets. Continuous collaboration between government and private sectors are crucial for a sustainable improvement for a better health of the nation.

13.3 Scientific basis

Consumer education to promote safe food consumption can be the best way of reducing the risk of food borne diseases at the consumer end of the food chain. The World Health Organization has introduced the Five Keys to Safer Food which incorporates all the messages of the Ten Golden Rules for Safe Food Preparation (WHO, 2006). The Five Keys are stated as in Figure 13.3.

The core concept remains the same and the information provided in the Five Keys to Safer Food Manual are adapted in our country. The Five Keys to Safer Food by WHO (2006) and articles published have been used as the basis or rationale for the proposed key recommendations namely; practice good personal hygiene, choose safe and clean foods and beverages, serve food at appropriate temperature, prepare food hygienically, cook food thoroughly, hold foods appropriately and choose safe and clean premises when eating out or getting from outside.

Establishing a good personal hygiene routine when handling foods could protect consumers from becoming sick from the illness-causing germs and hand washing is one of the important personal hygiene habits to be observed. Consumers are encouraged to always wash their hands using soap during food preparation and eating foods. In a systematic review on 22 randomized controlled trials reported by Ejemot-Nwadiaro *et al.* (2015), it was concluded that hand washing promotion may reduce the incidence of diarrhoea in children and adults by about 30%. In other words, hand washing can help to reduce the risk of food borne diseases.

According to WHO (2008), consumers are encouraged to monitor the expiry date, be alert on the adulteration of food when choosing and buying food. Raw and cooked food should be stored separately at all stages of the food handling process. This is to prevent cross contamination due to the spread of harmful pathogens from foods, hands, utensils, or food preparation surfaces to another food that can cause food poisoning. Insects, rodents and pests play a role in the transmission of food borne diseases. Hence, it is important to ensure that all the food products are well protected and be free from insects, rodents and pests to avoid the spread of food-borne pathogens. In addition, safe water consumption is important to ensure good health. Among all methods to make water safe to drink, boiling is the assured method that can kill disease-causing organisms including viruses, bacteria and parasites. However, in an emergency situation where water is contaminated with fuel or toxic chemicals, water will not be made safe to consume by boiling. In this situation, bottled water is the safest choice for drinking and cooking and washing (CDC, 2020).

Consumers also need to properly wash the raw material, equipment using clean and safe water because dangerous microorganisms are widely found in soil, water, animals and people. These microorganisms can also be carried on hands, wiping cloths and utensils. Furthermore, food cannot be exposed to room temperature more than two hours. This is due to the fact that the number of microbes multiplied within this duration is high enough to cause food borne disease (WHO, 2008).

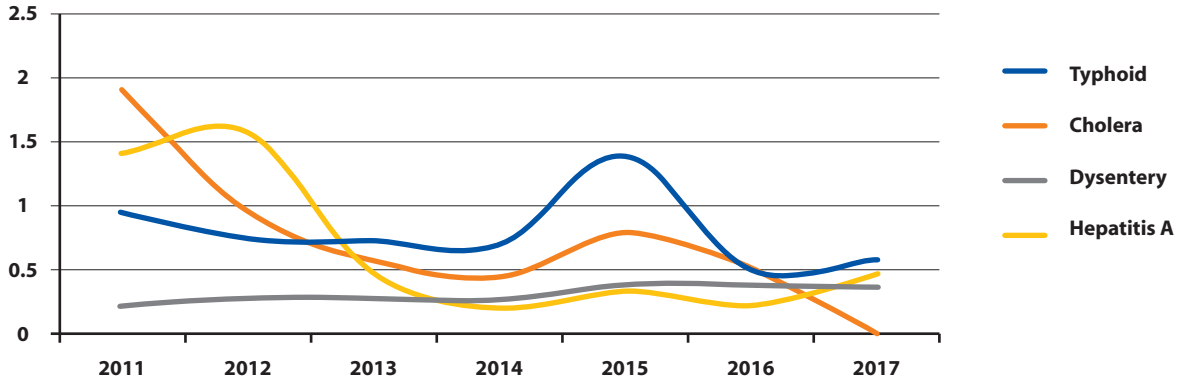
All cooked foods should be cooked thoroughly in order to prevent food contamination. Food that has been cooked should be held at a safe temperature (less than 5 °C or more than 60 °C). Holding food at these safe temperatures ranges will slow or stop the growth of microorganisms (WHO, 2008). On the other hand, maintaining food in the danger zone from 5°C to 60°C, can cause microorganisms to multiply very quickly (FAO, 2007). Improper holding temperature of food is the number one contributing factor that leads to food borne disease because spore forming bacteria like *Clostridium botulinum*, *Clostridium perfringens* and *Bacillus cereus* can still survive cooking temperatures. Foods, especially potentially hazardous food such as minced meats, rolled roasts, large joints of meat and whole poultry need to be properly cooked to a temperature of 70°C to kill almost all dangerous microorganisms (WHO, 2008). Any food that needs reheating, must be reheated to reach an internal temperature of 74°C within two hours to prevent the number of organisms reaching levels that can cause food borne illness (BC Cook Articulation Committee, 2015).

When deciding where to buy food and eating out, consumers are encouraged to make a visual check of the staff, cutlery and other equipment used for cleanliness and tidiness. It is being emphasized that personal hygiene for people who work in the food premises should be given priority to make sure that consumers can have safe food. Practising good personal hygiene will promote clean premises in the food establishment. This is also a good indicator of hygiene standards (WHO, 2008).

13.4 Current status

Control and prevention of diseases related to food and water through mandatory notification of those diseases is monitored under the Prevention and Control of Communicable Disease Act 1988 (MOH, 1988). The diseases under surveillance were typhoid, cholera, dysentery, Hepatitis A and food poisoning.

Report from Ministry of Health Malaysia (MOH, 2017) from 2011 to 2017, the food and waterborne disease (FWBD) incidences showing a downward trend except in 2015, with an increasing trend for most of FWBD. The 2017 report revealed that there was an increasing trend for typhoid and hepatitis A incidence and a downward trend for cholera and dysentery incidence as shown in Figure 13.1.



Incidence/ Year	2011	2012	2013	2014	2015	2016	2017
Typhoid	0.95	0.75	0.73	0.7	1.39	0.51	0.58
Cholera	1.91	0.96	0.58	0.45	0.79	0.52	0.01
Dysentery	0.22	0.29	0.28	0.27	0.39	0.38	0.37
Hepatitis A	1.42	1.58	0.48	0.21	0.34	0.23	0.47

Figure 13.1: Trend of incidence of typhoid, cholera, hepatitis A and dysentery in Malaysia, 2011 to 2017
Source: MOH (2017)

13.4.1 Typhoid

Typhoid incidence rate in 2017 increased slightly compared to 2016, contributed by high case incidence in Sabah, Kelantan, Selangor and Perak. Most cases of typhoid in Sabah were reported to occur in sea village settlements due to lack of clean water supply and sanitary facilities. Kelantan recorded six outbreak episodes in 2017. The risk of typhoid infection still exists because most wells in the Kelantan are still unsanitary despite well chlorination activities being carried out. Typhoid outbreaks in Wilayah Persekutuan Kuala Lumpur and areas around Selangor in 2015 were mainly contributed by food handlers who failed to comply with food hygiene practices.

13.4.2 Cholera

Cholera incidence in Sabah showed a cyclical trend where it peaked every 4 to 5 years. However, in 2017 the incidence rate declined abruptly with only two cases reported in Sabah, as compared to 170 cases in 2016. This was a result of prevention activities including prophylaxis in areas affected by the outbreak in 2016 in Sabah. Main risk factors include access to insanitary water supply, poor hygiene and sanitation and the practice of consuming contaminated seaweed such as *latok* which is collected from the same area where sewage effluents are discharged.

13.4.3 Dysentery

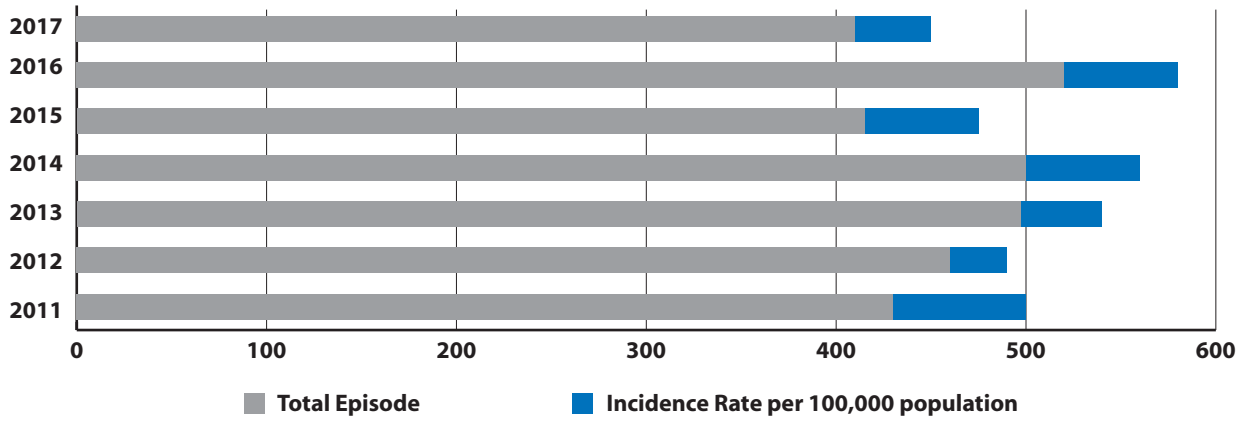
Dysentery has always been under notified disease due to incomplete information to fulfil case definition criteria. In 2017, the incidence rate of dysentery slightly reduced to 0.37 per 100,000 populations from 0.38 per 100,000 population in 2016.

13.4.4 Hepatitis A

Hepatitis A outbreaks are commonly associated with unsafe water supply and poor sanitation. *Orang Asli* communities were frequently affected with small outbreaks because of unsafe water supply. However, for 2015 to 2017, there were no OA communities affected with hepatitis A. The incidence of Hepatitis A in 2017 has increased to 0.47 per 100,000 populations compared to 0.23 per 100,000 population in 2016 with two outbreak episodes in Sabah which contributed to the increase in cases of hepatitis A throughout the country.

13.4.5 Food poisoning

The incidence rate of food poisoning per 100,000 population has decreased to 42.25 in 2017 compared to 56.62 in 2016 as in Figure 13.2. This figure is within the 5-year median rates for food poisoning which is 49.79 per 100,000 population. The total episode of food poisoning has also decreased to 404 episodes as compared to 526 episodes in 2016. The total episodes of food poisoning involving schools in 2017 have also decreased to 181 episodes as compared to 257 episodes in 2016. In 2017, from a total of 404 episodes of food poisoning nationwide, 181 (44.8%) episodes took place in the Ministry of Education's (MOE) schools. This represents an increase of 21.13% from food poisoning episodes in 2016 at MOE school canteens and hostel kitchens.



