Ministry of Health
Brunei Darussalam

NATIONAL DIETARY GUIDELINES FOR HEALTHY EATING BRUNEI DARUSSALAM

A SCIENTIFIC DOCUMENT OF THE TECHNICAL WORKING GROUP ON THE NATIONAL DIETARY GUIDELINES

Technical Working Group of the National Dietary Guidelines
Ministry of Health, Brunei Darussalam
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Content

MINISTRY OF HEALTH
BRUNEI DARUSSALAM

Foreword by The Honorable Minister of Health

Alhamdulilah, with the blessing of Allah Subhanahu Wataala, it is a great pleasure to share with you the publication of the revised National Dietary Guidelines for Brunei Darussalam 2020.

Over the past few decades, Brunei Darussalam has undergone rapid socioeconomic growth and development. Concurrent with globalization, trade liberation and urbanization, this has led to a dramatic transition in the population lifestyle and dietary habits which has resulted in a profound impact on the health and nutritional status of the Bruneian population. Over the same period of time, our knowledge and understanding has improved as progress and new discoveries and findings are being made in the science of nutrition and health. It is, therefore, timely that our dietary recommendations for the general public are updated consistent with the latest scientific research and the current challenges posed by noncommunicable diseases in Brunei Darussalam.

In January 2016, the Ministry of Health through the Technical Working Group of the National Dietary Guidelines embarked on a journey to review and revise the Ministry of Health's National Dietary Guidelines. The Technical Working Group went through a coordinated and step-by-step process of identifying the health and nutritional issues in Brunei Darussalam, and reviewing the latest scientific evidence. The outcome of the two-year long process is the finalised Scientific Document of the Technical Working Group of the National Dietary Guidelines.

This document brings together in-depth and critical reviews of the latest research related to nutrition, diet and health. The Technical Working Group has summarized the document into 11 key messages and 28 recommendations, aimed at the general public to promote good health and nutrition, and also at relevant stakeholders such as food and beverage industries which have significant influence and roles in creating a nutrition environment that is conducive to health. It also provides information needed for policymakers in formulating effective policies and strategies to address the range of health and nutrition issues in Brunei Darussalam.

I wish to take this opportunity to commend the efforts of all those who have contributed to the development of the National Dietary Guidelines for Brunei Darussalam 2020, and the publication of the Scientific Document of the Technical Working Group of the National Dietary Guidelines.

Dato Seri Setia Dr Haji Md Isham bin Haji Jaafar
The Honorable Minister of Health
Brunei Darussalam

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- The NDG Consensus Workshop committee members; Hjh Roseyati binti DP Hj Yaakub, Dyg Izzan Amalina binti Hj Abd Kadir, administration staff at the Health Promotion Centre and Deputy Permanent Secretary (Professional) Office, as well as facilitators and rapporteurs of the workshop.
- The NDG Consensus Workshop participants for providing inputs and comments on the scientific document;

Sincere thank goes to all those who were involved.

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Key Message 2	**Maintain calorie intake balanced with regular physical activity to keep body weight in a healthy range**	Nelson Dennis Dr Siti Rohaiza binti Ahmad Ummi Salmah binti Arrif Waajidun Ni'am bin Hj Dollah
Key Message 3	**Base meal on rice, bread, potatoes, pasta, noodles or other starchy carbohydrates, with at least half from wholegrain**	Hj Zakaria bin Hj Kamis Hjh Roseyati binti DP Hj Yaakub Siti Nadhirah binti Hj Rawi Yvonne Lee Hui Wen
Key Message 4	**Eat at least two servings of fruits and three servings of vegetables everyday**	Norsal bin Hj Salleh Chua Meah Lean Nurhaime binti Haji Suhaimi Nur Ainiedza binti Haji Idris Yvonne Lee Hui Wen
Key Message 5	**Eat fish, poultry, lean meat, legumes, nuts and other proteins in moderation**	Hj Zakaria bin Hj Kamis Hjh Roseyati binti DP Hj Yaakub Yong Hui Jee
Key Message 6	**Limit intake of fatty foods and use the recommended cooking oil sparingly**	Hj Zakaria bin Hj Kamis Hjh Roseyati binti DP Hj Yaakub Abdul Al Bari' bin Haji Kassim Ilham bin Haji Md Ali Norasma Aini binti Hj Mat Yasin

Key Message 7	**Reduce intake of sugary foods and beverages**	Suryani binti Haji Tamin Izzan Amalina binti Haji Abd Kadir Siti Khairani binti Haji Ramli Hj Zakaria bin Hj Kamis Dr James Lee Moh Kiang
Key Message 8	**Reduce salt and sauces in cooking and food preparations, and choose foods with less salt**	Hj Zakaria bin Hj Kamis Rusydiah binti Sudin Yong Hui Jee
Key Message 9	**Practice exclusive breastfeeding for the first six months and continue breastfeeding until two years while giving nutritious, complementary foods from six months of age**	Hjh Roseyati binti DP Hj Yaakub Chua Meah Lean Nurhaime binti Haji Suhaimi Nur Ainiedza binti Haji Idris
Key Message 10	**Ensure food and beverages are prepared hygienically, as well as clean and safe to consume**	Dr Mohammad Hussien bin Abdullah Hjh Siti Shamsiah binti Hj Abdul Samad Pg Nur Halimatussaadiah binti Pg Mohd Alias
Key Message 11	**Read and understand food labels to make healthier choices**	Siti Munawwarah binti Hj Md Tarif Siti Nadhirah binti Hj Mohd Rawi Yvonne Lee Hui Wen

List of Tables, Figures and Appendices

KEY MESSAGE 1: Enjoy a wide variety of nutritious foods daily within the recommended amount

KEY MESSAGE 2: Maintain calorie intake balanced with regular physical activity to keep body weight in a healthy range

KEY MESSAGE 3: Base meals on rice, bread, potatoes, pasta, noodles or other starchy carbohydrates, with at least half from wholegrain

KEY MESSAGE 4: Eat at least two servings of fruits and three servings of vegetables everyday

KEY MESSAGE 5: Eat fish, poultry, lean meat, legumes, nuts and other proteins in moderation

KEY MESSAGE 6: Limit intake of fatty foods and use the recommended cooking oil sparingly

KEY MESSAGE 7: Reduce intake of sugary foods and beverages

Executive Summary

A Technical Working Group of the National Dietary Guidelines (NDGs) was established to conduct a massive undertaking to review and revise the first National Dietary Guidelines 2000. The Technical Working Group convened several meetings to study and assess the health and nutrition status in Brunei Darussalam and identify key priority areas for the development of dietary recommendations. The key priority areas were delegated to sub-working groups to review the best available evidence and findings of the reviews were deliberated, where key messages and dietary recommendations were put forward.

Eleven key messages and 28 recommendations were presented. Principles and rationales underlying each key message and recommendation are documented in the scientific report. The key messages went through several rounds of discussion, pre-tested to a sample of the community and then optimised to ensure that the key messages are practical, comprehensive and culturally accepted, and the scientific report went through a series of the NDGs Consensus Workshops involving relevant stakeholders, government and non-government sectors and academia to ensure and promote a broad uptake of the dietary recommendations by the general public and stakeholders.

The key messages and the scientific document of the Technical Working Group on the NDGs was endorsed by the Executive Committee, Ministry of Health. The key messages of the National Dietary Guidelines are;

Key Message 1	:	**Enjoy a wide variety of nutritious foods daily within the recommended amount**
Key Message 2	:	**Maintain calorie intake balanced with regular physical activity to keep body weight in a healthy range**
Key Message 3	:	**Base meal on rice, bread, potatoes, pasta, noodles or other starchy carbohydrates, with at least half from whole grains**
Key Message 4	:	**Eat at least two servings of fruits and three servings of vegetables everyday**
Key Message 5	:	**Eat fish, poultry, lean meat, legumes, nuts and other proteins in moderation**
Key Message 6	:	**Limit intake of fatty foods and use the recommended cooking oil sparingly**
Key Message 7	:	**Reduce intake of sugary foods and beverages**

Key Message 8	:	**Reduce salt and sauces in cooking and food preparations, and choose foods with less salt**
Key Message 9	:	**Practice exclusive breastfeeding for the first six months and continue breastfeeding until two years while giving nutritious, complementary foods from six months of age**
Key Message 10	:	**Ensure food and beverages are prepared hygienically, as well as clean and safe to consume**
Key Message 11	:	**Read and understand food labels to make healthier choices**

The NDGs will be promoted and disseminated to the general public and stakeholders, and will be used as a cornerstone for developing and revising nutrition-related policies and guidelines. It will also be used to inform and direct public health policy. Essentially, the NDGs need to be reviewed and revised in the future to maintain its relevance, consistent with the evolving scientific literatures as well as health and nutritional status of the Bruneian population.

Introduction

Brunei Darussalam has experienced an socio-economic growth during the past few decades, accompanied by other subsequent social and food transformations. An increase in disposable income level has also resulted in a nutrition transition. Such transition along with reduced energy expenditure have consequently led to the increasing prevalence of non-communicable diseases (NCDs). A set of dietary guidelines, the National Dietary Guidelines (NDGs) for Brunei Darussalam, is thus developed to provide the general public with up-to-date and more informative dietary guidelines. The NDGs also aims to improve the dietary practices and lifestyle habits among the Bruneian population while serving as a guide to healthcare providers and policy makers.

Background

The first Brunei Darussalam's NDGs was printed in November 2000. The NDGs consisted of seven key messages ranging from the recommendation on variety of foods, fruits and vegetables, fatty and oily foods, salty and sugary foods, nuts and legumes, breastfeeding to physical activity.

A food guide pyramid called *Gangsa Pemakanan Sihat* was issued as a graphic representation of the guidelines. The *Gangsa* is divided into four horizontal sections, which depicts the types of foods from each of five food groups: rice, bread, cereal, and pasta are placed at the base; fruits and vegetables on the second tier; meat, poultry, fish, dry beans, eggs and nuts, milk, yoghurt and cheese are combined and placed on the third tier; and fats, oils and sweets at the top.

Rationale

While the prevalence of communicable diseases reduces, the prevalence of noncommunicable diseases (NCDs) such as obesity, hypertension, diabetes and cancer increases, due in part to changes in lifestyle behaviours. Increasing production of processed food, rapid urbanization, and changing lifestyles are transforming the dietary behaviours. Highly processed foods are increasing in availability and becoming more affordable in Brunei Darussalam. Consequently, Bruneians are consuming more energy-dense foods that are high in saturated fats, trans fats, sugars and salt. At the same time, as Bruneians' eating patterns shift; people are consuming less fruits, vegetables and dietary fibre that are key components of a healthy diet. Unhealthy eating coupled with sedentary lifestyle have a cumulative effect and consequently contributed to significant nutrition and health challenges in Brunei Darussalam.

The review and revision of the NDGs 2000 is essential so as to adapt the guidelines to evolving scientific knowledge on nutrition and public health in the past decade. The NDGs also need to be adapted to the changing and transition of dietary habits and lifestyle which plays fundamental roles in increasing prevalence of NCDs.

With unprecedented progression in the global technology, nutrition information has become more readily available. However, the information that is made available to the general public may originate from ambiguous and unreliable sources. This information may be misleading and contradicting to the majority of the population. The revised NDGs 2020 will provide the general public with a more accurate and trusted information

regarding nutrition and health in Brunei Darussalam.

This updated NDGs also have a vital function to inform and direct policy towards promoting and achieving dietary intake that meets nutrient requirements while reducing the risk of NCDs. Essentially, the revised NDGs will be a cornerstone for the revision or development of public health nutrition policies in Brunei Darussalam such as School Health Nutrition Policy; School Canteen Guidelines; Nutrient Guidelines of Foods and Beverages with the Healthier Choice Logo; Guidelines on Sale and Catering of Food and Beverages at Workplace; Nutrient Guidelines for Healthy Restaurants; Code of Marketing of Foods and Beverages for Children; Code of Practice for Healthcare Workers on Infant Foods and Breast-milk Substitutes and Fiscal policy on sugar-sweetened beverages.

Development of the National Dietary Guidelines 2020

The roadmap in the development of the National Dietary Guidelines Brunei Darussalam 2020;

January 2016

- The Health Promotion Centre and the Community Nutrition Division solicited nominations for the Technical Working Group of National Dietary Guidelines
- First meeting of the Technical Working Group was convened to discuss about health and nutritional issues, based on the National Nutritional Status Survey (NNSS, 2009), National Health and Nutritional Status Survey (NHANSS, 2010), Global School Health Surveys (2014), Cancer Registry (2015), Health Information Booklet (2015) and other national data and surveys
- The Technical Working Group identified population-level health and nutritional issues and key priority areas
- The task of reviewing the scientific literature delegated to the Technical Working Group

February 2016

- Training on concept of research, systematic literature review and meta-analysis
- The Technical Working Group convened the second technical meeting to present framework of the literature review and timeline

March - June 2016

- The Technical Working Groups convened technical meetings

July 2016

- An Internal Consultation Workshop was conducted to deliberate findings of the reviews, and present proposed key messages and recommendations
- Draft document of the literature reviews was amended accordingly based on the feedbacks at the Internal Consultation Workshop

September - November 2016

- Secretariat compiled, edited and amended the draft documents

December 2016

- Editorial work completed

January 2017

- Draft documents were first submitted to an external reviewer from the Western Pacific Regional Office, World Health Organization (WHO)

February 2017

- Training of pre-testing NDG key messages to a sample of community
- HPC interns from Universiti Brunei Darussalam and volunteers conducted a pre-testing of the key messages to more than 500 respondents

July 2018

- The Technical Working Group convened a meeting to discuss ways to proceed with the finalizing the NDGs scientific document without input from an external reviewer

October - November 2018

- A series of four NDGs Consensus Workshop involving relevant stakeholders were conducted (*Participants of the NDGs Consensus Workshop page: 201-211*)
- The scientific documents were presented to the participants. Discussion, feedbacks and consensus was achieved

December 2018 - March 2019

- The scientific document was further edited

KEY MESSAGE 1

Enjoy a wide variety of nutritious foods daily within the recommended amount

Key Message 1

Enjoy a wide variety of nutritious foods daily within the recommended amount

Introduction

Eating a wide variety of nutritious foods within the recommended amount from different food groups, coupled with an active lifestyle is the key to maintaining a good health throughout life. Each food group and their subgroups provide an array of nutrients, which have been associated with positive health outcomes.

A diet consisting of a variety of foods can be described as choosing and consuming:

- A mixture and diverse foods **across five major food groups**;
  - Starchy foods and grains,
  - Fruits and vegetables,
  - Meat, poultry and legumes
  - Dairy products,
  - and Oils and fats, sugar and salt
- Diverse foods **within each food group**

The basis behind the advice to consume a variety of foods come from the fact that no single food contains every single nutrient required and provides all the vitamins and minerals the body needs. Variety of food intake can also supply the nutrients that can potentially work synergistically and essential for meeting one's daily nutrient requirement.

Overview of the Health and Nutritional Status in Brunei Darussalam

The non-communicable diseases including cancer, heart disease, diabetes and cardiovascular diseases (CVD) have been the top four causes of death for more than three decades in Brunei Darussalam (Health information booklet, Ministry of Health 2016. The second National Health and Nutritional Status Survey (NHANSS) conducted in 2011 revealed that the prevalence of obesity in Brunei Darussalam was 27.1%, more than double when compared to the 1997 National Nutritional Status Survey (NNSS).

Figure 1.1 shows the percentage energy contribution of macronutrients (fat, protein and carbohydrate) to the total energy intake among adults (NHANSS, 2010). The percentage carbohydrate intake across the groups was lower than 55%, with the exception of females aged 60 years and above (56.8%). The protein intake of adults across all age groups exceeded the recommended percentage energy contribution of 15% from protein. Meanwhile, fat intake is shown to be slightly higher amongst adults aged 19 to 59 years, and lower amongst adults aged 60 years and above.

Calcium

Adequate Calcium status is important for optimal bone health. Calcium intake for population groups aged between 5 to 75 year olds was found to be very low, particularly amongst teenagers (18 years old and below) and older age groups (19-75 years old). Current findings show that calcium intakes do not meet the calcium RNI values for all ages (less than 50% RNI), whereas population groups below 5 years of age were at least meeting 50% RNI for calcium (NHANSS, 2010).

Target groups who require a particularly higher calcium intake are those approaching

or achieving puberty and those in early adulthood. There is an accelerated growth rate during puberty whereby inadequacy or failure to achieve peak bone mass (e.g. due to inadequate calcium intake) may result in stunted growth. Calcium intake should continue to be adequate throughout puberty and into early adulthood (~35 years of age) as during this time peak bone mass is achieved. In instances where this does not happen, the risks of suffering from osteoporosis later in life are greater. From a recent review of the evidence on colorectal cancer risk and milk intake revealed an inverse association, and the level of evidence judged as probable in the 2011 WRCF/AICR CUP report was confirmed by one new meta-analysis of 9 prospective studies (Latino-Martel et al., 2016). Similarly, the association with total dairy products also showed a decreased risk.

As for calcium intake in population groups aged between 5 to 75 years old, it was found to be very low, particularly among teenagers (18 years old and below) and older age groups (19-75 years old).

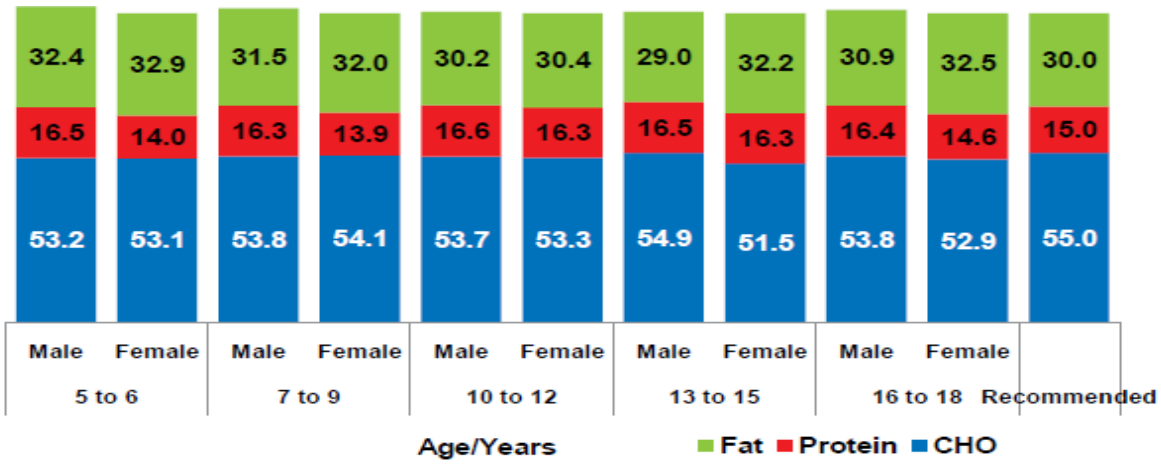
Current findings show that calcium intakes do not meet the calcium Reference Nutrient Intake (RNI) values for all ages (Recommended Nutrient Intakes for Malaysia, 2005), whereas population groups below 5 years of age were at least meeting 50% RNI for calcium.

Iron

Iron is an important component of haemoglobin, a protein in red blood cells that transports oxygen from lungs to the rest of the body. Insufficient iron intake can consecutively lead to a low production of healthy oxygen-carrying red blood cells by the body, which could result in a condition known as iron deficiency anaemia.

Based on the NHANSS (2010), 43% of Bruneian males met 100% of iron Rerence Nutrient Intake (RNI). As for females, only a small percentage of them (10.6%) met 100% of iron RNI. This shows that meeting the iron RNI is an issue for the females in Brunei Darussalam, and is particularly prevalent among menstruating females between 12 to 50 years old.

Figure 1.1: Percentage Energy Contribution of Macronutrients to Total Energy Intake Among Bruneian Adults



**Recommended percentage energy contribution is based on World Heart Organization's guide*

Source: NHANSS (2010)

Literature Review

Evidence on the Association between Consuming a Diverse Diet and Nutrient Adequacy

Earlier study assessing the effects of variety in food choices on dietary quality was conducted by Krebs-Smith et al. (1987). The study examined the effects of overall dietary variety, variety among major food groups, and variety within major food groups on dietary quality. The study involved 3,701 individuals selected from USDA's 1977-78 Nationwide Food Consumption Survey. The study showed that increasing variety among major food groups and variety (of food?) within major food groups increased overall dietary quality. The study added that none of the types of variety could account for a significant variation in the intakes of energy, fat, sugar, sodium or cholesterol (Krebs-Smith et al., 1987).

A more recent study consisting of 9,769 adults examined the effect of dietary variety on nutrient adequacy (Foote et al., 2004). The study reported that consuming a variety of basic foods within each of the five food groups has a strong association with certain nutrient adequacy; dairy variety improved intakes of calcium and vitamin A; grain variety improved intakes of folate and magnesium; fruit and vegetable variety improved intakes of vitamin A and C. The study concluded that consuming different food commodities in a day contributed significantly to nutrient adequacy, and that the results supported the dietary guidance that recommends choosing a variety of basic food commodities within each of the food groups.

Evidence from other studies show consistent results. Mirmiran et al. (2004) found a significant positive association between a diverse diet and the adequacy of a range of nutrients including vitamin A, riboflavin, zinc, calcium, potassium, phosphorus and magnesium. Mirmiran et al. (2006) further reported that dairy variety improved intakes of calciu m, phosphorus, protein, vitamin B_2, and zinc, meat variety improved intakes of vitamin B_6, B_{12}, iron, phosphorus and protein, grain variety improved intakes of vitamin B_2, protein and carbohydrate; fruit and vegetable variety improved intakes of vitamin A, C and potassium.

Based on the positive effect of having a variety of food choices on dietary quality and other related evidence, it is recommended that the general adult population to choose and consume variety of foods in their diet.

Evidence on the Association between Consuming a Diverse Diet and Obesity

The association between a highly diverse diet and obesity has been reported in a number of studies where the population with a highly diverse diet was observed to have a higher body mass index (BMI) (McCory et al., 1994; Togo et al., 2001; Tucker, 2001; Mirmiran et al., 2004). There were indications that such excess energy intake and overweight or obesity is commonly contributed by overconsumption of foods from the fats, snacks and sweets food groups (McCrory et al., 1999).

For this reason, the dietary guidelines on food variety had undergone several changes over the years. For instance, the Dietary Guidelines for Americans has omitted the variety guidelines in the 2000 Dietary Guidelines (Dietary Guidelines for Americans, 2000) based on the concerns that the advice to consume a variety of foods may contribute to overconsumption of foods, leading to the epidemic of obesity.

It may be possible that due to the lack of clear definition and misunderstandings about the previous dietary guidelines to consume a variety of foods has contributed to overconsumption of the fats, snacks and sweets food groups. It was reported that some consumers have indicated that they interpret dietary variety to mean the consumption of different flavors or forms of foods that would not be considered healthy, such as a variety of candy bars (Prospect Associates (1998). On the other hands, findings by McCrory et al. (1999) demonstrated that a diverse diet composed of a greater variety of foods from the low-fat dense food group such as vegetable was found negatively associated with energy intake and body fatness.

Over the years, evidences that a large diversity of foods is associated with positive health outcomes such as reduced incidence of cancer or mortality are mounting (Kant et al., 1991; Kant et al., 1993; Fernandez et al., 1996; La Vecchia et al., 1997; Michels and Wolk., 2002; Jansen et al., 2004; Drescher et al., 2007), and arguably outweigh the previous concern of the variety guideline being misinterpreted. The variety guideline has become an internationally accepted recommendation for a healthy diet. In 2005 the advice to have variety of foods reinstated in the Dietary Guidelines for Americans with additional message on adapting a balanced eating pattern within energy requirements (Dietary Guidelines for Americans, 2005). Based on the evidence, it is recommended that the general adult population to choose and consume variety of foods in the diet within the recommended intake.

Evidence on the Association between Consuming A Diverse Diet and Non-Communicable Diseases (NCDs)

Diverse diets have been consistently shown to have protective effects against non-communicable diseases. Inclusion of legumes such as beans, lentils and peas in a diverse diet has been documented to be negatively associated with hypertension (Miller et al., 1992). A more recent study using a diversity scoring system to measure the diversity of a diet found that highly diverse diet was inversely associated with cardiovascular (CVD) risk factors (Azadbakht et al., 2006). The probability of CVD risk factors such as high LDL-cholesterol, hypertension and diabetes significantly decreased as the diversity score increased. This was suggested to have attributed to higher intake of fruits, vegetables, and lower intake of meat. The increased intake of fruits and vegetables also consequently resulted in increased intake of dietary fibre and vitamin C. Other evidence also reported that a highly diverse diet was associated with lower risk of diabetes, coronary heart disease and some cancers (Mirmiran et al., 2006; Azadbakht and Esmaillzadeh, 2010).

Evidence on the Association between Dietary Calcium and Bone Health

Calcium intake has long been known to slow down bone loss and prevent the development of osteoporosis (Tang et al., 2007). The meta-analysis of 29 randomised trials, with 63 897 people aged 50 years and older by Tang et al. (2007) concluded that calcium with or without vitamin D supplementation was associated with a 12% decreased risk of fractures. Osteoporotic fractures in particular, are common amongst the elderly populations, especially in women. A longitudinal and prospective cohort study with 61 433 women

in Sweden reported that a low dietary calcium intake (lowest quintile) was associated with an increased risk of fractures and osteoporosis (Warensjö et al., 2011). The study also found that every 300 mg increase of dietary calcium intake was shown to result in an apparent decreased risk of osteoporosis.

Evidence on the Association between Dietary Iron and Health

Poor dietary intake of iron can lead to iron deficiency, which is the most significant and common cause of anaemia worldwide (Benoist et al, 2008). Iron deficiency anaemia actually affects 20% to 25% of infants worldwide. A study was previously carried out to determine the iron status in 1657 healthy full-term Chilean infants, who were divided into iron supplemented group (n=1123) and un-supplemented group (n=534) (Lozoff et al., 2003). At 12 months of age, results showed that iron deficiency anaemia was present in 3.1% and 22.6% of the supplemented and un-supplemented groups respectively.

Non-Diverse Diet

More and more people are following 'special' diets for various reasons of health, ethics or personal preference. Examples of some of the 'special' diets are vegetarian, vegan, low-carbohydrate, dairy-free and gluten-free diet. These types of diet commonly eliminate or lessen the intake of one or more of the major food groups. For example, vegetarian diet is one of the most common 'special' diets, which typically made up of plant-based foods such as fruits, vegetables, nuts, legumes, seeds as well as grains. As vegetarian diet excludes meat, fish, poultry, dairy product and/or egg consumption, the percentage daily energy intake from protein was significantly lower compared to that of non-vegetarians (Newby et al., 2005; Clarys et al., 2014). This finding is consistent with other similar studies as presented in Table 1.1. It is noted that vegetarians often consume between 13-14% or less of energy from protein, below the recommended 15% of energy from protein set by the Committee on Medical Aspects of Food and Nutrition Policy (COMA), which later renamed as the Scientific Advisory Committee on Nutrition (SACN) in 2000.

A number of vegetarians may also suffer from food intolerance to various plant-based foods such as soy and/or nuts. This causes narrower food choices, which will lead to difficulty in meeting their nutrient requirement. However, for the majority of vegetarians, with knowledge and skills to practice a well-balanced plant-based diet, it is possible to meet their nutrient and protein requirement. Foods such legumes, lentils, seeds and nuts contains different type of amino acids and micronutrients. It is therefore recommended that those who practice a vegetarian diet to consume a variety and mixed quantity of foods rich in protein and nutrients.

Table 1.1: Differences of energy from protein between vegetarians and non-vegetarians

Sources	Protein (% Energy)	
	Vegetarian	Non-vegetarian
Davey et al., (2003)	Male : 13.1 Female : 13.8	Male : 16.0 Female : 17.3
Cade et al., (2004)	13.1	15.7
Newby et al., (2005)	13.5	16.3
Rizzo et al., (2013)	13.7	14.7
Clarys et al., (2014)	14.0	15.0

Brunei Darussalam's Food Guide Illustrations

Food guide illustrations provide guidance on the recommended types and optimal number of servings of foods to be eaten in order to achieve a balanced, nutritious and healthy diet. The most common food guide illustration is in the form of the food guide pyramid.

Gangsa Pemakanan Sihat is a Brunei-specific food guide pyramid introduced in 2001 by the Community Nutrition Division, Ministry of Health. The *Gangsa* is divided into four horizontal sections, which depicts the types of foods from each of the five food groups: rice, bread, cereal, and pasta at the base, fruits and vegetables at the second section; meat, poultry, fish, dry beans, eggs and nuts, milk, yoghurt and cheese are combined and placed at the third section; and fats, oils and sweets at the top (Figure 1.2)

Over the past decade, the food guide pyramid has been criticized by experts, nutritionists and researchers (Willett and Stampfer, 2003). The Technical Working Group agrees that the food guide pyramid may provide unclear picture particularly for the general public, and it needs to be updated with the current nutritional research findings. It is particularly important to update the pictorial representation of the guidelines on the carbohydrate, protein and fat food group recommendation.

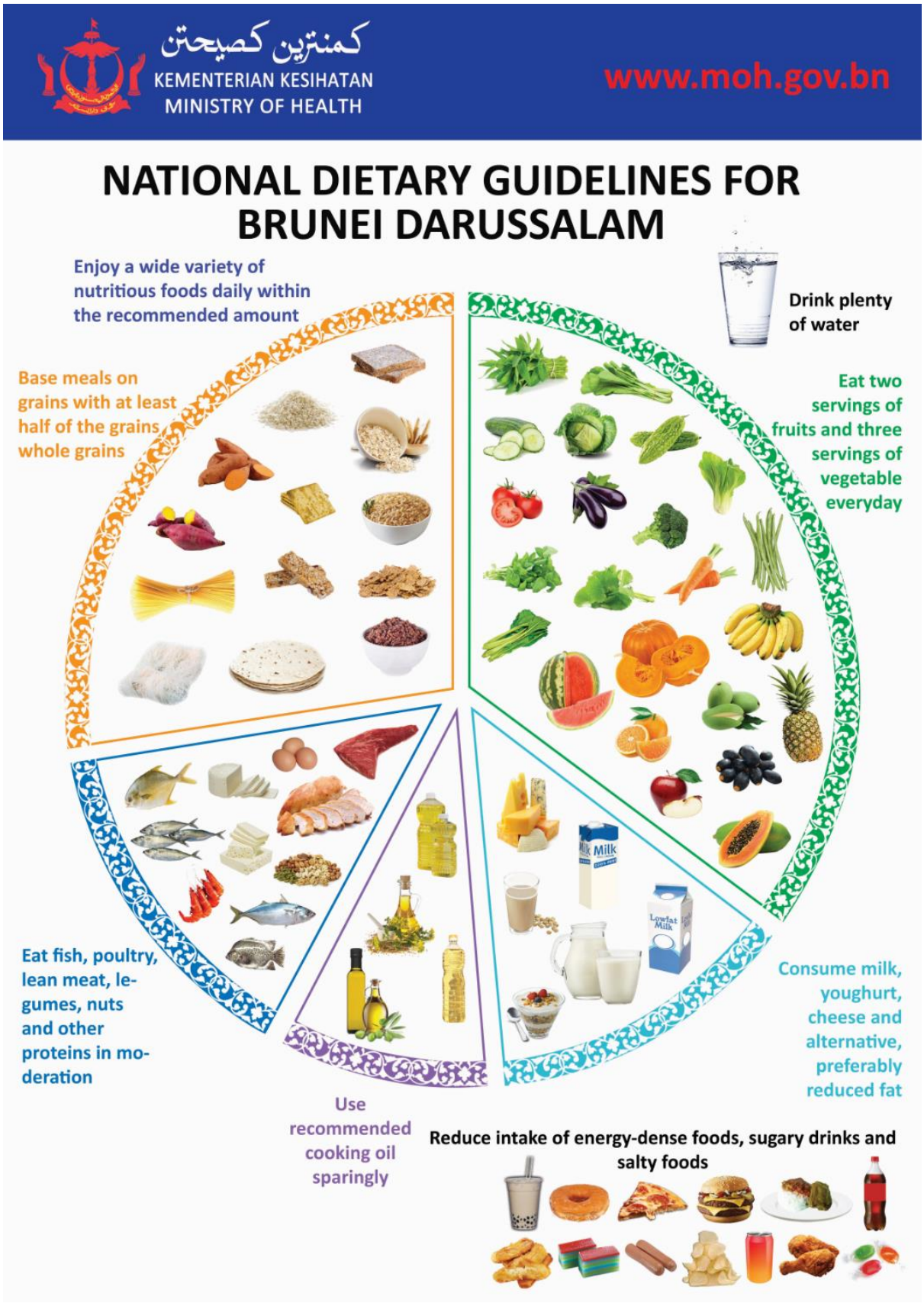
The food guides illustration needs to reflect the recommended sources of carbohydrates; complex carbohydrates, as oppose to refined carbohydrates e.g. crackers, white bread and white rice, and at least half of carbohydrate should come from whole grains e.g. whole meal breads, oatmeal and brown rice.

Figure 1.2: *Gangsa Pemakanan Sihat*

The common misconception about the food guide pyramid is the fact that fat and snacks are placed at the top of the pyramid, which gives a misleading impression that these foods are high in the hierarchy of the nutritious foods. However, a major concern regarding the food pyramid is that the proportion of carbohydrate in relation the proportion of other sources of foods, which put emphasise on the consumption of carbohydrate. Recently, more and more countries including the United State of America, United Kingdom and Australia have adopted 'Healthy Eating Food Plate' as a graphic representation of their dietary guidelines.

Therefore, The National Dietary Guidelines 2020 will be using the National Healthy Food Plate (*Piring Makanan Sihat Kebangsaan)* (Figure 1.3) as a graphic representation of the dietary guidelines. The National Healthy Food Plate should address the concerns and shortcomings of the food guide pyramid.