Year	2011	2012	2013	2014	2015	2016	2017
Total episode	434	454	495	501	409	526	404
Incidence rate per 100,000 population	57.06	44.23	47.79	58.65	47.45	56.62	42.25

Figure 13.2: Trend total episode and incidence rate of food poisoning in Malaysia, 2011 to 2017
Source: MOH (2017)

Food poisoning associated with 1Malaysia Milk Program (PS1M) has markedly reduced from 96 episodes in 2011 to four episodes in 2017. Continuous monitoring of PS1M along the supply chain and supplier's compliance to Standard Operating Procedures set by the Ministry of Health and Ministry of Education has significantly improved the management of PS1M.

13.4.6 Mortality associated with food water borne disease

Deaths due to Food Water Borne Disease are largely preventable. Mortality is commonly associated with delay in seeking treatment, toxicity of causative agents such as marine toxin and the presence of other comorbid medical conditions. Case Fatality Rate (CFR) has been reduced to 0.08 in 2013 to 0.03 in 2017.

Law enforcement in infectious disease control has gained momentum in Malaysia with the rise in focused enforcement activities. Enforcement in this area includes inspection of nurseries that have been identified as harbouring infectious disease. Whenever food poisoning, hand, foot and mouth disease, Leptospirosis or other infectious diseases are notified to a District Health Office, premise inspection will be carried out by authorized officers.

Even though 1,919 premises were inspected in the year 2017 compared to 7672 premises in 2016 as in Table 13.2, yet the ratio of premises given closure order has risen in 2017. This indicates a focused enforcement activity under this Act. This was partly due to the positive outcome of the inspection of food premises on a routine basis and the enforcement actions taken such as closure of unhygienic food premises.

Table 13.2: Enforcement of Prevention and Control of Infectious Diseases Act, 1988

Year	Premise inspected	Premise Closure
2015	8,737	275
2016	7,672	555
2017	1,919	461

Source: MOH (2017)

Since the control and prevention of diseases related to food and water are an essential component to safeguard the consumers, thus it is important to continue efforts by various stakeholders to promote the importance of consuming safe foods and beverages.

13.5 Key Recommendations

Key Recommendation 1

Practice good personal hygiene.

How to Achieve

1. Keep fingernail short and clean, wear clean clothing and restrain hair while handling food.
2. Wash hands well with soap and water before handling food and during food preparation, giving attention to areas between fingers and fingernails (Figure 13.4).
3. Dry hands thoroughly after washing, by using a clean towel, a paper towel or an electric hand dryer.
4. Handle food with clean utensils rather than bare hands as much as possible.
5. Cover cuts, wounds or burns with clean bandages and gloves when handling food.
6. Avoid direct contact with food preparation if suffering from a foodborne disease.

Key Recommendation 2

Choose safe, clean foods and beverages

How to Achieve

1. Select fresh, clean and wholesome foods.
    a) Fruits and vegetables must be fresh and reasonably free from insects.
    b) Fish with firm and elastic flesh, bright, clear and not sunken eyes, red gills and not of smelly odour.
    c) Meat and poultry must be fresh with firm and elastic flesh, not bruised, not slimy and no foul smell.
    d) Eggs with clean and uncracked shells and not expired.
    e) Dried food such as rice, cereal, flour and legumes are not moist or wet, not rotten and contain no insects or foreign substances.
2. Choose processed foods that are appropriately sealed and labeled.
    a) Choose cans that are not rusted, not dented, not bulging or not leaking.
    b) Choose foods (milk and fruit juice) that are processed for safety such as pasteurised, Ultra High Temperature and sterilised.
    c) Check the expiry date of processed food before purchasing and always read the label for storage instructions. Do not use food beyond its expiry date.
3. Purchase cold and frozen foods last when shopping and return home as soon as possible to avoid spoilage. Try to use cooler boxes or bags during transportation.
4. Use clean, safe and treated water.
5. Boil tap water for drinking.

Key Recommendation 3

Store foods appropriately.

How to Achieve

1. Store foods at the appropriate area and temperatures. Keep the area clean and orderly.

2. Foods should be properly covered and placed in containers or wrapped to avoid contact between raw and prepared foods. Stored food to be frozen in a closed container for single usage.

3. Store unripe fruits at room temperature or in a cool, dry place. Ripen fruits and fresh vegetables are kept in the refrigerator.

4. Keep perishable foods like meat, poultry and seafood in the freezer compartment while milk, yogurt and eggs in the chiller, as soon as possible upon returning home. Do not overload on storing food in the refrigerator as it leads to poor cold air circulation.

5. Do not keep very hot food in the refrigerator, as this will cause the temperature of the refrigerator to rise.

6. Store cooked foods and/ or meal leftovers in the chiller within two hours after cooking and do not keep them for longer than two days. If you like to keep these foods longer, deep freeze them. Frozen food can be kept for three months in a standard home freezer.

7. Store dried food such as rice, cereal, flour and legumes in a sealed container and placed in a cool, dry place, away from direct heat or sunlight. Regularly inspect for insect infestation.

8. Store foods away from chemical products, pesticides and cleaning agents.

9. Protect kitchen areas and food from insects, pests and other animals by keeping the kitchen and surrounding areas cleaned.

Key Recommendation 4

Prepare food hygienically

How to Achieve

1. Wash thoroughly fruits and vegetables that are to be eaten raw with safe and clean water.

2. Do not thaw frozen food at room temperature but do it in the refrigerator or under clean running water.

3. Do not refreeze thawed food.

4. Keep fruits and vegetables separate from raw meat, poultry and seafood while preparing.

5. Wash all surfaces, crockery, cutlery, cooking utensils and other equipment used for food preparation.

6. It is a good practice to separate equipment and utensils such as knives and cutting boards for handling raw foods and cooked foods. Make sure to wash the cutting board with soap prior to using it to cut other types of food.

7. Change cloth towels daily or after every meal prepared with raw meat and poultry. It is recommended to use paper towels for this purpose as well.

8. Keep appliances such as microwave ovens, toasters, can openers, blender and mixer blades free of residual food particles.

Key Recommendation 5

Cook food thoroughly.

How to Achieve

1. Foods must be cooked thoroughly, especially meat, poultry, eggs and seafood.

2. Bring foods like soups and stews to boiling. For meat and poultry, make sure that juices are clear and not pink.

3. Reheat cooked food thoroughly.

4. Do not reheat foods more than once.

Key Recommendation 6

Serve food at appropriate temperature.

How to Achieve

1. Serve cooked foods as soon as possible in crockery that are clean and in good condition (not crack or chip). If you need to hold food, keep them appropriately covered and never leave the cooked foods at room temperature for more than two hours.

2. Serve hot foods at temperature above 60 °C while cold foods at temperature below 5 °C.

Key Recommendation 7

Choose safe and clean premises when eating out or buying food from outside.

How to Achieve

1. Choose premises that are clean and tidy:

    a) located far away from street, rubbish dumps, clogged drains, septic tanks or waste disposals.

    b) with running pipe water, proper drainage system, and covered rubbish bins.

    c) free from signs or presence of pets, rodents, pests and insects.

2. Choose premises that use crockery, cutlery and utensils that are clean and in good condition and use them in the correct way.

3. Choose premises that serve appropriately covered foods and beverages.

4. Choose premises where the staff practise good personal hygiene and habits at work such as wearing a hair restraint (hat or hair net).

5. Choose premises which display certificates (on the wall) such as BeSS (Clean, Safe and Healthy), A Grade, Food Handler Training or any related certificate.

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Appendices

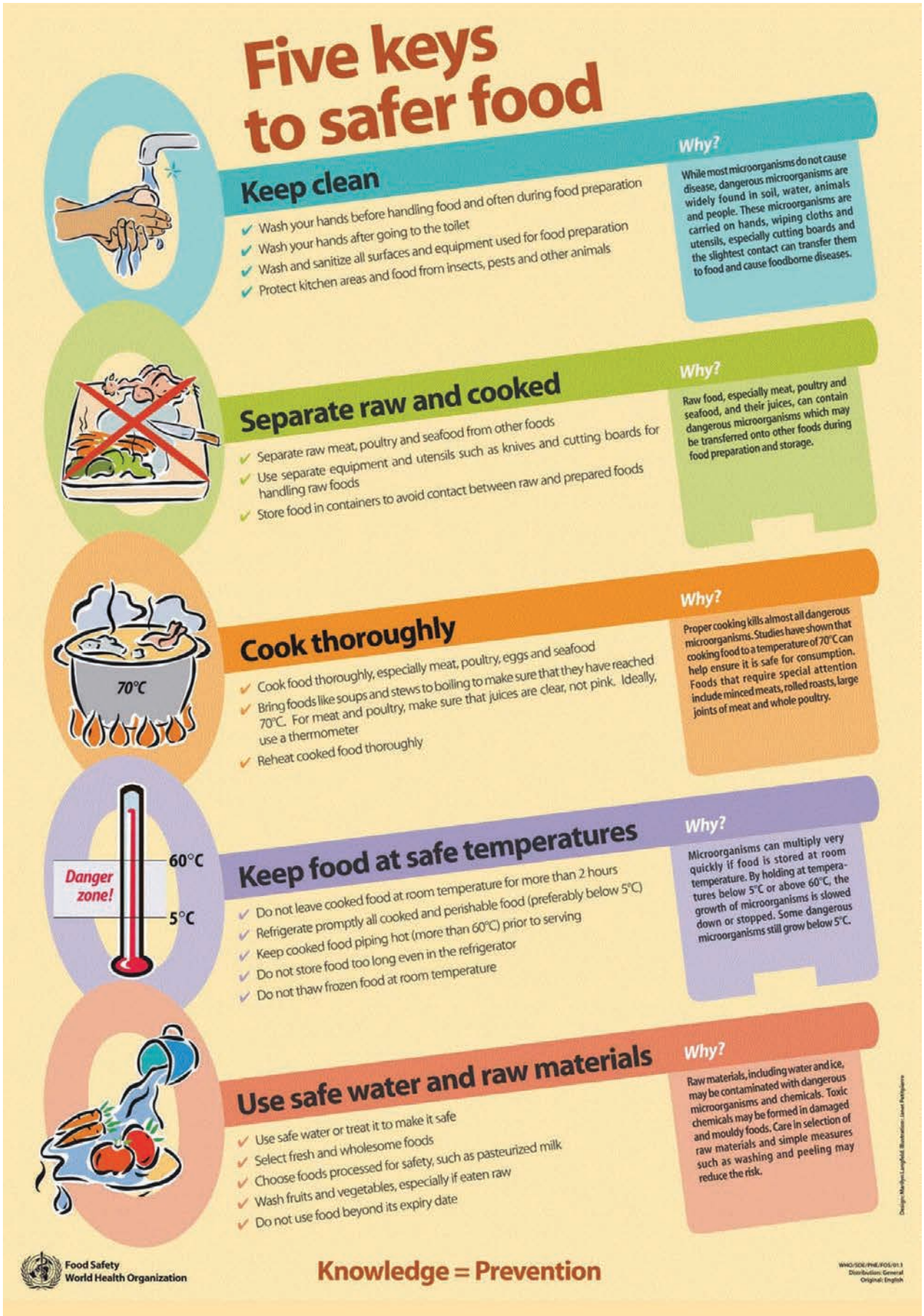

Figure 13.3: Five keys to safer food

Keep your hands clean

WASH YOUR HANDS PROPERLY

Steps

1 Lather hand with soap

2 Rub your palms

3 Rub each finger and between fingers

4 Scrub nails on palms

5 Rub back of hands and between fingers

6 Wash hands with sufficient clean water

7 Dry hands with clean cloth or tissue

Practice washing hands:

- After using the toilet
- Before eating
- Before and while preparing food
- When you touch raw food materials, contaminated surfaces; your face, nose, ears or other parts of the body
- Whenever your hands are dirty

Clean hands can prevent disease.
The choice is in your hands

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Choose Health
Be Healthy For Life

Figure 13.4: 7 steps of appropriate hand washing


CORN
FLAKES
MILK
cookies
MILK

Make effective use of nutrition information on food labels

KEY MESSAGE

14

MAKE EFFECTIVE USE OF NUTRITION INFORMATION ON FOOD LABELS

Dr. Tee E Siong, Ms. Fatimah Sulong, Ms. Maizatul Azlina Chee Din and Mr. Leong Han Yin.