Figure 1.3: National Healthy Food Plate 2020



Recommended Servings from Food Groups

Rice, noodle, bread, potatoes, pasta, cereals, tubers

Recommended serving of starchy foods: 6-8 servings per day, preferably half of which are wholegrains

Table 1.2: Examples of one serving of rice, noodle, bread, potatoes, pasta, cereals, tubers

Food Item	1 Serving
Bread	1 slice (40g)
Rice / Noodles/ Pasta	1 scoop (75-120g)
Cream Crackers	2-3 pieces (30g)
Oats (uncooked)	3-4 tablespoons
Potato	½ medium size
Ambuyat	4 *cungkil* (4 tablespoon)
Breakfast cereals	6-8 tablespoons

Fruit

Recommended serving of fruits: at least 2 servings per day

Table 1.3: Examples of one serving of fruits

Food Item	1 Serving
Apple/ Pear/ *Ciku*	1 whole
Mandarin orange (small to medium)	1 whole
Banana, *Berangan* (medium size)	1 whole
Banana, *Emas*	2 whole
Durian	3 *ulas*
Grapes	8 small
Papaya/ Pineapple/ Watermelon	1 slice

Vegetables

Recommended serving of vegetables: at least 3 servings per day

Table 1.4: Examples of one serving of vegetables

Food Item	1 Serving
Dark-green leafy vegetables, cooked	½ cup
Raw vegetable	1 cup

Lean meat and poultry, fish, poultry, eggs meats, legumes / beans, nuts and meat alternatives

Recommended serving of protein-rich foods: 2-3 serving per day

Table 1.5: Examples of one serving of poultry, fish, egg, meat and meat alternatives, legumes or beans, and nuts

Food Item	1 Serving
Chicken (drumstick)	1 portion (90-100g)
Chicken (breast)	½ portion (84g)
Fish (Local)	1 fish (120g)
Small Fish (Anchovies)	4 tablespoons (24g)
Big Fish (*Bakulan, Tenggiri, Putih*)	1 slice, palm size
Meat (Cooked)	1 scoop (90-100g)
Prawn, Squid	120g
Egg	1-2 eggs
Bean curd	½ large size (150g)
Bean, lentils, legumes (cooked)	1 cup (150g)

Milk, yoghurt and cheese and/or alternatives

Recommended serving of milk and dairy products: 2-3 servings per day

Table 1.6: Examples of one serving of milk and dairy products

Food Item	1 Serving
Milk	1 glass 250ml
Milk Powder	4 tablespoons
Cheese	2 slices
Yoghurt	¾ cup (200g)

***Note**: Examples of one serving are based on average daily intake of 1500-1800 kcal per day*

Recommendation

Key Message

Enjoy a wide variety of nutritious foods daily within the recommended amount

Key Recommendation 1:

Choose a wide variety of nutritious foods from five food groups everyday based on the Brunei Darussalam National Healthy Food Plate

How to achieve:

- Choose foods from the five food groups based on the national Healthy Food Plate (*Piring Makanan Sihat Kebangsaan)*
- Vary your food choices within each food group during main meals
- Foods should be eaten in the right amounts and in the right combination
- Increase dietary diversity between and within the food groups, while maintaining an appropriate energy balance
- Choose complex carbohydrates such as whole grain foods instead of refined carbohydrates
- Consume foods high in calcium such as dairy products. Consider having dairy alternatives (e.g. unsweetened/ low sugar soya drinks, almond milk with fortified calcium) for those with lactose intolerance.
- Consume less from the high-fat dense food groups and more from the low-fat dense food groups (e.g. fruits and vegetables).
- Choose unsaturated oils and spreads, eaten in small amounts.

Key Recommendation 2:

Consume foods within the recommended serving size

How to achieve:

- Take note of the recommended serving size of each food group to ensure adequate intake of all nutrients required by the body.
- Eat at least 2 servings of fruits and 3 servings of vegetables everyday.
- Drink 8 glasses of water every day.

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KEY MESSAGE 2

Maintain calorie intake balanced with regular physical activity to keep body weight in a healthy range

Key message 2
Maintain calorie intake balanced with regular physical activity to keep body weight in a healthy range

Introduction

In the recent decades, rapid industrialization and modernization has shifted the global food industry with increasing control of the food markets, and diversification of products (World Health Organization, 2010). As a result of these changes, an expansion of energy dense nutrient poor (EDNP) foods and beverages has become available to consumers. Evidence has shown that high intake of EDNP foods and beverages including soft drinks, chips, biscuits and confectionaries have been associated with the increased likelihood of childhood obesity (World Health Organization, 2010). Furthermore, the increase in a sedentary lifestyle has also lead to increased incidences of positive energy balance, thus promoting weight gain and consequently leads to obesity (Carlson et al., 2012).

The definition of overweight and obesity is "*abnormal or excessive fat accumulation that may impair health*" (World Health Organization, 2016). According to Barton (2012), childhood obesity has the tendency leading to adult obesity. Both childhood obesity and adult obesity have been linked to cardiovascular diseases, metabolic disorders, disorders of the central nervous system and psychological disorder as shown in Figure 2.1 (Barton, 2012). Apart from that, the consequences of obesity include detrimental to a country's economic development, not the least of which is the increased need to provide medical specialists and other hospital services (Selassie & Sinha, 2011). Figure 2.2 indicates the increasing trend of budget and expenditure on health in Brunei Darussalam (Ministry of Health, 2013).

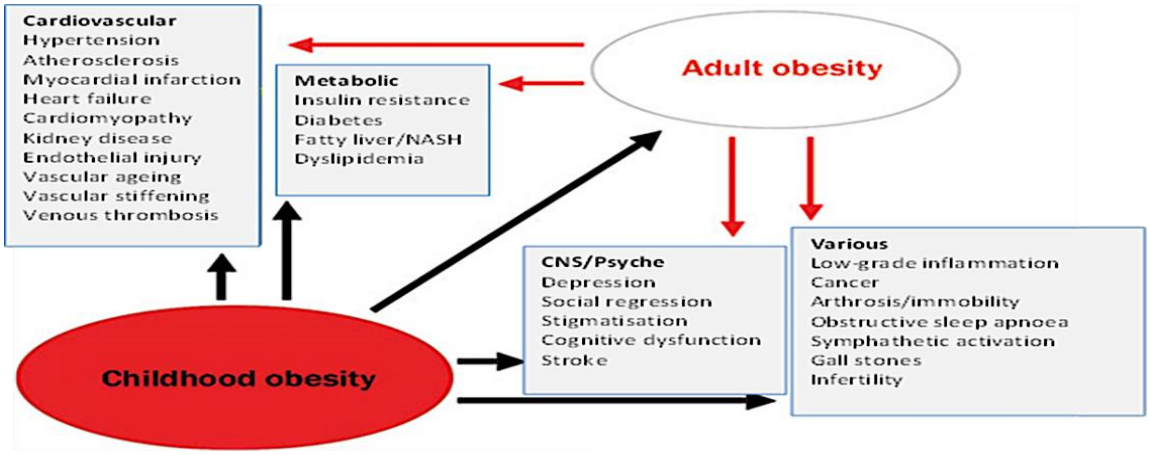
Assuming the level of NCDs continues to escalate this may result in increased healthcare costs for the Government of Brunei. A major component of healthy body weight is balancing energy consumption and expenditure. The largest component of energy expenditure is Basal Metabolic Rate (BMR), the lowest rate of energy exchange in the body to support life, which can be as high as 70% among sedentary individuals. Energy requirement also includes energy expenditure for optimal growth and development of children, tissues development during pregnancy and milk secretion during lactation in line with fostering good mother and child health (FAO/WHO/UNU, 2004).

Energy requirement is defined as "the amount of food energy needed to balance energy expenditure in order to maintain body size, body composition and a level of necessary and desirable physical activity, consistent with long-term good health" (FAO/WHO/UNU, 2004).

Established recommendations for total energy requirements (i.e. Total Energy Expenditure, TEE) throughout the life cycle have been guided by FAO/WHO/UNU, 2004 Report using predictive equations for Basal Metabolic Rate (BMR) calculations already adopted by FAO/WHO/UNU Expert Committee 1985 Report. To determine total energy

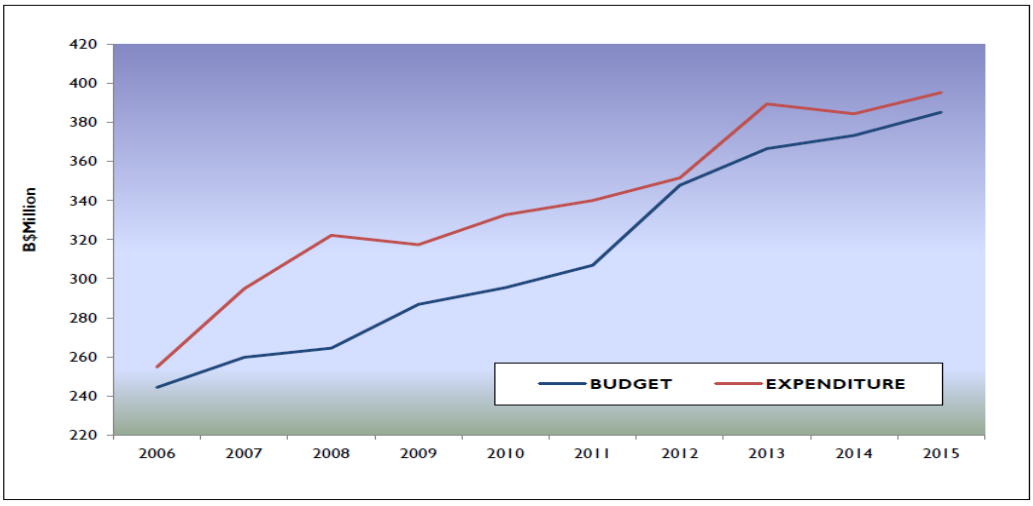
requirement, BMR is multiplied by a factor reflecting other energy costs such as Physical Activity Level (PAL) and other physiological functions. Recommended Nutrient Intake (RNI) for energy requirement across all ages in the recent 2nd NHANSS was done using Malaysian RNI, (Ministry of Health Malaysia, 2017), which has been compared favourably against other standards (e.g. FAO/WHO/UNU, 2004 and Institute of Medicine, 2002).

Figure 2.1: Health consequences of childhood and adult obesity



Source: Barton (2012)

Figure 2.2: Brunei Government's budget and expenditure on general health from the year 2006 to 2015



Source: Health Information Booklet (2016)

Overview of the current health status in Brunei Darussalam

In year 2010 to 2011, Brunei Darussalam conducted a comprehensive national health survey called Brunei Darussalam 2nd National Health and Nutritional Status Survey (NHANSS). This report provides detailed information and highlights on the health and nutritional status of the population. In NHANSS 2010, the prevalence of obesity in adults was 27.1 %. This figure has remained fairly consistent with a marginal increase to 28.2% in WHO STEPS 2016. However, the prevalence of overweight in adults has doubled from 33.4% in NHANSS 2010 to 62.8% in WHO STEPS 2016 as illustrated in Figure 2.3. Alarmingly, our children are not spared from being overweight (as defined by BMI for age ≥ 1 SD) and obese (as defined by BMI for age ≥ 2 SD) where prevalence in children was found to be 33.5% and 18.2% respectively in NHANSS 2010. Routine surveillance through School Health Screening of 6 to 13 year olds shows the same worsening trend in their obesity status. Since 2008, percentage of obesity increased from 12.3% to 18.6% in 2015 (HIB 2015).

Calorie Intake Status

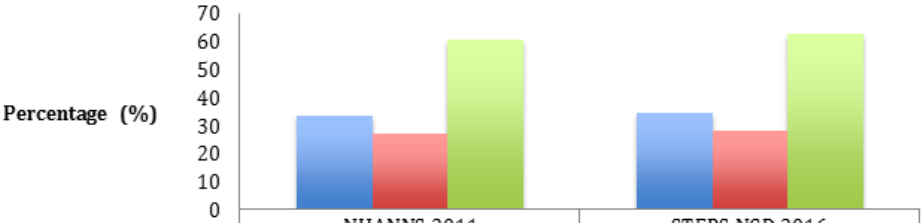
According to the 24-hour dietary recall NHANSS 2010, the median daily calorie (energy) intake ranged from 1381 to 1714 kcal/day in males and 957.5 to 1400 kcal/day in females. Across all the age groups for both genders, the calorie intake was lower than the RNI.

In Table 2.1, the lowest calorie intake was among males aged 5 to 6 years old with 1381 to 1751 kcal/day and in females aged 60 years and above with 957.5 to 1279.5 kcal/day. These two groups may show potential to be high-risk groups for under-nutrition. In addition, the highest calorie intake was among males aged 19 to 59 years old with 1714 to 2277 kcal/day and in females aged 16 to 18 years old with 1400 to 1860 kcal/day.

The sources of calorie intake in the Bruneian diet are illustrated in Figure 2.4. The two major food sources of calorie intake for all age groups was derived from rice and from beverages. The high calorie intake from beverages, which contributed to over 10% may indicate a preference for high-calorie or sugar-sweetened beverages, presenting a potential significant health issue.

According to the NHANNS 2010, across all the age groups, about 50-55% of energy intake was derived from carbohydrates (RNI 55-70%), whilst more than half the population surveyed, 53.3% of males and 54.6% of females, derived more than 30% of their total energy from fat (exceeding RNI 20-30%). Although saturated fat contribution towards energy only ranged from 9.5-10.8% in males and 10.4-11.4% in females, more than half of the population studied (55.4% males and 58.5% females) consumed more than the recommended 10% energy from saturated fat, presenting a potential significant health consideration.

Figure 2.3: Prevalence of Overweight and Obesity amongst Adults between 2011 and 2016 in Brunei Darussalam



	NHANNS 2011	STEPS NCD 2016
Overweight	33.4	34.6
Obese	27.1	28.2
Overweight & Obese	60.5	62.8

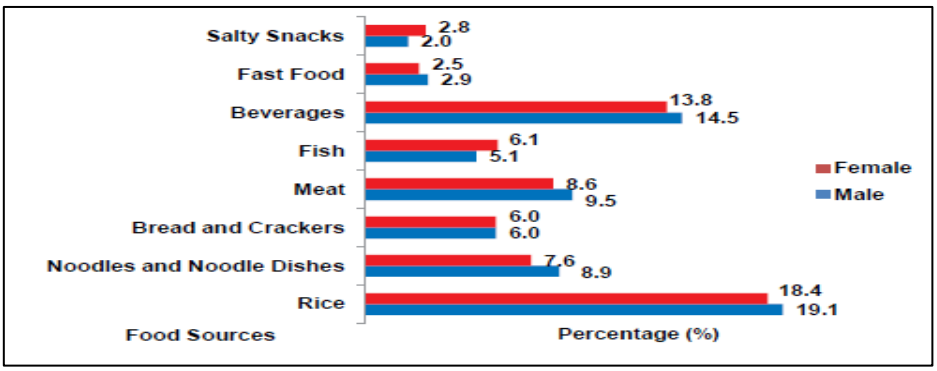
Source: NHANSS (2010) and STEPS NCD (2016)

Table 2.1: Median daily calorie (energy) intake according to age-groups

Age / years old	n	Median Energy			
		kJ	±SD	kcal	±SD
Males					
5-6	40	5777	1547	1381	370
7-9	87	6359	1734	1520	414.5
10-12	72	6544	2002.5	1564	479
13-15	68	6482	2334	1549	558
16-18	62	6086	2074	1455	496
19-59	630	7173	2355	1714	563
60+	54	5947	1752	1421	419
Total	**1013**	**6746**	**2260**	**1612**	**540**
Females					
5-6	44	5208	1640	1245	392
7-9	90	5418	1723	1295	412
10-12	66	5611	1911	1341	457
13-15	54	5721	1341	1367	320.5
16-18	67	5858	1924	1400	460
19-59	756	5444	1727	1301	413
60+	59	4006	1346	957.5	322
Total	**1136**	**5387**	**1749**	**1287.5**	**418**

Source: NHANSS (2010)

Figure 2.4: Percentage contribution of calorie intake from food sources



Source: NHANSS (2010)

Physical Activity Status

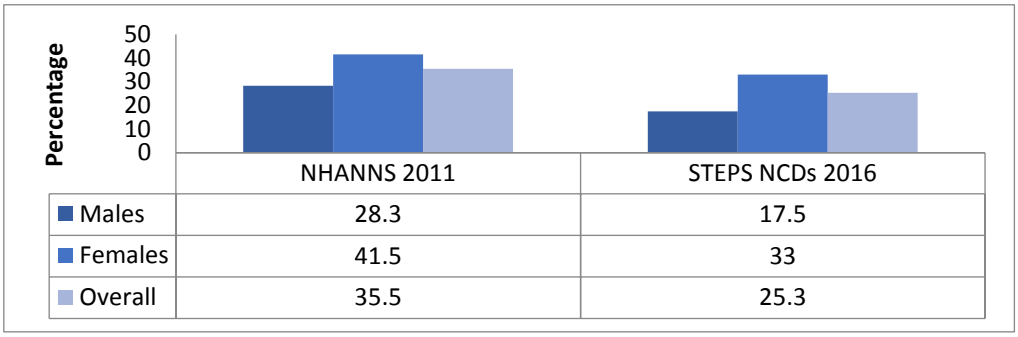
Physical activity should be an important part of daily energy expenditure. Many different types of activity contribute to the total physical activity including occupational activity, household chores, exercise, leisure-time activity, transport (walking or cycling to work) and sport.

The prevalence of physical inactivity (proportion of those who did not meet the recommended duration of moderate physical activity in a week, which is 150 minutes/week) in adults was 35.5% in 2011.

This figure improved in 2016, whereby the prevalence has decreased to 25.3%. Physical inactivity is shown to be higher in adult females than in adult males both in 2011 and 2016, as illustrated in Figure 2.5.

Children and adolescent are recommended to engage in at least 60 minutes of at least moderate physical activity every day. The adolescents aged group where the Global School Health Survey 2014 revealed that the rate of adolescents who are physically inactive among boys and girls are 19.7% and 5.5% respectively.

Figure 2.5: Prevalence of Physical Inactivity in Adults between 2011 and 2016 in Brunei Darussalam



	NHANNS 2011	STEPS NCDs 2016
Males	28.3	17.5
Females	41.5	33
Overall	35.5	25.3

Source: NHANSS (2010) and STEPS (2016)

Literature Review

Body Mass Index (BMI)

Body Mass Index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults and also applicable to children (BMI-for-age) (World Health Organization, 2016). It is also widely used as an indicator of risk factor for the development of or the prevalence of several health issues.

Adult

BMI for adult is defined as a person's weight in kilograms divided by the square of his height in meters (kg/m^2) and is considered as a rough guide to indicate whether the person is underweight, normal, overweight, or obese.

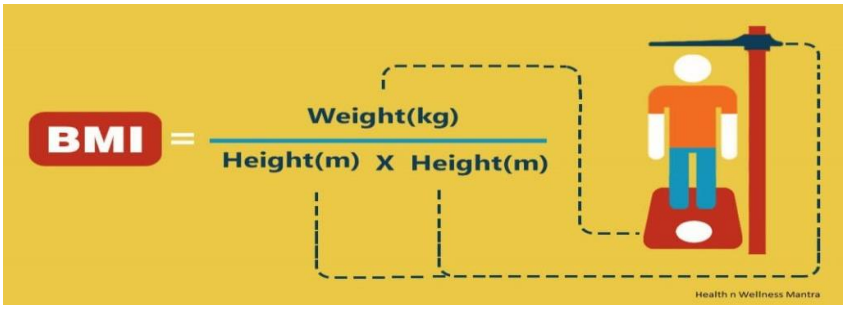


Table 2.2: WHO BMI cut-off-points

Classification	BMI(kg/m²)	
	Principal cut-off points	Additional cut-off points
Underweight	<18.50	<18.50
Severe thinness	<16.00	<16.00
Moderate thinness	16.00 - 16.99	16.00 - 16.99
Mild thinness	17.00 - 18.49	17.00 - 18.49
Normal range	18.50 - 24.99	18.50 - 22.99
		23.00 - 24.99
Overweight	≥25.00	≥25.00
Pre-obese	25.00 - 29.99	25.00 - 27.49
		27.50 - 29.99
Obese	≥30.00	≥30.00
Obese class I	30.00 - 34.99	30.00 - 32.49
		32.50 - 34.99
Obese class II	35.00 - 39.99	35.00 - 37.49
		37.50 - 39.99
Obese class III	≥40.00	≥40.00

Source: Adapted from WHO (1995; 2000 and 2004)

Children

For children aged 5 to 19 years old, growth chart is used for the classification as illustrated in Table 2.3. Figure 2.6 and 2.7 show the BMI-for-age charts for boys and girls respectively, which are currently used in Brunei Health Centres.

Table 2.3: The classification of BMI-for-age

Underweight	Less than the 5th percentile
Normal or Healthy weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obese	Equal to or greater than the 95th percentile

Source: CDC, UK

Figure 2.6: BMI-for-age for boys used in Brunei Health Centres

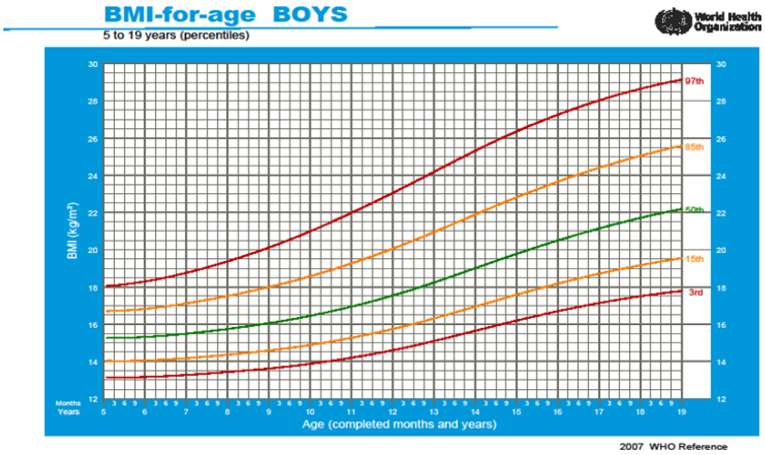
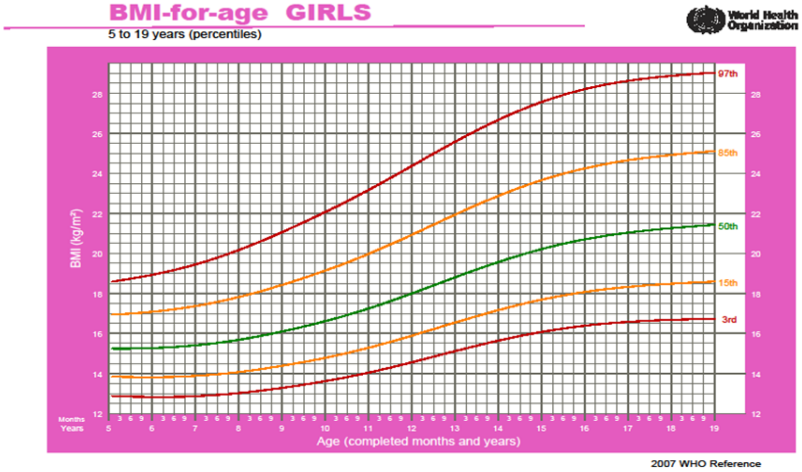


Figure 2.7: BMI-for-age for girls used in Brunei Health Centre



Energy/Calorie Intake

Energy requirement is determined on the basis of energy expenditure and not from energy intake, hence, it is energy expenditure that drives energy needs (FAO/WHO/UNU, 2004). In principle, energy requirement is estimated and based on the factorial approach expressed in terms of energy requirement/expenditure (Negating the need for correction of body weight; a source for variability) and may include additional factors expressed in terms of multiples of BMR. This same simplification provides the residual effects of variance in BMR/kg of body weight attribution among diverse population groups (e.g. bias of higher value for small stature compared to bigger individuals). Although well established and documented, limitations of predictive equations have been cited and discussed in population studies (Antoine-Jonville et al., 2009) and systematic reviews (Madden et al., 2016) concerning obese population groups, where there is no evidence to support the use of predictive equations in estimating Total Energy Expenditure (TEE) yet.

The 2nd NHANSS Report on calorie intake values based on a 24-hour dietary recall method (24 hour recalls capture a 'snapshot' so it may not truly reflect one's total dietary

energy intake) carried out by the Ministry Of Health included a second recall from 10% of the respondents. However, the nature of the survey being self-reported may impose study limitations upon findings (Westerterp and Goris, 2002). It is also noted that there may be potential under-reporting bias (Macdiarmid and Blundell, 1998 and Poslusna et al., 2009) on energy intake. This may impact the consideration of any initiative towards supporting a generalised 1800 kcal/day (for males) and 1500 kcal/day (for females) intake recommendations for Brunei population. Further review and studies may be needed to establish suitable population-based recommendations for specific groups.

Nishida et al. (2004) prescribed that efforts to incorporate energy intake-related key messages into Public Health Policy need to be increased, which is in conjunction with the FAO/WHO/UNU (2004) Report recommendations. As a high percentage of energy intakes from beverages was reported in the 2nd NHANSS Report, recommendation to limit the consumption of high calorie beverages containing free sugars and fats is enforced by the 2004 Expert Consultation. This initiative can favourably help to prevent or reduce the risk of unhealthy weight gain.

Physical Inactivity

Sedentary behaviour, can be defined as *"a state when body movement is minimal and energy expenditure approximates resting metabolic rate".* However, physical inactivity represents more than an absence of activity. It also refers to participation in physically passive behaviours such as television viewing, reading, working at computer, talking with friends on the telephone, driving a car, meditating or eating (Ministry of Health Malaysia, 2010).

WHO recommendation for Physical Activity

World Health Organisation recommends:

Children and adolescents aged 5-17 years

- Should do at least 60 minutes of moderate to vigorous intensity physical activity daily.
- Physical activity of more than 60 minutes daily will provide additional benefits.
- Muscle-strengthening, flexibility and bone-strengthening exercises should be incorporated at least 3 times a week.

Adults aged 18-64 years

- Should do at least 150 minutes of moderate-intensity physical activity throughout the week, or do at least 75 minutes of vigorous-intensity physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity.
- For additional health benefits, adults should increase their moderate-intensity physical activity to 300 minutes per week, or equivalent.
- Muscle-strengthening activities involving major muscle groups should also be done, at least twice a week.

Adults aged 65 years and above

- Should do at least 150 minutes of moderate-intensity physical activity throughout the week, or at least 75 minutes of vigorous-intensity physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity.
- For additional health benefits, they should increase moderate-intensity physical activity to 300 minutes per week, or equivalent.
- Those with poor mobility should perform physical activity to enhance balance and prevent falls, at least 3 times per week.
- Muscle-strengthening activities involving major muscle groups should also be done, at least twice a week.

Recommendation

Key Message

Maintain calorie intake balanced with regular physical activity to keep body weight within a healthy range.

Key Recommendation 1:

All calories consumed should meet all our energy needs

Remember to maintain a healthy energy balance.

How to achieve:

- Eat according to estimated calorie needs based on age, sex and physical activity level
- Be habitually physically active
- Take note of unusual weight gain/loss
- Maintain BMI in a healthy range

Key Recommendation 2:

Watch your calorie intake wherever you are

Be aware of the energy content of foods and beverages at home, at work, while shopping and during events.

How to achieve:

- Be more aware of foods & beverages high in sugar & fats
- Learn to use Nutritional Information Labels
- Compare similar products and choose one with lower calories
- Choose lower calorie snack options (such as fresh fruit, salads)
- Choose smaller portions.
- Encourage and advocate the use of calorie content labels (catering, workplace, etc.)

Key Recommendation 3:

Be active wherever you are

Small changes made throughout the day can add-up and lead to an increased daily activity (i.e. increased daily energy expenditure). Remember that some activities are better than none and more is better than less.

How to achieve:

- Walk or cycle instead of using a car
- Take the stairs instead of a lift
- Park farther away from your destination and walk the rest of the way
- Do your own household chores
- Play with your children
- Invite family, friends and colleagues to be active with you
- Spend more time on outdoor activities
- Limit sedentary behaviour such as watching TV and using electronic media
- Break up long periods of sitting as much as possible

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KEY MESSAGE 3

Base meal on rice, bread, potatoes, pasta, noodles or other starchy carbohydrates, with at least half from wholegrains

Key Message 3
Base meal on rice, bread, potatoes, pasta, noodles or other starchy carbohydrates, with at least half from wholegrains

Introduction

Starchy foods and grains are carbohydrates consisting of a large number of glucose units joined by glycosidic bonds. Grains and starches are the most common carbohydrates consumed in the human diet and are considered to be staple foods in most countries around the world. Grains or sometimes refer to as cereals can be derived from rice, wheat, oats, barley, corn, millet and rye, while starches can be derived from starchy tubers or root vegetables such as potatoes, yams, taro, arrowroot or cassava.

However, grains tend to undergo a process to remove the bran and germ. The products of such process are referred to as refined carbohydrate. Ironically, the process of removing bran and germ lead to the removal of essential micronutrients such as zinc, iron, manganese, folate, magnesium, copper, thiamine, niacin, vitamin B6, phosphorus, selenium, riboflavin, and vitamin A as well as dietary fibre.

Historically, people consumed large amounts of unprocessed grains or starches. Microbiotics in the large intestine fermented the starch, produced short-chain fatty acids, which were used as energy as well as maintenance and growth of the microbes. As foods become more and more processed, they were more easily digested and released more glucose in the small intestine, resulting in less starch reaching the large intestine and more energy being absorbed by the human body. This shift in energy delivery has been suggested to be one of the contributing factors to the development of metabolic disorders of modern life, including obesity and diabetes (Walter and Ley, 2011).

Physiological function of Grains and starchy foods

Grains and starches are essential sources of energy. They provide 3.75 kcal of energy per unit gram, and in addition to providing energy, grains and starches provide a wide range of physiological effects which influence human health such as:

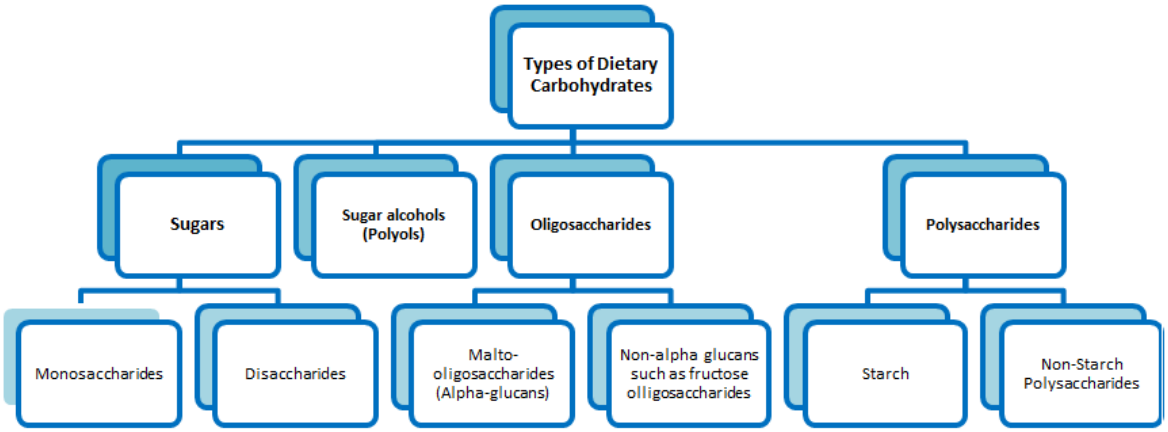
- Effects on satiety and gastric emptying
- Control of blood glucose and insulin metabolism
- Cholesterol and triglyceride metabolism
- Bile acid dihydroxylation
- Fermentation
- Gastrointestinal functions including bowel health
- Effects on large bowel microflora

Carbohydrates

Carbohydrate can be classified into sugars, sugars alcohols (polyols), oligosaccharides and polysaccharides. Sugars can be subdivided into monosaccharides and disaccharides. Sugars can be found in glucose, galactose, fructose, sucrose, maltose and lactose. Sugars that are added to foods by food manufacturer, cook or consumer and sugars naturally present in honey, syrups and fruit juices are called free sugar (WHO, 2003). Oligosaccharides can be divided into malto-oligosaccharides and other oligosaccharides

such as fructose-oligosaccharides. Fructose-oligosaccharides can be found in onion, chicory, garlic, asparagus, and banana. Polysaccharides can be divided into starch and non-starch polysaccharides (NSP). Starches such as those found in grains and starchy tubers or root vegetables are made up of varying proportions of amylose and amylopectin, whilst NSP are made up of cellulose, hemicellulose, pectins and hydrocolloids. A slightly different but commonly used term in nutrition, dietary fibre, consists mainly of the NSP and lignin, a non-carbohydrate component of the plant cell wall (WHO, 1998).

Figure 3.1: Types of Dietary Carbohydrates



Source: Adapted from Palou A., Bonet M.L., and Picó C. On the role and fate of sugars in human nutrition and health. Introduction. *Obesity Reviews*. 2009; 10: 1–8. doi:10.1111/j.1467-789x.2008.00560.x

General Sources of Carbohydrates

Table 3.1 shows examples of refined carbohydrate are white rice, white bread, white flours, pasta and noodles. These types of foods tend to be prepared or cooked with excessive amount of sugar, salt, saturated and trans-fat, produced industrially at a massive scale and sold at a relatively cheaper price. Cakes, biscuits, discretionary snacks *e.g. keropok* and instant noodles are examples of these foods. Heavy reliance on processed foods may displace a more traditional and micronutrient-dense diet, resulting in nutrient deficiency or chronic diseases in the long term.

Discretionary' foods and drinks include sweet biscuits, cakes, desserts and pastries; processed meats and fattier/salty sausages; sweetened condensed milk; ice cream and other ice confections; confectionary and chocolate; savoury pastries and pies; commercial burgers with a high fat and/or salt content; commercially fried foods; potato chips, crisps and other fatty and/or salty snack foods including some savoury biscuits; cream, butter and spreads which are high in saturated fats; sugar-sweetened soft drinks and cordials, sports and energy drinks and alcoholic drinks.

Source: *Source*: Dept. of Health, Australian Government (2017), Discretionary Food and Drink Choices.

Table 3.1: Sources of Refined and Whole Grains

Grain Products	
Refined	**Whole Grain**
White rice	Brown rice Eg. *Beras kebun merah*
White bread	Whole grain bread
Pasta and macaroni	Whole grain or whole wheat pasta
White Flour White Rice Flour Corn Flour Potato Flour	Whole grain or atta flour
Noodles	Oatmeal
Biscuits	Whole gran biscuits
Pizza base	Whole grain pizza base
Cakes	Corn
Muffins	

Recommendation of Energy from CHO

As important as ensuring that the total calorie intake is meeting an individual's energy requirement, it is also essential to ensure the appropriate proportion of energy from the macronutrients. The joint WHO/FAO expert consultation (WHO, 2002) recommended that energy derived from total carbohydrate should be between 55-75%, with a set limit for free sugars <10% of total energy. A further reduction to <5% of energy will provide additional health benefits (WHO, 2015).

Malaysia revised its recommendation for carbohydrate recently where it is recommended that carbohydrate intake should comprise of 50-65% of total energy (Ministry of Health, Malaysia (2017). The Dietary Guidelines for Singapore in 1988 recommends Singaporeans to maintain intake of complex carbohydrates at about 50% of total energy intake (Benjamin LC, 2011). Although carbohydrate plays a crucial role in providing calorie, excessive consumption of carbohydrate may lead to weight gain and obesity, and a diet consisting exclusively of carbohydrate may result in protein-energy malnutrition. On the other end of the spectrum, a diet consisting of a low amount of carbohydrate for a prolong period of time may result in insufficient dietary fibre, leading to constipation or other digestive problems or possibly cancer.

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Energy derived from total carbohydrates should be between **55-75%**, with a set limit for free sugars **<10%** of total energy. A further reduction to **<5%** of energy will provide additional health benefits. (World Health Organization, 2015).

Recommendation of Non-Starch Polysaccharides (NSP)

The major source of the non-starch polysaccharides in the diet should come from wholegrains together with fruits and vegetables. The recommended intake of wholegrains, fruits and vegetable should provide >20 g per day of NSP (or >25 g per day of total dietary fibre) (WHO, 2003).