14.1 Terminology

Claim

Claim means any representation which states, suggests or implies that a food has particular qualities relating to its origin, nutritional properties, nature, processing, composition or any other quality.

Reduction of disease risk claim

Reduction of disease risk claim relates the consumption of a food or food component to the reduced risk of developing a disease or health-related condition.

Food label

A food label includes any tag, brand, mark, pictorial or other descriptive matter, written, printed, stenciled, marked, painted, embossed or impressed on, or attached to or included in, belonging to, or accompanying any food.

Front-of-pack nutrition labelling (FOP-NL)

Front-of-pack nutrition labelling (FOP-NL) is any system that presents simplified nutrition information on the front-of-pack of pre-packaged foods. It can include symbols/ graphics, text or a combination thereof, that provide information on the overall nutritional value of the food and/ or on the nutrients (FAO/ WHO, 2019).

Nutrient addition or fortification claim

A claim in which the food "contains" or "added" (or words of similar meaning) or "enriched" or "fortified" (or words of similar meaning) with specific vitamins, minerals, amino acids, fatty acids, nucleotides or other food components. The food must meet specified conditions stipulated in the Food Regulation 1985 (MOH, 1985).

Nutrient comparative claim

A nutrient comparative claim is a claim that compares the nutrient levels and/ or energy values of two or more foods.

Nutrient content claim

A nutrient content claim describes the level of a nutrient in a food product.

Nutrient function claim

A nutrient function claim describes the physiological role of the nutrient in growth, development and normal functions of the body.

Nutrition information panel

The nutrition information panel or NIP is a table found in one section of a food label declaring the amount of nutrients contained in the food.

Nutrition labelling

A nutrition label is a listing of the level of nutrient(s) as displayed on the food label. It is meant to provide factual information about the nutritional content of the product.

Other function claim

A claim that describes specific beneficial effect of other food component in the food that gives positive contribution to health or improvement of a function of the body.

14.2 Introduction

Consumers gather information about the foods they purchase from a wide variety of sources. Family members, relatives, friends, the media and advertising all convey messages about different food characteristics. Information may also be found on the food product label. From a health standpoint, nutrition information on a food label is particularly important. Such information may assist consumers in making better food choices when planning their daily meals.

Providing nutrition information on food labels has thus been recognised as one of the strategies adopted to assist consumers in adopting healthy dietary practices. It is however essential to ensure that the information provided are accurate and truthful (WHO, 2004). Recognising the need for more effective regulation of the nutrition labels and claims on food packages, the Ministry of Health (MOH) Malaysia gazetted amendments to Food Regulations 1985 in 2003 (MOH, 1985). Regulations were introduced to enable manufacturers to describe the nutritional qualities of a food product factually and informatively, thereby assisting the consumers in making informed choices of food when planning daily diets. These regulations, especially those pertaining to nutrition and health claims, have been updated periodically. To assist all stakeholders in understanding and using these regulations, a guide book was published by the MOH (MOH, 2010).

In recent years, in addition to the regulations on mandated back or side NIP and nutrition and health claims, the MOH has introduced other forms of nutrition information guide. Through voluntary schemes, food manufacturers may also add summary nutrition information on the front-of-pack (FOP) to provide further guidance to consumers.

These different approaches to communicate nutrition information through food labels have become important part of the strategy to assist consumers in adopting healthy dietary practices. In addition, these approaches also aim to encourage food industries to be mindful of the importance of nutritional quality of their products and make available healthier food options to consumers.

This key message aims to update the MDG 2010 (NCCFN, 2010) and assist consumers in understanding and effectively utilising the nutrition information permitted under the Food Regulations, 1985 (MOH, 1985), namely (1) nutrition labelling, (2) nutrition and health claims, (3) authorised FOP-NL systems in Malaysia, (4) ingredient list (Figure 14.3). It is important to emphasise to consumers that such nutrition information should be used appropriately, in combination, to serve as effective guides in making healthier food choices.

14.2.1 Understanding nutrition labelling

Nutrition labelling or nutrient declaration describes the nutrient content of a food product. The nutrients are declared as a table in one section of a food label, commonly known as a nutrition information panel or NIP (Table 14.1). Such information on nutritional quality, when factually and informatively provided, can assist the consumer in making better choices of food when planning their daily meals. Such information serves to remind the consumer to think of nutritional quality of a food in addition to other information such as storage conditions, instructions for use and expiry date. Nutrition labelling can be a useful educational tool (WHO, 2004; FAO/ WHO, 2017).

14.2.1.1 Nutrition labelling is compulsory for a wide variety of foods

Nutrition labelling has been made compulsory for selected foods in Malaysia since 2003. The regulations require the following foods to have compulsory nutrition labelling (MOH, 1985):

- 153 types of food, including: pasta, breakfast cereals, bread; milk and milk products; sweetening creamer; flour confection; meat products and canned meat; fish products and canned fish; preserved egg; edible fats and oil; vegetable products and juices; soup and soup stock; fruit products and juices; jam, fruit jelly marmalade and seri kaya; nuts and nut products; premix coffee; chocolate, milk chocolate, milk shake; sauces, salad dressing, mayonnaise, chutney and pickle; soft drinks; and isotonic electrolyte drink.

A complete list of the foods is given in the Table 14.3 (MOH, 1985).

- Foods making nutrition claims
- Foods that "contain" or "added" (or words of similar meaning) or "enriched" or "fortified" (or words of similar meaning) with specific vitamins, minerals, amino acids, fatty acids, nucleotides or other food components (with permitted other function claims).
- Special purpose foods: infant formula, follow-up formula, canned food for infants and young children and cereal-based food for infants and young children.

The following are examples of some foods that are exempted from the nutrition labelling requirements:

- Fresh fruits and vegetables
- Raw meat and poultry (except when ground), raw fish and seafood
- Foods prepared or processed at the store (bakery items, salads)
- Foods that contain very few nutrients such as coffee, tea, herbs and spices
- Alcoholic beverages

14.2.1.2 The nutrients that must be declared and the format for declaration

- Energy (calorie) (in kilocalories – kcal or kilojoules – kJ or both)
- Protein (in gram – g)
- Carbohydrate (in gram – g)
- Fat (in gram – g)
- Total sugars (in gram – g)
- Sodium (in milligram – mg)

The regulations require the information of energy content and all the mandatory nutrients must be declared in each serving of a food. For product that contains more than 1 serving of food, the nutrition information should be expressed per 100 g or per 100 ml as well. Also, the serving size should be stated on the label.

The energy and nutrients mentioned above, commonly presented in a table, known as a Nutrition Information Panel (NIP). A sample NIP, declaring only the mandatory or core nutrients, is given in Table 14.1.

Table 14.1: An example of Nutrition Information Panel (NIP) with only mandatory nutrients

Nutrition Information		
Serving size : **200 ml**		
Servings per package : **5**		
	Per 100 ml	**Per serving (200 ml)**
Energy (kcal)	100	200
(kJ)	420	840
Carbohydrate (g)	23.8	47.6
Total sugars* (g)	11.5	23.0
Protein (g)	1.1	2.2
Fat (g)	0	0
Sodium (mg)	0	0

*Total sugars refer to all monosaccharides and disaccharides contained in the food
Source: MOH (1985)

14.2.1.3 Optional nutrients that may be declared

Besides the mandatory nutrients, other nutrients that are present in the product may also be declared in NIP. For instance, dietary fibre and cholesterol content may be declared even the product only contains a minimum amount of those nutrients. However, product may only declare vitamins and minerals if they are present in significant amounts, which is at least 5% of the Nutrient Reference Value.

The format for declaration of these optional nutrients is the same as that for the mandatory nutrients, i.e., in per 100 g or per 100 ml and per serving. A sample NIP for the declaration of optional nutrients is given in Table 14.2.

Table 14.2: An example of of Nutrition Information Panel (NIP) with optional nutrients

Nutrition Information		
Serving size : **200 ml**		
Servings per package : **5**		
	Per 100 ml	**Per serving (200 ml)**
Energy (kcal)	100	200
(kJ)	420	840
Carbohydrate (g)	23.8	47.6
Total sugars (g)	11.5	23.0
Protein (g)	1.1	2.2
Fat (g)	5.8	11.6
Monounsaturated fatty acids (g)	2.1	4.2
Polyunsaturated fatty acids (g)	1.0	2.0
Saturated fatty acids (g)	2.4	4.8
Trans fatty acids (g)	0.3	0.6
Sodium (mg)	20	40
Cholesterol (mg)	49	98
Dietary fibre (g)	1.8	3.6
Vitamin A (µg RE)	80	160
Vitamin D (µg NE)	1.2	2.4
Vitamin E (mg)	0.5	1.0
Vitamin C (mg)	10.0	20.0
Thiamin (mg)	0.1	0.2
Riboflavin (mg)	0.6	1.2
Niacin (mg)	1.0	2.0
Vitamin B6 (mg)	0.1	0.2
Folate (µg DFE)	22	44
Vitamin B_{12} (µg)	0.4	0.8
Calcium (mg)	270	540
Magnesium (mg)	19	38
Iron (mg)	1.5	3.0
Zinc (mg)	2.3	4.6
Iodine (µg)	8	16

*Optional nutrients refer to those nutrients that are not classified as mandatory nutrients, namely energy, carbohydrate, total sugars, protein, fat and sodium.
Source: MOH (1985)

14.2.1.4 Use nutrition label wisely

Nutrition labels can be a useful source for nutrition information. This information is commonly found in a table on the product label, known as the Nutrition Information Panel (NIP) (Tee *et al.,* 2018). Food regulations in Malaysia require that products must provide information on the amount of energy, carbohydrate, protein, fat, sodium and total sugars on the label. In certain products, consumer may also find content of other nutrients such as vitamins, minerals, dietary fibre and cholesterol. The consumer can then consider how this food contributes to the total nutrient intake of the day. Figure 14.4 explains the different components of the Nutrition Information Panel and can serve as a guide to its use.

Nutrition labels will also enable a consumer to compare the nutrient composition of the different brands available for the same food item (Figure 14.5). He should be guided by the content of all the nutrients provided on the label, not merely the level of one nutrient, for example fat. He should choose a product that meets energy and nutrient requirements, whether he need more or less of certain nutrients. Nutrition labels can stimulate the consumer to be more nutrition conscious. He should think of "nutrition", not just when he is purchasing processed foods, but also when he is making choices for fresh food, cooked meals, as well as when preparing his daily meals (Tee, 2006a).

It should be borne in mind that nutrition labelling is only one of the educational tools in guiding food choices. Use this, in addition to other reliable sources of nutrition information, to strengthen nutrition knowledge about food and nutrition and their role in health and disease.

14.2.2 Permitted nutrition claims

Nutrition claims are permitted on food labels, with the introduction of a nutrition claims regulations by the Ministry of Health in 2003 (MOH, 1985).

Five types of nutrition claims are permitted and these are along the line of the guidelines of the Codex Alimentarius, a set of international standards and guidelines established by a Joint Food Programme of the Food and Agriculture Organization and World Health Organization (FAO/WHO, 2013).

The five types of nutrition claims permitted in Malaysia are:

a. Nutrient content claim
b. Nutrient comparative claim
c. Nutrient function claim
d. Other function claim
e. Nutrient addition or fortification claim

As the name suggests, nutrient content claim describes the level of a nutrient in a food product. A permitted nutrient content claim on the label of a beverage is, for example, "source of vitamin C" or "high in calcium". Similarly, such claims can be made for protein, dietary fiber, alpha-linolenic acid, ganglioside and 13 vitamins as well as 11 minerals. These are the so-called "good nutrients" which are encouraged to be consumed as they are supposedly beneficial to health. In contrast to the above, another type of nutrient content claim is, for example, "low in cholesterol" or "fat free". These claims are the so-called "bad nutrients", namely, energy, fat, saturated fat, cholesterol, trans fatty acids, sugars and sodium which are discouraged to be consumed. There are, of course, no "bad nutrients", with the exception of trans fatty acids. All nutrients, including energy, fat and cholesterol are all required for normal body functions. It is really the excessive intakes of these nutrients that are undesirable. Indeed, excessive intakes of vitamins and minerals too, are undesirable! The permitted nutrient content claims and the required conditions for making such claims are given in Table 14.4.

A nutrient comparative claim is a claim that compares the nutrient levels and/ or energy values of two or more foods. One such claim is "less fat", or "reduced sodium". The opposing comparative claim is "extra vitamin A", or "more protein", and so on.

The third type of nutrition claim is the nutrient function claim, which describes the physiological role of the nutrient in growth, development and normal functions of the body. An example of such claim is: calcium helps in the development of strong bones and teeth.

Besides nutrients in the classical sense, the fourth type of claims are other function claims for several food components. Other function claim that describes specific beneficial effect of other food component in the food that gives positive contribution to health or improvement of a function of the body. Examples are: plant sterol helps to lower blood cholesterol; oat soluble fibre (beta-glucan) helps to lower blood cholesterol.

The Ministry of Health has published a total of 23 permitted nutrient function claims for 15 vitamins and minerals (Table 14.5). These claims include those for nutrients and have been supported by scientific data for a long time, e.g., for iron, vitamins A, B and C. MOH has also provided another list of 43 permitted other function claims for 22 other food components, which have been approved based on more recent scientific findings (Table 14.6) (MOH, 1985). These are mostly for non-nutrients, or the "other food components". Only the claims on these two lists are permitted on food labels. If the food industry wishes to propose a new claim for a nutrient or other food component, an application has to be made to the Ministry of Health. In the process of permitting a new nutrition claim, MOH adheres to stringent rules that require the application to submit a dossier which includes scientific evidence to substantiate the intended claim (MOH, 2010).

This food regulation has required the food must contain a specified minimum amount of the nutrient or other food component, where specific criteria that must be met before the nutrient function claims and other function claims are permitted on a label.

The fifth type of claim is related to the addition or fortification of nutrients and other food components to food. Claim for "contain", or "added" (or words of similar meaning) or "enriched" or "fortified" (or words of similar meaning) with specific vitamins, minerals, amino acids, fatty acids, nucleotides, or other food components (with permitted other function claims). To be able to make these claims, the food must meet specified minimum levels as stipulated by Food Regulations 1985 (Table 14.7). Some examples of nutrient addition claim are: "This beverage contains prebiotics" or "This milk powder has added DHA" while examples of nutrient enrichment or fortification claims are: "This bread is enriched with vitamin B_2", or "This flour is fortified with iron".

If a food label has any of the nutrition claims mentioned above, a further condition must be met: the amount of all the mandatory core nutrients (energy, protein, carbohydrate, total sugars, fat and sodium) as well as the nutrient or other food component that is being claimed are mandatory to be declared on the label.

14.2.2.1 Reduction of disease risk claims are not permitted

Claims linking the consumption of a food or food component to the reduced risk of developing a disease is not permitted. Hence, a claim that "nutrient A helps reduce risk to coronary heart disease" is not permitted to be made on the food label.

Consumers should realise that chronic diseases have multiple causes and taking a particular nutrient or food component alone will not reduce risk to any diseases, for instance: coronary heart diseases, diabetes or cancers. In addition to taking that nutrient or food, one must practice overall healthy eating and adopt a healthy lifestyle. The consumers should not be misled by a health claim and consume excessive amounts of this food and omit other items from his diet.

14.2.2.2 Appropriate and effective use of nutrition claims

Nutrition claims provide further information to the consumer, in addition to the declaration of amounts of nutrients on the label. For consumers, the nutrition claim on the label becomes a value-added point of product differentiation. Provided that they are scientifically substantiated, nutrition claims related to food products can facilitate consumers to make well-informed food choices. Nutrient content claim describes the level of nutrient in a food product, for example, "high in" or "source of" certain nutrients (e.g., protein, fibre, vitamins, minerals), or "low in" or "free of" certain nutrients (e.g., sugar, sodium, fat). Nutrient comparative claim compares the nutrient levels between two or more similar foods, for example "more", "extra" or "lower" or "less". Both of these claims provide descriptions of what those amounts of nutrients are.

Some consumers incorrectly view that a food with nutrition claim is a healthier option compared to another similar product without such claims. Indeed, it should be pointed out to the consumers that it does necessarily mean that a product carrying a nutrition claim on the label is automatically a better choice. Over emphasis on a nutrition claim on a label could hinder the consumer from seeking additional information (NIP, ingredient list etc.) on the label and could lead to a wrong food choice. Consumers should be advised that such descriptors should be viewed in the right context and used appropriately (WHO, 2004; Tee, 2006b).

Amongst the same category or type of food, a consumer may use such claims to guide in the selection of a particular brand. For example, amongst several similar beverages, the consumer may give preference to the one with "high vitamin C" claim. Amongst various brands of curry chicken, he may prefer the one with "low sodium" claim.

A consumer, however, should not select a food merely based on one such claim. The beverage with the "high vitamin C" claim may have a high sugar content. Similarly, the chicken curry with the "low sodium" claim may have more fat compared to another brand. It does not mean that a food that does not have a "low in fat" claim is bad for the consumer. Similarly, it does not mean that a food with a "cholesterol free" claim is the best choice. It should be emphasised that the consumer must look for the overall nutritional profile as provided by the NIP of the food and not just rely on one or two claims on the label (Tee *et al*, 2019).

Nutrient function claim and other function claim provide information to the consumers regarding the physiological role and specific beneficial effect of that particular nutrient or food component that gives positive contribution to the functioning of the body. These types of claims can potentially provide useful information to a consumer, when used together with other nutrition information from various sources. It should be emphasised to the consumer that this claim should not imply that the nutrient cures, treats or protects a person from diseases (Tee, 2006b).

14.2.3 Front-of-Pack Nutrition Labelling (FOP-NL) as additional guides in making food choice

Front-of-pack nutrition labelling (FOP-NL) is any system that presents simplified nutrition information on the front-of-pack of pre-packaged foods. It can include symbols/ graphics, text or a combination thereof, that provide information on the overall nutritional value of the food and/ or on the nutrients contained in the product (FAO/ WHO, 2019). Two FOP-NL systems, namely energy icon and Healthier Choices Logo (HCL) were introduced in Malaysia in 2012 and 2017, respectively.

14.2.3.1 Energy icon

Energy Icon or the Front of Pack Labelling for Energy is a tool that was introduced by the Ministry of Health Malaysia in 2012. This informative system aims at providing instant information on the amount of calorie/ energy content (in one serving) of a particular product at the front panel of a package. The icon also shows the percentage of calorie/ energy contributed by one serving of that product, expressed as percentage of 2000 kcal, which is the average daily energy requirement of a normal weight adult. During grocery shopping, consumers might use the Energy Icon as a quick guide of a packaged food's calorie/ energy content. Figure 14.1 shows how the calorie/ energy contained in a serving of a food and percent contribution to daily energy-requirement can be quickly interpreted.

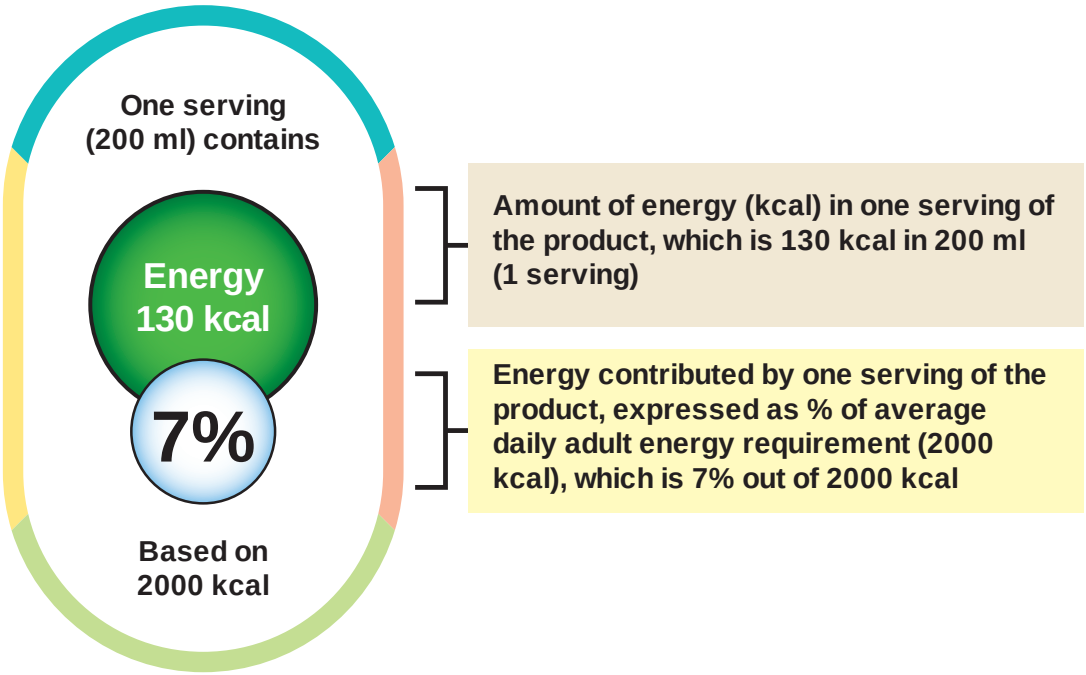

Figure 14.1: An example of NIP of Energy Icon
Source: Tee *et al.* (2019)

The nutrition information that can be obtained and interpreted from the Energy Icon helps the consumers to monitor their total calorie intake according to their actual requirement. It helps to ensure that the total calorie intake do not exceed the recommended daily calorie intake, thereby helping consumers to avoid over-consumption. In addition, consumers who are concerned about excessive energy intake can use the Energy Icon to compare the calorie contents of two or more products within the same category and hence make smarter choice (Tee *et al.,* 2018).