Sources of Carbohydrates

NHANSS (2010) shows that grains and starches such as rice (about 30%), noodles and noodle dishes (about 8%), bread and cream crackers (about 7%) contributed to the main sources of complex carbohydrate intake in Brunei Darussalam. Beverages, which may contribute to the majority of simple carbohydrate intake contributed to about 20% of carbohydrate intake among Bruneian population.

Overview of the health and nutritional status in Brunei Darussalam

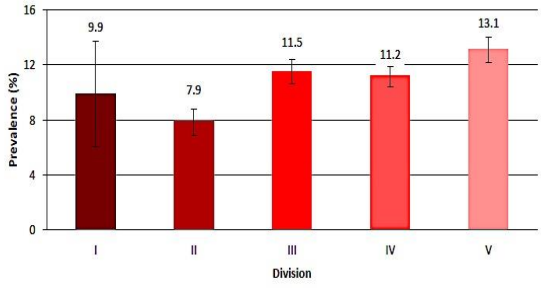
Obesity

The prevalence of obesity in Brunei Darussalam has doubled from 12% in 1997 (NNSS, 1997) to 27% in 2010 (NHANSS, 2010). Data from the Integrated Health Screening consisting of 21,437 civil servants showed that the prevalence of obesity and abdominal obesity was 27% and 64% respectively (IHSHPP, 2011). The STEPS NCD Survey in 2016 showed the prevalence of obesity among adults had risen to 28.2% (MoH, 2016).

Diabetes Mellitus

NHANSS (2010) showed that the prevalence of diabetes, defined as known diabetes or newly diagnosed diabetes was 12.5%. A survey involving more than 21,000 civil servants in Brunei Darussalam showed that the prevalence of diabetes was the highest among those in division V compared to others as shown in Figure 3.3 (IHSHPP, 2011).

Figure 3.3: The prevalence of diabetes among civil servants by division

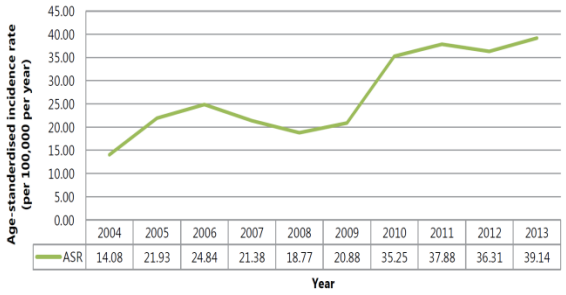


Source: IHSHPP (2011)

Colorectal cancer

Over the past decade, the incidence rate of colorectal cancer is increasing (Figure 3.4). The age-standardized incidence rate of newly diagnosed colorectal cancer increased from 14 per 100,000 per year in 2004 to 39 per 100,000 per year in 2013. Between 2009 and 2013, colorectal cancer has become the most frequent cancer diagnosed among males & females in Brunei Darussalam, surpassing lung cancer (Cancer Registry, 2014).

Figure 3.4: Age-standardised Incidence Rates for Colorectal Cancer (both genders), 2004-2013



Source: Cancer Registry (2014)

Gastric cancer

From 2004 to 2013, gastric cancer has been reported to be the sixth and eighth most frequent cancers among males and females respectively in Brunei Darussalam (Brunei Darussalam Cancer Registry, 2014).

Literature Review

The scientific evidence for role of carbohydrate in obesity

There are numerous controversies surrounding the extent to which carbohydrate promotes obesity. Much of the controversy may have been fuelled by the popularity of carbohydrate-restricted diet that claims to cause a dramatic weight loss. While the diet may have been shown to cause a weight loss among participants with obesity, the weight loss was not sustainable in the long-term (Astrup et al., 2004).

Furthermore, under isocaloric conditions, very low versus high carbohydrate diet showed similar weight loss in 24 weeks, and with regard to cardiovascular health, high carbohydrate diet had more favourable effects on the blood lipid profile compared to the very low carbohydrate diet (Tay et al., 2008).

Regular consumption of a specific class of carbohydrate does cause weight gain in the long term. Strong evidence showed that sugars such as those found in sugar-sweetened beverages have been associated with weight gain and obesity (Malik et al., 2006; Krieger et al., 2006).

This is attributed by the fact that item in the liquid form induces less satiety compared to foods in solid form, leading to insufficient energy compensation. As oppose to polysaccharides such as starch and NSP, their effect on satiety and impact on body weight are different. In other words, due to the less satiety effect of sugar-sweetened beverages, those who consumed them tend to continue consuming other foods or beverages, leading to a positive energy balance.

Energy compensation is the adjustment of energy intake provoked by the previous ingestion of a given stimulus (preload), whether a meal, a snack, or a beverage (Blundell et al., 2010).

To date, there is no direct evidence to implicate starch in the aetiology of obesity (Jebb, 2015). The evidence reinforces the dominance of total energy intake as a more relevant determinant of body weight and excessive energy intake in any form will inevitably promote body fat accumulation (Jebb, 2015).

On the contrary, high carbohydrate diet consisting of starch and NSP may promote satiety, and that may help in reducing the risk of obesity. Therefore, for individuals with overweight and obesity, it is more important to restrict the total calorie intake to reduce and achieve a healthy body weight.

The role of dietary fibre in reducing the risk of diabetes

There is a convincing level of evidence that the onset of type 2 diabetes can be prevented. Lifestyle intervention combining healthy diet and regular physical activity reduced the relative risk of diabetes by up to 58%, far more effective compared to pharmacological intervention that reduced risk of diabetes by 25-36% (Diabetes Prevention Program, 2002).

A meta-analysis of large prospective cohort studies consisting of 328,212 subjects showed that the consumption of dietary fibre was significantly associated with reduced risk of diabetes (Schulze et al., 2007). Consistently, a systematic analysis that included 286,125 subjects indicated that a two-serving-per-day

increment in whole grain consumption significantly reduced diabetes risk by 21% (de Munter et al., 2007).

A more recent systematic review of prospective cohort studies showed that subjects who consumed a high intake of cereal fibre or mixtures of whole grains and bran had significantly reduced risk of type 2 diabetes (Cho et al., 2013). Insoluble fibre in particular those found in whole grains products have been demonstrated to be effective in the prevention of type 2 diabetes (Kaline et al., 2007). In a large European Prospective Investigation into Cancer and Nutrition (EPIC) InterAct study, evidence indicates that the intake of total cereal fibre was inversely related to the risk of type 2 diabetes. The link between dietary fibre and diabetes risk remained even after adjustment for lifestyle and dietary factors (EPIC, 2015).

A number of potential mechanisms explain how dietary fibre may alter the risk of diabetes. This includes the effects of the dietary fibre on satiety and body weight. Consumption of high fibre diet induces satiety, leading to maintenance of normal body weight, hence reduces diabetes risk (EPIC, 2015). Recent research also indicates that dietary fibre contributes to a number of metabolic effects independent of changes in body weight. This includes improvement of insulin sensitivity, modulation of the secretion of certain gut hormones, and effects on various metabolic and inflammatory markers that are associated with the metabolic syndrome (Weickert and Pfeiffer, 2008).

The role of dietary fibre in reducing the risk of cardiovascular diseases

The prevention of cardiovascular disease is one of the key public health priorities. A number of meta-analysis has been conducted over the past years to determine the association between dietary fibre and cardiovascular risk factors. The pooled analyses from a recent Cochrane systematic review of randomized controlled trial showed a reduction in total cholesterol, low-density lipoprotein cholesterol and diastolic blood pressure with increased dietary fibre intake (Hartley et al., 2016).

A recent systematic review of prospective cohort studies demonstrated that subjects who consumed a high intake of cereal fibre or mixtures of whole grains and bran had significantly reduced the risk of cardiovascular disease (Cho et al., 2013). Consistent with the previous review, a meta-analysis of prospective cohort studies showed that the dietary fibre had a strong dose-response relation with the cardiovascular disease mortality (Liu et al., 2015). Another meta-analysis also suggested that high dietary fibre intake is significantly associated with a reduced risk of mortality from cardiovascular disease and all cancers (Kim and Je 2016).

There are a number of plausible explanations for the protective effect of dietary fibre in cardiovascular health. Soluble fibres bind bile acids or cholesterol, reducing the cholesterol content of liver cells, which lead to the up-regulation of LDL receptors and thus increased clearance of the LDL cholesterol (Anderson and Tietyen-Clark, 1986); dietary fibre in the colon undergoes a process called fermentation, producing short-chain fatty acids such as acetate, butyrate and propionate. Short-chain fatty acids inhibit hepatic fatty acid synthesis (Nishina and Freedland, 1990); dietary fibre with a high viscosity slows the absorption of macronutrients, leading to increased insulin sensitivity (Schneeman 1987); and increased satiety, leading to lower overall energy intake (Blundell and Burley 1987).

The role of dietary fibre in gastrointestinal health

The beneficial role of dietary fibre in human gastrointestinal health has long been established. Dietary fibre is an important contributor to stool weight. Convincing level of evidence demonstrated that increasing consumption of foods rich in dietary fibre is a very effective mean of preventing and treating constipation. A meta-analysis of randomized controlled trials showed that dietary fibre intake had a significant advantage over placebo in stool frequency and also significantly increased stool frequency in individuals with constipation (Yang et al., 2016). A systematic review to assess the effects of cereals on human faecal weight and transit time suggested that adequate intake of cereals fibre have the potential to increase population-wide healthy bowel function, hence reducing the economic burden of gastrointestinal disorders (de Vries et al., 2016)

Research studies also showed that bran and other cereal sources containing NSP appear to protect against diverticular disease and have an important role in the treatment of diverticular disease. Dietary fibre may also facilitate the colonization of bifidobacteria and lactobacilli in the gut and thus reduce the risk of acute infective gastrointestinal illnesses.

The role of dietary fibre in the cancer risk reduction

The link between dietary fibre and colon cancer has been studied extensively over the past decades. There is convincing level of evidence on the beneficial role of dietary fibre in reducing the risk of colorectal cancer. A large prospective study called the European Prospective Investigation into Cancer and Nutrition (EPIC) involving more than five million individuals who were followed up for cancer incidence showed that dietary fibre was inversely related to the incidence of colon cancer. The study estimated that in a population with low average intake of dietary fibre, a doubling of total fibre intake could reduce the risk of colorectal cancer by 40%.

Consistent with the study, a meta-analysis that included 20 studies prospective studies with a total of 10,948 subjects diagnosed with colorectal cancer over the course of the study, found that high dietary fibre intake was inversely associated with colorectal cancer risk (Ben et al., 2014). The Women's Health Initiative prospective cohort consisting of 134,017 subjects with a mean follow-up of 11.7 years found that higher dietary fibre intake had protective effect on colorectal cancer risk (Navarro et al., 2016). Another meta-analysis aimed to investigate dietary fibre consumption and cause-specific mortality found that compared to participants who consumed the least amount of dietary fibre, those who consumed the highest amount of dietary fibre had lower mortality rate by 17% (Liu et al., 2015).

The link between dietary fibre and other cancer has also been explored. Increasing number of epidemiological studies suggest that whole grain intake may reduce pancreatic cancer risk. A meta-analysis of eight observational studies showed that a high intake of whole grains was associated with a reduced risk of pancreatic cancer (Lei et al., 2016). However, the implication of the finding is restricted by the small number of studies.

A number of plausible mechanisms contribute to the protective properties of dietary fibre against colorectal cancer. Dietary fibre

contributes to stool bulking effect, which stimulates the apoptosis and proliferation of colonic cells. Whole grains contain phenolic compounds, which have a high antioxidant capacity (Van Hung P, 2016).

Fermentation of dietary fibre in the colon produces short-chain fatty acids such as acetate, butyrate, propionate (Nishina and Freedland, 1990), which serve as energy for the growth of intestinal microbes. The process of fermentation protects the colorectal area against the genetic damage that leads to colorectal cancer.

Recommendation

Key Message

Base meal on rice, bread, potatoes, pasta, noodles or other starchy carbohydrates, with at least half from whole grains

In view of the strong link between dietary fibre and obesity, diabetes, cardiovascular disease, gastrointestinal health and cancers, and the increasing rate of chronic diseases in Brunei Darussalam, the general population is recommended to base their meals on grains or other starches. For the adult population in Brunei Darussalam, the recommendation of energy from carbohydrates should be between 55-65% of the total energy intake *(refer to Table 1.2).*

Key recommendation 1:

Eat three main meals a day with optional one or two healthy snacks in between

How to achieve:

- Eat three main meals (breakfast, lunch and dinner) a day with optional one or two healthy snacks in between (Refer to Appendix)
- Start your day with high fibre carbohydrates such as wholemeal bread, oats, tubers, fruits and vegetables
- Include high fibre carbohydrates for every meal
- Choose healthy snacks such as fruits, nuts, wholemeal crackers and low fat milk.

Key recommendation 2:

Choose at least half of the carbohydrates from whole grains

How to achieve:

- Mix half white rice with half brown (unrefined) rice
- Choose products that are labelled with 'whole grains', 'wholemeal', 'whole wheat', 'whole rye', or 'high fibre'
- Choose products with at least 50% of the total weight as whole grain ingredients
- Limit the intake of all products made with refined grains, especially those high in saturated fats, added sugars, and/or sodium such as biscuits, cakes, discretionary snacks.

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KEY MESSAGE 4

Eat at least two servings of fruits and three servings of vegetables everyday

Key Message 4
Eat at least two servings of fruits and three servings of vegetables everyday

Introduction

Fruits and vegetables are important components of a healthy and balanced diet. They are excellent sources of vitamins and minerals, essential fatty acids (EFAs), fibres (soluble and insoluble) and antioxidants. A growing body of evidence suggests that the regular consumption of fruits and vegetables reduces the risks of many chronic human illnesses and increases life span and quality in human (He et al., 2007). Most fruits and vegetables are lower in energy density and the presence of non-digestible fibres contribute to the feeling of satiety (Desjardins, 2014).

According to WHO/FAO (2003) expert consultation report on diet, nutrition and prevention of chronic diseases, they recommend at least 400g or 5 servings of fruits and vegetables daily, to lower the risk of non-communicable diseases. This is further advocated by the European Commission (2007): increasing consumption of fruits and vegetables as one of the strategies to compensate poor diet intake and sedentary lifestyle.

In spite of the numerous benefits of fruits and vegetables, Bruneians are still consuming far less than the daily recommended intake of 2-3 servings of fruits and 2-3 servings of vegetables per day (Ministry of Health, 2014). This similar trend is also observed in other countries worldwide (EUFIC, 2012).

Fruits

In general, a fruit is an edible part of a plant that matured from a flower and usually contains seeds. Fruits add colour and flavour to our diet and it is also refreshing to eat as they are sweet, juicy and succulent. They can be eaten as a healthy option for snacks or desserts. Fruits can also be consumed as dried fruits, frozen fruits and canned fruits (preferably in its natural juice with no-added sugar and preservatives).

Fruit Juice

In countries, such as the United Kingdom and Australia, they limit the consumption of fruit juice to 150ml and 125ml of fruit juice respectively as a portion of fruit, regardless how much a person drinks. This is because in reality, a person can easily gobble up a large glass of juice (250ml or more), which is also equivalent to consuming many pieces of fruit at one time, but without the dietary fibre, and end up taking in more sugars than the recommended amount.

Other countries such as Belgium and Spain exclude fruits juice as fruit (EUFIC, 2012). Fruit juices of any kind, including the 'No Added Sugar' do not count as a serve of fruit. This is because the calories and sugar content in fruit juices can be equally as high as or higher than the sugar content in carbonated drinks. As an example, a single can of sugar-sweetened beverages (330ml) contains up to 40g (around 10 teaspoons) of free sugars. Whereas, a small packet (250ml) of 'No Added Sugar' fruit juice contains up to 45g (around 11 teaspoons) of free sugars. WHO (2015) recently revised a guideline and recommends cutting down free sugar intake to less than 10% of energy, a further reduction to less than 5% of total energy would provide additional benefits. For adults, 5% of energy is

equivalent to less than 25g of sugar (6 teaspoons).

The types of sugar found in whole fruit are different from the sugar in fruit juice. Sugars in whole fruit are contained within the structure of the fruit, thus less likely to cause health problem such as dental caries or overweight/obesity. When the fruit is blended, or crushed, the sugars released are known as free sugars. Free sugars will cause health problems if over-consumed. It has been reported that consumption of free sugars, particularly in the form of beverages, can lead to an increase in total sugars intake and a reduction in the consumption of more nutritionally valuable food, thus leading to an unhealthy diet, increased weight and risk of non-communicable diseases (Boulton et al., 2016).

Furthermore, in view of overweight/obesity rate in Brunei at 60.6% among adults (Ministry of Health, 2014), it is reasonable not to include fruit juice as a portion of fruit. However, fruit juice (preferably 100% with No Added Sugar), can be part of your healthier choice of drink that you can enjoy occasionally, but is not counted as a portion of fruit.

Vegetables

The term vegetables include all fresh, green leafy (e.g. *sawi, kangkong*), coloured vegetables (e.g. *bayam merah,* purple cabbage), roots and tubers (e.g. carrots) and other types of vegetables (e.g. cucumber, *petola,* pumpkin), bean vegetables (e.g. french bean, long bean, okra), cruciferous vegetables (e.g. broccoli, cauliflower), *ulam-ulam* (e.g. *pegaga*, *ulam raja*) and edible plant stems (e.g. *batang keladi, batang pisang*, asparagus, celery) (Table 5).

Vegetables are also available in canned and frozen. They can be eaten raw as salads, or cooked to make them more palatable and digestible. Unripe fruits such as papaya, jackfruit, *tarap* fruit can also be eaten as savoury dishes, which are treated as vegetables in cooking. Edible mushrooms, *umbut* (coconut palm shoot)*, rebung* (bamboo shoot) are eaten as vegetables in Brunei, even though there are no clear classifications that consider them as vegetable.

The definition of vegetable does not include potato, cassava and yam since their carbohydrate content is high (WHO, 2003). Also, vegetables do not include pickles, Gherkins or any vegetables that have been preserved with added salt.

Table 4.1: Examples of vegetables

Dark green or cruciferous	Root/ tubular/ bulb vegetables	Dark Green or Coloured Leafy	Other vegetables
Asparagus Broccoli Brussels sprouts Cabbages, all types, including red Cauliflower Lettuce	Artichoke Bamboo shoots Beetroot Carrots Fennel Garlic Ginger Leeks Onions Parsnip Radish Shallots Spring onions Swede Turnip	*Bok choy* *Sawi* *Kangkong* *Pakis* *Lembiding* Spinach including red Kale *Pengaga* *Ulam Raja*	Long beans Bitterguord Capsicum Celery Cucumber Eggplant Green peas Snowpeas Mushrooms Okra Pumpkin Sprouts Squash Sweetcorn Tomato Zucchini *Petola* *Batang keladi* *Batang pisang*

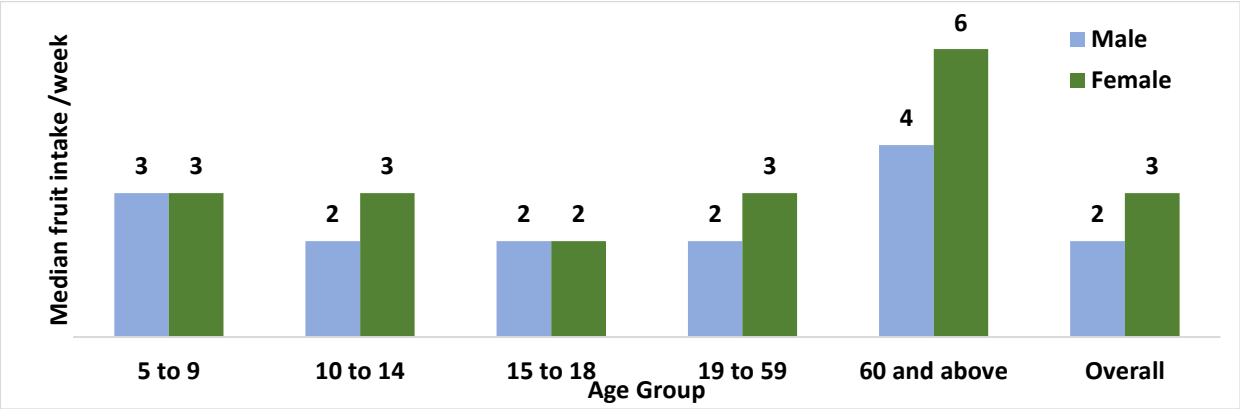
Source: National Health and Medical Research Council (2013)

Overview of the health and nutritional status in Brunei Darussalam

Status of Fruit and Vegetable Consumption

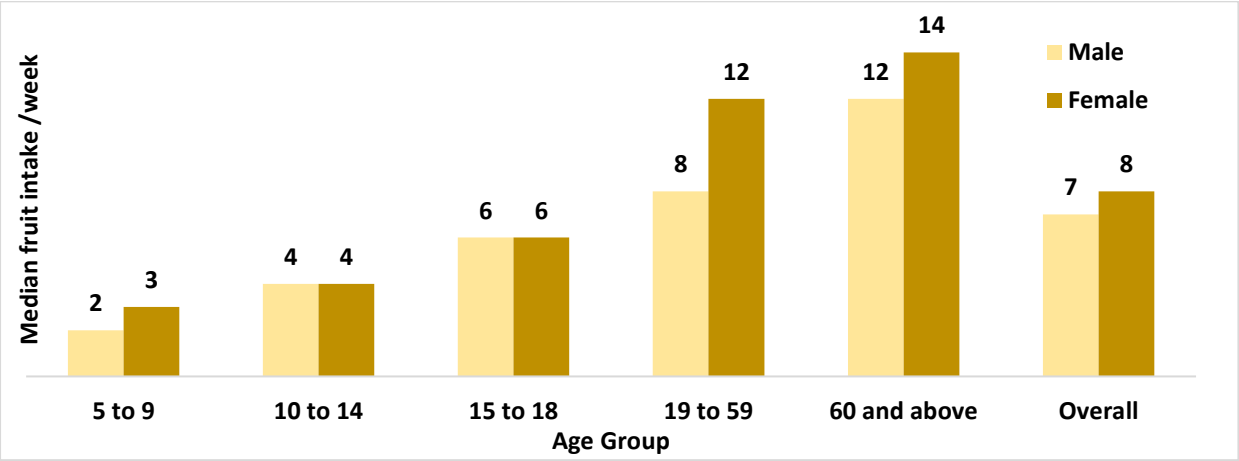
The National Health and Nutritional Status Survey (NHANSS) Phase 2 (Ministry of Health, 2014) indicated that the consumption of fruits and vegetables based on Food Frequency Questionnaires (FFQ) among population of Brunei above 5 years old was low.

Figure 4.1: Median intake of fruit (serve/week) categorised by age group



Source: NHANSS (2010)

Figure 4.2: Median intake of vegetables (serve/week) categorised by age group



Source: NHANSS (2010)

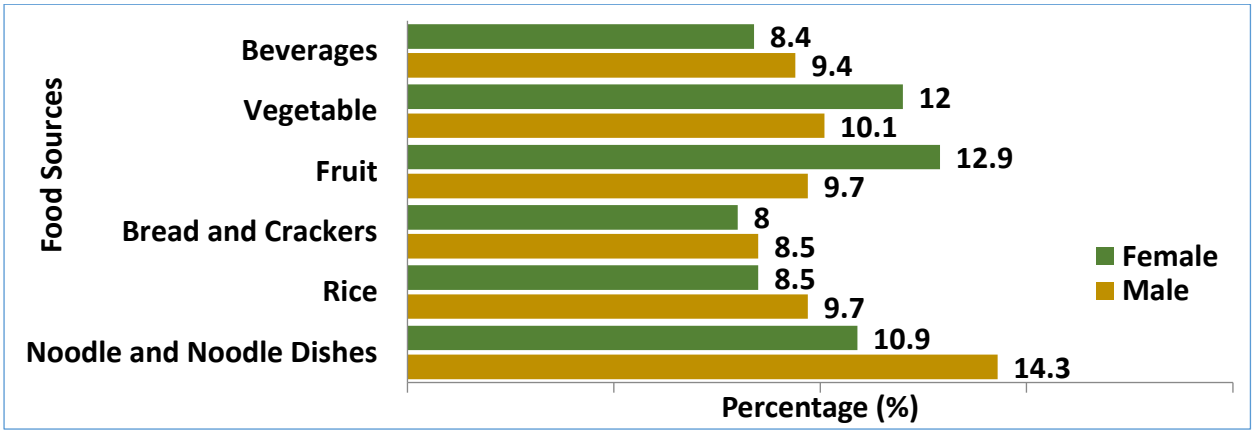
Figure 4.1 and 4.2 indicate that the overall weekly intake of fruits and vegetables were 2 serves of fruit and 7 serves of vegetables for male and 3 serves of fruit and 8 serves of vegetables for female. On average, male daily consumption of fruits and vegetables were 0.29 serve and 1 serve respectively. Female consumed more serving of fruits and vegetables (0.43 serves and 1.14 serves respectively) than male. These findings support several studies, which showed that women are more health conscious than men through higher consumption of fruits and vegetables (Baker & Wardle, 2003; Friel et al.,

2005; Azagba & Sharaf, 2011; Esteghamati et al., 2012).

It was also observed that those aged 60 years and above had higher intake of fruits and vegetables per week compared to their younger counterparts. This same trend was also reported in a fruits and vegetables study in Europe (OECD, 2012). Overall, across the age groups, the daily intake of fruits and vegetables is below the recommended amounts of 2 serves of fruits and 3 serves of vegetables.

Figure 4.3 shows fruits and vegetables contribute 19.8 % and 24.9% of fibre in males and females respectively from different food sources.

Figure 4.3: Percentage Contribution of Fibre from different food sources



Source: NHANSS (2010)

Literature Review

Role of fruits and vegetables intake in human health

The primary role of fruits and vegetables in the diet is to provide nutrients needed by the body. It is recommended that a minimum intake of 400g of fruits and vegetables per day (excluding potatoes and other starchy tubers) is needed for the prevention of chronic diseases such as heart disease, cancer, diabetes and obesity as well as several micronutrient deficiencies, especially in less developed countries (FAO/WHO, 2003).

Positive Impact on Body Weight

Most fruits and vegetables are low in energy density and high in fibre (CDC, 2005; Mytton et al., 2014). The presence of water and fibre lowers the energy density of fruits and vegetables (Rolls et al., 1998; Grunwald et al., 2001). High fibre together with high volume ratio to energy content increase bulkiness in the stomach, which helps in signaling early satiety and regulating hunger as foods move slowly down the gastro intestinal tract (Yao & Roberts, 2001; Boeing et al., 2012). Several evidences have indicated that by displacing foods that are high in fats and energy with fruits and vegetables increase fibre intake which promotes weight loss and slows down weight gain (CDC, 2005; Whybrow et al., 2006; Tucker et al, 2009; Boeing et al , 2012).

Cardiovascular Disease

A review was conducted on ecological, case-control and cohort studies examining the association of dietary fruits and vegetables with cardiovascular disease (Ness & Powles, 1997). Nine of ten ecological studies, two of three case-control studies and six of sixteen cohort studies found a significant protective association between consumption of fruits and vegetables and Coronary Heart Disease (CHD). As for stroke, three of five ecological studies and six of eight cohort studies found a significant protective association, while for circulatory disease, one of two cohort studies reported a significant protective association.

In 2001, Joshipura et al. evaluated two cohort studies and found that each increase of one serving per day in intake of fruits or vegetables was associated with a 4% lower risk of CHD. Similar findings were portrayed from a meta-analysis of cohort studies by Dauchet et al. (2006) where the risk of CHD being decreased by 4% for each additional portion of fruits and vegetables per day and by 7% for fruit consumption.

These evidence is further supported by a meta-analysis on 13 cohort studies by He et al. (2007) that showed an increased consumption of fruits and vegetables from less than 3 to more than 5 servings/day was related to a 17% reduction in CHD risk, whereas increased intake to 3-5 servings/day was associated with a smaller and borderline significant reduction in the CHD risk. Hence, these studies support the WHO's recommendation of at least 400g of fruits and vegetables per day.

Another cohort study of 40 349 men and women were followed up for 18 years found that daily consumption of green and yellow vegetables and fruits was associated with a lower risk of stroke, intracerebral haemorrhage and cerebral infarction mortality in both men and women (Sauvaget et al., 2003).

This can be explained by several potential mechanisms linked to atherosclerosis

prevention: fibre may reduce cholesterol deposits (He and Whelton, 1999; Jenkins et al., 2000); beta-carotene and vitamin C may reduce lipid oxidation of LDL cholesterol (Gaziano, 1999; Savige, 2001); potassium may inhibit platelet aggregation and arterial thrombosis (Young et al., 1995; Suter, 1999; He and MacGregor, 2001); and folate may reduce serum homocysteine levels involved in stimulating arterial dysfunction (Woo et al., 1997; Feldman, 2001; Bazzano et al., 2002).

Cancer

Latino-Martel et al (2016) reported the association between the intakes of fruits and vegetables and the risk of various cancers have been evaluated by WCRF / AICR in 2007 and 2010-2014 CUP reports (WCRD / AICR, 2007, 2010, 2011, 2012, 2013, 2014a). Overall, with a level of evidence previously judged as 'probable', these results confirm the decrease risks of cancers of mouth, pharynx, larynx, oesophagus and stomach associated with the consumption of fruit and vegetables; the decrease risks of lung cancer associated with the consumption of fruits; the decreased risk of breast cancer associated with the consumption of vegetables.

With a level of evidence previously judged as 'suggestive', other new studies confirm a decrease in lung cancer associated with consumption of vegetables (Soerjamataram et al 2010); they indicate a decreased risk of lung (Wu et al, 2013c), colorectal (Wu et al, 2013b) and breast cancer (Liu & Lv, 2013) associated with the consumption of cruciferous vegetables.

Type 2 Diabetes Mellitus (T2DM)

Fibre in fruit and vegetables may help in lowering postprandial glucose level by delaying absorption of carbohydrates, thus improving blood sugar control (Montonen et al., 2005; Slavin & Green, 2007). High magnesium content and α-linolenic acid, an omega 3 polyunsaturated fatty acid in green leafy vegetables may also have an effect in lowering the risk of diabetes mellitus (Carter et al., 2010). Vitamins such as vitamin C and beta-carotene compounds as well as polyphenols in green leafy vegetables have antioxidant properties, which can potentially help in reducing oxidative stress that contributes to the development of diabetes mellitus (Villegas et al., 2008; Carter et al., 2010; Woodside et al., 2013; Wang et al., 2016).

Hypertension/Blood Pressure

In a critical review done by Heiner et al (2012), increased intake of fruit and vegetables is linked with improved blood pressure. In a meta-analysis of randomized controlled trials by Whelton et al. (2005), indicates that increased intake of dietary fiber may reduce blood pressure in patients with hypertension and a smaller reduction in normotensives. This was similarly reported in other prospective cohort studies (Ascherio et al., 1996; Wang et al., 2012). However, in another study by Appel et al. (1997), the blood-pressure-lowering effect of increased consumption of fruit and vegetables was more effective when combined with a low fat diet.

Vision

Consumption of fruits and vegetables keep eyes healthy and may help to prevent two common aging-related eye diseases: cataracts and macular degeneration (Brown et al., 1999; Cho et al., 2004). Analysis of prospective data from the women's health study of 39 876 female health professionals aged ≥ 45 years old, followed for 10 years

indicated that 3.4 servings of fruits and vegetables per day was associated with 10–15% reduced risks of cataract and cataract extraction (Christen et al., 2005). Another study in women also confirmed that high intake of fruit and vegetables lower the prevalence of cataract by 23% compared with those with lower levels (Moeller et al., 2008) .

Serving sizes

Brunei's key recommendation on fruits and vegetables is based on WHO recommendation of at least 400g of fruits and vegetables per day (WHO/FAO, 2003). A general consensus was achieved among the Technical Working Group that two servings of fruits and three servings of vegetables per day will be the recommended guideline for the general population in Brunei Darussalam.

Rationale for two servings of fruits per day

The amount of natural sugar (glucose, sucrose and fructose) in fruit is also taken into account when considering the serving size for fruits i.e. 15g carbohydrate exchange for one serve of fruit. Some fruits weigh more than others, despite having the same amount of 15g of carbohydrate exchange.

The recommended guideline is achievable as fruits are:

1. very handy – minimal preparation, can be eaten as snacks and easy to be brought everywhere
2. can be eaten raw at any time (does not require any cooking)
3. easily available – easy to find everywhere
4. appetizing and mouth- watering

Examples of fruit portion per serving can be found in Appendix 1.

Rationale for three servings of vegetables per day

The estimated levels of vegetable intake vary around the world. According to Micha et al (2015), vegetable intake of countries worldwide ranged from 34.6–493.1 g/day.

The recommended guideline is achievable as vegetables are:

1. normally taken during lunch and dinner. It is recommended that every meal is based on the healthy plate model that emphasis half plate of vegetables which is equivalent to one and a half (1½) serves of vegetables per meal
2. easily available, cheap and can be bought in bundles (especially green leafy vegetables)
3. easily accessible everywhere

Example of vegetables portion per serving can be found in Appendix 2.

Recommendation

Key Message

Eat at least two servings of fruits and three servings of vegetables everyday

Key recommendation 1:

Eat at least two servings of fruits everyday

How to achieve:

- Eat one serve of fruit in every main meal or as snack
- Bring fruit to your workplace or school
- Add fresh or dried fruits into cereals or oats
- Add fresh or dried fruit in plain (unflavoured) low-fat yoghurt
- Make fruit visible (e.g. put fruit in a fruit bowl in living room) to remind and encourage you to eat
- Prepare fruit in a creative way by cutting into different shapes and sizes
- Ensure that fruits are always available at home

Key recommendation 2:

Eat at least three servings of vegetables everyday

How to achieve:

- Always include vegetables during lunch and dinner
- Ensure half of your plate is filled with vegetables during lunch and dinner
- Add vegetables into your sandwiches, kebab, home-made pizza, pasta, noodles, soup
- Vegetables can also be eaten as soup (e.g. mushroom, mixed vegetables, *sawi, petola*, corn)
- Always include and request more vegetables when eating out
- Ensure that vegetables are always available at home

Key recommendation 3:

Eat a variety of colourful fruits and vegetables

How to achieve:

- Buy and enjoy a variety of fruits and vegetables, including fresh and frozen
- Make a rainbow of fruit salad of each colour

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Appendices

Appendix 1: Fruit Serving Sizes

Fruit	1 serve	Fruit	1 serve
Banana (*Pisang emas*)	2 small (66g)	Mandarin orange	1 whole (165g)
Dates	3 pc (21 g)	Mango	1pc medium sized (106g)
Belimbing	2 pc medium	Mangosteen	8 whole
Ciku	1 pc (82g)	*Mata Kucing*	18pc (159g)
Dragon fruit	3 slices (94 g)	Jackfruit (*Nangka*)	4 ulas No seeds (205 g)
Dried Apricot	4 pcs (23g)	Papaya	1 slice (211g)
Dried Fig		Pear, yellow Chinese	1 whole (197g)
Duku	6 pcs (124g)	Pineapple (*Nenas*)	1 slice (142g)
Durian (local)	3 ulas No seeds (54g)	*Pisang Berangan/ Pisang Kapas*	1 pc (62g)
Grapes	8-10 medium sized	Plums	2 small
Green Pear	1 whole (93 g)	Prune	3 pcs No seeds (21g)
Guava (*Jambu batu*)	½ pc No seeds (150 g)	Raisins (*Kismis*)	1 heaped tb (20g)
Honeydew	1 slice (175g)	Rambutan	7 pcs (222g)
Jering	6pc (152g)	Red apple	1 whole (115g)
Langsat	7pcs	*Salak*	1 whole (116g)
Limau manis	1 whole (144g)	*Tarap*	
***Limau* Sunkist**	1 whole (137g)	Watermelon	1 slice (250g)

Source: Shahar et al (2015)

Appendix 2: Vegetable Serving Sizes

Vegetable	1 serve (80g)
Raw non-leafy (cucumber, tomato, carrot)	2 scoops (2 *senduk*)
Raw, leafy (*pengaga, ulam raja*, lettuce)	4-5 scoops or 2 cups or 2 small bowls
Cooked, leafy (spinach, mustard leaves, *pak choy)*	2 scoops (6 tablespoon)
Cooked, non-leafy (broccoli, *umbut*, long beans)	2 scoops

KEY MESSAGE 5

Eat fish, poultry, lean meat, legumes, nuts and other proteins in moderation

Key message 5
Eat fish, poultry, lean meat, legumes, nuts and other proteins in moderation

Introduction

Fish, poultry, lean meat, legumes, nuts and eggs are protein-rich foods. Proteins are large, complex molecules that are critical for normal functioning of the human body and essential for the structure, function, and regulation of the body's tissues and organs.