It should be noted that not all the packaged foods on the market will have the Energy Icon on their label. This is because the FOP-NL is a voluntary programme agreed upon by the food and beverage industries and not mandated by law.

14.2.3.2 Healthier Choice Logo (HCL)

The Healthier Choices Logo (HCL) is an initiative introduced by the Ministry of Health in April 2017. HCL is a criteria-based front-of-pack scheme that is intended to provide point-of-sale information to the consumers in making informed food choices by merely looking at the front panel of the food packages. Packaged foods and beverages can be awarded the HCL Logo if they meet the nutrient criteria specified by the Ministry of Health Malaysia. Consumers can easily identify the healthier products within the same category if the products carry the HCL Logo as per shown in Figure 14.2. A specific HCL statement is required to be displayed below the HCL Logo to further indicate that the comparison is only within the same product category. Consumers should be reminded not to choose products solely based on the HCL Logo. They should be advised to refer to other available information (NIP, nutrition and health claims, ingredient list etc.) as well to understand the nutritional quality of a product (Tee *et al,* 2019).

Perbandingan produk dalam kategori **bijirin sarapan* sahaja
Compared within **breakfast cereal* category only

Note:
***Except for drinking water / mineral water and fresh milk, products are required to include this statement below the logo to indicate that the comparison is only within the same product category.**

Figure 14.2: Prescribed HCL Logo
Source: MOH (2020)

A standard set of nutrient profile, termed as HCL nutrient criteria has been established to determine the healthier product within the same category in the HCL programme. In 2017, an HCL Expert Committee that comprises policy makers, experts and academicians from the fields of nutrition, food technology and food science was formed to revise and develop the HCL nutrient criteria. Different nutrient criteria have been established for each food category and is used to determine the healthier products within the same product category. Only products that comply with the prescribed HCL nutrient criteria will be deemed as healthier within that category and will be approved to carry the HCL logo. These standardised nutrient profiles for the different food categories provides guidance to the food and beverage industries and stimulate product innovation and reformulation towards healthier options. The MOH has also informed stakeholders that the criteria will be reviewed and tightened from time to time to reflect either the latest scientific updates or the prevailing food and nutrition situation in the country. This stepwise nutrient criteria revision provides impetus to the industries to continuously improve their products. In addition, this gradual approach helps facilitates the consumers to gradually accustom their taste and preference towards products with lower calories, sugar, fat and sodium content (CIF, 2019). Ultimately, the desired outcome of this FOP-NL is to create an environment that supports healthy eating and hence combating the increasing trend of non-communicable diseases (NCDs) and the prevalence of obesity in Malaysia (MOH, 2020).

The implementation of HCL is also on a voluntary basis. Food and beverage companies may apply to Ministry of Health for the use of this logo. Only products which are in full compliance with the Food Regulation 1985 as well as Guidelines on Healthier Choice Logo Malaysia may be approved to carry the logo on the product label for a duration of 2 years. Further details on the HCL may be obtained from the Guidelines on Healthier Choice Logo Malaysia (MOH, 2020).

14.2.4 Ingredients list

The ingredients that are used to formulate a product will determine its nutritional value. All prepackaged food products must contain an ingredient list. Hence, this ingredient list can be useful in guiding consumers in choosing products appropriate to his needs. The ingredients are listed in order of weight, from the most to the least. For example, if the first few ingredients are whole grains such as whole grain wheat, oat, or barley, the food contains a high proportion of whole grain. If sugar or similar terms such as sucrose, glucose, fructose, corn syrup is listed as the first few ingredients, the food is high in sugar (Tee *et al.,* 2019). It should be noted that an ingredient maybe listed in different terms. For example, sugar may be listed as sucrose, glucose, fructose or corn syrup.

14.2.5 Educate from an early age

Children begin to have a further interaction with the environment when they start going to school. During this time, they begin to take care of themselves more, and need to make many choices. These include making food choices. It is vital for the children to establish good habits, and this should include choosing proper and healthy foods on their own. Therefore, it is important to inculcate the habit of reading food labels among our children to influence their eating habits from the early ages. Such knowledge and experience gained will have a tremendous long-term impact and assist them in making healthy food choices for life. In this regard, parents and teachers can play key roles.

Educating children to understand nutrition information on food label can be anywhere, whether in supermarkets, at home or as part of the school syllabus. There are many opportunities to create an enjoyable environment to decode new experience on food labels and make healthier choices. Never underestimate the potential benefits of informal education opportunities. Children who tag along with parents when shopping in supermarkets could be educated on nutrition labelling. These are excellent opportunities to discuss with children about making healthy food choices, how to use the nutrition information on the label and the significance of the nutrients and the values declared. It can be in the form of games too, like hunting to find nutritious options – example: wholegrain cereal that is low in sugar and sodium, but high in calcium and fibre. Educating the basics nutrition principle and nutrition label to children can also be done easily at home. The foods they like to eat can be used as an example with the nutritional information on hand. While snacking, point to them to look at the nutrition information panel and serving size to discover what they are eating.

Helping children to understand nutrition information on food label is a lot easier if parents and teachers themselves understand the content of those labels. They can start by focusing on a few simple items on the food label. For example, start with the basics by showing the healthier choice logo or ingredient listing on the food label. Once the children have mastered that, move to the next phase to the more complex parts of the label, for example the nutrition information panel (NIP). Even within the NIP, break up into several sessions and start with understanding basic information such as serving size. Understanding the calorie content of foods is useful. However, depending on the age of the children, it may not be useful to explain the content of all the vitamins and minerals declared on the NIP.

Children must be familiarised with nutrition even in their early years and let nutrition principles guide them to a healthier future (Tee, 2006a). By educating children to understand nutrition information on food labels early, we are preparing them with an important skill for making healthier food choices, which will help shaping their eating habits for life.

14.3 Current status

Since the gazetting of the nutrition labelling and claims regulations in 2003 in Malaysia, several small scale studies, amongst various consumer groups in different parts of the country have been conducted since 2010 to determine the extent consumers are reading nutrition labels and claims, their understanding and utilisation of these information.

Zul Ariff & Mohamad Armizi (2015) reported that consumers believed that those food products with nutrition label might indicate that they are quality products. Their purchasing behaviour were based on the availability of nutrition declaration on food labels. There were reported mixed findings between gender and attitude towards the use of nutrition label (Nurliyana *et al.*, 2011; Norazlanshah *et al.*, 2013; Hayati Adlin *et al.*, 2015; Anne Tan *et al.*, 2020). The investigators also reported that even though consumers have better knowledge about nutrition labelling, this finding had no effect on the use of nutrition label (Nurliyana *et al.*, 2011; Norazlanshah *et al.*, 2013; Norsakira *et al.*, 2019; Anne Tan *et al.*, 2020).

Several factors were determined to be associated with the reasons why consumers did not read nutrition label such as difficulty in understanding, confusion, time constraints, small font size, lack of interest, purchasing the same products regularly and no health concern (Norazmir *et al.*, 2012; Nurliyana *et al.*, 2011; Norsakira *et al.*, 2019; Anne Tan *et al.*, 2020). Fatimah *et al.* (2010) also reported that despite a "perfect" NIP format preferred, it was not necessarily resulted the ability to extract information from the NIP. A few studies also highlighted the importance to strengthen the strategy on nutrition labelling education and advocacy programmes (Fatimah *et al.*, 2010; Hayati Adlin *et al.*, 2015).

The largest data set available on the use and understanding of nutrition labelling are findings from the Third National Health and Morbidity Survey (NHMS III) carried out in 2006 (IPH, 2008). This nationwide survey included a section on determining the practices of seeking information on food and nutrition labels among the community. The total number of respondents in this survey who responded to questions on food/ nutrition labelling was 39,506. The study reported that 78.2% of the responses read the nutrition label when buying or receiving food. The most popular information in food label that the respondents read was the expiry date (71.2%). Less than 15% of the responses were looking for nutritional information such as energy (4.7%), fat (9.7%), carbohydrate (7.5%), vitamin (8.2%), salt (5.3%), mineral contents (4.3%), food additives (6.2%) and others (6.2%). Only 27 respondents (< 1%) actually took note of all the six elements of nutritional labelling (total energy, carbohydrate content and sugar, fat, salt/ sodium, vitamin, mineral). The study did not include aspects related to nutrition and health claims.

When the same study was repeated under Malaysian Adult Nutrition Surveys (MANS) in 2014, involving 2992 subjects nationwide, the prevalence of reading nutrition information from food label was 45.0% (IPH, 2014). Among those who read nutrition label, the nutritional information they were looking for were energy (14.5%), fat (19.9%), carbohydrate (including sugar) (21.6%), vitamin (9.1%), salt (6.7%), mineral contents (5.6%), food additives (6.2%) and fibre (3.3%). Expiry date remained the most popular information been read compare to nutritional information (82.2%).

There has been no published national study focusing on the FOP-NL in Malaysia.The first study to determine the awareness and understanding of the FOP energy icon on food labels was done in Negeri Sembilan, Malaysia (Fatimah, Ruhaya & Zainudin, 2019a). The study showed that a high percentage (84.7%) (n = 310) were aware of the energy icon on food label. Among these respondents, more than half or 66.1% (n = 242) reported that it was easy to recognise the energy icon, while18.9% (n = 69) responded that it was hard to find the icon and 15.0% (n = 55) were not sure of the icon. The study also showed that almost half (47.6%) (n = 174) of the respondents can extract the information from the energy icon "excellently" (scored 10 and 9 marks) when were requested to do so.

Fatimah, Ruhaya & Zainudin, (2019b) also reported that 80% of the respondents in Negeri Sembilan (n = 294) supported the implementation of HCL in Malaysia. Majority of them (81%, n = 297) believed that the use of the HCL is foreseen to increase one's confidence in choosing food products. About 60% (n = 220) of the respondents would still choose to buy the products that bears the HCL even though the price may be slightly higher. The study also reported that a combination of three labelling systems, namely Nutrition Information Panel (NIP), Healthier Choice Logo (HCL) and Energy Icon was most preferred by the respondents (57.9%, n = 212).

14.4 Key Recommendations

Key Recommendation 1

Be aware of the importance of reading food labels.

How to Achieve

1. Make reading labels as a habit while doing grocery shopping.

2. Identify the nutrition information on food labels.

3. Be familiar with all the available nutrition information on food labels to have a better understanding of the nutritional value of a product.

Key Recommendation 2

Use Nutrition Information Panel (NIP) to guide in making healthier food product choices.

How to Achieve

1. Be familiar with information on the amount of energy and nutrients in prepackaged foods.

2. Consider how the energy and nutrients contained in a food contribute to the total intake of the day by referring to the "per serving" column in NIP.

3. Compare the content of all the nutrients on the label of the different brands available for the same food item by referring to the "per 100 g or per 100 ml" column in NIP.

Key Recommendation 3

Make use of nutrition claims wisely.

How to Achieve

1. Look out for the following key words in relation to nutrient content claim and comparative claim:

    - Nutrient Content Claim

        - **"low in", "free of", "zero", "no"** or words of similar meaning for product that contains certain nutrients that are to be reduced in intake (e.g., sugar, sodium and cholesterol).