Proteins are polymer chains made up of amino acids linked together by peptide bonds. There are twenty common amino acids. Nine of which that cannot be synthesized by the human body are called the essential amino acids and hence, must be obtained from daily diet. These essential amino acids are histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine, which can be found in various protein-rich foods.

It is vital to include adequate amount of protein in our diet. If an individual fails to consume sufficient amount of protein, the body's own structural proteins are broken down to meet metabolic needs for repair. In addition, if other protein-requiring functions fail, this may result in significant morbidity and mortality. For this reason, one of the main constituents of a healthy and balanced diet is to include protein foods from a wide variety of sources.

Function of Protein

Proteins serve a large number of functions in the body. They are key components in structure of cells, muscles, bones, connective tissues, blood cells, glands and organs. They function as enzymes, hormones or buffers. They also play an important part in immunity and act as transporting medium around the body. Proteins are essential for healing wounds and repairing tissues, especially in the muscles, bones, skin and hair.

Dietary Sources of Protein

Dietary sources of protein are derived from animal and plant origin. Animal sources of protein include all forms of beef, lamb, veal, goat and venison. Protein is also found in eggs; poultry including chicken, turkey, duck and geese; and birds including ostrich, pigeon and quail. Fish is another excellent source of protein. Typically, animal sources provide protein with a high biological value, primarily due to the essential amino acids consistency that is in a proportion similar to that required by humans.

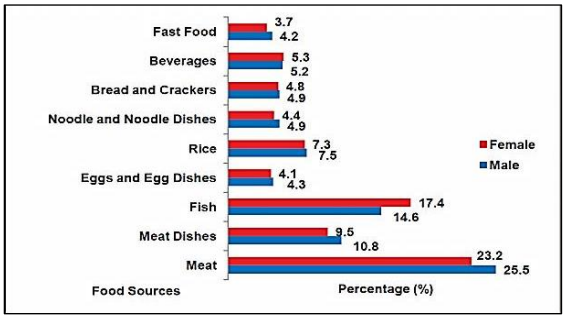
Plant sources of protein include legumes such as beans and lentils, nuts, seeds, soy and soy products such as bean curds (*tofu*) and *tempe*. However, plant sources are of lower biological value in comparison to animal sources. It is still possible to provide the body with a balanced intake of essential amino acids if an appropriate and varied combination of plant proteins are consumed.

In addition to providing a valuable and cost-effective source of protein, legumes and nuts are also excellent sources of iron, essential fatty acids, soluble and insoluble fibre and micronutrients. Legumes and nuts contain phytochemicals, bioactive compounds such as flavonoids, phytohemagglutinins (lectins), phytoestrogens, saponins, and phenolic compounds, which play metabolic roles in humans. Dietary intake of phytochemicals provides many health benefits: protecting

against chronic diseases such as coronary heart disease, diabetes, high blood pressure and inflammation.

Protein-rich foods are also excellent sources of other micronutrients, such as niacin, vitamin B_{12}, vitamin B_6, riboflavin, selenium, choline, phosphorus, zinc, copper, vitamin D, and vitamin E. Red meat provides the most zinc, iron and vitamin B12; poultry provides the most niacin; fish provides the most vitamin D, as well as omega-3 polyunsaturated fatty acids namely eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA); eggs are good source of choline; nuts and seeds provide the most vitamin E.

Figure 5.2: Percentage contribution of protein intake from different food sources



Source: NHANSS (**2010**)

Overview of the health and nutritional status in Brunei Darussalam

Protein Intake in Brunei Darussalam

The NHANSS (2010) showed that the majority of males in Brunei Darussalam (71%) met the Reference Nutrient Intake (RNI). The highest percentage of males who met the RNI was among those in 5-6 years old age group. All males in this group met their protein RNI, followed by age group 7-9 years old (98%) and 10-12 years old (87%). The lowest percentage of males who met the RNI were among those in age group 13-15 years old (46%) and 16-18 years old (39%).

Only about half of the female population (54%) met the protein RNI. Females aged 60 years and older were of particular concern, with only 29% met their RNI. Less than half of the females in age group 16-18 years old and 19-59 years old met the protein RNI. This is of a particular concern, considering that the males and females in age group 13-15 years old and 16-18 years old require protein for optimum body growth and development (Figure 5.1a and 5.1b). Figure 5.2 shows percentage contribution of protein intake in Brunei Darussalam.

Figure 5.1a: Protein intake among Bruneian males and the RNI of protein for males

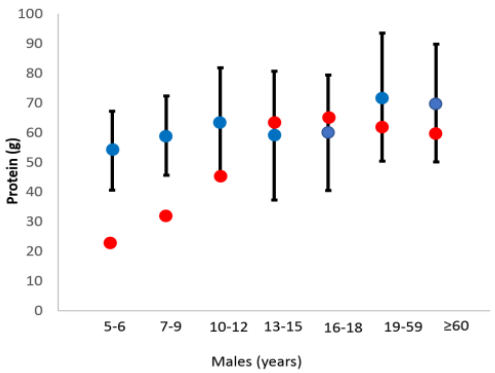
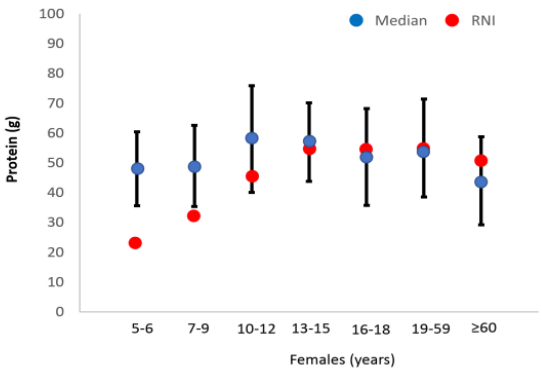


Figure 5.1b: Protein intake among Bruneian females and the RNI of protein for females



Source: NHANSS (2010)

Literature Review

Evidence on the association between meat consumption and cancer risk

Hypotheses on the association between red meat and cancer risk began to emerge in the 1970s. A number of earlier studies suggested that a high consumption of meat and meat products in western countries have a role in increasing the risk of certain cancer such as colorectal cancer, which was prominent in westernized high-income countries such as North America, Australasia and much of Europe (Cummings et al., 1979; Doll and Peto, 1981).

The association between other protein-rich sources such as poultry and fish and cancer risk appeared to be less noticeable. Evidence linking high intake of red meat to colon cancer but not of chicken or fish was first reported in prospective studies (Willett et al., 1990).

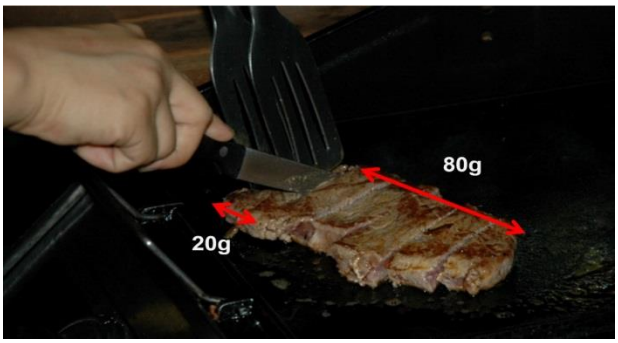
Red meat refers to all types of mammalian muscle meat, such as beef, veal, lamb, mutton and goat.

Processed meat refers to meat that has been transformed through salting, curing, fermentation, smoking or other processes to enhance flavour or improve preservation (WCRF/AICR,2018). This includes sausages, corned beef, cold cuts, *daging lalap* and *belutak.*

In 2007, The World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) published a comprehensive systematic literature review on the relationship between diet and cancer. The review concluded that there was a convincing level of evidence that red meat and processed meat increased the risk of colorectal cancer.

Numerous ongoing studies and evidence on meat and cancer emerge. Most notably was the evidence from the European Prospective Investigation into Cancer involving 478 040 men and women from 10 European countries for a mean follow-up of 4.8 years. The investigation confirmed that colorectal cancer risk was positively associated with high consumption of red and processed meat. The study showed that individuals who ate two daily 80g servings of red and processed meat increased their colorectal cancer risk by a third, compared to those who only ate 20g daily (Norat et al., 2005).

Figure 5.3: 80g vs 20g serving of red meat



Red meat and processed meat has also been implicated with increased risk of other cancers including gastric cancer (Gonzalez et al., 2006) and bladder cancer (Crippa et al., 2016). In a study that determined the association between meat consumption and mortality, Rohrmann et al. (2013) found a positive association between processed meat consumption and mortality.

Evidence on the link between egg consumption and coronary heart disease

The vast majority of the general public, including healthcare professionals and dietitians are contented with a long-held belief that egg, owing to its highly-concentrated cholesterol content in the yolk, can increase blood cholesterol and increase risk of heart disease. This belief may have

stemmed from misinterpretation and postulation of research findings that showed an association between high level of blood cholesterol and a high risk of coronary heart disease mortality. While it is true that egg yolks contain dietary cholesterol, evidence shows that for majority of the people, dietary cholesterol has a much smaller effect on total cholesterol and low-density lipoprotein (LDL) cholesterol when compared to saturated fats and trans fats.

A mounting body of evidence has shown that saturated fat and trans fat have a far more significant role in atherosclerosis compared to dietary cholesterol. Reducing saturated fat and eliminating trans fat in the diet are more important at reducing the LDL cholesterol and very low density lipoprotein (VLCD), an atherogenic sub-type of lipoprotein cholesterol, than restricting eggs and cholesterol-rich foods such as shellfish (Graham et al., 2007). Recent evidence has consistently supported the finding that moderate egg consumption, up to one a day, did not increase heart disease risk in healthy individuals (Hu et al., 1999; Fernandez, 2006) and should be part of a healthy diet instead. Another finding from the Physicians' Health Study also supported the evidence that consuming an egg a day is generally safe for the heart. However, the study added that having more than one egg per day could increase the risk of heart failure later in life, which could also be potentially influenced by other lifestyle or dietary factors (Djousse and Gaziano, 2008).

A more recent study with over 0.5 million adults aged 30-79 years in China reported that daily consumption of egg (< 1 egg per day) significantly reduced risk of cardiovascular disease (CVD), ischaemic heart disease (IHD), major coronary events (MCE), haemorrhagic stroke and ischaemic stroke (Qin et al., 2017). Daily egg consumers were also shown to have 18% lower risk of CVD death and 28% lower risk of haemorrhagic stroke death.

For individuals with diabetes and those who are prone to hypercholesterolemia, the effect of egg consumption may be different. In the Nurses' Health Study and Health Professionals follow-up study, heart disease risk increased among men and women with diabetes who consumed one or more eggs per day (Hu et al., 1999). However, there are inconsistent findings over the years. One of the latest studies revealed that there was no significant difference in cardiometabolic markers between people with prediabetes or type 2 diabetes on high-egg and low-egg diets (Fuller et al., 2018).

Dietary cholesterol content of protein-rich foods;

- Not all shellfish are high in cholesterol. Cockles, muscles, oysters, scallops and clams contain very little cholesterol.
- One large egg has about 186 mg milligrams (mg) of cholesterol — all of which is found in the yolk.
- One average egg (58g) contains around 4.6g fat - about a teaspoon. But only one quarter of this fat is saturated fat, which is the type of fat that increases cholesterol levels in the body.

Evidence for the protective effects of fish intake and chronic diseases

Fish intake has been linked with a number of protective effects against chronic diseases such as atherosclerosis, coronary heart disease, diabetes and cancer. Low incidence of cardiovascular disease in populations with a high fish intake such as Alaskan Natives, Greenland Eskimos, and Japanese have led the researchers to suggest that fish

consumption may protect against atherosclerosis.

Early investigations found an inverse relationship between fish consumption and risk of coronary heart disease (Kromhout et al., 1985; Daviglus et al., 1997; Albert et al., 1998). A meta-analysis comprising of 176 441 subjects from seven prospective studies supported the evidence that fish intake significantly reduced the risk of heart failure.

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Several mechanisms put forward to explain the role of fish in reducing the risk of chronic diseases. Animal, clinical and epidemiological studies documented that the critical component of fish, omega-3 polyunsaturated fatty acids, namely EPA and DHA may lower blood pressure (Morris et al., 1993), modulate serum lipids (Hartweg et al., 2007; Sato et al., 2010), improve diabetes and insulin resistance (Gonzalez-Periz et al. 2009), reduce arrhythmia (Brouwer et al., 2006), suppress platelet aggregation (Hartweg et al., 2007), improve endothelial function (Rizza et al., 2009), and inhibit inflammation (Tull et al.,2009).

Other benefits of fish and omega-3 polyunsaturated fatty acid that have also been documented include decreased rate of cognitive decline in the elderly (Van Gelder et al., 2007; Lukaschek et al., 2016; Zhang et al., 2016); alleviation of depressive disorders (Grosso et al., 2014) and knee synovitis (Baker et al., 2012).

Evidence on the link between legumes, nuts and cardiovascular disease risk

Controlled trials have shown beneficial effects of legumes and nuts consumption on cardiovascular disease risk factors (Mozaffarin et al., 2011). A trial in high-risk adults showed that consumption of a Mediterranean diet supplemented with nuts significantly reduced cardiovascular disease events by up to 30% (Estruch et al., 2013). A meta-analysis

comprising of eight prospective cohort studies, with a total of 468 887 subjects and 10 493 stroke events revealed that a diet containing greater amounts of nuts may be associated with a lower risk of stroke (Shi et al., 2014). Another meta-analysis reviewed the relationship between nuts consumption and ischemic heart disease and found an inverse relationship between nuts consumption and fatal ischemic heart disease (Kelly et al., 2006). The finding is supported by a recent meta-analysis of prospective cohort studies comprising of 501 791 participants (Afshin et al., 2014). The meta-analysis showed that the consumption of nuts was inversely associated with ischemic heart disease and diabetes. Specifically, four weekly 28g servings of nuts were associated with 24% lower risk of fatal ischemic heart disease. Similarly, the meta-analysis also found that legume consumption was inversely associated with total ischemic heart disease, with four weekly 100g servings of legumes was associated with 14% lower risk of total ischemic heart disease (Afshin et al., 2014).

The protective role of legumes and nuts are thought to be attributable to their total and LDL cholesterol lowering effects (Afshin et al., 2014). Consumption of pinto beans, for example, resulted in a lower LDL-cholesterol level without affecting serum TAG, VLDL-cholesterol, or glucose (Finley et al., 2007). Legumes are also a good source of soluble fibre, which has cholesterol-lowering properties. A number of biological mechanisms have been proposed to explain the cholesterol-reducing effects of soluble fibre: prevention of bile salt reabsorption from small intestine leading to the excretion of bile salt in faecal matter; reduced glycaemic response leading to a lower insulin stimulation of hepatic cholesterol synthesis; and through by-products of soluble fibre fermentation in the large intestine. Short-chain fatty acid such as propionate has been shown to inhibit cholesterol synthesis (Duane 1997; Brown et al., 1999; Gunnes and Gidley, 2010).

Evidence on the protective effects of legume and cancer risk reduction

There is an accumulating evidence on the protective role of legume intake in cancer risk reduction. A meta-analysis consisting of three prospective cohort studies and eleven case control studies with 101,856 participants, showed that higher intake of legumes significantly reduced risk of colorectal cancer (Wang et al., 2013). Consistent with the study, a more recent meta-analysis consisting of 14 prospective cohort studies, involving 1,903,459 participants found that higher legume consumption was associated with a decreased risk of colorectal cancer. The researchers demonstrated that legume consumption was inversely associated with colorectal cancer risk among Asians (Zhu et al., 2015). Legumes are rich source of phytochemicals such as flavonoids, phytohemagglutinins (lectins), phytoestrogens, saponins, and phenolic compounds, all of which are strong anti-oxidants, protective against cancer development. Legumes are also high in dietary fibre; soluble and insoluble fibre.

Recommendation

Key Message

Eat fish, poultry, lean meat, legumes, nuts and other proteins in moderation

Key recommendation 1:

Eat fish, poultry, lean meat and eggs

How to achieve:

- Eat two to three servings of fish, poultry, lean meat daily.
- Limit intake of red meat to no more than two servings (240g) per week; 120g per serving.
- Avoid processed meats such as sausages, *belutak*, corned beef, nuggets and cold cuts.
- For the general population, consume no more than an egg per day.

Key recommendation 2:

Include legumes and nuts in your diet

How to achieve:

- Eat three heaped tablespoons of cooked legumes, approximately 80g for one serving
- Add legumes or legume products such as *tempe* to dishes
- Eat a small, cupped handful of non-fried nuts, approximately 30g serving per day
- Incorporate plain or unsalted nuts as snacks

Figure 5.4: One serving of nuts

Source: American Institute for Cancer Research (2016)

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KEY MESSAGE 6

Limit intake of fatty foods and use the recommended cooking oil sparingly

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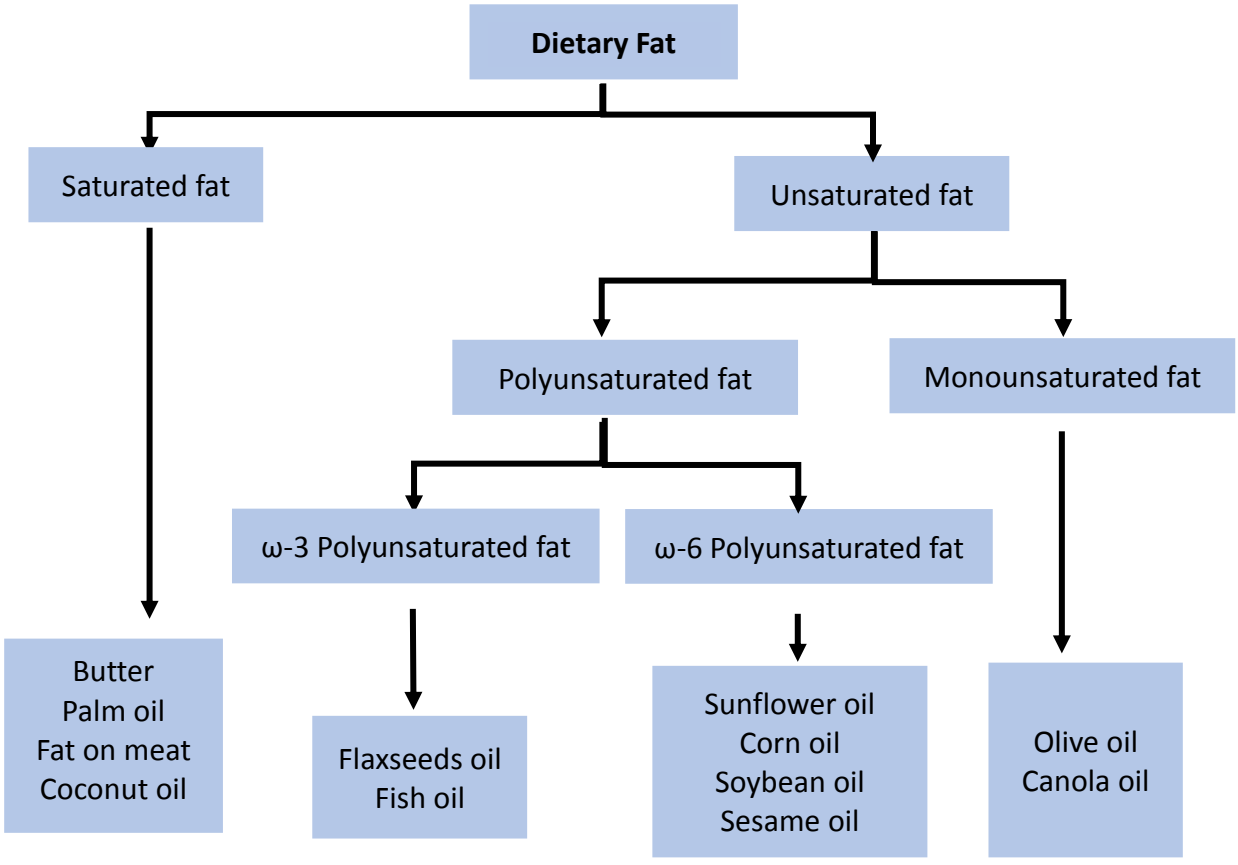
Introduction

There have been substantial advances in our knowledge and understanding on the role of dietary fat over the past decades. To date, our understanding on dietary fat goes well beyond their traditional role as a source of energy. Much of the progress on our knowledge of dietary fat revolved around the novel findings of the intricate balance between different type of fats, and a more detailed understanding in the vast field of fatty acids.

Dietary fat is one of the three main macronutrients. Due to its wide range of melting points, dietary fat can be found as liquid (oil) and solid fats at room temperature. Fats are esters consisting of a glycerol molecule and three fatty acids.

The main division of fats are saturated and unsaturated fat (Figure 6.1). The unsaturated fat can be subdivided into two broad classes: monounsaturated fat and polyunsaturated fat. Polyunsaturated fat can be further divided into ω-3 polyunsaturated fat and ω-6 polyunsaturated fat.

Figure 6.1: Divisions and subdivisions of dietary fats



Function of dietary fat

Dietary fat is the most energy dense macronutrient, providing 9 kcal of energy per unit gram. In addition to providing energy, dietary fat is a primary contributor to the palatability of food, as it determines the texture, flavour and aroma of foods. Dietary fat also plays a wide range of physiological functions in human body; made up the main structural component of cell membranes, which acts as cellular barriers that regulate the passage of substances in and out of the cells; acts as an insulator to regulate body temperature; helps in the production of hormones and absorption of fat-soluble vitamins; slows gastric emptying and intestinal motility, thus prolonging satiety.

Essential Fatty Acids

Dietary fat also provides essential fatty acids (EFA), which cannot be synthesized by human body. EFA are needed for the development of brain and central nervous system. EFA are particularly crucial to the early stages of life-embryonic development and early growth after birth through infancy and childhood. In addition, EFA are also essential for blood coagulation and for their anti-inflammation properties. The major sources of essential fatty acids are:

- Short-chain ω-3 PUFA; Alpha-linolenic acid (ALA)
- Long-chain ω-3 PUFA; Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA)
- Long-chain ω-6 PUFA; Linoleic acid (LA)

Alpha-linolenic acid (ALA), the short-chain ω-3 PUFA can be found in flaxseed oil, while EPA and DHA, the long-chain ω-3 PUFA are found in high concentrations in fish, particularly oily fish such as anchovies, sardines, mackerel, salmon and herring. In Brunei Darussalam, oily fish that can be found are *duai kuning (pompano), rumahan, sembilang, kitang, tamban, kuasi, belanak, terubok* and *ikan patin* (Figure 6.2). ALA is a precursor of EPA and DHA but it has a very low conversion efficiency. Therefore, it is recommended to obtain EPA and DHA from food sources.

Linoleic acid (LA) is the ω-6 PUFA that can be found in evening primrose oil, sunflower oil, corn oil, soybean oil, walnut oil and sesame oil.

Figure 6.2: Examples of oily fish that can be found in Brunei Darussalam

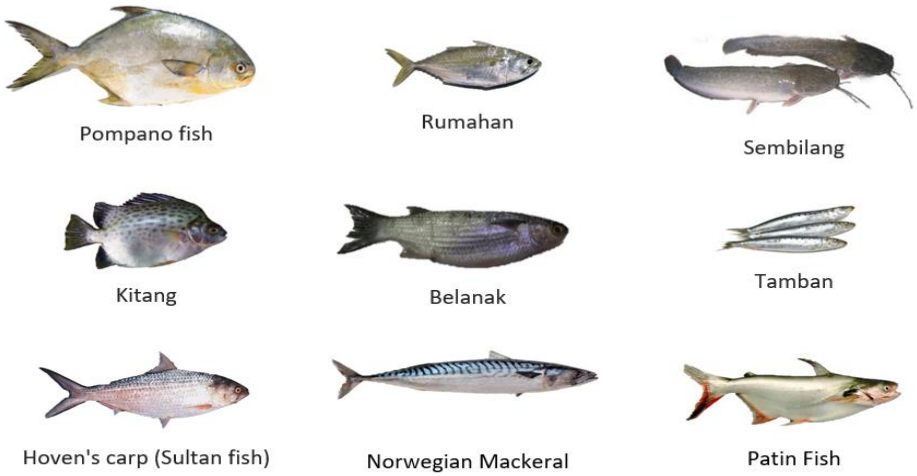


Table 6.1: Total fat, EPA and DHA content of different fish species

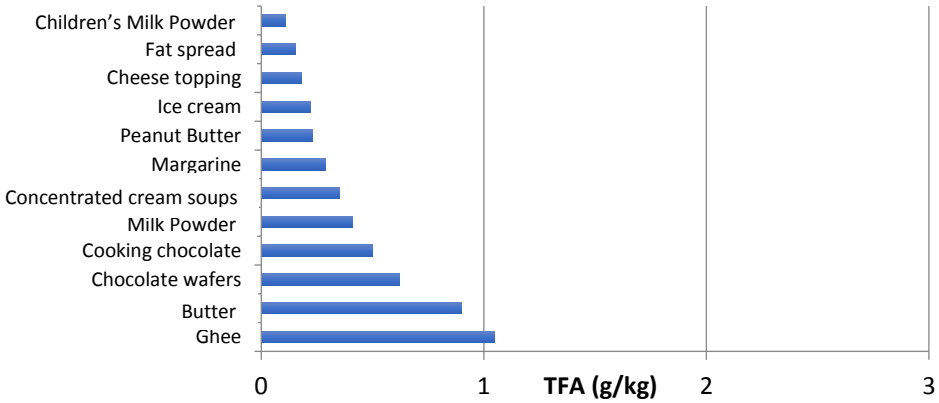
Species	(g/100g)			
	Total Fat	EPA	DHA	EPA + DHA*
Salmon, Atlantic, farmed	12.4	0.690	1.457	2.147
Anchovy, European, canned in oil	9.7	0.763	1.292	2.055
Herring, Atlantic, cooked	11.6	0.909	1.105	2.014
Salmon, Atlantic, wild, cooked	8.1	0.411	1.429	1.840
Tuna, Bluefin, fresh, cooked	6.3	0.363	1.141	1.504
Sardine, Pacific, canned in tomb	10.5	0.532	0.865	1.397
Mackerel, Atlantic, cooked	17.8	0.504	0.699	1.203
Halibut, Greenland, cooked	17.7	0.674	0.504	1.178
Trout, Rainbow, farmed, cooked	7.2	0.334	0.820	1.154
Trout, Rainbow, wild, cooked	5.8	0.468	0.520	0.988
Swordfish, cooked	5.1	0.138	0.681	0.819
Halibut, Atlantic and Pacific, cooked	2.9	0.091	0.374	0.465
Shrimp, mixed species, cooked	1.1	0.171	0.144	0.315
Tuna, light, canned in water	0.8	0.047	0.223	0.270
Grouper, mixed species, cooked	1.3	0.035	0.213	0.248
Haddock, cooked	0.9	0.076	0.162	0.238
Catfish, Channel, wild, cooked	2.9	0.100	0.137	0.237
Catfish, Channel, farmed, cooked	8.0	0.049	0.128	0.177
Cod, Atlantic, cooked	0.9	0.004	0.154	0.158

*Ranked from highest to lowest EPA + DHA value. *Source*: Adapted from Uauy-Dagach R and Valenzuela A, 1992

Trans fatty acids (TFA)

Trans fat emerged in the food supply in the early 20th century. These artificial fatty acids are industrially manufactured through the process of hydrogenation of vegetable oils, which extend its shelf life substantially. Trans fats can be found naturally in meat and dairy products. However, the amount found naturally in foods is mostly negligible. Below are the sources of trans fat from food products (Figure 6.3).

Figure 6.3: Sources of trans fat from supermarkets



Source: Karupaiah T et al (2014)

Dietary sources of fats

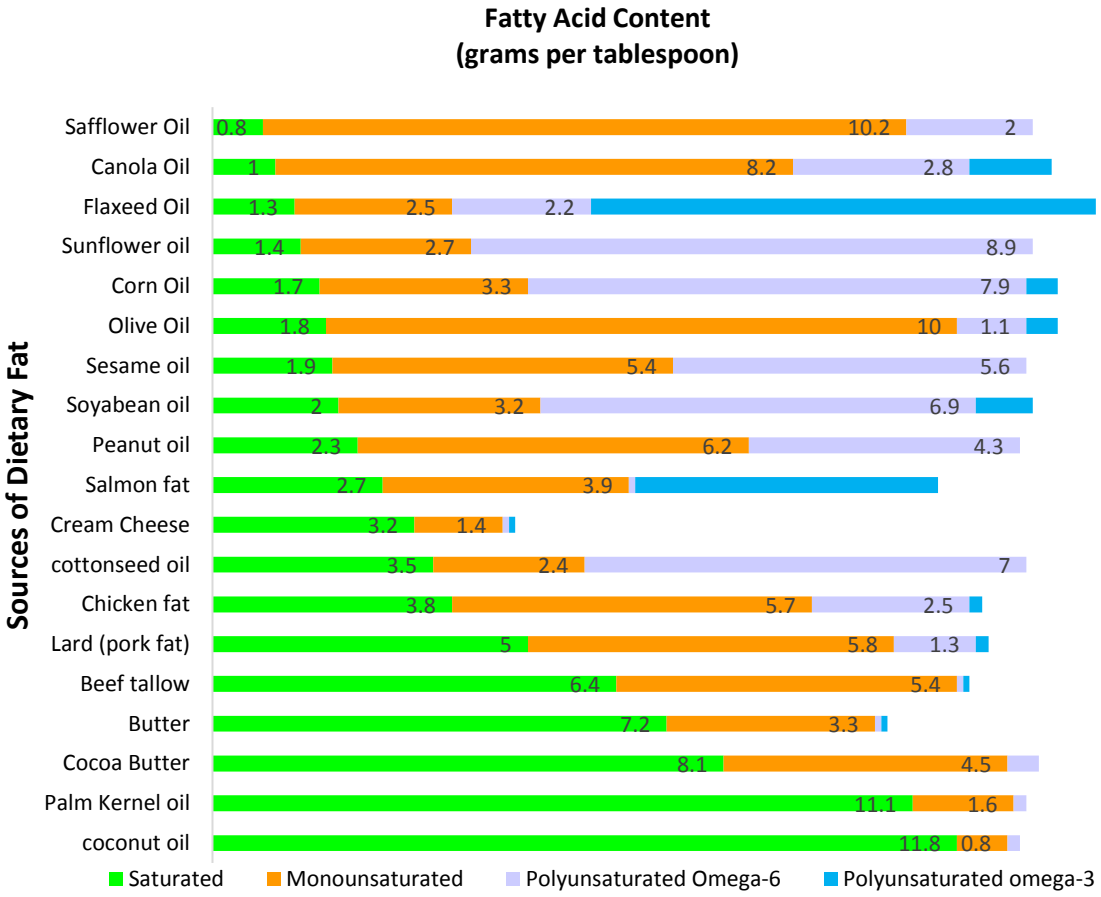
Meats

Red meat from cow, water buffalo, lamb and goat is a source of fats, besides providing protein, vitamins and minerals. For example, beef typically contains about 50g of total fat per 100g, in which half of the total fat is saturated type (McCance and Widdowson's composition of foods integrated dataset).

Vegetable oils

Vegetable oils or cooking oils is one of the main sources of fat in human diet. Fatty acid composition in different vegetable oils varies depending on the origin of the cooking oils.

Figure 6.4: Fatty acid content of fatty foods (grams per tablespoon) and their respective ω-3: ω-6 ratio



Source: Adapted from https://www.gbhealthwatch.com/Science-Omega3-Omega6.php

Overview of the health and nutritional status in Brunei Darussalam

As mentioned elsewhere, the prevalence of non-communicable diseases such as diabetes, cardiovascular diseases, obesity and cancer are increasing in Brunei Darussalam (NNSS, 1997; NHANSS, 2010; IHSHPP, 2011).

The prevalence of dyslipidaemia is 73.8% (NHANSS, 2010). Dyslipidaemia increased with age and peaked in the 50-59 age group. (32.7%) of males and 16.1% of females have high triglyceride.

About half (52.2%) of females and 30% of males have low HDL cholesterol and a third (32.7%) of males and 16.1% of females have high triglyceride.

Fat Intake in Brunei Darussalam

Total fat contributed to about 30.4% and 30.5% of total energy for male and female adults respectively (NHANSS, 2010). However, more than half of the males (53.3%) and females (54.6%) consumed more than 30% of energy from fat.

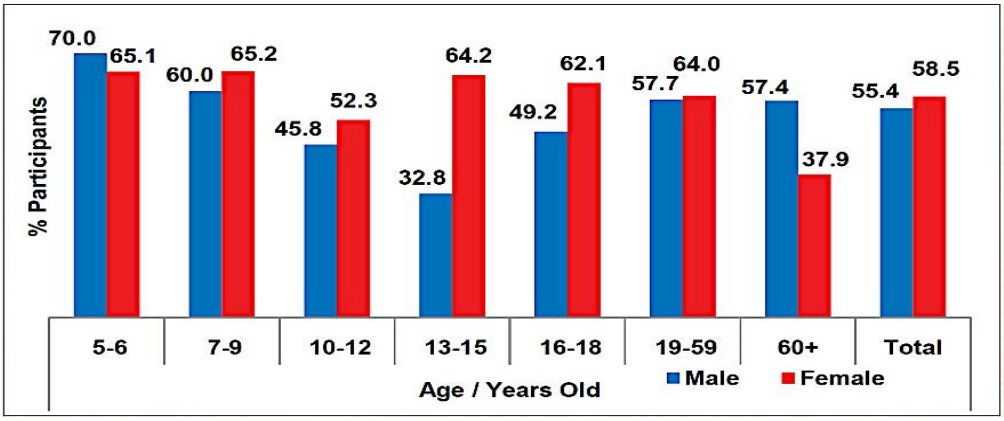
The mean energy derived from saturated fat were 10.8% and 10.7% among male and female adults respectively. More than half of the adult populations consumed more than 10% of energy from saturated fat (Figure 6.5). A slightly higher percentage of female adults (58.5%) consumed more than 10% of energy from saturated fat compared to male adults (55.4%) (Figure 6.6).