        - **"source of", "high in", "rich in"** or words of similar meaning for product that contains certain nutrients that are encouraged to be consumed (e.g., calcium, dietary fibre and protein).

    - Nutrient Comparative Claim

        - **"reduced", "less than", "light", "fewer"** or words of similar meaning for product that has a new formulation with lower or reduced amount of certain nutrients.

        - **"increased", "more", "extra"** or words of similar meaning for product that has a new formulation with increased or extra amount of certain nutrients.

2. Be mindful that nutrient function claims and other function claims do not imply that the nutrient cures, treats or protects a person from diseases.

3. Be aware that disease risk reduction claims that suggest that a food or food component can reduce the risk of a disease are not permitted.

4. Make use of nutrition claims together with other nutrition information from various sources in making food choices.

Key Recommendation 4

Use Front-Of-Pack Nutrition Labelling (FOP-NL) as additional guide to make informed choices.

How to Achieve

1. Use Energy Icon to know the energy content of a packaged food.

2. Use Energy Icon to know how many percent of energy one serving of the product contributes to the amount needed daily.

3. Use Healthier Choice Logo (HCL) to identify the healthier products within the same food category.

4. Make use of FOP-NL in conjunction with other nutrition information on the food labels (NIP, nutrition claims and ingredient listing) to make food choices.

Key Recommendation 5

Use ingredient list on food label to understand the content of a food product.

How to Achieve

1. Look at the ingredient list, which lists ingredients in descending order by weight; the first few ingredients listed are the main ingredients of that particular product.

2. Look for products with sugars and salt towards the end of the list if you are looking for products that are lower in sugars or salt.

3. Note that an ingredient maybe listed in different terms. For example, sugar may be listed as sucrose, glucose, fructose or corn syrup.

Key Recommendation 6

Educate children on the use of all the nutrition information on food label.

How to Achieve

1. Familiarise children with nutrition information even in their early years and let nutrition principles guide them in making healthier food choices throughout life.

2. Create opportunities to educate children about nutrition information on food label.

3. Explain to them the nutrition information and the significance of each component on the label.

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Appendices

Figure 14.3: Nutrition information on food label
Source: MOH (2019)

Table 14.3: Foods requiring mandatory nutrition labeling

Regulation No	Food category	Types of food (as extracted from Food Regulations 1985)
63-75	Prepared cereal food and bread	Pasta, prepared cereal food (including breakfast cereals), bread (white bread, fruit bread, milk bread, meal bread, rye bread, wheat-germ bread, wholemeal bread, enriched bread).
84-87, 89-113, 116	Milk & milk products	Skimmed milk or skim milk or non-fat milk or separated milk, pasteurized milk, sterilised milk, ultra-high temperature milk or U.H.T. milk, flavoured milk, full cream milk powder or dried full cream milk, skimmed milk powder or skim milk powder or dried non-fat milk solids or separated milk powder, malted milk powder, recombined milk, reconstituted milk, evaporated milk or unsweetened condensed milk, condensed milk, sweetened condensed milk, lactose hydrolysed milk, filled milk, filled milk powder, evaporated filled milk/ unsweetened condensed filled milk, condensed filled milk/ sweetened condensed filled milk, cream/ raw cream, pasteurized cream, reduced cream/ pouring cream, butter, recombined butter, ghee, cheese, cottage cheese, cream cheese, processed cheese, cheese paste, cheese spread/ cheese mixture, club cheese/ luncheon cheese, dried cheese/ powdered cheese, cultured milk/ fermented milk, ice cream.
134B	Sweetening substance	Sweetened creamer.
135	Flour confection	Any pastry, cake, biscuit/ other product prepared from mixture of flour/ meal and other food.
146-152	Meat products and canned meat	Meat paste, manufactured meat, smoked meat, canned meat, canned meat with other food, meat extract/ meat essence.
157-170	Fish products and canned fish	Fish product, cured, pickled/ salted fish, smoked fish, prepared fish, canned fish, fish paste, *belacan*, fish sauce, *cincalok,* oyster sauce, oyster flavoured sauce, fish ball or fish cake, fish *keropok, otak udang, petis/ heko, pekasam.*
177	Egg product	Preserved egg
185-207 palm	Edible fats and edible oil	Margarine, fat spread, *vanaspati,* general standard for edible oil, cooking oil, refined coconut oil, unrefined coconut oil, corn oil, cottonseed oil, groundnut oil, peanut oil/ arachis oil, mustard seed oil, refined, bleached, deodorized palm oil, neutralised, bleached, deodorized palm oil, refined, bleached, deodorized palm olein, neutralised, bleached, deodorized olein, refined, bleached, deodorized palm kernel oil, olive oil, rice bran oil, rapeseed oil or toria oil, safflower seed oil, sesame seed oil/ gingelly oil, soya bean oil, sunflower seed oil.
214-221	Vegetable products and juices	Salted vegetable, dried salted vegetable, tomato paste, tomato pulp, tomato puree, vegetable juice, canned vegetable, fermented soya bean product.
223-224	Soup and soup stock	Soup, soup stock.

Table 14.3: Foods requiring mandatory nutrition labeling (cont...)

Regulation No	Food category	Types of food (as extracted from Food Regulations 1985)
226-242	Fruit products and juices	Dried fruit, mixed dried fruit, fruit product, candied fruit or glaced fruit/ crystallised fruit, salted fruit, dried salted fruit, candied peel, canned fruit, canned fruit cocktail, fruit juice,apple juice, grapefruit juice, lemon juice, lime juice, orange juice, passion fruit juice, pineapple juice.
246-249	Jam, fruit jelly, marmalade and seri kaya	Jam, fruit jelly, marmalade, *seri kaya.*
252-259	Nuts and nut products	Nut, coconut milk, coconut cream, coconut cream concentrate, coconut cream powder, dessicated coconut, coconut paste, peanut butter.
269A	Tea, coffee, chicory and related products	Premix coffee.
279-281	Cocoa products	Chocolate, white chocolate, milk chocolate.
282	Milk shake	Milk shake.
339-347	Sauce, chutney and pickle	Sauce, soya sauce/ soya bean sauce/ kicap, hydrolysed vegetable protein sauce/ hydrolysed plant protein sauce, blended hydrolysed vegetable protein sauce/ blended hydrolysed plant protein sauce, chilli sauce, tomato sauce/ tomato ketchup/ tomato catsup, salad dressing, mayonnaise, chutney, pickle.
348-358	Soft drinks	Syrup, fruit syrup/ fruit cordial/ fruit squash, flavoured syrup/ flavoured cordial, fruit juice drink, fruit drink, flavoured drink, soft drink base/ soft drink premix, botanical beverage mix, soya bean milk, soya bean drink.
360D–360E	Packaged drinking water	Isotonic electrolyte drink, isotonic electrolyte drink base.
26 (7)	Foods that “contain” or “added” (or words of similar meaning) or “enriched” or “fortified” (or words of similar meaning) with specific vitamins, minerals, amino acids, fatty acids, nucleotides or other food components (with permitted other function claims).	
18B (14)	Foods that make any nutrition claim on a label of a food product pertaining to its nutritional quality.	
388-391	Special purpose foods: infant formula, follow-up formula, canned food for infants and young children and cereal-based food for infants and young children.	

Source: MOH (1985)

The NIP lists the amount of energy and several nutrients contained in the food. Example below explains the different components of the NIP.

Nutrition Information		
Serving size : **5 pieces (20 g)**		
Servings per package : **5**		
Nutrients	**Per 100 g**	**Per serving (20 g)**
Energy (kcal)	525	105
Carbohydrate (g)	56.2	11.2
Total sugars (g)	12.5	2.5
Protein (g)	8.0	1.8
Fat (g)	29.8	6.0
Sodium (mg)	25.0	5.0

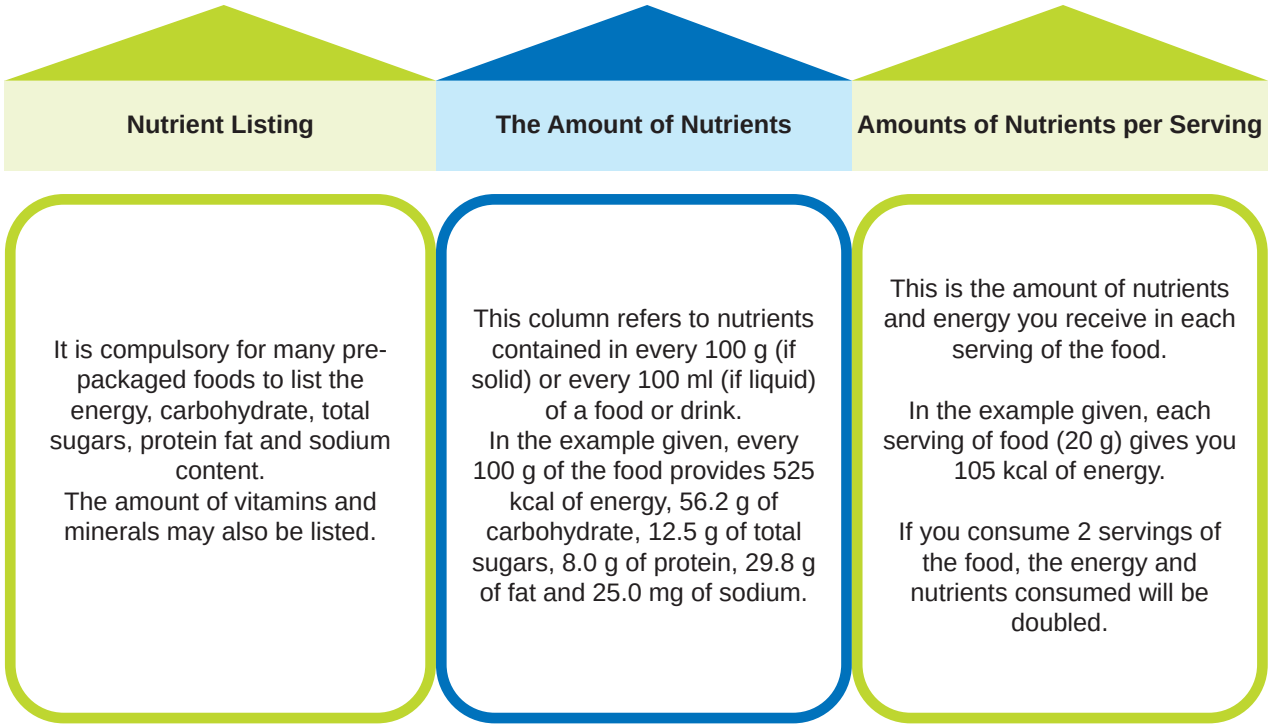

Figure 14.4: Components of Nutrition Information Panel (NIP)
Source: Tee *et al.* (2008)

The NIP on food label enables the comparison of the nutritional content among different brands of similar food and find out which ones are higher or lower in certain nutrients, thereby guiding choice of food. Example below compares two brands of a similar food product.