Dietary sources of fat among Bruneian adult population

The major source of dietary fat in Brunei Darussalam comes from meat and meat dishes combined, followed by noodle and noodle dishes (NHANSS, 2010). Other foods such as battered or fried snacks, fast foods and beverages also contributed to a significant proportion of the dietary fat (Figure 6.6).

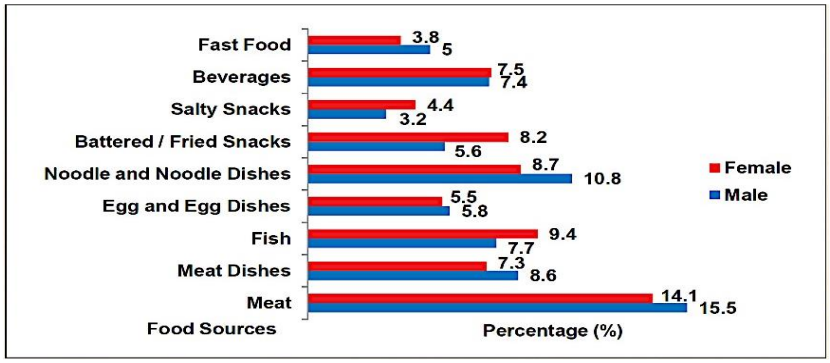
Across all food categories, beverages provided the most saturated fat in diet, followed by meat, battered or fried snacks, meat dishes and dairy products. About 15% of total saturated fat came from beverages.

Figure 6.5: Percentage consuming >10% energy from saturated fat intake by age group



Source: NHANSS (2010)

Figure 6.6: Percentage of total fat intake obtained from different food sources



Source: NHANSS (2010)

A substantial proportion of the fats in foods such as noodle and noodle dishes, fried snacks and fast foods were thought to come from vegetable oils. The majority of Bruneian adults (77%) reportedly used palm oil in cooking (NHANSS, 2010). Only 17.3% used cooking oils with PUFA such as corn oil, sunflower oil and soya bean oil, and 3.1% used cooking oils with MUFA such as canola and olive oil.

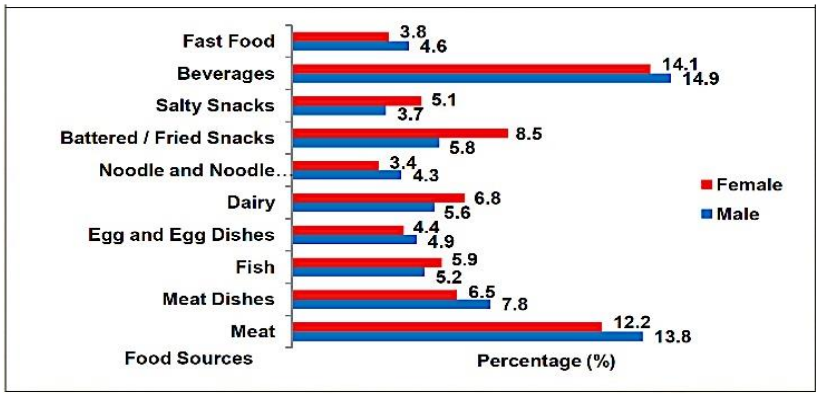
The saturated fat in beverages was thought to come from dairy or non-dairy products added into them. Female adults consumed higher percentage energy from saturated fat compared to male adults. This can be explained by differences in the level of intake of battered/fried snacks, salty snacks and dairy products between the males and females (Figure 6.8).

Sweetened condensed milk

Sweetened condensed milk is a form of concentrated milk, in which approximately 60% of the water content has been removed. As the name implies, sugar is added to the condensed milk before canning. Typically, sweetened condensed milk contains as much as 50% added sugar and 10% total fat by weight, half of which is saturated fat.

Based on data collected from the supermarkets, the fat content of 11 different sweetened condensed milk products ranged from 10-10.6 g/100g while their carbohydrate content ranged from 58-60 g/100g. Out of these 11 products, only one indicated its sugar content on the nutrition information panel, which is 50% (Appendix 1).

Figure 6.7: Percentage of total saturated fat intake obtained from different food sources



Source: NHANSS (2010)

Literature Review

Over the past decades, there have been significant advances in the research of fats and fatty acids. This section reviews evidence derived from population-based cohort studies, randomized controlled trials (RCT), systematic reviews and meta-analyses of fats and fatty acids, specifically on the quantity of total fat, energy from total fat relative to energy from other macronutrients and relative to other type of fats, as well as new findings on specific classes and sub-classes of fatty acids.

Evidence between different proportion of energy from total fat relative to energy from other macronutrients on body weight and obesity

Observational studies investigating the link between the percentage of energy from fat relative to percentage energy from other macronutrients such as carbohydrates and protein and obesity appear to show consistent findings. For example, the Nurses' Health Study, an 8-year prospective cohort study consisted of 41,518 women, showed that increased percentage energy from fat had a positive but weak association with weight gain (Field et al., 2007). Observational studies in developing countries also suggested that increased percentage energy from fat was associated with weight gain, thus potentially contributing to the increasing problem of overweight and obesity (FAO, 2008). A large meta-analysis, consisted of 33 RCTs with 73,589 participants, showed that a study population with 28-43% of energy from fat and reduced total fat intake have led to a small but statistically significant, clinically meaningful and sustainable reduction in body weight (Hooper et al., 2012). More recently, the same team conducted another meta-analysis to investigate the relationship between the proportion of energy from fat and body weight and BMI of the general population. The meta-analysis consisted of 32 RCTs with approximately 54,000 participants, showed that participants who were randomized to an intervention group with lower fat intake had consistent lower body weight, BMI and waist circumference compared to the control group with usual or moderate fat intake (Hooper et al., 2015). This evidence supports the recommendation to reduce the amount of total fat intake to less than 30% of the total energy.

Evidence on the link between total fat on CHD and cancer risk

Evidence has consistently showed a lack of association between total fat and CHD and cancer risk. Based on several RCTs, a low-fat diet consisting of between 27-30% of energy from fat paired with a high-carbohydrate diet did not favourably influence the blood lipids, fasting blood glucose, fasting blood insulin, or blood pressure, compared to a high fat diet (Appel et al., 2005; Schaefer et al., 2005; Gardner et al., 2007). Prospective observational studies found either no or small associations between total dietary fat intake and CHD and cancer risk (Beresford et al., 2006; Howard et al., 2006; Prentice et al., 2006). The position and statement papers by Australia Heart Foundation, British Heart Foundation and American Heart Association stated that there is no direct relationship between total fat intake and the incidence of CHD. WHO (2003), WCRF/AICR (2007) and FAO (2008) consistently documented that there is no probable or convincing evidence

for significant effects of total dietary fats on CHD or cancers.

Evidence to-date indicates that dietary fat and various type of cancers has no or weak association. A meta-analysis of 22 prospective cohort studies found a positive but statistically insignificant association between dietary fat and gastric cancer risk (Han et al., 2015). Likewise, lack of significant associations between dietary fat and ovarian cancer risk (Hou et al., 2015); prostate cancer risk (Xu et al., 2015) and pancreatic cancer risk (Shen and Yao, 2015) have been documented. However, there are some existing evidences that show the association between dietary fat and breast cancer.

The Women's Health Initiative study reported breast cancer risk reduction following a low-fat diet, but only with a borderline significance (Prentice et al., 2006). Findings from the Nurses' Health Study, which consisted of 88,804 women followed over 20 years, showed that total fat intake was not associated with the risk of breast cancer. A positive association between fat intake from animal source and breast cancer was observed only after adjusting for demographic, anthropometric, lifestyle, and dietary factors. A high intake of saturated fat has also been shown to be associated with breast cancer (Farvid et al., 2014). More evidence is needed to establish the association between dietary fat and breast cancer.

Evidence on the effect of replacing SFA with Carbohydrate, PUFA or MUFA

Results from previous studies on the role of saturated fat on CHD risk were clouded by the fact that saturated fat were not assessed by its individual fatty acid components. Subsequent studies show that individual saturated fatty acids (SFA) have different effects on the concentration of plasma lipoprotein cholesterol fractions. For example, lauric (C12:0), myristic (C14:0) and palmitic (C16:0) acids may increase LDL cholesterol whereas stearic (C18:0) has no effect.

A meta-analysis of 11 prospective cohort studies showed that reducing SFA (C12:0–C16:0) and replacing it with carbohydrates decreased both LDL and HDL cholesterol concentrations. However, that did not change the total/HDL cholesterol ratio (Jakobsen et al., 2009). Jakobsen et al. (2009) also suggested that replacing SFA with largely refined carbohydrates may have no benefit on CHD, and may even increase the risk of CHD and favour metabolic syndrome development.

On the other hand, replacing SFA (C12:0–C16:0) with PUFA may have a more favourable effect than replacing it with carbohydrate. A recent expert consultation stated that there is a convincing level of evidence that replacing SFA (C12:0–C16:0) with PUFA decreases LDL cholesterol concentration, total/HDL cholesterol ratio and the risk of CHD (FAO, 2008).

Research study further analysed the types of PUFA that may contribute to the CHD risk reduction. A meta-analysis consisted of 13 prospective cohort studies, with 310 602 participants, showed that dietary linoleic acid (LA), a predominant ω-6 PUFA, was inversely associated with the CHD risk in a dose-response manner. These data provide support for current recommendations to replace SFA with PUFA for the primary prevention of CHD (Farvid et al., 2014).

Similarly, replacing SFA (C12:0–C16:0) with MUFA has also showed favourable outcomes. An expert consultation on fats and fatty acids concluded that there is a convincing level of evidence that replacing SFA (C12:0–C16:0) with MUFA decreases LDL cholesterol concentration and total/HDL cholesterol ratio (FAO, 2008). Replacing SFA (C12:0–C16:0) with trans fatty acids (TFA), however, decreases HDL cholesterol and increases the total /HDL cholesterol ratio (FAO, 2008).

Reducing SFA by itself, either by reducing the amount of SFA intake or the percentage energy from SFA, had no effect on CHD and stroke (Siri-Tarino et al., 2010).

Evidence on the link between trans fatty acids and lipid profiles and CHD risk

Evidence that emerged over the past two decades consistently shows that trans fatty acid (TFA) produced commercially has adverse effects on serum lipid profiles and health. TFA has been shown to increase the atherogenic LDL cholesterol, lipoprotein(a), AopB level, while decreasing the protective HDL cholesterol and ApoA1 levels (Mensink and Katan, 1992; Katan et al., 1994; Mozaffarian et al., 2006; Mozaffarian and Clarke, 2009).

A recent meta-analysis documented that TFA was associated with all cause mortality, total CHD, and CHD mortality (de Souza et al., 2015). FAO (2008) expert consultation concluded that there is a convincing level of evidence that TFA increases CHD risk and CHD events.

Table 6.2: The level of evidence on the effect of replacing saturated fat or carbohydrate with other types of fat or macronutrient

Replacing	With	Effect	Level of Evidence
Saturated	Carbohydrate	Decreases LDL cholesterol Decreases HDL cholesterol May increase risk of CHD	Probable
	PUFA	Decreases LDL cholesterol Decreases the total/HDL cholesterol ratio Decreases risk of CHD death	Convincing
	MUFA	Decreases LDL cholesterol Decreases total/HDL cholesterol ratio	Convincing
	TFA	Decreases HDL cholesterol Increases total/HDL cholesterol ratio	Convincing
	Reducing amount of saturated fat or % energy from saturated fat	No effect on CHD and stroke	
Carbohydrates	MUFA	Increases HDL cholesterol	Convincing
		Increase insulin sensitivity	Probable

Source: Adapted from FAO (2008)

Evidence on the link between repeatedly used frying oil and health

Repeated use of frying oil can alter the chemical structure and deteriorate the PUFA content of cooking oil over time. The changes in its chemical structure can be aggravated by the type and volume of cooking oil, products being fried, temperature of frying and exposure of cooking oil to the air. Some evidence suggested that highly oxidized and heated oils may have some carcinogenic properties. FAO (2008) explained that PUFA are lost during the frying process, which affects the nutritional value of frying oil rich in PUFA. It is thus recommended to keep the consumption of foods cooked with reused frying oil to a minimum.

Evidence on the role of ω-3 polyunsaturated fatty acids in health

Over the past decades, research in the field of fatty acids has advanced further with the findings on the significant role of ω-3 PUFA. RCTs and cohort studies of ω-3 PUFA intakes have demonstrated numerous physiological benefits in human health.

ω-3 PUFA and Coronary Heart Disease

A mounting body of evidence from RCTs and prospective cohort studies have documented the protective roles of ω-3 PUFA intake on CHD risk. Observational studies consistently documented the inverse relationship between ω-3 PUFA or fish intake and the risk of CHD. A recent meta-analysis, which comprised of 19 prospective cohort and retrospective studies aimed at examining the relationship between circulating biomarkers of seafood-derived eicosapentaenoic acid (EPA; 20:5ω-3), docosapentaenoic acid (DPA; 22:5ω-3), docosahexaenoic acid (DHA; 22:6ω-3), and plant-derived α-linolenic acid (ALA; 18:3ω-3) with CHD incident, showed that the biomarker concentrations of ω-3 fatty acids were associated with a lower incidence of fatal CHD (Del Gobbo et al., 2016). Another meta-analysis of 18 RCTs and 16 prospective cohort studies, found that EPA and DHA may be associated with a reduced CHD risk, with a greater benefit being observed among the higher-risk populations of RCTs (Alexander et al., 2017).

ω-3 PUFA and Cardiovascular Disease (CVD)

ω-3 PUFA intake may not have similar protective effect on CVD risk as CHD. Results from four meta-analyses described below showed that ω-3 fatty acids do not significantly reduce the risk of cardiovascular events or total mortality.

A meta-analysis of RCTs and prospective cohort studies documented that ω-3 fatty acids do not significantly reduce the risk of total mortality or cardiovascular events (Hooper et al., 2006). A more recent meta-analysis with 20 RCTs indicated that ω-3 supplementation had no significant effect on all-cause mortality, cardiac death, sudden death, myocardial infarction, or stroke (Rizos et al., 2012). The finding is consistent with another meta-analysis of RCTs, where the authors concluded that there was no significant effect of ω-3 supplementation on inflammatory biomarkers in both healthy and ill individuals (Rangel-Huerta et al., 2012). Another meta-analysis with 26 prospective cohort studies and 12 RCTs, showed the limited protective effect of fish consumption or ω-3 supplementation against CVD, which include fatal or non-fatal ischemic stroke, haemorrhagic stroke, cerebrovascular accident, or transient ischemic attack (Chowdhury et al., 2012).

Other Protective Benefits of ω-3 PUFA

Despite the lack of clear association between ω-3 PUFA and CVD risk, other health benefits of ω-3 fatty acids (EPA and DHA) include:

- Lowering blood pressure slightly
- Decreasing inflammation
- Decreasing serum triglyceride levels
- Improving vascular endothelial function
- Improving bipolar disorder
- Improving cognitive decline
- Reducing depression
- Reducing aggression
- Reducing age-related muscular degeneration

Recommended Intake of ω-3 PUFA

As far as the intake levels of essential fatty acids is concerned, the minimum intake levels for essential fatty acids to prevent deficiency symptoms are estimated to be 0.5% energy from Alpha-linolenic acid (Short-chain ω-3 PUFA) and 2.5% energy from linoleic acid (ω-6 PUFA) (DACH, 2000). FAO (2008) estimated that between 2.5-3.5% of energy should come from total PUFA (ω-3 and ω-6 fatty acids) to prevent deficiency. To reduce the risk of fatal CHD and sudden cardiac death, evidence indicates an intake of 250 mg/day of EPA plus DHA is recommended (Burr et al., 1989; Mozaffarian and Rimm, 2006; Yokoyama et al., 2007; Gissi-Hf, 2008).

Many institutions recommend a higher intake. International Society for the Study of Fatty Acids and Lipids (2004) recommends a daily intake of 500 mg/day EPA plus DHA for the primary prevention of CHD. This is equivalent to consuming at least two portions (90 g each) of oily fish per week. The American Heart Association recommends the general adult population to eat fish, particularly oily fish, at least twice a week.

With regard to ω-6 to ω-3 ratio, the 2002 Joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases and its scientific review indicated that a balanced intake of ω-6 and ω-3 PUFAs is essential for health (WHO, 2003; Reddy and Katan, 2004).

In summary, current evidence indicates that some specific dietary fatty acids play more important roles in the public health perspective as opposed to the total dietary fat. Emphasis should be made to encourage the general public and to facilitate change in environment such as the food supply to reduce the dietary intakes of saturated fat, particularly the SFA C12:0–C16:0, and favourably replace it with PUFA or MUFA, or a combination of PUFA and MUFA. Evidence also clearly shows the adverse effects of trans fatty acids from partially hydrogenated vegetable oils and hence, trans fat should be eliminated from all chains of food supply.

Recommendation of Energy from Fat

Due to the methodological limitations in assessing the population dietary intake in the NHANSS (2010), it is not possible to deduce if there is a change in the level of energy intake among Bruneian adult populations over the past decades. However, with the rapidly growing socioeconomic development, the population energy intake is likely increased. Coupled with reducing physical activity level and increasing sedentary lifestyle, this combination has resulted in an increased overweight and obesity rate in Brunei Darussalam. Evidence indicates that more than half of the adult population in Brunei

Darussalam consumed excessive energy from total fat and saturated fat (NHANSS, 2010).
In a population with relatively adequate energy intake, half of which are consuming an excessive energy from fat and saturated fat, it is important to ensure that the amount of the macronutrients is driven towards a more balanced energy intake.

It is therefore, crucial for Bruneian adult population in general to maintain a healthy body weight range by reducing or achieving a more appropriate energy level, while balancing and correcting the type of fats included in their diet. For example, by reducing energy obtained from saturated fat and replacing it with PUFA and/or MUFA. This can be achieved by replacing cooking oils high in saturated fat content to cooking oils high in PUFA and/or MUFA, consuming foods high in PUFA/MUFA such as avocados and nuts, with emphasis placed on consuming two servings of oily fish a week. Bruneian adults should limit their intake of processed foods such as crisps, cakes, biscuits, margarine, ghee, butter-blend, and ice-cream, as these foods are typically high in trans fat.

The recommendation to reduce saturated fat intakes need to be emphasised, especially among female adults in Brunei Darussalam. NHANSS (2010) indicates that a higher percentage of females (64%) consumed more than 10% of energy from saturated fat compared to male adults (58%), placing many female adults at a higher risk of CHD. Compared to Bruneian males, the females consumed higher saturated fat energy from battered/fried snacks, dairy products and salty snacks (Figure 20). Therefore, it is recommended to reduce intake of battered/fried foods or salty snacks and replace them with healthier snacks, and choose dairy products with lower fat content.

Table 6.3: Recommended Total Fat and Fatty Acid Intake for Adults

Types of Fat	Measure	Percentage of energy
Total Fat	AMDR U-AMDR L-AMDR	20 -35% 35% 15%
SFA	U-AMDR	10%
MUFA	AMDR	Total Fat – SFA – PUFA – TFA Can be up to 15 – 20%, according to total fat intake
Total PUFA	AMDR (LA + ALA + EPA + DHA) U-AMDR L-AMDR AI	6–11% 11% 6% 2.5–3.5%
n-6 PUFA	AMDR (LA) EAR AI	2.5–9% 2% (SD of 0.5%) 2–3%E
n-3 PUFA	AMDR (n-3) L-AMDR (ALA) AMDR (EPA + DHA)	0.5 – 2% >0.5 % 0.250 – 2 g/day
Trans Fatty Acid	UL	<1%

Source: Adapted from FAO (2008)

Abbreviations:

ALA	*alpha linolenic acid*
AMDR	*acceptable macronutrient distribution range*
AI	*adequate intake (expressed as a range)*
DHA	*docosahexaenoic acid [cervonic acid]*
EAR	*estimated average requirement*
EPA	*eicosapentaenoic acid [timnodonic acid]*
L-AMDR	*lower value of acceptable macronutrient distribution range*
U-AMDR	*upper value of acceptable macronutrient distribution range*
UL	*tolerable upper intake level*

Recommendation

Key Message

Limit intake of fatty foods and use recommended cooking oil sparingly

Key recommendation 1:

Limit intake of fatty foods

How to achieve:

- Avoid or limit intake of deep-fried and battered foods to no more than twice a week.
- Trim off any visible fat and/or skin on meat and poultry
- Avoid or limit intake of processed foods such as nuggets, corned beef and sausages.
- Avoid or limit intake of foods with high content of trans fat such as crisps, cakes and pastries, biscuits, margarine, ghee, butter-blend, and ice-cream.

Key recommendation 2:

Replace saturated and trans fats with foods containing polyunsaturated and monounsaturated fats.

How to achieve:

- Replace foods high in saturated fats such as palm oil, butter, ghee, coconut oil with foods which contain predominantly polyunsaturated and monounsaturated fats such as canola oil, olive oil, sunflower oil, soybean oil and other cooking oil
- Avoid using used cooking oil repeatedly
- Replace deep frying with alternative low fat cooking methods such as steaming, baking, grilling and boiling
- Choose low fat dairy products such as skimmed/low fat milk to replace non-dairy creamer, evaporated milk and sweetened condensed milk
- Use reduced fat milk to replace coconut milk in dishes
- Consume at least two servings of fish per week, preferably oily fish such as *duai kuning, kembura*, *balanak, tamban, tenggiri* and salmon
- Choose 'trans-fat free' products.

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Appendices

Appendix 1: Fat content of sweetened condensed milk

Products	Fat g/100g	Total Sugar g/100g	Carbohydrates g/100g
A	10		58
B	10	-	58
C	10.3	-	58.7
D	10	-	59
E	10		58
F	10		59
G	10.6		59.8
H	10		60
I	10.2		58.1
J	10.6		59.8
K	10	50	58

Source: Data is based on the nutrition information panels collected from various brands of sweetened condensed milks in major supermarkets and convenience stores in Brunei Muara (2016)

KEY MESSAGE 7

Reduce intake of sugary foods and beverages

Key Message 7
Reduce Intake of Sugary Foods and Beverages

Introduction

Sugars are type of carbohydrate that includes glucose, fructose, galactose, lactose, maltose and sucrose. The latter is the most abundant type of sugar found naturally, and occurs in the greatest quantities in sugar cane and sugar beets, which are used to produce sugar commercially. Chemically, the term sugars are used to describe a group of compounds comprise of carbon, hydrogen, and oxygen atoms. Sugars are classified as either monosaccharides or disaccharides (Sigman-Grant, 2003). Example of monosaccharides are glucose, fructose and galactose. Example of dissacharides are sucrose (glucose and fructose) found in sugar cane, honey and corn syrup; lactose (glucose and galactose) found in milk products; and maltose (glucose and glucose) found in malt (Bunn S, 2015).

A number of terms have been used to categorize sugar specifically. This is mainly to highlight their origin and identify them for labelling purposes. For example, total sugars; added sugar; free sugars (WHO, 2003); refined sugars (the Nordic Council, 2004); discretionary sugars (New Zealand Nutrition Foundation, 2004) and intrinsic sugars; milk sugars and non-milk extrinsic sugars (Department of Health, 1989).

Free sugars are a term used by the WHO (WHO, 2015) to describe all monosaccharides and disaccharides added to foods by food manufacturer, cook or consumer, plus sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates. The origin of the term intrinsic and extrinsic sugar is from the United Kingdom (Department of Health, 1989). Intrinsic sugars occur naturally and are found within cell structures. The main sources of intrinsic sugars are whole fruits and vegetables and milk products. Extrinsic sugars describe all sugars added to food, sugar in fruit juice, table sugar and honey, including sugars in milk. Non-Milk Extrinsic Sugars (NMES) are all extrinsic sugars that are not from milk; that is excluding lactose. This include sugars in fruit juices, honey, hot drinks, and sugars added to foods in cooking or during processing.

Uses of sugar

Sugars are used in foods for their various properties: chemical, biological, sensory and physical. In addition to giving the taste of sweetness, sugars give a wide variety of other favourable qualities to food. Sugars give functional features to foods, such as viscosity, texture, body and browning capacity. They also increase dough yield in baked goods, influence starch and protein breakdown, and control moisture thus preventing drying.

Physiologically, sugars provide the body with a readily absorbable source of energy. Excessive intake of free sugar may result in increased energy content of the diet while diluting its nutrient density. For this reason, food and beverages with high sugar content often labelled as ‘empty calorie’. Globally, there is an increasing concern over the consumption of free sugars in the population, particularly in the form of sugar-sweetened beverages. Consumption of food and beverages high in free sugars are often associated with dental caries, obesity and diabetes.

Overview of the health and nutritional status in Brunei Darussalam

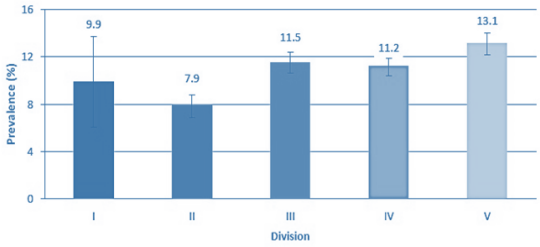
Prevalence of dental caries

In Brunei Darussalam, it was observed that there are now fewer decayed, missing or filled primary teeth (DMFT) for five year olds and 12 year olds. Data from the Oral Health Promotion Division at the Department of Dental Services found that 64% of the children below five years old were reported to be free from tooth decay in 2014. Data from 2015 showed that a five-year-old has four DMFT on average while a 12-year-old only has one. The National Oral Health Survey back in 1999 reported that a five-year-old child on average had seven DMFT while a 12-year-old had five DMFT (Abu Khair, 2013; Yap, 2015).

Prevalence of diabetes

The National Health and Nutritional Status Survey (NHANSS) showed that the prevalence of diabetes, defined as known diabetes or newly diagnosed diabetes was 12.5% in 2011, with a slightly higher prevalence of diabetes among females (12.7%) compared to males (12.2%). A survey involving more than 21,000 civil servants in Brunei Darussalam showed that the prevalence of diabetes increased from division II to division V (IHSHPP, 2011) (Figure 7.1).

Figure 7.1: Prevalence of diabetes among civil servants in different divisions

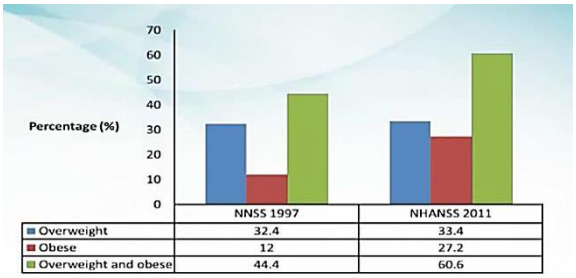


Source: IHSHPP (2011)

Prevalence of obesity

A third of the adult population is overweight and this is relatively unchanged from 1997 to 2011. However, the prevalence of obesity in adults has more than doubled from 12% in 1997 to 27% in 2011 (Figure 7.2) There was no gender difference in the prevalence of obesity [males (27.1%) and females (27.3%)] (NHANSS, 2010).

Figure 7.2: Prevalence of overweight and obesity in adults between 1997 and 2011 in Brunei Darussalam



Source: BruMAP-NCD 2013-2018

Sugar intake

The data on sugar consumption is limited in Brunei Darussalam in the last decade. Data from the Department of Economic Planning and Development (DEPD, 2014) (Table 7.1) and the World Data Atlas (World Data Atlas, 2012) (Figure 7.3) indicate that sugar import was increasing in Brunei Darussalam. However, it is important to note that the data may not reflect the actual consumption as these data also include sweeteners. Hence, making it difficult to extract the data on sugar alone.

In Brunei Darussalam, sugar is not produced locally. Sugar is mainly imported from Thailand (GAIN Report, 2009) and the import of sugar is increasing steadily from 1997 to 2007 (Figure 7.3). The actual sugar consumption may be lower due to household food waste and loss during storage,

preparation and cooking; as plate-waste or quantities fed to domestic pets and animals; and thrown or given away. The sugar may have also been used to produce food products that were exported. Nevertheless, the overall trend showed an increase in the import of sugar in Brunei Darussalam. In 2007, the population in Brunei Darussalam consumed the highest amount of sugar compared to other Southeast Asian countries (Figure 7.4). Sugar and sweeteners consumption reached at 127 g/person/day.

Table 7.1: Value of import of selected food and drinks

Items	Year				
	2007	2008	2009	2010	2011
SUGAR AND HONEY – INCLUDING SWEETENERS (BND THOUSAND)	4776	5515	4284	8150	7938
MILK AND CREAM, EVAPORATED, CONDENSED (BND THOUSAND)	36595	43814	36885	33009	35042
BEVERAGES AND TOBACCO (BND MILLION)	77.40	77.94	78.87	76.43	59.37

Source: DEPD (2014)

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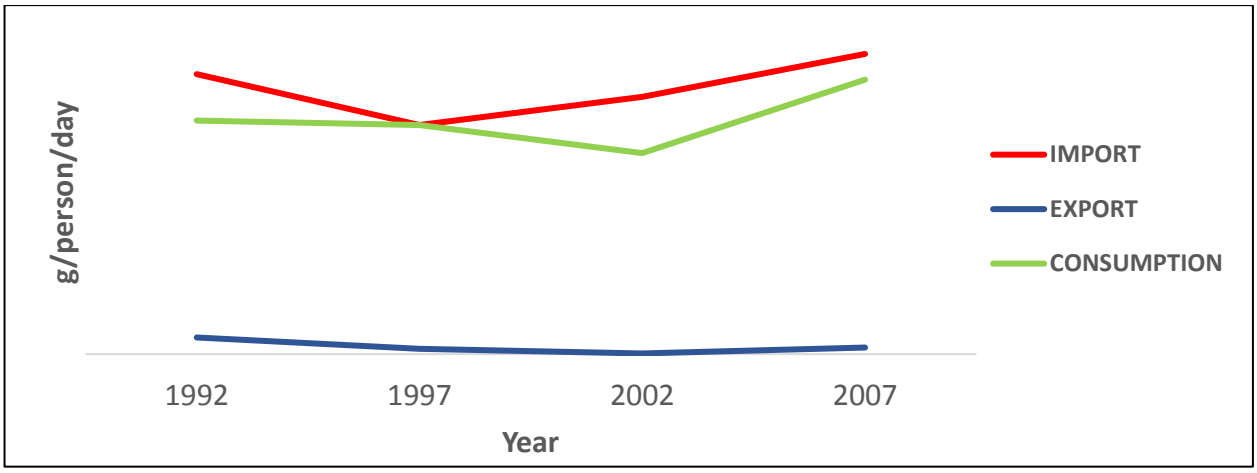
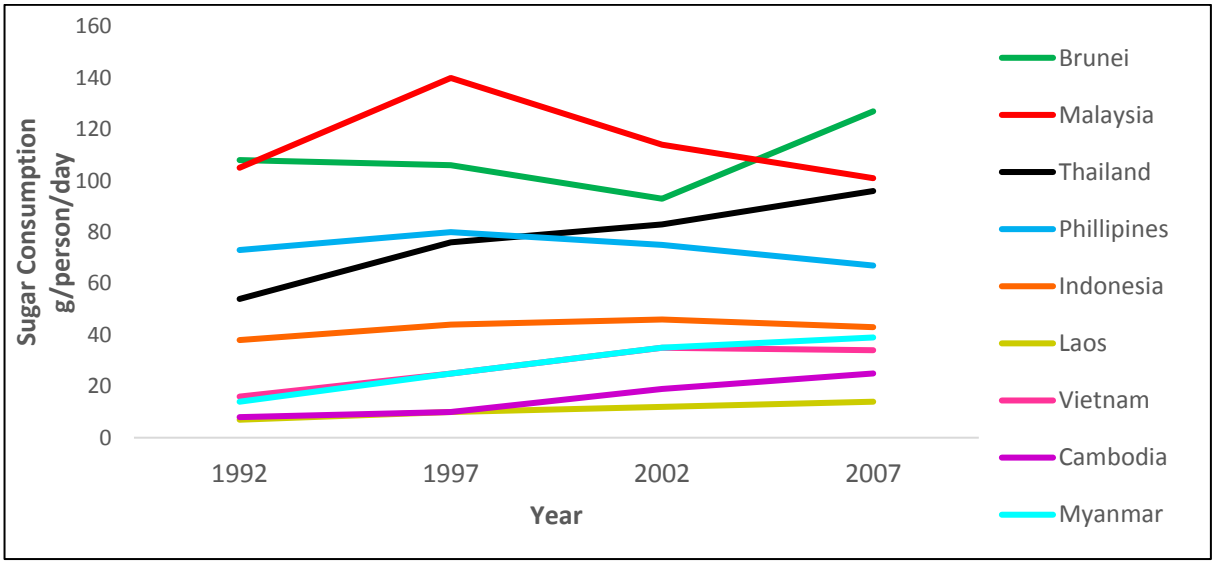
In 2007, the population in Brunei Darussalam consumed the highest amount of sugar compared to other Southeast Asian countries (Figure 7.4). Sugar and sweeteners consumption reached at 127 g/person/day.

Figure 7.3: Comparison of sugar and sweeteners export, import and consumption in Brunei Darussalam (g/person/day)



Source: World Data Atlas (2012)

Figure 7.4: Comparison of sugar and sweeteners consumption among the Southeast Asian Countries (g/person/day)



Dietary sources of sugar

Specific data on dietary sources of sugar is limited in Brunei Darussalam. However, data on daily consumption of sugar-sweetened beverages are available and presented in Figure 7.5 below.

Sugar-sweetened beverages

Beverages contributed to over 10% of total energy intake, which indicates a preference for high calorie, sugar-sweetened beverages among Bruneians. A can of sugar-sweetened beverage (12 fl oz, 368g) typically contains about 130-150 kcal, with more than 90% of the energy comes from free sugars, such as sucrose or high-fructose corn syrup. In 2014, a school-based survey involving 2599 students in Brunei Darussalam found that about half (46.2%) of the students consumed SSB on a daily basis (GSHS, 2014). more male students (52%) than female students (40%) consumed SSB on a daily basis.

The NHANSS (2010) revealed that the percentage of daily SSB intake was the highest among the youngest age group across all age groups (Figure 7.5). Overall, about a quarter of the Bruneian population consumed SSB on a daily basis.

The Figure 7.6 above showed that beverages are the second main energy source for both males and females (NHANSS, 2010). In 2014, a school-based survey involving 2599 students in Brunei Darussalam found that about half (46.2%) of the students consumed SSB on a daily basis (GSHS, 2014).

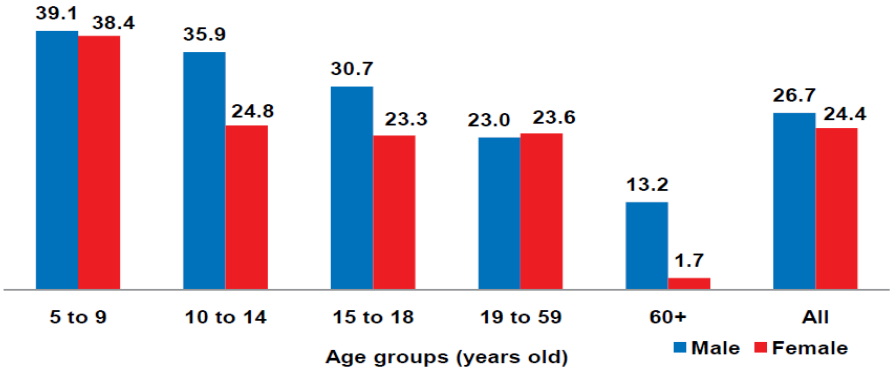
Instant drinks

Instant drinks refer to beverages designed for quick preparation and are readily soluble in hot or cold water. These include premix, 2-in-1 and 3-in-1 beverages in which the main ingredient is sugar. Hence, the sugar content in instant drinks tends to be very high. Overall consumption of instant drinks was slightly higher among males (23%) compared to females (21%) as shown in Figure 7.7 (NHANSS, 2010).

Sweetened condensed milk

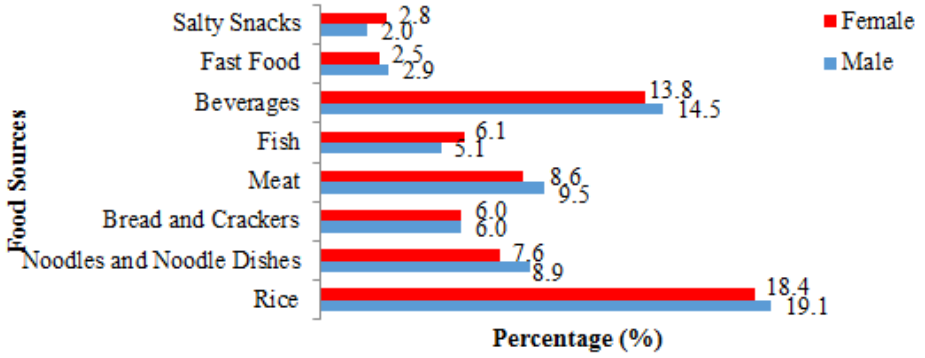
Sugar content in sweetened condensed milk is very high. By weight, as much as half of the sweetened condensed milk is made up of sugar. In Brunei Darussalam, sweetened condensed milk was the most common type of milk consumed by the population (Figure 7.8) (NHANSS, 2010). Results from the 2nd NHANSS revealed that 18% of the 2 to 5 years old consumed sweetened condensed milk.

Figure 7.5: Percentage daily consumption of Sugar-Sweetened Beverages (5-75 Years Old)



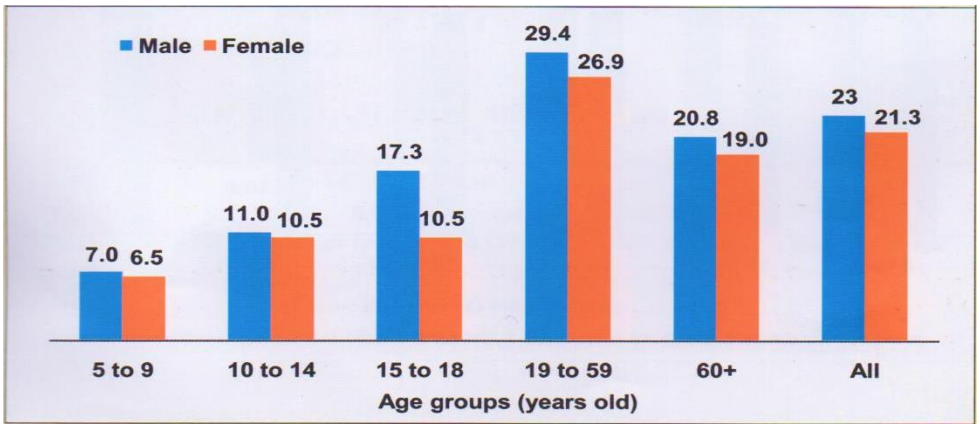
Source: NHANSS (2010)

Figure 7.6: Percentage contribution of energy intake from food sources



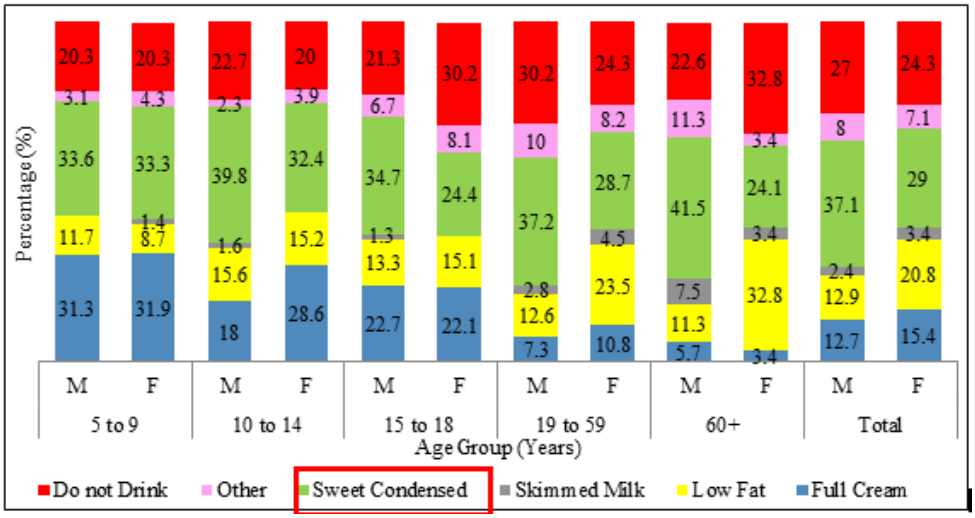
Source: NHANSS (2010)

Figure 7.7: Percentage daily consumption of instant drinks



Source: NHANSS (2010)

Figure 7.8: Percentage consumption of different types of milk



Source: NHANSS (2010)

Literature Review

Scientific evidence on the role of sugar and sugar-sweetened beverages in dental caries and chronic diseases

There is a wide body of evidence on the association between sugar consumption and health, notably dental health, as well as possible associations with obesity and diabetes.

Dental caries

Numerous studies over the past 50 years have established a strong association between sugar and dental caries. Dental disease is the most prevalent NCD globally (WHO, 2003) and sugar is a major factor in the development of dental caries. A number of evidence has linked sugar sweetened beverage consumption with the promotion of dental caries and erosion, particularly beverages with acidic content (Marshall TA, 2003; American Academy of Pediatrics Committee on School Health, 2004; Sohn W, 2006; Tahmassebi JF, 2006; Vartanian LR, 2007; Sheiham & James, 2014).

Obesity

A mounting body of evidence suggests that dietary sugar plays an important role in the obesity epidemic. A meta-analysis of 30 RCTs and 38 prospective cohort studies showed that in trials of adults, a reduced intake of dietary sugars was associated with a decrease in body weight while an increased sugar intake was associated with body weight gain (Te Morenga et al., 2012).

An epidemiological cross-national study consisting of participants from 75 countries revealed a significant association between sugar-sweetened beverages and overweight and obesity (Basu et al., 2013 Prospective cohort studies in the meta-analysis revealed that after one year follow-up, the risk of being overweight and obese increased significantly among children with the highest intake of sugar-sweetened beverages compared with those with the lowest intake.

Consistently, another systematic review and meta-analysis of randomized controlled trials and prospective cohort studies showed that sugar-sweetened beverage consumption promoted weight gain in children and adults (Malik et al., 2013). A review of sugar-sweetened beverages by the Scientific Advisory Committee on Nutrition in 2014 also revealed that the consumption of sugar-sweetened beverages resulted in weight gain and increased BMI in children and adolescents, as compared with non-calorically sweetened beverages. In addition, the reduction in the intake of sugar-sweetened beverages may reduce weight gain in overweight children (Ebbeling, 2012; de Ruyter, 2012; Malik, 2013).

Sugar and Type 2 Diabetes Mellitus

The rising prevalence of diabetes may be attributable to a number of factors including obesity, diet and a sedentary lifestyle. Sugar consumption has been linked to the risk of type 2 diabetes.

It is postulated that excessive sugar intake may be a primary and independent contributor of the emerging global diabetes prevalence (Lustig et al., 2012). A recent study of repeated cross-sectional data from 175 countries using econometric models documented that sugar appeared to be

correlated to diabetes prevalence, independent of overweight and obesity rates.

The correlation was also independent of economic and social changes such as urbanization, aging; household income changes; sedentary lifestyles; and tobacco or alcohol use. The study also showed that the duration of the high sugar intake was positively associated with increased diabetes prevalence, while reduced sugar intake was associated with decreased diabetes prevalence (Basu et al., 2013). However, due to the magnitude of the data, the study has a number of limitations, including the fact that different cut off points were used to define obesity and the study examined type 1 and type 2 diabetes.

More studies are needed to determine the direct association between sugar intake and the risk of diabetes. Interestingly, the association between sugar in the form of sugar-sweetened beverages is more evident than sugar intake alone.

Numerous evidence suggested an association between sugar-sweetened beverages and type 2 diabetes (Weed, 2011; Malik, 2012; Stanhope, 2012). Findings from a meta-analysis of nine prospective cohort studies consistently indicated a positive association between sugar-sweetened beverages and type 2 diabetes risk. The link, however, was attenuated after adjustment for BMI (Greenwood et al., 2014).

A more recent meta-analysis with eight prospective studies indicated that the intake of sugar-sweetened beverages (1-2 servings per day compared to less than 1 serving per month) was associated with an elevated risk of type 2 diabetes. The findings also concluded that the consumption of artificially sweetened beverages or fruit juice was unlikely to prevent type 2 diabetes and hence, they are not recommended as healthier alternatives.

The meta-analysis additionally revealed that a high intake of sugar-sweetened beverages was associated with the risk of developing metabolic syndrome, a strong predictor of type 2 diabetes (Imamura F, 2015).

Recommendation on free sugars from the WHO

The World Health Organization (WHO) recommends reducing the intake of free sugars to less than 10% of total energy intake for both adults and children. A further reduction of 5% would provide additional benefit (WHO, 2015).

For example, an average adult male requiring 2000 kcal a day, of this, 10% energy from free sugar is 200 kcal. This is equivalent to about 50 grams or 12 teaspoons of sugar. Whilst 5% energy from free sugar is equivalent to 100 kcal (25 grams or 6 teaspoons of sugar).

Recommendation

Key Message
Reduce intake of sugary foods and beverages

Key recommendation 1: Limit intake of sugar-sweetened beverages

How to achieve:

- Water is the best choice– drink at least eight glasses (2 litre) of water a day.
- Avoid or limit drinks with high sugar (i.e. containing more than 6 g of sugar per 100ml).
- Read nutrition information panel on packaging and compare products.
- Choose drinks with the 'Healthier Choice' logo or symbol.
- Limit your intake of fruit juice or smoothies to 120ml a day.
- Eat whole fruit instead of drinking fruit juice.

Key recommendation 2: Limit intake of sugary foods

How to achieve:

- Choose fruits and vegetables instead of sugary foods.
- High sugary foods such as confectionaries, chocolate, ice cream, *kueh*, sweets, honey and candies should only be consumed as occasional treats or taken in small amount.
- Choose unsweetened wholegrain breakfast cereals instead of sugar-coated cereals.
- Choose reduced sugar jam and spread.
- Avoid using sugar as flavour enhancer in cooking.

Key recommendation 3: Drink at least eight glasses of water a day

How to achieve:

- Choose water instead of sugary drinks during main meals and when eating out. This helps to save money and reduce calorie intake.
- Drink water before, during and after physical activities.
- Encourage children to drink water if thirsty.
- Always carry a water bottle including schoolchildren.
- Make water as the main choice during family gathering such as birthday celebrations, weddings and any formal events.
- Add a wedge of lime or lemon to water for taste if necessary.

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KEY MESSAGE 8

Reduce salt and sauces in cooking and food preparations, and choose foods with less salt

Key Message 8
Reduce salt and sauces in cooking and food preparations, and choose foods with less salt

Introduction

Salt is a natural mineral made up of white cube-shaped crystals. It is an ionic compound with the chemical formula NaCl, representing equal proportions of sodium and chlorine ions. Salt is essential in human life and it plays many important roles in food. It adds flavour to food and is used as a binder and stabilizer. It is also used as a preservative to extend shelf life, enhance colour of food, or give it a firmer texture.

Historically, before the invention of electrically powered refrigeration, salting was one of the main methods used for food preservation. Physiologically, sodium serves a vital purpose in the human body. It helps nerves and muscles to function normally. It is also a factor involved in the osmotic regulation of water content in body organs. Sodium in salt is essential for the maintenance of plasma volume, acid-base balance, transmission of nerve impulses and normal cell function.

The most common form of sodium is table salt or common salt. Sodium may also present in the form of monosodium glutamate (MSG), sodium nitrate and sodium benzoate. Sodium is found naturally in a variety of foods, such as milk, meat and shellfish. It is often found in high amount in processed foods such as processed meat, snacks and condiments such as soy sauce and chilli sauce. Other processed foods include canned foods, salted foods, pickled foods, (ready meals) or other convenience foods.

The difference between sodium and salt

Salt and sodium are often used interchangeably, but they are not exactly the same substance. Table salt is a combination of sodium and chloride. By weight, salt has about 40 percent sodium and 60 percent chloride. The approximate amounts of sodium in a given amount of table salt are shown below:

1/4 teaspoon salt = 575 mg sodium
1/2 teaspoon salt = 1,150 mg sodium
3/4 teaspoon salt = 1,725 mg sodium
1 teaspoon salt = 2,300 mg sodium

Although sodium plays a key role in human body, but it should not be consumed excessively. During the past decades, evidence for the risks imposed on human health with excessive salt consumption has become compelling. The causal relation between dietary salt intake and blood pressure, heart disease, stroke and cancer has been established through experimental, epidemiological, migration, and intervention studies.

Overview of the health and nutritional status in Brunei Darussalam

Hypertension

The prevalence of hypertension in Brunei Darussalam currently stands at 33.8%, a marked increase from 28.6% in 1997 (NNSS 1997; NHANSS, 2010). Data from the Integrated Health Screening consisting of 21,437 civil servants in Brunei Darussalam showed that the mean prevalence of raised blood pressure was 29.2%, with significantly higher prevalence among the males (33.7%) compared to the females (25.8%) (IHSHPP, 2011). The prevalence of raised blood pressure generally increased with age. Across all divisions, the prevalence of raised blood pressure was highest among those in division V (33.3%), followed by division I (30.6%), division IV (28.8%), division III (28.6%) and lowest among those in division II (24.8%) (IHSHPP, 2011) (Figure 8.1).

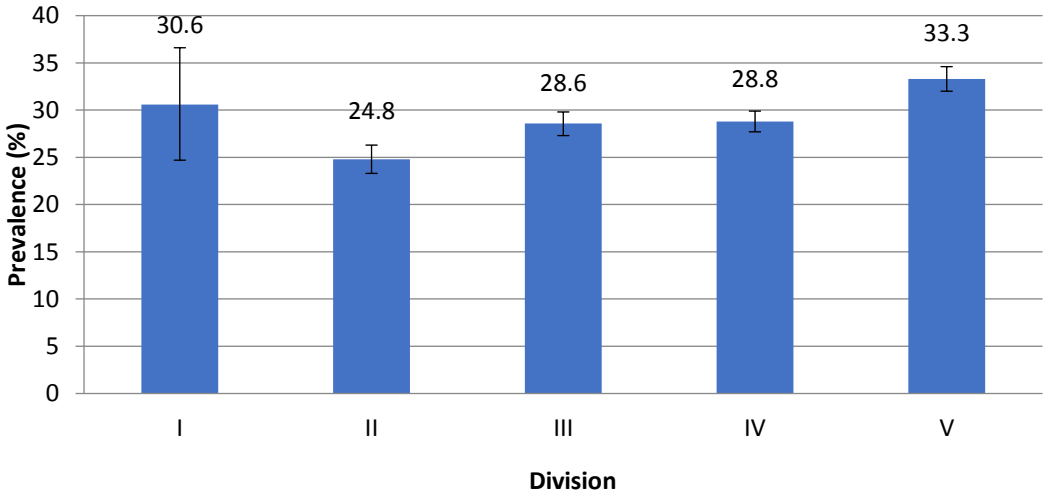
Cerebrovascular diseases and hypertensive diseases

In Brunei Darussalam, cerebrovascular diseases and hypertensive diseases are the fourth and fifth leading causes of death in 2014. These accounted for 13.4% of the total deaths in Brunei Darussalam (Health Information Booklet, 2017).

Gastric cancer

From 2004 to 2013, gastric cancer has been reported to be the sixth and eighth most frequent cancers among males and females respectively in Brunei Darussalam (Brunei Darussalam Cancer Registry, 2014).

Figure 8.1: Prevalence of Raised Blood Pressure of Civil Servants by Division

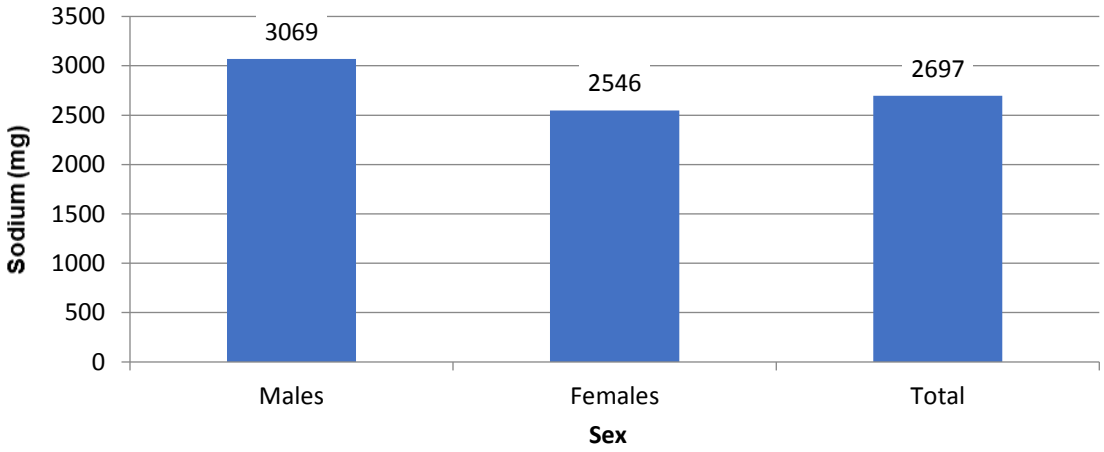


Source: IHSHPP (2011)

Dietary sodium intake

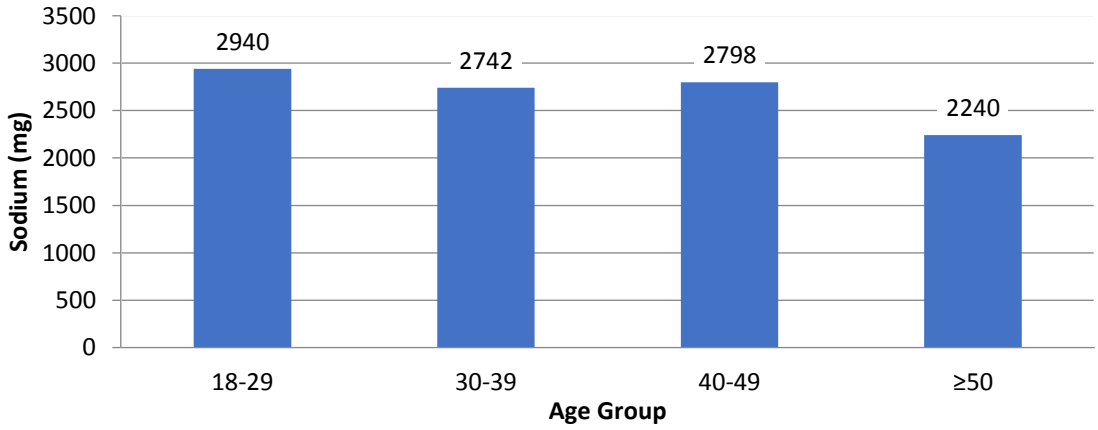
Currently there is limited research study conducted to assess the sources of sodium and sodium intake in Brunei Darussalam. A recent study using the gold standard of measuring sodium intake on a conveniently sampled population in Brunei Darussalam showed that the mean 24 h urinary sodium excretion was 2697 mg/day (salt equivalent 6.85 g/day) (Kamis et al., 2016). The urinary sodium excretion was higher in males 3069mg/day (salt 7.80 g/day) compared to females 2546 mg/day (salt 6.47 g/day) (Figure 8.2). There was a significant inverse relationship between sodium excretion and age. The urinary sodium excretion was highest among the youngest age group with 2940 mg/day (salt 7.47 g/day) and lowest among the oldest age group with 2240 mg/day (salt 5.70 g/day) (Figure 8.3).

Figure 8.2: 24h Urinary Sodium Excretion by Sex



Source: Adapted from Kamis et al (2016)

Figure 8.3: 24h Urinary Sodium Excretion by Age Group



Source: Adapted from Kamis et al (2016)

The percentage of individuals who exceeded the WHO recommendation of sodium intake (<2000 mg/day) was 71%. More males (84%) than females (65%) exceeded the <2000 mg/day sodium limit. By age group, a decreasing trend was observed, with the highest prevalence among the 18-29 age group (82%) who exceeded the <2000 mg/day sodium limit and lowest among the ≥50 age group (49%) (Kamis et al., 2016). Results of the study, however, should be taken with a pinch of salt due to the sampling method and small number of subjects.

Assessing the sodium intake in a population-based survey with a large sample size, using the 24h urinary sodium excretion method is notoriously difficult due to the fact that the collection procedure is intrusive and inconvenient for the subjects. For this reason, spot urine collection has become an alternative method to estimate the population sodium intake. This method has been used in a population-based survey of Bruneian adults aged 18-69 years. A cross-sectional population-based study sample design was used to produce a representative sample of the population.

Based on 3808 adults who participated in the survey, the result shows that the mean salt intake was 3930mg/day (salt 10.0 g/day). Males were found to consume more salt (4520 mg/day, salt 11.5 g/day) compared to females (3341 mg/day, salt 8.4 g/day) (WHO, STEPS 2016).

Dietary sources of sodium

Most of the sodium in Western diet comes from processed foods such as bread, pre-packaged and canned foods. For example, in the United States, 75% of the population's sodium intake comes from processed and restaurant foods and 11% from discretionary salt in cooking and at table (Anderson et al., 2010). On the contrary, most of the sodium in the Asian diet comes from discretionary salt including sauces during cooking (WHO, 2007).

In Brunei Darussalam, the major source of sodium came from discretionary salt and sauces in cooking and at table, which accounted for about 61% of the total sodium intake, while the remaining 39% comes from processed foods (Kamis et al., 2016).

Discretionary salt and sauces

In the discretionary salt and sauces category, the most common source of sodium was from discretionary salt in cooking (43.1%), followed by soy sauce added at table (7.5%), and chilli and tomato sauce added at table (5.2%). While in the cooked dishes with discretionary salt category, the most common sources of sodium were from noodle soup (7.8%) and plain soup (5.7%). The study by Kamis et al (2016) showed that the frequency of added discretionary salt and sauces at table was about six times a week. The discretionary salt and sauces were in the form of table salt, soy sauce, oyster sauce, chilli sauce and tomato sauce. Based on the evidence available and population-level initiative to reduce sodium intake in Brunei Darussalam, emphasis should strategically be placed on the use of discretionary salt in sauces and cooking.

Dietary salt in processed foods

Sodium from processed foods contributed to 39% of all sodium in diet. In the processed foods category, the most common sources of sodium were from bread (5.8%), crisps and extruded snack (keropok) (4.8%), instant noodle (4.7%), as well as canned and packet soup (4.7%) (Figure 8.4).

Bread

Like many other countries, bread contributed the most sodium in the processed food category due to the lack of sodium information displayed on the bread packaging in Brunei Darussalam, it is not possible to provide an in-depth nutritional review of the breads. A study on a sub-group of Bruneian population showed that bread was frequently consumed. The mean intake of bread was 3.5 times per week, with 18% reported that they consumed bread at least six times a week (Kamis et al., 2016). For this reason, future sodium reduction initiative aimed at reformulating or reducing the sodium content of bread may potentially produce a significant impact on the population sodium intake.

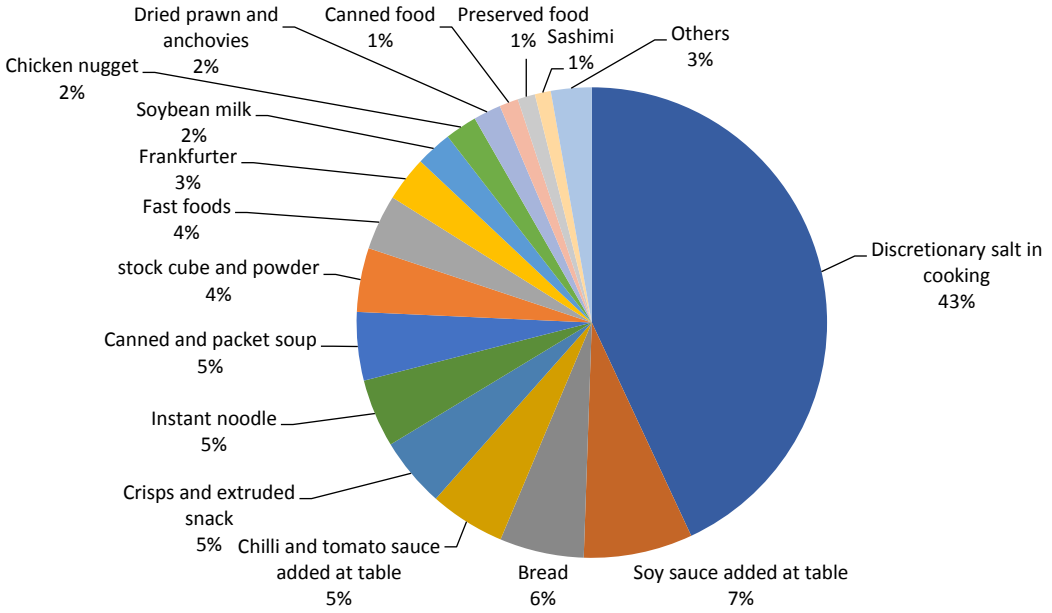
Crisps and extruded snacks

Following bread, crisps and extruded snacks contributed the highest sodium in the processed foods category. Alarmingly, 23.3% of children aged 5-9 years old consumed crisps and extruded snack at least six times a week (NHANSS, 2010).

Instant noodles

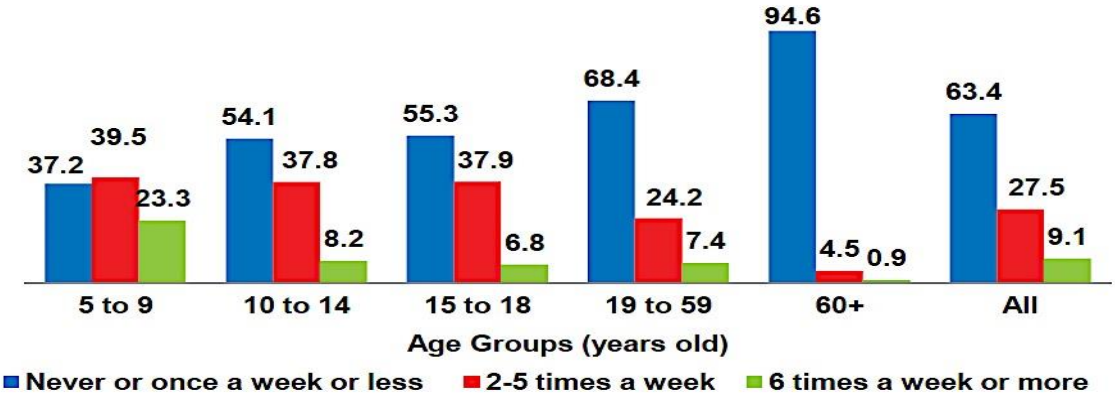
Instant noodle was also among the largest contributor of sodium in the processed food category (Kamis et al., 2016). Frequent consumption of instant noodles was prevalent across all age groups except those in the >60-year-old age group (Figure 8.6). More than a quarter of the population, except those in the >60-year-old age group, consumed more than five times a week of instant noodles (NHANSS, 2010).

Figure 8.4: Dietary Sources of Sodium in Diet



Source: Adapted from Kamis et al (2016)

Figure 8.5: Percentage of Respondents Consuming Extruded Snacks



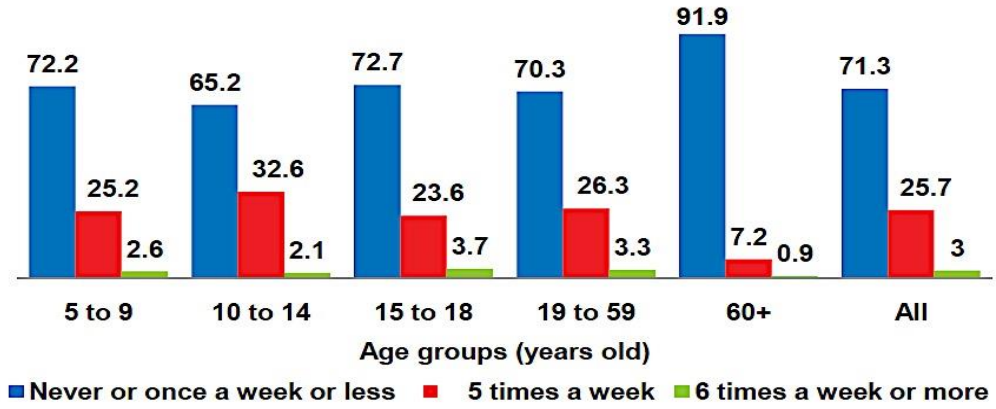
Source: NHANSS (2010)

Based on a processed food database collected by the Health Promotion Centre, consisting of 24 different instant noodles, the range of sodium content was 834 – 2770mg per 100g. None of the instant noodles, which were mostly manufactured in Malaysia, Singapore and Indonesia, met the sodium benchmark for foods with the Healthier Choice Logo (Brunei Darussalam's Nutrient Criteria of Foods and Beverages with the Healthier Choice Logo, 2016). Essentially, all instant noodles available in Brunei Darussalam contain high sodium content.

Sodium content of processed foods in Brunei Darussalam

Overall, 51% of the processed foods in Brunei Darussalam did not meet the recommended sodium benchmarks (Kamis et al., 2015). Foods in the recipe mix (Asian), fresh and frozen meat and poultry, and soup and broth sub-categories exceeded the sodium benchmarks excessively. It is also important to note that the result may be under-reported, as most of the pre-packaged foods in Brunei Darussalam did not display any sodium contents. This may have been attributable to the fact that there is a lack of food laboratory with comprehensive food analysis capacity in Brunei Darussalam, and nutrition labelling requirement in Brunei Darussalam is currently on a voluntary basis.

Figure 8.6: Percentage of Respondents Consuming Instant Noodles



Source: NHANSS (2010)

Literature Review

The scientific evidence for the role of dietary sodium in cardiovascular health and cancer

Blood pressure

The role of sodium in elevating blood pressure has been recognized in the past 30 years. Population-based evidence have consistently shown that sodium intake is the major factor in increasing population blood pressure. In 1988, the INTERSALT study examining 24-hour urine sodium excretion of more than 10,000 adults from 32 countries found that populations with the highest salt intake had higher mean blood pressures, while countries with relatively low salt intake had low mean blood pressures (INTERSALT Cooperative Group 1988).

The efficacy of reduced sodium intake in lowering blood pressure is well established. A strong body of evidence documented that the blood pressure in adults decreased as sodium intake decreased. Trials of Hypertension Prevention (TOHP) that investigated the impact of lifestyle changes on blood pressure showed that blood pressure decreased with a reduction of sodium over 18 to 36 months.

A follow-up study of the TOHP after 10-15 years revealed that the participants in the sodium-reduction group were 25% less likely to have a heart attack or stroke, need a procedure to open or bypass a coronary artery, or die from cardiovascular disease (Cook et al., 2007). The study also found that participants with higher dietary potassium to sodium ratio had a lower chance of developing cardiovascular disease (Cook et al., 2007). This suggests that a strategy to increase potassium and lower sodium may be effective in maintaining a normal blood pressure.

The Dietary Approaches to Stop Hypertension (DASH) trials also demonstrated some associations between diet and blood pressure. The randomised controlled clinical trials showed that it was possible to achieve significant reductions in blood pressure by reducing salt intake in people with and without hypertension (Sacks et al., 2001).

Similarly, the results from a meta-analysis of randomized controlled trials observed that a reduction of salt by 6 grams per day would lower blood pressure by 7/4 mmHg in people with high blood pressure and 4/2 mmHg in people with normal blood pressure (He and MacGregor, 2002).

Stroke

A meta-analysis involving more than 177 000 participants found that a high salt intake was associated with a significantly greater risk of stroke (Pasquale et al., 2009). Other extensive studies by Tomonari et al. (2011) and Xiu-Yang Li et al. (2012) showed a significant dose-response relationship between the dietary salt intake and stroke risk. The risk of stroke increased notably when salt consumption reached 500mg/day (Gardener et al., 2011).

Cancer

The associations between dietary sodium and cancer risk have been extensively investigated. However, many of these studies revealed inconclusive results. A Japanese prospective cohort study reported that a high consumption of sodium was associated with a high risk of cardiovascular disease but not with the risk of total cancer (Takachi et al., 2010).

On the other hand, evidence reported a positive correlation between high salt and salt-preserved foods consumption and incidence or mortality risk for gastric cancer and colorectal cancer (Kim et al., 2010; Takachi et al., 2010). Even though the findings are marginal, reducing dietary salt intake is thought to be beneficial for preventing gastric cancer.

The World Cancer Research Fund and American Institute for Cancer Research concluded that salt, as well as salted and salty foods are a probable cause of gastric cancer.

To date, the largest meta-analysis with 76 prospective cohort studies, made up of more than six million subjects, found a dose-response relationship between dietary sodium intake and gastric cancer. The studies found that with every five grams of dietary salt increment per day, risk of gastric cancer also increased by 12% (Xuexian et al., 2015).

Recommendation

In view of the strong association between dietary salt and blood pressure, stroke, and gastric cancer, as well as the increasing prevalence of raised blood pressure among Bruneian adults, the general population in Brunei Darussalam is recommended to limit their sodium intake to less than 2000 mg/day or 5g of salt. This is consistent with the Sodium Intake for Adults and Children Guideline (WHO, 2012).