Source: Tee *et al.* (2019)

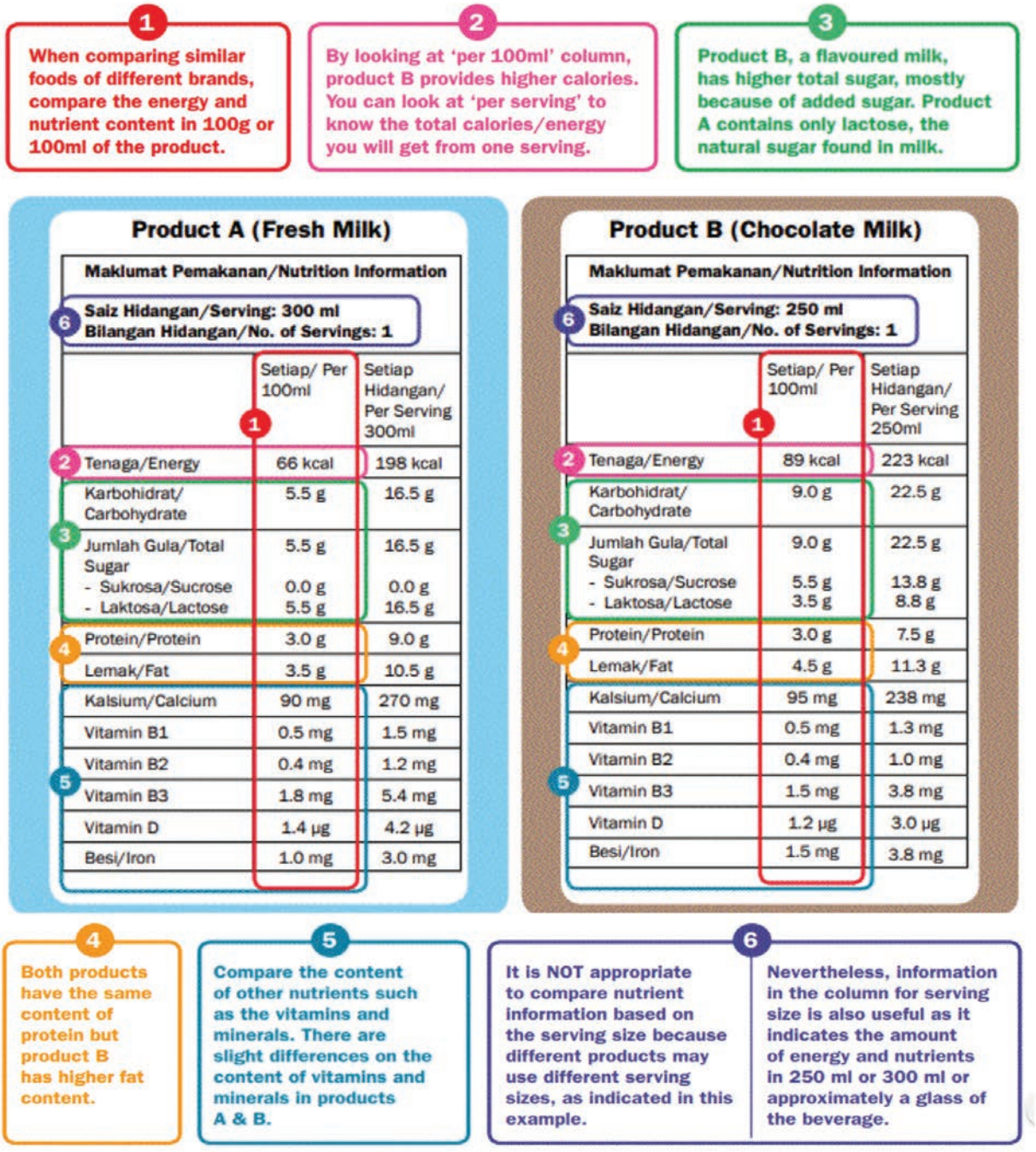

Figure 14.5: Guide to use of NIP to compare nutrient content of different brands

Table 14.4: Permitted nutrient content claims and the conditions to carry the claims on labels

Component	Claim	Not more than
Energy	Low	40 kcal (170 kJ) per 100 g (solids) or
		20 kcal (80 kJ) per 100 ml (liquids)
	Free	4 kcal per 100 g (or 100 ml)
Fat	Low	3 g per 100 g (solids) or
		1.5 g per 100 ml (liquids)
	Free	0.15 g per 100 g (or 100 ml)
Saturated fat	Low	1.5 g per 100 g (solids) or
		0.75 g per 100 ml (liquids) and
		10% of total energy of the food
	Free	0.1 g per 100 g (solids) or
		0.1 g per 100 ml (liquids)
Cholesterol	Low	0.02 g per 100 g (solids) or
		0.01 g per 100 ml (liquids)
	Free	0.005 g per 100 g (solids) or
		0.005 g per 100 ml (liquids)
Trans fatty acids	Low	1.5 g per 100 g (solids) or
		0.75 g per 100 ml (liquids) and
		10% of total energy of the food
	Free	0.1 g per 100 g (solids) or
		0.1 g per 100 ml (liquids)
Sugars*	Low	5 g per 100 g (solids) or
		2.5 g per 100 ml (liquids)
	Free	0.5 g per 100 g (solids) or
		0.5 g per 100 ml (liquids)
Sodium	Low	0.12 g per 100 g (solids) or
		0.06 g per 100 ml (liquids)
	Very low	0.04 g per 100 g (solids) or
		0.02 g per 100 ml (liquids)

Table 14.4: Permitted nutrient content claims and the conditions to carry the claims on labels (cont...)

Component	Claim	Not more than
	Free	0.005 g per 100 g (solids) or
		0.005 g per 100 ml (liquids)
Gluten	Reduced	0.01 g per 100 g (solids or liquids)
	Free	0.002 g per 100 g (solids or liquids) *The claim of "reduced gluten" is only permitted in food consisting of one or more ingredients from wheat, rye, barley, oats or their crossbred varieties, which have been specially processed to reduce the gluten content*

Component	Claim	Not less than
Protein	Source	10 % of NRV per 100 g (solids) or
		5 % of NRV per 100 ml (liquids) or
		5 % of NRV per 100 kcal
	High	(at least 2 times the value for "source of")
Vitamins and minerals	Source	15 % of NRV per 100 g (solids) or
		7.5 % of NRV per 100 ml (liquids) or
		5 % of NRV per 100 kcal
	High	(at least 2 times the value for "source of")
Dietary fibre	Source	3 g per 100 g (solids) or
		1.5 g per 100 ml (liquids)
	High	6 g per 100 g (solids) or
		3 g per 100 ml (liquids)
Alpha-linolenic acid	Source	0.3 g per 100 g
	High	0.6 g per 100 g
Ganglioside	Source	11 mg per 100 g This claim is only permitted in milk product and dairy products that naturally contains ganglioside

*Refer to all monosaccharides and disaccharides
NRV = Nutrient Reference Value
Source: MOH (1985)

Table 14.5: Permitted nutrient function claims

Component	Claim	Minimum Amount Required
Folic acid	(i) Folic acid is essential for growth and division of cells. (ii) Folate plays a role in the formation of red blood cells. (iii) Folate helps to maintain the growth and development of the foetus.	60 μg DFE per 100 g (solid) 30 μg DFE per 100 ml (liquid) 20 μg DFE per 100 kcal
Iron	(i) Iron is a factor in red blood cell formation. (ii) Iron is a component of haemoglobin in red blood cell which carries oxygen to all parts of the body.	2.1 mg per 100 g (solid) 1.05 mg per 100 ml (liquid) 0.7 mg per 100 kcal
Iodine	Iodine is essential for the formation of thyroid hormone.	22.5 μg per 100 g (solid) 11.25 μg per 100 ml (liquid) 7.5 μg per 100 kcal
Calcium	Calcium aids in the development of strong bones and teeth.	150 mg per 100 g (solid) 75 mg per 100 ml (liquid) 50 mg per 100 kcal
Magnesium	Magnesium promotes calcium absorption and retention.	46.5 mg per 100 g (solid) 23.25 mg per 100 ml (liquid) 15.5 mg per 100 kcal
Niacin	Niacin is needed for the release of energy from proteins, fats and carbohydrates.	2.25 mg NE per 100 g (solid) 1.125 mg NE per 100 ml (liquid) 0.75 mg NE per 100 kcal
Protein	(i) Protein helps build and repair body tissues. (ii) Protein is essential for growth and development. (iii) Protein provides amino acids necessary for protein synthesis.	5 g per 100 g (solid) 2.5 g per 100 ml (liquid) 2.5 g per 100 kcal
Vitamin A	(i) Vitamin A aids in maintaining the health of the skin and mucous membrane. (ii) Vitamin A is essential for the functioning of the eye.	120 μg RE per 100 g (solid) 60 μg RE per 100 ml (liquid) 40 μg RE per 100 kcal
Zinc	Zinc is essential for growth.	1.65 mg per 100 g (solid) 0.825 mg per 100 ml (liquid) 0.55 mg per 100 kcal
Vitamin B_1/ thiamine	Vitamin B1/ thiamine is needed for the release of energy from carbohydrate.	0.18 mg per 100 g (solid) 0.09 mg per 100 ml (liquid) 0.06 mg per 100 kcal
Vitamin B_2/ riboflavin	Vitamin B2/ riboflavin is needed for release of energy from proteins, fats and carbohydrates.	0.18 mg per 100 g (solid) 0.09 mg per 100 ml (liquid) 0.06 mg per 100 kcal

Table 14.5: Permitted nutrient function claims (cont...)

Component	Claim	Minimum Amount Required
Vitamin B_{12}/ cyanocobalamin	Vitamin B_{12}/ cyanocobalamin is needed for red blood cell production.	0.36 μg per 100 g (solid) 0.18 μg per 100 ml (liquid) 0.12 μg per 100 kcal
Vitamin C	(i) Vitamin C enhances absorption of iron from non-meat sources. (ii) Vitamin C contributes to the absorption of iron from food.	15 mg per 100 g (solid) 7.5 mg per 100 ml (liquid) 5 mg per 100 kcal
Vitamin D	(i) Vitamin D helps the body utilise calcium and phosphorus. (ii) Vitamin D is necessary for the absorption and utilisation of calcium and phosphorus.	2.25 μg per 100 g (solid) 1.125 μg per 100 ml (liquid) 0.75 μg per 100 kcal
Vitamin E	Vitamin E protects the fat in body tissues from oxidation.	1.5 mg per 100 g (solid) 0.75 mg per 100 ml (liquid) 0.5 mg per 100 kcal

Note:
- For all the above claims, words/ sentences of similar meaning can also be used.
- The above function claims will be reviewed from time to time based on new relevant scientific evidence as well as applications from the food industry. Updated list of permitted claims are available on the website of the Food Safety and Quality Division of the Ministry of Health Malaysia, *http://fsq.moh.gov.my/*

Source: MOH (1985)

Table 14.6: Permitted other function claims

Component	Claim	Minimum Amount Required	Conditions
Beta glucan	Beta glucan from (state the source) helps reduce cholesterol.	0.75 g per serving	i. Source of beta glucan shall be from oat and barley. ii. The food to be added with beta glucan shall also contain total dietary fibre for not less than amount required to claim as "source": • 3 g per 100 g (solids) • 1.5 g per 100 ml (liquids) iii. There shall be written on the label the following statement: • "Amount recommended for cholesterol lowering effect is 3 g per day".
Beta glucan from barley soluble fibre	i. Beta glucan from barley soluble fibre helps lower the rise of blood glucose provided it is not consumed together with other food. ii. Beta glucan from barley soluble fibre contributes to the reduction of the rise in blood glucose provided it is not consumed together with other food.	6.5 g per 100 g	i. This claim is only permitted in cereal and cereal based product. ii. This claim is only permitted for product where the macronutrient profile (carbohydrate, protein and fat) complies with Recommended Nutrient Intake (RNI) Malaysia. iii. There shall be written on the label the following statement: • "Before deciding to use this product, seek the advice of a health professional".
Beta glucan from oat soluble fibre	Beta glucan from oat soluble fibre helps to lower the rise of blood glucose provided it is not consumed together with other food.	6.5 g per 100 g	i. This claim is only permitted in cereal and cereal based product.