Key Message

Reduce salt and sauces in cooking and food preparations, and choose foods with less salt

Key recommendation 1:

Reduce your salt intake and use less salt and sauces in cooking

How to achieve:

- Reduce salt intake to less than one teaspoon (5g or 2000mg sodium) a day
- Cut down salt and other flavour enhancer such as MSG, soy sauce and other sauces in cooking
- Use a pinch as a method to regulate the amount of salt added in cooking
- Avoid placing salt or other sauces at table
- Use spices, herbs and citrus to replace salt in cooking

Key recommendation 2:

Prepare and choose foods and sauces with less salt

How to achieve:

- Choose food products with a 'Healthier Choice' logo or symbol
- Read food labels and choose food products with 'less salt', 'lower salt', 'reduced salt' or 'no added salt' content
- Order noodle soup with less salt or limit your intake of salty soup and gravy when eating out
- Request for MSG free and lower salt dishes when eating out
- Choose fresh and unprocessed foods
- Avoid salted, preserved or pickled foods
- Limit, or if possible, avoid salty snacks such as crisps and extruded snacks, and replace with fruits, nuts or healthier snacks.

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KEY MESSAGE 9

Practice exclusive breastfeeding for the first six months and continue breastfeeding until two years while giving nutritious, complementary foods from six months of age

Key Message 9
Practice exclusive breastfeeding for the first six months and continue breastfeeding until two years while giving nutritious, complementary foods from six months of age

Exclusive Breastfeeding
Exclusive breastfeeding is defined as no other food or drink, not even water, except breast milk (including milk expressed or from a wet nurse) for the first six months of life, but allows the infant to receive oral rehydration solutions, drops and syrups (vitamins, minerals and medicines) (WHO, 2016).

Complementary Feeding
Complementary feeding is defined as the process starting when breast milk alone is no longer sufficient to meet the nutritional requirements of infants, and therefore other foods and liquids are needed, along with breast milk. The transition from exclusive breastfeeding to family foods – referred to as complementary feeding – typically covers the period from 6–24 months of age, even though breastfeeding may continue to two years of age and beyond. This is a critical period of growth during which nutrient deficiencies and illnesses contribute globally to higher rates of undernutrition among children under five years of age (WHO, 2018)

Complementary Foods
Complementary foods: any non-breastmilk foods or nutritive liquids, which are introduced during complementary feeding (WHO, 2016).

Introduction

Promoting, supporting and protecting breastfeeding is the single most important, cost-effective, public health intervention in preventing childhood mortality and morbidity. In terms of NCDs prevention, breastfeeding has long-term benefits in the form of reduced risk of chronic illnesses such as cardiovascular diseases, chronic respiratory diseases, diabetes and cancers during adolescents and adulthood (Horta & Victora, 2013; Kelishadi and Farajian, 2014).

The health of mothers and children has always been an utmost priority in Brunei Darussalam because they contribute to the solid foundation for the well-being of society. Therefore, the government of Brunei Darussalam, through the Ministry of Health is committed to lead, scale-up and sustain its efforts in protecting, promoting and supporting the value of breastfeeding and improving breastfeeding rates in the nation. This action is crucial in supporting *Wawasan 2035 National Vision* as breastfeeding generates healthy, smart, confident and affectionate citizens.

Overview of the health and nutritional status in Brunei Darussalam

The Need to Improve Population Breastfeeding Rates.

Achieving optimal breastfeeding practices remains a challenge in Brunei Darussalam. Despite the clear health and societal benefits, data presented in Table 9.1 from the 2nd NHANSS (2010) indicated that many mothers in Brunei Darussalam were not breastfeeding as recommended in the National Breastfeeding Policy adopted in 2001 (Appendix 1). While initiation rate was excellent (92.2%), only half of all infants were exclusively breastfed at two months and less than one third (26.7%) of mothers continued to exclusively breastfeed until six months.

Table 9.1: National Breastfeeding Status from findings of the 2nd National Health and Nutritional Status Survey (2010)

Status
Almost all children (98.7%) were breastfed at some time in their lives.
Breastfeeding was initiated within one hour of birth in 92.2% of infants.
By two months of age, half of Bruneian infants were no longer exclusively breastfed.
At five months of age, only 26.7% of infants were exclusively breastfed.
A very high proportion (above 70%) of infants aged six months and above was given infant formula.

Findings from the survey suggested that Bruneian mothers have good intentions to breastfeed, however, formula milk is often introduced too early.

A new Maternity Leave Regulation, was introduced on the 1st January 2011 (PMO, 2011). The regulation extends the duration of maternity leave from 56 days (8 weeks) to 105 days (15 weeks). A study involving 6168 mothers in Brunei Darussalam was conducted between 2010 and 2013, to investigate the impact of the newly introduced regulation on breastfeeding practices (Said et al, 2015). Key findings of the study include:

Working mothers are now exclusively breastfeeding their babies for a longer period. The prevalence of exclusive breastfeeding to six months increased from 23% in 2010 to 33% in 2012 and 37% in 2013. This indicates an improvement of 10% and 14% respectively. Women working in both the public and private sectors showed improvements in their exclusive breastfeeding rates compared to 2010 (Table 9.2).

The prevalence of exclusive breastfeeding is highest at one month after birth and declined gradually thereafter. In 2013, the prevalence of exclusive breastfeeding fell from 79% at one month to 54% at three months, coinciding with the return to work.

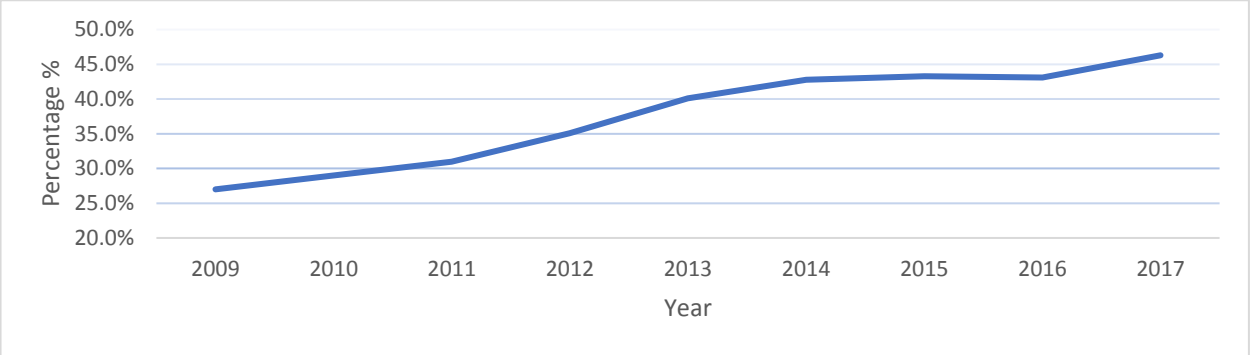
However, recent trends of exclusive breastfeeding practices for all mothers had shown a steady increase since the introduction of the new Maternity Leave Regulation in 2011. Based on data collected routinely by the Maternal and Child Health Services, exclusive breastfeeding rates has increased from 31.0% in 2011 to 46.3% in 2017 (Figure 9.1).

These recent positive trends clearly show that current strategies and interventions are effective. However, there are still rooms for further strengthening of current strategies and interventions in order to protect, promote and support mothers to continue exclusively breastfeeding to six months and sustain up to two years.

Table 9.2: Exclusive breastfeeding prevalence at 6 months among working mothers by employment sector

Year	2010	2012	2013
Public sector	25%	37%	40%
Private sector	18%	23%	29%

Figure 9.1: Exclusive breastfeeding rates in Brunei Darussalam



Source: Annual Data Collection of Maternal and Child Health Services (MOH, 2018) (unpublished)

Literature review

Importance of breastfeeding

There is a considerable amount of evidence that justify the recommendation to encourage, protect, support and promote breastfeeding. Breastfeeding provides significant values to mothers, infants, children and society (Table 9.3). Such benefits however, can only be gained if mothers are practicing exclusive breastfeeding for the first six months of infants' life and continue breastfeeding up to two years while giving nutritious, complementary foods from six months of age.

Table 9.3: Benefits of Breastfeeding for Mothers, Infants, Children and Society

Mothers	Infants & Children	Society
Faster maternal recovery from childbirth through accelerated uterine involution and reduced risk of haemorrhage, thus reducing maternal mortality (Sobhy & Mohame, 2004) Prolonging lactational amenorrhoea (Chowdhury et al., 2015), thus preserving maternal haemoglobin stores through reduced blood loss, leading to improved iron status Improved bone mineralization and thereby, decreased risk of	*Halal,* hygienic, inexpensive, convenient and readily available source of complete nutrition to support growth and development Personalised medicine to infants and young children (Victora et al., 2016) Higher performance in intelligence tests of children and adolescents, with an increase of 3.4 Intelligence Quotient (IQ) points (Horta et al., 2015) Prevent childhood deaths and illnesses in both high-income and low-middle income countries	Contributes both directly/indirectly to the achievement of the newly launched Sustainable Development Goals by 2030 (Victora et al., 2016) Breastfeeding can break the cycle of poverty by preventing malnutrition and ensuring food security for infants and young children (WABA, 2018) Protective effects of breastfeeding in infancy extend to later life, with

post-menopausal hip fracture (Chantry et al., 2004; Dursun et al., 2006) Prolonged period of post-partum infertility, leading to increased spacing between pregnancies (Rutstein, 2005; Erenal et al., 2010) Possible accelerated weight loss and return to pre-pregnancy body weight (Neville et al., 2014) Reduced risk of breast cancer by 4.3% for every 12-month of lifetime breastfeeding. In addition, a further 7.0% reduction for each birth (Victora et al., 2016); strong evidence that breastfeeding helps protect against breast cancer (WCRF/AICR, 2018) Reduced risk of ovarian cancer by 18% (Victora et al., 2016) Significant protection against Type 2 Diabetes (Aune et al., 2014)	(Victora et al., 2016); lower mortality rates and incidence of infections (Stuebe, 2009) Major protection against diarrhoeal illnesses (Victora et al., 2016) Breastfeeding could prevent 72% and 57% of hospital admissions due to diarrhea and respiratory infections respectively (Horta & Victora, 2013) Reduced prevalence of asthma (Australian Centre for Asthma Monitoring, 2009; Victora et al., 2016) Reduced occurrence of acute otitis media in the first two years of life (Bowatte et al., 2015) Provides some protection in the development of allergies in infants regardless of familial history of allergies (Kramer, 2011; Prescott & Nowak-Wegrzyn, 2011) Suggestive evidence of protection against overweight or obesity in childhood, adolescence and early adulthood (Victora et al., 2016) Breastfeeding is associated with a 19% reduction of childhood leukaemia incidence (Amitay & Keinan-Boker, 2015) Associated with 68% reduction in malocclusions (Peres et al., 2015) Reduction of Sudden Infant Death Syndrome (SIDS) by 36% (Ip et al.,	reduced risks of obesity and NCDs; (WHO, 2007; Victora et al., 2016) Longer breastfeeding duration is associated with increased IQ and higher income, which contributes to the economy of a country (Horta et al., 2015) Promotes bonding and attachment between mothers and their children (WCRF/AICR, 2018) Significantly reduces national health costs (UNICEFF, 2012) Breastfeeding women are less likely to be absent from work because of baby-related illnesses (Murtagh & Moultan, 2011) Breast milk is an environmentally safe and friendly product (Francis & Mulford, 2002, Victora et al., 2016)

	2007); breastfeeding duration of least 2 months was associated with half the risk of SIDS (Thompson et al, 2017) Improved visual-motor performance for very low birthweight infants (<1500g) after adjustment of socioenvironmental factors (Smith et al, 2003) Improved visual functions in full-term and premature infants (Anderson et al, 1990 & Carlson et al, 1993) Particular benefits for premature infants include: • Protection from infection (e.g. urinary tract infection and sepsis) • Protection against necrotizing enterocolitis (NEC) • shorter duration of hospital stay • Protection from retinopathy of prematurity • Protection from bronchopulmonary dysplasia • Possible beneficial effects on cardiovascular development • (Schanler et al, 2018)	

Breastfeeding should be in the mainstream of preventative programmes for non-communicable diseases in any country, on top of the initiatives to prevent early childhood morbidity and mortality. In Brunei Darussalam, there are still room for improvement to create an enabling environment to support women who want to breastfeed. The Government of Brunei Darussalam is continuously committed to actively invest in the promotion, protection and support of breastfeeding and will involve the civil society, international bodies and relevant stakeholders. Without such commitment, breastfeeding practices will remain low in the nation and the outcome will lead to major losses and costs that will be borne by generations to come.

The importance of breastfeeding has led to its continuous inclusion in the current

National Dietary Guidelines 2018 endorsed by the Ministry of Health.

Complementary Feeding in Brunei Darussalam

Based on findings from the 2nd National Health and Nutritional Status Survey (2010), majority (93.2%) of infants received their first solid foods at the age of six months as recommended by WHO. However, the types of complementary foods introduced is a major concern, where 51.3% of Bruneian mothers relied heavily on commercially-produced infant foods as their babies' first foods (Ministry of Health, 2012).

Literature review on the importance of complementary feeding

In the first six months, infants double their birthweight and triple by the end of the first year. Hence, needing higher requirement of energy, vitamins and minerals despite their size (Shaw et al, 2007). In addition, nutrient stores such as iron will be depleted by approximately 6 months of age (Cowbrough, 2010). Therefore, breastmilk or infant formula milk alone will no longer be sufficient to meet the increase requirement in energy and nutrients.

It is estimated that 200 kcal, 300 kcal and 550 kcal per day of energy is expected to be covered by complementary feeding at 6-8, 8-11 and 11-23 month of age respectively, as well as providing micronutrients such as iron, zinc, phosphorous, magnesium, calcium and vitamin B6 (Abeshu et al, 2016).

Complementary feeding should not be delayed beyond 6 months as this increases the risk of nutrient and energy deficiencies. Iron deficiency anaemia is known to be more common among infants who were offered complementary feeding beyond 6 months of age (DOH, 1994). Therefore, it is important to include iron rich food such as red meat, chicken, eggs, pulses and green leafy vegetables to prevent iron deficiency.

There is strong evidence on the importance of starting complementary feeding at 6 months of age, whilst continuing breastmilk or formula milk. These include:

Provision of extra energy and nutrients to sustain normal growth, development and optimal health (Cowbrough, 2010);

Signs of readiness to accept solid food are generally seen at this stage. This is the best window of opportunity for infants to learn, accept and like new tastes and textures which potentially prevents from food refusal later (Shaw et al, 2007);

Children who were introduced solids at around 6 months had a lower risk of feeding difficulties than children who were introduced solids between 4 to 6 months (Hollis et al, 2016). On the other hand, failure to introduce lumpy, solid foods by approximately 9 to 10 months of age, has been associated with an increased risk of feeding difficulties and reduced consumption of important food groups such as fruits and vegetables later on (Fewtrell et al, 2017);

Prevention of micronutrient deficiencies especially iron, zinc and calcium deficiencies. Iron and zinc are generally the most common nutrient deficiency during the period of complementary feeding especially the second 6 months of life (Dewy, 2013; Abeshu et al 2016). Since average expected energy intake from complementary food at 6-8month old is estimated about 200kcal per

day, the minimum target nutrient density in those foods tend to be highest for that age i.e. 4.5mg iron per 100kcal and 1.14mg zinc per 100kcal. Target nutrient density for iron and zinc is lower for breastfeeding infants at 9-11month old due to average expected energy intake from complementary food increases to 300kcal per day. Expected energy intake from complementary food increases to 550kcal at 12-23 months old but lower in iron and zinc i.e. 1.0mg per 100kcal and 0.6mg of zinc per 100kcal at 12-23months old. Hence, the important of nutrient dense complementary food is be offered during their second 6 months of life;

Adequate intakes of micronutrients, such as iron, zinc, and calcium, are important to ensure optimal health, growth, and development of infants and young children (Abeshu et al 2016) According to the 2001 World Health Organization (WHO) data, 30% of the children aged between 0 and 4 years and 48% of the children aged between 5 and 14 years are anemic in developing countries.

The most common causes of iron deficiency in children include insufficient intake together with rapid growth, low birth weight and gastrointestinal losses related to excessive intake of cow's milk (Ozdemir N, 2015). It is estimated that the percentage of total daily requirement for micronutrients needed from complementary foods ranges from 30 to 97%. For instance, 97% of iron, 86% of zinc, 81% of phosphorus, 76% of magnesium, 73% of sodium, and 72% of calcium during 9–11 months are expected from complementary foods (Abeshu et al, 2016).

Recommendation

Key Message

Practice exclusive breastfeeding for the first six months and continue breastfeeding until two years while giving nutritious, complementary foods from six months of age

Key recommendation 1:

Practice exclusive breastfeeding for the first six months and continue breastfeeding until two years

How to achieve:

Learn about breastfeeding, especially during pregnancy

- Establish a genuine intention and commitment to breastfeed
- Be prepared mentally and spiritually
- Get information on breastfeeding from reliable sources including books, pamphlets, breastfeeding education talks, trusted websites, healthcare personnel and breastfeeding support groups
- Learn how to hold baby confidently and acquire knowledge on positioning and effective attachment for breastfeeding
- Learn about methods of breastmilk expression especially hand expression
- Share about breastfeeding experiences with friends, mothers, parents-to-be and other family members

Encourage and support immediate skin-to-skin contact after birth if possible to facilitate breastfeeding initiation

- Place baby on mother's chest immediately after birth if possible, allowing uninterrupted skin-to-skin contact, ideally for at least one hour
- Encourage continuous skin-to-skin contact within the first three days of birth, if possible, to maximise the protective effect of skin-to-skin
- Build mother's confidence by providing continuous support

Skin-to-skin contact means holding the baby bare chest to bare chest. It helps newborns adjust to being outside the womb. It is ideally done immediately after the birth and as much as possible during the first few days of life. This is a simple act of love, which transfers lifesaving warmth and protective bacteria from the mother to the newborn. Skin-to-skin contact also promotes bonding, helps to initiate and establish breastfeeding.

Start breastfeeding within one hour of birth, if possible

- Initiate breastfeeding within one hour of birth as babies are more alert and interested to feed
- Educate mothers to recognize baby's cues to breastfeed and offer support if needed
- Allow uninterrupted breastfeeding as much as possible

Baby's cues:
Include: stirring, mouth opening, turning head, seeking, rooting, stretching, increase physical movement, hand to mouth

From birth to six months of age, feed babies exclusively with breast milk and feed them frequently 'on demand'

- Keep mother and baby together so that baby can be fed whenever he/she wants
- Learn and recognize the early cues of feeding
- Let the baby breastfeed on demand (as often as they want, day and night but no longer than three hours in between feeds)
- Inform mothers that breastfeeding frequently and on demand will increase milk production. The more milk is removed, the more milk will be made
- Avoid the use of bottles, teats or pacifiers as these will interfere with breastfeeding

Supply expressed breast milk, if mother cannot be with her baby

- In circumstances where mother cannot be with her baby, support her appropriately so that she can accept the situation and build her confidence
- Stimulate the breasts by gentle hand-massaging every 2-3 hours
- Start expressing breastmilk on the day the baby is born, within the first six hours of delivery if possible
- Express as much breastmilk as the mother can, as often as her baby would want (at least every 3 hours, including at night)
- Store expressed breastmilk safely and appropriately
- For working mothers, practice expressing breastmilk during maternity leave (at least 2 weeks) before returning to work

- Train the baby to accept expressed breastmilk two weeks before going back to work

Key recommendation 2:
Introduce safe, nutritious, complementary foods at six months of age

How to achieve:

At six months of age, introduce a variety of safe, appropriate and nutritious family foods to complement breastfeeding, and continue breastfeeding until babies are two years of age

- Introduce complementary foods at the age of six months
- Start with appropriate, home-prepared family foods in ways that the infant can handle. These, if fed in adequate quantities, can meet the nutritional requirements of the child
- Emphasize the importance of introducing iron-rich sources (Appendix 2)
- Avoid commercially processed complementary food as these may not contain the diversity of nutrients in quantities required by a growing infant. In addition, these food products contain added sugar and salt. This may accustom the child to sweet taste, and may eventually lead to the refusal of home-prepared baby foods such as mixed rice porridge
- Make feeding times fun and enjoyable by talking to the infant/child, making eye-to-eye contact, stimulating their verbal and intellectual development
- Create feeding times as a period of encouragement rather than a forced experience
- Continue to breastfeed until the age of two years even after baby has started taking complementary foods

Key recommendation 3:
Encourage, protect, support and promote breastfeeding

How to achieve:

Healthcare personnel, husbands, family members, friends, employers, departmental heads and retailers should provide full support and encouragement to breastfeeding mothers

- Respect and support a mother's decision to exclusively breastfeed and protect her from unsupportive people and negative advice
- Learn practical aspects of breastfeeding by discussing with wife/mother-to-be, healthcare personnel, experienced friends and family members and breastfeeding support groups
- Care for the baby in ways other than feeding (baths, diaper changes, walks)
- Help around the house such as taking care of other children
- Make sure breastfeeding mother gets enough rest, eat and drink healthily
- Health facilities should implement the UNICEF and WHO Baby-Friendly Hospital Initiative (BFHI) and early newborn care package (WHO, 2014)
- Ensure relevant healthcare workers receive training on skills to support initiation of breastfeeding and resolution of any early problems. Discourage intervention that interfere with breastfeeding establishment e.g. the use of artificial teats or pacifiers
- Provide breastfeeding friendly facilities in public amenities
- Provide adequate maternity leave, breastfeeding rooms and breastfeeding breaks for working mothers

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Appendices

Appendix 9.1:

DASAR PENYUSUAN SUSU IBU, KEMENTERIAN KESIHATAN

NEGARA BRUNEI DARUSSALAM

Semua ibu digalakkan memberi susu ibu SAHAJA selama 6 bulan dan meneruskan sehingga anak berumur 2 tahun.

Makanan tambahan perlu dimulakan semasa anak berumur 6 bulan.

Langkah-langkah kearah perlaksanaan dasar ini ialah:

1. Memaklumkan kepada semua ibu-ibu mengandung mengenai dasar ini.
2. Semua pekerja kesihatan yang terlibat dalam penjagaan ibu-ibu mengandung dan anak-anak damit diberi latihan kemahiran dalam pengendalian penyusuan susu ibu.
3. Semua ibu-ibu mengandung diberi tunjuk ajar mengenai pengendalian penyusuan susu ibu dan kebaikkannya.
4. Semua ibu hendaklah dibantu memulakan penyusuan susu ibu dalam masa ½ -1 jam selepas bersalin. Bagi ibu-ibu yang melahirkan secara pembedahan menggunakan bius 'sedar', mereka dibantu oleh pekerja kesihatan untuk bersentuhan kulit dengan anak damitnya selama 15 minit dalam masa ½ -1 jam selepas kelahiran dan memulakan penyusuan susu ibu apabila ibu sudah bersedia. Bagi ibu-ibu yang melahirkan secara pembedahan menggunakan bius am, mereka hendaklan dibantu oleh pekerja kesihatan membuat sentuhan pertama dan memulakan penyusuan awal susu ibu sebaik-baik sahaja ibu sampai ke wad selepas bersalin.
5. Semua ibu diberikan tunjuk ajar penyusuan yang betul dan cara mengekalkan penyusuan yang berterusan, meskipun ibu-ibu terpaksa berasingan dengan anak damitnya.
6. Semua anak damit diberikan susu ibu sahaja kecuali diatas sebab-sebab perubatan.
7. Mengamalkan 'rooming-in' iaitu anak damit sentiasa bersama pada setiap masa.
8. Mengalakkan penyusuan susu ibu mengikut kehendak ibu dan anak damit dengan tidak mengira masa.
9. Tidak memberi putting tiruan atau putting kosong kepada anak damit.
10. Menubuhkan Kumpulan Pendorong Penyusuan Susu Ibu dan merujuk ibu kepada kumpulan ini apabila ibu keluar dari hospital atau klinik.
11. Semua kakitangan Kemeterian Kesihatan hendaklah mematuhi dengan sepenuhnya Dasar Penyusuan Susu Ibu dan Kod Etika Antarabangsa Pemasaran Susu Gantian.

Kementerian Kesihatan

Negara Brunei Darussalam

Appendix 9.2

Recommended Dietary Allowances (RDA) for iron according to age group and sources of iron

Full term infants store enough iron for the first six months of life. Thereafter, their iron needs increase. The table below is an example of Recommended Dietary Allowances (RDA) for iron according to age group:

Age	Male	Female	Pregnancy	Lactation
Birth to 6 months	0.27 mg	0.27 mg		
7–12 months	11 mg	11 mg		
1–3 years	7 mg	7 mg		
4–8 years	10 mg	10 mg		
9–13 years	8 mg	8 mg		
14–18 years	11 mg	15 mg	27 mg	10 mg
19–50 years	8 mg	18 mg	27 mg	9 mg
51+ years	8 mg	8 mg		

Source: National Institute of Health, U.S. Department of Health and Human Services. 2018. [Accessed on 13 December 2018]. Available from: https://ods.od.nih.gov/factsheets/Iron-HealthProfessional/

Iron can be found in both animal and plant foods. Animal sources are called 'heme iron' which is more easily absorb by the body. Plant sources are called 'non-heme iron' which is not easily absorb by the body.

The following table lists several sources of iron:

Food	Iron (mg) per 100g
Beef, lean	2.19
Chicken breast	0.91
Chicken thigh	0.80
Chicken wing	0.47
Chicken liver	10.19
Mutton, lean	2.32
Lamb, lean	3.10
Beef, lean	2.19
Eggs, cooked	1.87
Rumahan, cooked	0.47
Salmon, cooked	1.02
Kale / *Sawi*	1.95
Peas, fresh	0.83
Pumpkin	0.7
Tomato	0.67
Spinach / *Bayam (putih)*	3.75
Spinach / *Bayam (merah)*	4.04
Cauliflower	0.89
Chickpeas / *Kacang kuda*	6.88
Dhal	4.14
Tauhu	2.24
Kacang panjang	0.76
Beetroot	1.41
Broccoli	0.74
Carrot	0.78
Cabbage / *Kubis*	0.59

KEY MESSAGE 10

Prepare and consume foods and beverages that are clean and free from contaminations

Key Message 10
Prepare and consume foods and beverages that are clean and free from contaminations

Introduction

In Codex Alimentarius, food is defined as *"any substance, whether processed, semi-processed or raw, which is intended for human consumption, and includes drink, chewing gum and any substance which has been used in the manufacture, preparation or treatment of "food" but does not include cosmetics, tobacco or substances used only as drugs"*. As food is a primary source of nutritional sustenance besides contributing to social, emotional and psychological needs, emphasizing the importance of food safety is never exhaustive (Alum et al., 2016).

Safe food is, however, defined differently depending on variations in perspectives from consumers, regulators, industry, academics or special interest groups. It is more commonly defined as food that is not hazardous to health and is not contaminated with harmful bacteria, parasites, viruses, toxins and chemicals (WHO, 2015). Unfortunately, food being the main carrier for foodborne diseases, is easily contaminated by these harmful agents.

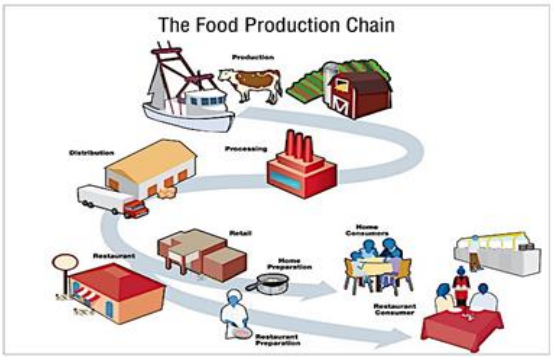
Food poisoning and foodborne illnesses

Currently, there are more than 250 known foodborne diseases. Food-related illnesses usually cause symptoms such as fever, chills, nausea, vomiting, diarrhoea, stomach cramps or abdominal pain, lack of energy or weakness, loss of appetite and aching muscles. The onset times of the symptoms from the ingestion of contaminated food

Contamination, either of biological or non-biological origin, may occur at any point within the food chain (Figure 10.1); from farms where fresh commodities are grown to homes and domestic kitchens of consumers. The consumption of contaminated food can cause poisoning or diseases which may lead to multiple health implications, mostly minor, short-term symptoms, but occasionally major, long-term complications and even death. It is therefore important to emphasize that foodborne diseases are actually preventable. Each person is responsible and has a critical role in ensuring safe food handling practices and good hygiene in the efforts of preventing foodborne diseases.

Food safety is of significant international concern, affecting health and national economies. In the present globalized world where technologies and societies are dynamic and constantly evolving, it is imperative that food safety principles are instilled by every individual regardless of social, economic or regional diversities.

Figure 10.1: Food Production Chain *"Every year, almost 1 in 10 people are affected by foodborne diseases."* Source: CDC (2015)



vary depending on the type of infection. Although not all cases affect the gastrointestinal tract, it is the most commonly known indicator of food poisoning (CDC, 2004).

Six of the most common causes of food-related deaths are *Salmonella, Listeria*, *Toxoplasma*, Norwalk-like viruses, *Campylobacter* & *E. coli* O157:H7 (Alum et al., 2016). Other known hazards are viral and parasitic in addition to other non-infectious physical, chemical or biochemical contaminations (Table 10.1). The aetiology of the diseases may be identified via assessment of the symptoms by healthcare professionals and confirmed via laboratory analysis (ANNEX 1) (CDC, 2004).

Table 10.1: Most common contaminants and their incubation period, clinical symptoms and characteristic food

Agent		Symptoms	Characteristic Foods
Heavy Metals			
Antimony ***Cadmium*** ***Copper*** ***Iron*** ***Tin*** ***Zinc***		*Vomiting, often metallic taste*	*Foods and beverages prepared / stored / cooked in containers coated / lined / contaminated with offending metal*
Microbiological Contaminants			
Bacillus cereus		*Diarrhea, abdominal Cramps, vomiting, fever*	*Cooked rice, custards, cereals, puddings, sauces, meat loaf*
Clostridium spp.	*Clostridium botulinum*	*Diarrhea, abdominal cramps; vomiting and fever*	*Meat, poultry*
	Clostridium perfringens	*Illness of variable severity; common symptoms include Double or blurred vision, neuromotor weakness and paralysis*	*Improperly canned or similarly preserved foods*
Cryptosporidium parvum		*Diarrhea, nausea, vomiting; fever*	*Uncooked foods; water*
Cyclospora cayetanensis		*Fatigue, protracted diarrhea, often relapsing*	*Raw produce; water*
Escherichia coli	*enterotoxigenic (ETEC)*	*Diarrhea, abdominal cramps, nausea; vomiting and fever*	*Uncooked vegetables, salads, water, cheese*

	enteroinvasive (EIEC)	*diarrhea (might be bloody), fever, abdominal cramps*	*Uncooked vegetables, salads, water, cheese*
	enterohemorrhagic (E. coli O157:H7 and others)	*Diarrhea (often bloody), abdominal cramps (often severe), little or no fever*	*Beef, raw milk, water, apple cider, lettuce*
Listeria monocytogenes	*Invasive Disease*	*Meningitis, neonatal sepsis, fever*	*Milk, soft cheeses*
	Diarrheal Disease	*Diarrhea, fever, abdominal cramps*	*Milk, soft cheeses*
Salmonella (nontyhpoid)		*Diarrhea, often with fever and abdominal cramps*	*Poultry, eggs, meat, raw milk (cross contamination important)*
Shigella spp.		*Diarrhea (often bloody), often accompanied by fever and abdominal cramps*	*Foods contaminated by infected foodhandler; usually not foodborne*
Staphylococcus aureus		*Vomiting, diarrhea*	*Sliced/chopped ham and meats, custards, cream fillings*
Vibrio parahemolyticus		*Diarrhea*	*Seafood*
Vibrio cholerae	*non-01 and non-0139*	*Watery diarrhea*	Shellfish
	O1 or 0139	*Watery diarrhea, often accompanied by vomiting*	Shellfish, water or foods contaminated by infected person or obtained from contaminated environmental source
Viral Contaminants			
Norovirus (formerly, "Norwalk-like viruses")		*Vomiting, cramps, diarrhea, headache, fever*	*Raw or undercooked shellfish; water; many others*
Rotavirus		*Vomiting, chills, and diarrhea, especially in infants and children*	*Foodborne transmission not well documents*

Source: CDC (2003)

Global prevalence of foodborne disease

Every year foodborne diseases affect almost 1 in 10 people worldwide. The World Health Organization (WHO) estimated that food-related diseases have contributed to an estimated 600 million cases and 420,000 deaths in 2010. Almost one third of these deaths are attributable to children due to their weaker immune system. The most common ones are diarrhoeal diseases, which are responsible for half of the global burden of total foodborne illnesses (WHO, 2015).

These illnesses are caused by 31 different hazards resulting in an estimated 32 different diseases including 11 diarrhoeal disease agents (1 virus, 7 bacteria, 3 protozoa), 7 invasive infectious disease agents (1 virus, 5 bacteria, 1 protozoon), 10 helminths and 3 chemicals (WHO, 2015). Experts from the WHO made a recent study on the exposure routes of different hazards as shown in Table 10.2, demonstrating that although the hazards may be acquired from other sources such as soil, animal or human contact, but food is the most common mode of transfer.

Table 10.2: Exposure Routes by Hazards Compiled by Experts (WHO, 2015).

HAZARD	FOOD	ANIMAL CONTACT (DOMESTIC AND WILD)	HUMAN TO HUMAN CONTACT	WATER	SOIL	AIR	PAINT	COOKWARE, POTTERY OR GLASSWARE	TOYS	OTHER
DIARRHOEAL DISEASE										
Campylobacter spp.	x	x	x	x	x	na	N/A	N/A	N/A	x
Non-typhoid *Salmonella* spp.	x	x	x	x	x	N/A	N/A	N/A	N/A	x
Shiga toxin-producing *E. coli*	x	x	x	x	x	N/A	N/A	N/A	N/A	x
Brucella spp.	x	x	N/A	x	x	N/A	N/A	N/A	N/A	x
Shigella spp.	x	N/A	x	x	x	N/A	N/A	N/A	N/A	x
Enteropathogenic *E. coli*	x	x	x	x	N/A	N/A	N/A	N/A	N/A	x
Enterotoxigenic *E. coli*	x	x	x	x	N/A	N/A	N/A	N/A	N/A	x
Cryptosporidium spp.	x	x	x	x	N/A	N/A	N/A	N/A	N/A	x
Giardia spp.	x	x	x	x	N/A	N/A	N/A	N/A	N/A	x
Tyhoid *Salmonella* spp.	x	N/A	x	x	N/A	N/A	N/A	N/A	N/A	x
Vibrio cholerae	x	N/A	x	x	N/A	N/A	N/A	N/A	N/A	x
Entamoeba histolytica	x	N/A	x	x	N/A	N/A	N/A	N/A	N/A	x
Norovirus	x	N/A	x	x	N/A	N/A	N/A	N/A	N/A	x
Hepatitis A virus	x	N/A	x	x	N/A	N/A	N/A	N/A	N/A	x
PARASITIC DISEASE										
Toxoplasma gondii	x	x	N/A	x	x	N/A	N/A	N/A	N/A	x
Echinococcus granulosus	x	x	N/A	x	x	x	N/A	N/A	N/A	x
Echinococcus multilocularis	x	x	N/A	x	x	x	N/A	N/A	N/A	x
Ascaris spp.	x	x	x	x	x	N/A	N/A	N/A	N/A	x
CHEMICALS										
Lead	x	N/A	N/A	x	x	x	x	x	x	x

Notes: N/A = not applicable, meaning that these exposure routes were considered not possible or extremely unlikely by the respective FERG TF.