Table 14.6: Permitted other function claims (cont...)

Component	Claim	Minimum Amount Required	Conditions
			ii. This claim is only permitted for product where the macronutrient profile (carbohydrates, proteins and fats) complies with the Recommended Nutrient Intake (RNI) Malaysia. iii. There shall be written on the label of cereal and cereal based product the following statement: • "Before deciding to use this product seek the advice of a health professional".
Beta glucan from yeast	Beta glucan from yeast may help to support immune system associated with colds.	0.05 g per serving	i. Beta glucan from yeast shall be more than 75% on a dry weight basis. ii. There shall be written on the label the following statement: • "Amount recommended for claim effect is 0.2 g per day".
Beta Palmitin	i. Beta palmitin contributes to increase calcium absorption. ii. Beta palmitin contributes to increase fat absorption.	i. > 18% C16:0 content based on total fatty acids ii. > 40% C16:0 in sn-2 position based on total C16:0 content	Nil
Bifidobacterium lactis	i. *Bifidobacterium lactis* helps to improve a beneficial intestinal microflora. ii. *Bifidobacterium lactis* helps to reduce the incidence of diarrhea.	1 x 10^6 minimum viable cells per gram	These claims are only permitted in infant formula, follow-up formula, formulated milk powder for children and cereal based food for infant and children.
Calcium 3-hydroxy-3-methyl butyrate monohydrate (CaHMB)	i. CaHMB helps to regain strength. ii. CaHMB supports tissue building.	1.5 g per serving	This claim is only permitted in formula dietary foods.

Table 14.6: Permitted other function claims (cont...)

Component	Claim	Minimum Amount Required	Conditions
Galactooligo-saccaride (GOS) and polydextrose (PDX) mixture.	GOS and PDX mixture is a prebiotic. GOS and PDX mixture is a bifidogenic.	0.4 g per 100ml (0.2 g per 100ml GOS and 0.2 g per 100ml PDX)	i. Mixture containing 50% (weight over weight) GOS and 50% (weight over weight) PDX. ii. These claims are only permitted in infant formula and follow-up formula.
Oligofructose-inulin mixture	Oligofructose-inulin mixture helps to increase calcium absorption and increase bone mineral density when taken with calcium rich food.	2 g per serving	i. Oligofructose-inulin mixture containing shorter chain inulin (oligofructose DP 3-9) and longer chain inulin (inulin DP ≥ 10) in a 50:50 ratio ± 10% each. ii. Total fructant content in the mixture shall be more than 90% on dry weight basis.
Oligosaccharide mixture containing galactooligo-saccharide (GOS) and long chain Fructooligosacc-haride (lcFOS)	Oligosaccharide mixture containing GOS and lcFOS helps to improve the gut or intestinal immune system of infant.	The component (oligosaccharide mixture) shall be 0.8 g per 100 ml.	i. Oligosaccharide mixture containing 90% (weight per weight) GOS and 10% (weight per weight) lcFOS. ii. This claim is only permitted in infant formula and follow up formula.
	i. Oligosaccharide mixture containing GOS and lcFOS is a prebiotic. ii. Oligosaccharide mixture containing GOS and lcFOS is a bifidogenic. iii. Oligosaccharide mixture containing GOS and lcFOS helps to increase intestinal bifidobacteria. iv. Oligosaccharide mixture containing GOS and lcFOS helps to maintain a good intestinal environment.	0.4 g per 100 ml	i. Oligosaccharide mixture containing 90% (weight per weight) GOS and 10% (weight per weight) lcFOS. ii. These claims are only permitted in infant formula, follow up formula and formulated milk powder for children. iii. The component (oligosaccharide mixture) shall not exceed 0.8 g per 100 ml.

Table 14.6: Permitted other function claims (cont...)

Component	Claim	Minimum Amount Required	Conditions
Resistant dextrin or resistant maltodextrin	Resistant dextrin or resistant maltodextrin is a soluble dietary fibre that helps to regulate or promote regular bowel movement.	2.5 g per serving	Addition and claim for resistant dextrin or resistant maltodextrin are not permitted in infant formula.
	i. Resistant dextrin or resistant maltodextrin is a prebiotic. ii. Resistant dextrin or resistant maltodextrin is a bifidogenic. iii. Resistant dextrin or resistant maltodextrin helps increase intestinal bifidobacteria. iv. Resistant dextrin or resistant maltodextrin helps maintain a good intestinal environment.	4 g per serving	The minimum amount that must be present in the food to give the claim effect is proposed to be 8 g per day.
DHA and ARA	DHA and ARA helps to contribute in the visual development of infant.	A combination of 17 mg per 100 kcal DHA & 34 mg per 100 kcal of ARA	This claim is only permitted in infant formula product.
D-ribose	D-ribose helps to promote energy recovery during or after physical activities.	3 g per serving	i. This claim is only permitted in formula dietary foods. ii. There shall be written on the label the following statement: • "Do not exceed 2 servings per day".
Inulin	i. Inulin is a prebiotic. ii. Inulin is a bifidogenic. iii. Inulin helps to increase intestinal bifidobacteria and maintain a good intestinal environment.	1.25 g per serving	This minimum level is specified for food other than infant formula.
		0.4 g per 100 ml on a ready to drink basis	i. This minimum level is specified for infant formula only. ii. The component [inulin and oligofructose/ fructooligosaccride (FOS)] shall not exceed 0.6 g per 100 ml.

Table 14.6: Permitted other function claims (cont...)

Component	Claim	Minimum Amount Required	Conditions
Isomaltulose	i. Isomaltulose is a slowly hydrolysed to glucose and fructose compared to sucrose. ii. Isomaltulose provides longer lasting energy compared to sucrose. iii. Isomaltulose is a slowly released source of energy compared to sucrose.	15 g per serving	Addition and claim for isomaltulose are not permitted in infant formula.
High amylose maize resistant starch (HAMRS)	HAMRS helps to improve or promote intestinal function or environment.	2.5 g per serving	Nil
Lutein	Lutein as a predominant macular pigment in the retina that is able to filter blue light and helps to protect the eyes.	2.5 µg per 100ml (3.7 µg per 100 kcal) 20 µg per 100ml (30 µg per100 kcal) 20 µg per 100ml (20 µg per100 kcal)	This minimum level is specified for infant formula only. This minimum level is specified for follow up formula only. This minimum level is specified for formulated milk powder for children only.
Oligofructose/ fructooligosaccharide (FOS)	i. FOS is a prebiotic. ii. FOS is a bifidogenic. iii. FOS helps to increase intestinal bifidobacteria and maintain a good intestinal environment.	1.25 g per serving 0.4 g per 100 ml on a ready to drink basis	This minimum level is specified for food other than infant formula. i. This minimum level is specified for infant formula only. ii. The component of inulin and FOS shall not exceed 0.6 g per 100 ml.
Polydextrose	i. Polydextrose is a bifidogenic. ii. Polydextrose helps increase intestinal bifidobacteria. iii. Polydextrose helps maintain a good intestinal microflora.	1.25 g per serving	Nil

Table 14.6: Permitted other function claims (cont...)

Component	Claim	Minimum Amount Required	Conditions
Soy protein	Soy protein helps to reduce cholesterol.	5 g per serving	There shall be written on the label the following statement: • "Amount recommended to give the lowering effect on the blood cholesterol is 25 g per day".
Plant sterol or plant stanol or plant sterol ester	Plant sterol or plant stanol or plant sterol ester helps reduce cholesterol.	0.4 g per serving in a "free basis" form.	i. Types of plant sterol or plant stanol permitted: • "plant sterol or plant stanol, phytosterols or phytostanol, sitosterol, campesterol, stigmasterol or other related plant stanol". ii. Types of plant sterol esters permitted: • "campesterol ester, stigmasterol ester and beta-sitosterol ester" iii. Amount of plant sterol or plant stanol or plant sterol ester in a "free basis" form to be added in food shall not exceed 3 g per day. iv. Statement of the total amount of plant sterol or plant stanol or plant sterol ester contained in the product shall be expressed in metric units per 100 g or per 100 ml or per package if the package contains only a single portion and per serving as quantified on the label. v. Only the terms "plant sterol" or "plant stanol" or "plant sterol ester" shall be used in stating the presence of such components. vi. There shall be written on the label the following statements:

Table 14.6: Permitted other function claims (cont...)

Component	Claim	Minimum Amount Required	Conditions
			• "Not recommended for pregnant and lactating women, and young children under the age of five years"; • "Persons on cholesterol-lowering medication shall seek medical advice before consuming this product"; • "This product is consumed as part of a balanced and varied diet and shall include regular consumption of fruits and vegetables to help maintain the carotenoid level"; and • "With added plant sterols or plant stanol or plant sterol ester" in not less than 10 point lettering".
Slowly digestible starch (SDS)	A food containing slowly digestible starch (SDS), consumed as part of the normal first meal of the day, releases carbohydrates gradually and provides energy throughout the morning.	At least 40% of the available starch must be present as slowly disgestible starch (SDS)	Claim only permitted for SDS from starch naturally occurring in starchy foods where available carbohydrates provide at least 55 % of the total energy and where at least 55 % of the available carbohydrates is available starch.

Note:
- For all the above claims, words/sentences of similar meaning can also be used.
- The above function claims will be reviewed from time to time based on new relevant scientific evidence as well as applications from the food industry. Updated list of permitted claims are available on the website of the Food Safety and Quality Division of the Ministry of Health Malaysia, *http://fsq.moh.gov.my/*

Source: MOH (1985)

Table 14.7: Conditions for claims related to addition of nutrients or other food components

Permitted Claims	Nutrient	Conditions
"enriched", "fortified", "strengthened", "enhanced" or any other words of similar meaning.	Vitamins and minerals	Meet minimum level for claim "high in" in Table 14.4
	Amino acids, fatty acids and nucleotides	To declare the amount added in a specified quantity of the food
	Other food components (with permitted other function claims)	Meet minimum level for other function claims in Table 14.6
"contain", "added", "with" or any other words of similar meaning.	Vitamins and minerals	Meet minimum level for claim "source of" in Table 14.4
	Amino acids, fatty acids and nucleotides and other food components	To declare the amount added in a specified quantity of the food

Source: MOH (1985)

Focus Group Discussion on the Key Messages, Key Recommendations and How to Achieve of the Malaysian Dietary Guidelines 2020 (MDG 2020) (5 - 7 February 2020)

Focus Group Discussion on the Key Messages, Key Recommendations and How to Achieve of the Malaysian Dietary Guidelines 2020 (MDG 2020) (5 - 7 February 2020)

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