Source: WHO (2005)

Foodborne diseases in Brunei Darussalam

In Brunei Darussalam, food poisoning is the main cause of disease outbreaks in the country, some contributed by contamination of cooked food or packed beverages consumed by school children. Between 2007 to Oct 2018, there have been a total of 67 food poisoning outbreaks affecting 1602 individuals. Although the trend illustrates a decrease of food poisoning outbreaks, the unpredictability of diseases and human and environmental influences, preventive and proactive measures should consistently be taken to ensure food safety.

In most circumstances, the outbreaks are caused by:

- Failure of enforcing good hygienic habits resulting in poor food-handling practices,
- Poor personal hygiene as food handlers insufficiently washing their hands, clean utensils, equipment;
- Lack of sanitary upkeep of the surrounding kitchen area; and
- Improper storage of food at unsuitable temperatures for a long period of time.

Between 2007 and 2018, there have been 36,993 gastroenteritis cases, which may or may not be linked to food poisoning. Laboratory confirmed cases of food poisoning also shows that Salmonella spp. is comparatively the most common pathogen in food poisoning cases (76%). It was also demonstrated that these confirmed cases are spread out within the country, with 85% of cases originating in Brunei Muara, 8% in Belait, 5% in Tutong and 2% in Temburong districts.

Figure 10.2: Food Poisoning Outbreak in Brunei Darussalam between 2007 and Oct 2018

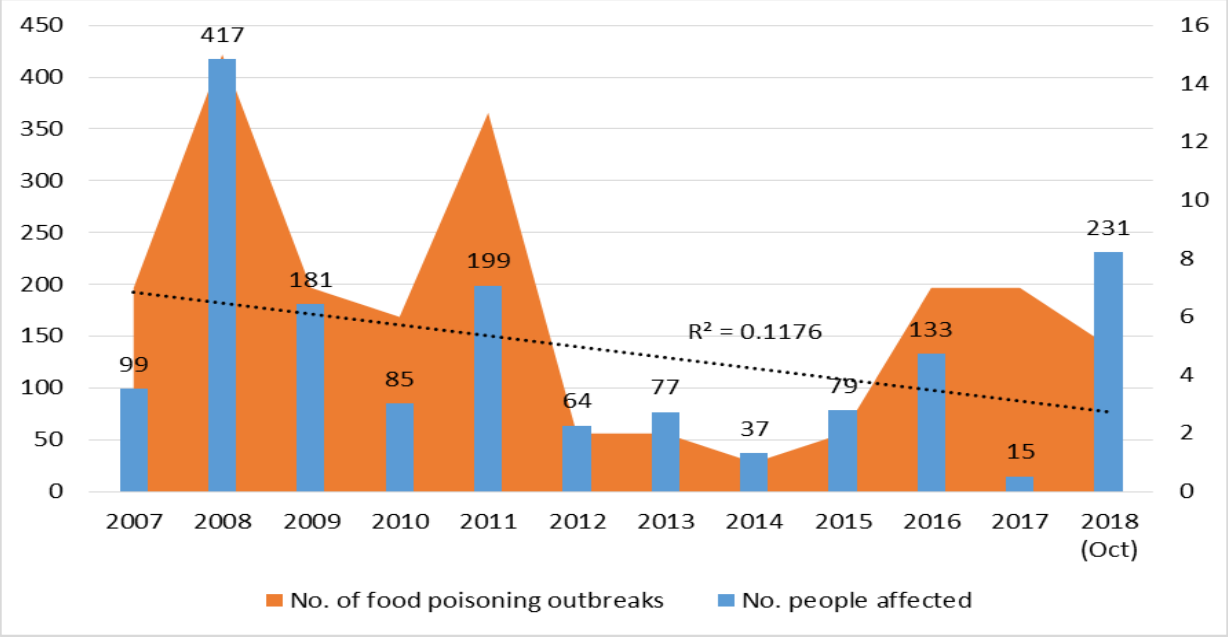
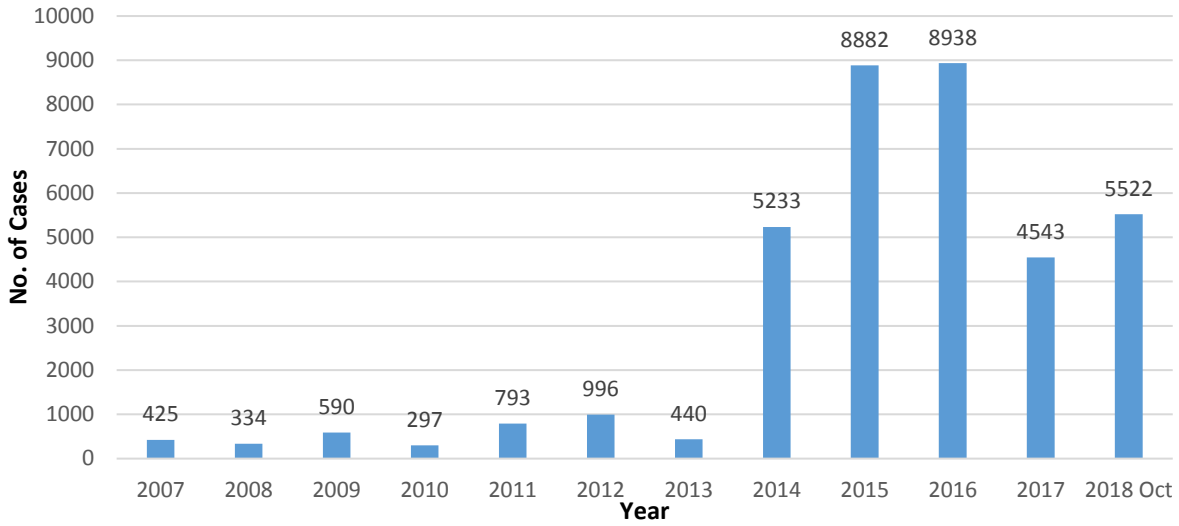


Figure 10.3: Gastroenteritis cases reported between 2007 and Oct 2018



**The peak in 2014 may be contributed by the increased reporting efficiency, following the introduction of BruHIMs system.*

Figure 10.4: Laboratory Confirmed Notifiable Foodborne Diseases between 2007 and Oct 2018

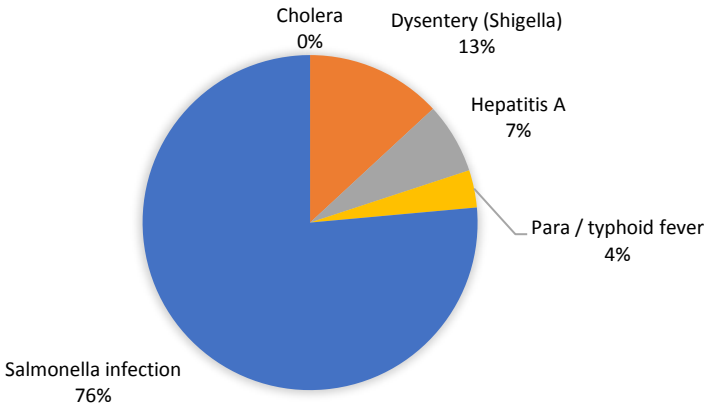
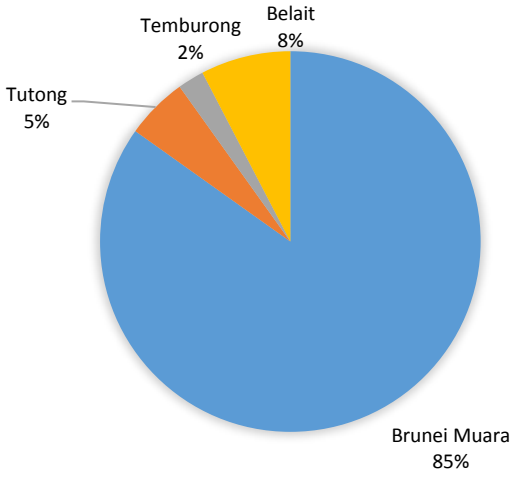


Figure 10.5: Laboratory Confirmed Cases by District between 2007 and Oct 2018



Literature Review

Rationale 1

The Centers for Disease Control and Prevention (CDC) assessed food handlers who failed or insufficiently washed their hands contributed to 50% of all foodborne disease outbreaks in USA (Mead et al., 1999). The probability of diarrheal diseases can be reduced by more than 40%, saving one million lives each year, by enforcing hand washing interventions with soap and clean water (Curtis and Cairncross, 2003).

Unsatisfactory hygiene of food handlers is a frequent contributor of foodborne disease outbreaks, typically due to *Staphylococcus aureus* and other gram negative microbes such as *Salmonella spp*., *Shigella spp*., *Campylobacter jejuni*, Exterotoxigenic *E. coli* and viral agents such as Hepatitis (Hundy and Cameron, 2002; Lee and Middleton, 2003). Although hand washing can be perceived as trivial by some individuals (Shojaei et al., 2006), cross contamination can occur due to feces-to-hand-to-mouth transfer of potentially pathogenic organisms when food handlers do not employ proper hand washing techniques (Allwood et al., 2004; Sneed et al., 2004).

A study conducted within the domestic kitchens showed varying levels of contamination throughout the day, high post meal preparation and gradually minimizing overnight. Hand-to-surface cross contamination can be observed on frequently touched surfaces such as refrigerator handles, kettle handles and taps (Haysom and Sharp, 2005). It also indicated that certain sites are more prone to contamination due to raw chicken preparation, including chopping boards, surfaces, tap handles, kettles and refrigerators (Haysom and Sharp, 2004), especially microbes such as *Salmonella*, *Campylobacter, E. Coli* and *S. aureus* (Boer and Hahne, 1990; Gorman et al., 2002). Other studies also concluded that household cleaning items such as sponges and cloths can act as vehicles and contaminate surfaces and utensils (Josephson et al., 1997; Kusumaningrum et al., 2003; Mattick et al., 2003). When sponges and cloths were observed microscopically, they have irregular surfaces, thus facilitating the deposition of food residues and in turn causing pathogens to adhere and thrive on those surfaces (Sinde and Carballo, 2000). Microbes transferred to surfaces from sponges are able to survive for hours, increasing the risk of contamination (Kusumaningrum et al., 2003).

Food handlers are encouraged to understand the risks of unhygienic practices and be trained on proper personal and environmental hygiene. Consequently, premise owners should invest in sanitation programs for all their staffs to improve food safety at all stages of food operations. This includes procedures for personal hygiene such as habitual hand washing (frequency and techniques), prohibition of jewelries during food preparation and the use of proper, clean attires including hair nets and safety, non-slip shoes.

Precautions should also be made to restrict accessibility of their food premise from any disease-carrying vectors and eliminate the probability of physical contamination by insects, vermin or other animals. Besides the spread of zoonotic diseases, animals and pests may also contaminate food preparation area with feces or pathogens gained from external environments (EFSA, 2015).

In the event of a foodborne outbreak, the presence of organisms such as *E. coli*, *S. Aureus* or *Enterobacteriaceae* as well as Total

Plate Count / Total Aerobic Count and Total Coliform Count Analysis are usually used by health authorities as indicators to assess the level of efficient hygienic practices and sanitation programs. In most cases, large-scale food manufacturers monitor contamination levels internally via company run laboratories to assure food safety. This is usually due to the realization that any health risks associated with their products may demean their reliability and brand, and the release of any food recalls can cause a significant financial burden to the company.

As this is not viable for domestic setting or for SMEs and CIs, the general consumers, food handlers and small or medium food manufacturers are highly encouraged to practice preventive measures and enforce hygienic measures before, during and after food preparation.

Rationale 2

Foodborne pathogens such as *clostridium perfringens, E.coli* OI57:H7, *yersinia enterocolitis*, *campylobacter* spp., *salmonella* spp., Hepatitis A, cryptosporidium, *cyclospora cayetanensis* and *toxoplasma gondii* can be present on raw meats, seafood, poultry and vegetables (Alum et al., 2016). These pathogens can easily be transferred onto ready-to-eat foods if proper segregation, storage and hygiene are not practiced. Segregating raw produce at the bottom of the fridge reduces the risk of any juices or drippings from contaminating ready-to-eat products. Placing them in containers further protects surrounding food from contamination.

Rationale 3

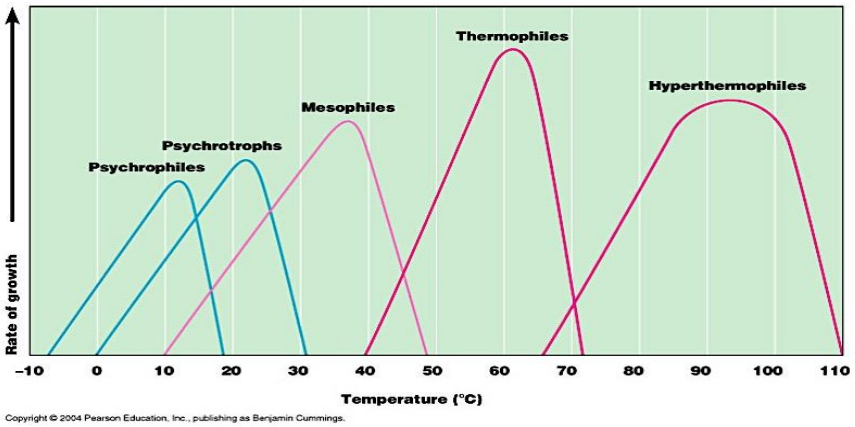
Temperature has a significant influence on microbial growth in addition to other factors such as pH, oxygen, time, redox potential and water activity. Microorganisms have different ranges for optimal growth (Figure 10.6) (Table 20). The WHO considers temperatures between 5-60^{o}C as “danger zones” (Figure 10.7) (WHO, 2006) for optimal growth of food related pathogens while cooking at temperatures above 60^{o}C will stop most microbial activity and growth, denaturing any reactive enzymes and proteins.

Rationale 4

A variety of intrinsic and extrinsic factors promote the growth rate of microorganisms, however, the control of time and temperature is integral to ensure food safety (FDA, 2015).

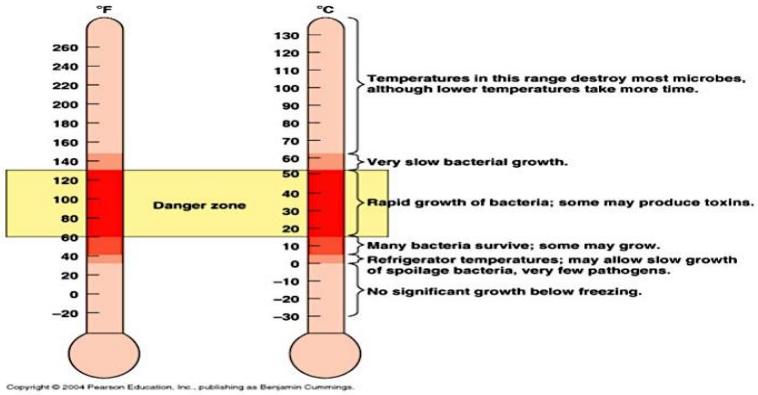
In connection to the prior key message, keeping food at lower temperatures can reduce and stop the growth of foodborne pathogens, but at a slower rate. Improper and prolonged thawing of food permits the growth of bacteria, especially spore-forming pathogens such as *C. perfringens* and *B. cereus* that has a short lag time and can multiply exponentially (Figure 10.8). It was also shown that growth temperatures can regulate the expression of virulence genes in certain pathogens (Montville and Matthews, 2001). A balance of factor can still encourage microbial growth with time, thus discouraging the storage of food for long periods of time.

Figure 10.6: Rate of Growth of Different Microorganisms by Temperature



Source: College (2004)

Figure 10.7: "Danger Zone" Temperatures for Optimal Growth of Food Borne Pathogens



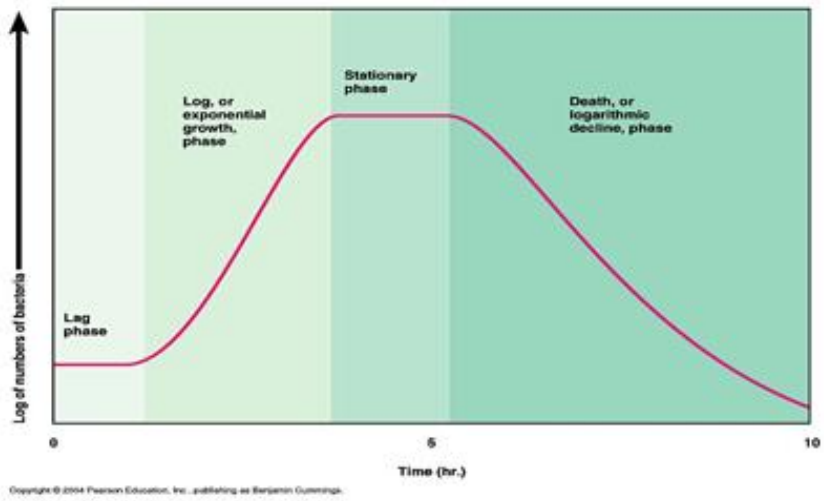
Source: Woolhouse and Gowtage-Sequeria (2005)

Table 10.3: Approximate Temperature Values Permitting Growth of Certain Foodborne Pathogens

Organism	Minimum (°C)	Optimum (°C)	Maximum (°C)
Bacillus cereus	5	28-40	55
Campylobacter spp	32	42-45	45
Clostridium botulinum types A & B (proteolytic)	10-12	42-45	45
Clostridium botulinum type E (non-proteolytic)	3-3.3	25-37	45
Clostridium perfringens	12	43-47	50
Enterotoxigenic Escherichia coli	7	35-40	46
Listeria monocytogenes	0	30-37	45
Salmonella spp.	5	35-37	45
Staphylococcus aureus growth	7	35-40	48
Staphylococcus aureus toxins	10	40-45	46
Shigella spp.	7	37	45-47
Vibrio cholerae	10	37	43
Vibrio parahaemolyticus	5	37	43
Vibrio vulnificus	8	37	43
Yersinia enterocolitica	-1	28-30	42

Source: Compiled from ICMSF et al (1996); Lund et al (2000); and Doyle et al (2001)

Figure 10.8: Four-phase pattern of microbial growth in relation to time



Source: Woolhouse and Gowtage-Sequeria (20050

Rationale 5

Fresh fruits and vegetables can be contaminated in the fields through water used for irrigation, pesticide exposure or from the use of animal manure as fertilizers. Contaminated irrigation water has been linked to food poisoning outbreaks due to *E. coli O157:H7, Vibrio spp.* and *salmonella* spp. Contamination (Alum et al., 2016) in addition to other factors such as unhygienic practices in the fields and processing area. Farmers are encouraged to adhere to Good Agricultural Practices (GAP) during production of fresh produce to minimize contamination on edible commodities, especially fresh fruits and vegetables as they are often consumed raw. Raw milk often contains *E. coli, Campylobacter* spp. Tuberculosis or Brucella. Hence, raw milk should be avoided if they are not heat treated or pasteurized in order to significantly reduce the pathogen levels. Damaged cans can increase the risk of food poisoning due to the presence of *C. clostridium* toxins and should thus be thrown away immediately (Alum et al., 2016).

Recommendation

Key Message

Prepare and consume foods and beverages that are clean and free from contaminations

Key Recommendation 1: Keep clean

How to achieve:

- Wash your hands before handling food and often during food preparation
- Wash your hands after going to the toilet
- Wash and sanitize all surfaces and equipment used for food preparation
- Keep kitchen areas and food free from insects, pests and other animals
- Wash foods including fruits before eating

Trainers are also suggested to emphasize on:

- Safety and hygienic precautions should be taken in the slaughterhouse of animals i.e. abattoirs
- Risk of insufficient hand washing. Food handlers should wash their hands thoroughly before handling food
- The importance of cleaning utensils, kitchen surfaces and equipment before and after preparing a meal

Proper hand washing techniques:

- Wet hands under running water
- Rub together for at least 20 seconds with soap
- Rinse hands under running water
- Dry hands thoroughly with a clean dry towel

Key Recommendation 2: Separate raw and cooked foods

How to achieve:

- Separate raw meat, poultry and seafood from other cooked foods
- Use separate equipment and utensils such as knives and cutting boards for handling raw foods
- Store food in containers to avoid contact between raw and prepared foods

Trainers are also suggested to emphasize on:

- Keeping raw meat, poultry and seafood separated from other food products when shopping
- Keeping raw meat, poultry and seafood on the lower shelves of refrigerator and ready-to-eat food on the upper shelves to avoid cross contamination
- Store food in tightly closed containers
- Different plates should be used for raw and cooked foods

Key Recommendation 3: Cook foods thoroughly

How to achieve:

- Cook food thoroughly, especially meat, poultry, eggs and seafood
- Bring foods like soups and stews to boil by making sure that the temperature reach 70^{o}C. For meat and poultry, make sure the juices are clear, not pink. Ideally, use a thermometer
- Reheat cooked food thoroughly

Trainers are also suggested to emphasize on:

- Using colour as an indicator of thorough cooking, if a thermometer is not readily available in the domestic kitchen
- Uneven heating when using microwaves that leaves cold spots in food and the importance thorough cooking
- Avoid using plastics which may release toxic chemicals when microwaved

Key Recommendation 4: Keep foods at safe temperatures

How to achieve:

- Do not leave cooked food at room temperature for more than 2 hours
- Refrigerate all cooked and perishable food (preferably below 5°C) promptly
- Keep cooked food piping hot (more than 60°C) prior to serving
- Do not store food in the refrigerator for too long
- Do not thaw frozen food at room temperature

Trainers were also suggested to emphasize on:

- Familiarizing with safe storage practices
- Tracking storage time for food commonly consumed in the region
- Exploring other options to cool food products (e.g. cold water or ice packs)
- If safe storing is not logistically feasible, handlers have the option to obtain fresh products and use them immediately
- Prolonged storage of leftover food. They should not be stored for more than three days and reheated more than once
- Thawing food in refrigerators or other cool locations.

Key Recommendation 5: Use safe water and raw materials

How to achieve:

- Use safe water or treat it to make it safe for consuming
- Select fresh and wholesome foods
- Choose foods processed for safety purposes, such as pasteurized milk
- Do not use food beyond its expiry date

Trainers were also suggested to emphasize on:

- The dangers of consuming untreated water
- Importance of washing fresh fruits and vegetables prior to consumption
- Minding expiry dates of food products
- Buying fresh, wholesome, undamaged food
- Using safe water to wash fruits and vegetables, adding into food and beverages, making ice, cleaning equipment and utensils as well as hand washing
- Throwing away damaged, smashed, swollen or oxidized cans.

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KEY MESSAGE 11

Read and understand food labels to make healthier choices

Key message 11
Read and understand food labels to make healthier choices

Introduction

Over the years, there has been an increased production of energy-dense and poor nutritional value foods. The emerging accessibility of these said foods through various food establishments and food outlets such as restaurants, cafés, food trucks and many more add to the burden of non-communicable diseases. Information regarding the contents of these foods found printed on product packaging or restaurant menus can influence the purchasing habit of consumers, and can potentially help in disseminating important nutritional messages to them.

Most pre-packaged foods sold in the market today display food labelling to inform consumers regarding details of its origin, manufacture, storage and usage instructions, expiry dates, and ingredients, along with the nutrition information panel. In particular, the nutrition information panel lists out the amount of nutrients in a product to inform consumers about its nutritional properties. Displaying such factual information on pre-packaged products and restaurant menus can help consumers to make informed decisions for their dietary intake. For example, consumers will be able to compare similar products from looking at their nutrition information panels and identify which nutrients are in appropriate amounts for them.

Food manufacturers may also benefit from providing nutritional labelling on packaging as they can highlight and promote the healthier properties of their products to consumers.

Overview of the health and nutritional status in Brunei Darussalam

According to the Public Health (Food) Regulations (R1, Chapter 182), nutrition labelling is mandatory for any product that makes a nutrition claim. The nutrition information panel must include the quantity of energy, protein, fat and carbohydrate, along with other nutrients, where nutrition claims have to be made per 100g or 100ml of the product. Table 11.1 below shows the required format for the nutrition information panel as stated in the Public Health Food Regulations.

Regarding the use of nutritional labels on products sold locally, a local study was conducted to assess sodium content from a total of 1470 processed food products. Results showed that 425 products (29%) did not display any information about sodium content which suggests that the available nutrition information of products may be lacking for consumers (Kamis et al., 2015).

From another local study in 2015, data collection of 671 local products was carried out to assess if nutrition information panels were displayed (Ministry of Health, 2015). Out of 671 local products, only 113 (17%) displayed the nutrition information panel displaying the four cores nutrient; energy, carbohydrate, protein and fat. Twenty-eight (4%) out of the 671 local products displayed nutrition claims, however, only five of these products specified the nutrition information related to those claims.

Table 11.1: Form for Nutrition Information Panel

NUTRITION INFORMATION

Servings per package (here insert number of servings)* Serving size: (here insert the serving size)*		
	Per Serving* or	Per 100 g (or 100 ml)
Energy	Kcal, kJ or both	Kcal, kJ or both
Protein	g	g
Fat	g	g
Carbohydrate	g	g
(here insert the nutrients for which nutrition claims are made or any other nutrients to be declared)**		

* Applicable only if the nutrients are declared on a per serving basis.

** Amounts of sodium, potassium and cholesterol are to be declared in mg.

Reflecting the availability of nutritional labelling, findings from the population-based Knowledge, Attitudes and Practices Survey on Non-Communicable Diseases (2015) suggested that the practice of reading nutrition labelling in Brunei Darussalam is not widespread; with less than one-third (27.1%) of respondents claiming to do so (Ministry of Health, 2016).

However, 27% of the respondents claimed nutrition labelling was found to be second most useful and important after checking for expiration dates (42.9%). Worth mentioning also is that 84.9% of the respondents claimed that the 'healthfulness' of a product impacts their decision to buy a food or beverage (Ministry of Health, 2016), which suggests that more and more of the population are interested in being healthy, entailing the consumption of healthier products, by which a nutrition information panel is needed. Therefore, reading and understanding nutrition information needs to be put into practice.

Nutrition Labelling: The Brunei Darussalam Context

Several efforts have been undertaken by the Ministry of Health to assess the current views and understanding of nutrition labelling in Brunei Darussalam. Table 11.2 displays results from the *Nutritional Labelling Awareness and Uptake of Healthier Food Branding* Survey conducted by the Health Promotion Centre (HPC) in 2014; results showed that 85.3% of consumers (n=265) read nutrition labels, of which 26.3% read them frequently, 25.6% sometimes and 33.5% rarely. Reasons for not reading nutrition labels were commonly *'no time'* (14.3%) or *'for frequently consumed items there is no need to read the label'* (37.2%). Out of those who read nutrition labels, 55.3% stated the reasons for doing so was *'to choose healthier items'*. However, when asked if it is important to have nutritional labels on food products, the majority (95.1%) agreed it was either '*important'* or *'very important'.* Furthermore,

97.4% of consumers support having a healthier choice logo on packaged food.

Table 11.2 Results from the Nutritional Labelling Awareness and Uptake of Healthier Food Branding Survey (2014)

	Percentage (%)		Percentage (%)
Total Reading Nutrition Labels	85.3%	- Reading Nutrition Labels Frequently	26.3%
		- Reading Nutrition Labels Sometimes	25.6%
		- Reading Nutrition Labels to Choose Healthier Items	55.3%
Reading Nutrition Labels Rarely	33.5%	- Not Reading Nutrition Labels Due to No Time	14.3%
		- Not Reading Nutrition Labels for Frequently Consumed Items - There is No Need to Read the Label	37.2%
Having Nutritional Labels on Food Products Is Important	95.1%		
Support Having a Healthier Choice Logo on Pre-Packaged Foods	97.4%		

These findings suggest that there is a need for healthier choice products to be available in the local market. This can drive the impetus for local or regional food manufacturers and Micro Small Medium Enterprises (MSMEs) to reformulate their products to be healthier and acceptable by the Bruneian public. In response to this, the Health Promotion Centre, Ministry of Health Brunei introduced the Healthier Choice Logo.

Figure 11.1: Healthier Choice Logo (*Logo Pilihan Lebih Sihat*)

The Healthier Choice Logo (HCL) was introduced in February 2017 to influence the purchasing and dietary behaviours of the general public. This front-of-pack logo enables consumers to identify healthier options available in the market, as only products that meet the predefined nutrient criteria can display the HCL on their packaging. With the HCL present on product packaging, consumers can know that the product is a healthier choice without having to read through detailed nutritional labelling.

It also aims to encourage local food industries to reformulate their products by limiting the levels of saturated fat, trans-fat, added sugars and sodium. With regard to this, campaigns and promotional activities on the use of the HCL need to be conducted to promote the purchase of products with the Healthier Choice Logo.

Literature Review

Usage of Nutritional Labels Amongst Consumers

Several studies have found that use and understanding of nutrition labels are affected by various factors such as difference in interest in healthy eating, nutrition knowledge and social grade (Grunert, K.G et al., 2010). According to global studies, approximately half of the American adults reported using nutrition labels when making food decisions, suggesting that it is an important source of information for consumers (Blitsen, Byrd-Bredbenner, C. et al., 2000; J.L & Evans, W.D, 2006; Ollberding, N.J et al., 2010).

Although the nutrition label is beneficial for various populations, it is more likely to be used by those who are well-educated, Caucasian, female and/or young adults, as well as by those with healthier eating habits, higher incomes and greater nutrition knowledge (Cowburn, G. and Stockley, L, 2005; Campos, S. et al., 2011). Furthermore, a study claimed that patients with chronic diseases (such as hypertension, diabetes and heart disease) were reported to have greater nutrition awareness and food label use compared to those without chronic diseases (Lewis, J.E et al., 2009). This suggests that patients with chronic diseases are more likely to make use of food and nutrition labels. On the other end, reasons for not using nutrition labels include not being able to understand them as well as having no motivation to use them (Grunet, K.G. et al., 2010).

Benefits of nutrition labelling

From a review of consumers' use of nutritional labels, it was found that nutrition label use may contribute to improved dietary consumption or may reduce intake of unhealthy foods (Drichouitis A.C et al., 2006). Twenty-four-hour dietary recall interviews were conducted amongst over 4,000 participants in the United States whereby significant differences were found between food label users and non-label users, whereby the label users reported healthier nutrient consumption; with lower intakes of total energy and total fat (Ollberding, et al., 2010). Additionally, food label users reported healthier nutrition consumption in terms of total energy, total fat, saturated fat, sugars, cholesterol and higher intake of dietary fibre (Ollberding N.J et al., 2010). From other research studies, it has been suggested that the use of nutrition labels is associated with diets high in vitamin C, lower in cholesterol and lower percentage of calories from fat (Drichouitis A.C et al., 2006).

In recent years, restaurants have been presenting calorie counts for their menu items on their display boards or menus for

their customers. Several studies have results that suggest nutrition labelling on restaurant menus encouraged reductions in calories purchased and/or consumed (Chu Y.H et al., 2009; Pulos E & Leng K, 2010; Roberto C.A et al., 2010; Bollinger B et al., 2011; Dumanovsky T et al., 2011; Krieger J.W et al., 2013). In general, the studies show that there was a significant reduction in calories of the meals purchased (Dumanovsky T et al., 2011; Krieger J.W. et al., 2013), but this may depend on whether the customers see the calorie information or not (Pulos E. & Leng K., 2010). In support of the abovementioned studies, it was also found that nutrition labelling on restaurant menus is considered as a way to educate the public about calories in restaurant food (Block J.P et al., 2013; Roberto C.A et al., 2013).

Consumer perception and behaviour of nutrition logo

Front-of-pack nutrition logo has been shown to be effective in helping consumers to make healthier choices (Feunekes et al., 2008). A study in the United States with 520 adult consumers examined the impacts of front-of-pack nutrition logo and reported that the products displaying "Smart Choices" logo were perceived as significantly more favourable and healthier than products with no front-of-pack nutrition logo (Andrews J.C et al., 2011). Products with such logo also to contain less calories fat sodium.

However, such positive perceptions may not necessarily be translated into the purchasing patterns of consumers. This statement was proven in a study observing the impacts of nutrition logo on influencing the purchasing patterns of consumers in The Netherlands, where only 72 out of 246 participants who were aware of the use of nutrition logo actually purchased products with the logo (Vyth et al., 2010). However, for the 72 participants that reported intention to purchase products with the "Smart Choices" logo actually purchased more of these products; giving the impression that more awareness is needed of such logos to promote healthier product choices (Vyth et al., 2010). Other motives to purchase products with the said logo were for weight control and due to the product information (Vyth et al., 2010).

Recommendation

Key Message
Read and understand food labels to make healthier choices

Key Recommendation 1: Read food labels and make healthier food choices

How to achieve:

- Read the Nutrition Information Panel (NIP) with emphasis on key nutrients such as calories, fat, sugars and salt
- Read the ingredients list and check for the amounts fats, sugars and salt and its alternative names
- Check food labels for nutrition claims and remember to check the NIP if any claims are made
- Compare the nutrient content of similar products to select healthier choices
- Choose products with Healthier Choice Logos (below are the examples of logos and symbols from other countries).

Singapore

Malaysia

Thailand

European Region

Australia

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Summary of the Key Messages and Recommendations

Summary of the Key Messages and Recommendations

Key Message 1

Enjoy a wide variety of nutritious foods daily within the recommended amount

Key recommendation 1:
Choose a wide variety of nutritious foods from five food groups everyday based on the Brunei Darussalam National Healthy Food Plate

Key recommendation 2:
Consume foods within the recommended serving size

Key Message 2

Maintain calorie intake balanced with regular physical activity to keep body weight within a healthy range

Key recommendation 1:
All calories consumed should meet all our energy needs

Key recommendation 2:
Watch your calorie intake wherever you are

Key recommendation 3:
Be active wherever you are

Key Message 3

Base meal on rice, bread, potatoes, pasta, noodles or other starchy carbohydrates, with at least half from whole grains

Key recommendation 1:
Eat three main meals a day with optional one or two healthy snacks in between

Key recommendation 2:
Choose at least half of the carbohydrates from whole grains

Key Message 4

Eat at least two servings of fruits and three servings of vegetables everyday

Key recommendation 1:
Eat at least two servings of fruits everyday

Key recommendation 2:
Eat at least three servings of vegetables everyday

Key recommendation 3:
Eat a variety of colourful fruits and vegetables

Key Message 5

Eat fish, poultry, lean meat, legumes, nuts and other proteins in moderation

Key recommendation 1:
Eat fish, poultry, lean meat and eggs

Key recommendation 2:
Include legumes and nuts in your diet

Key Message 6

Limit intake of fatty foods and use recommended cooking oil sparingly

Key recommendation 1:
Limit intake of fatty foods

Key recommendation 2:
Replace saturated and trans fats with foods containing polyunsaturated and monounsaturated fats.

Key Message 7

Reduce intake of sugary foods and beverages

Key recommendation 1:
Limit intake of sugar-sweetened beverages

Key recommendation 2:
Limit intake of sugary foods

Key recommendation 3:
Drink at least eight glasses of water a day

Key Message 8

Reduce salt and sauces in cooking and food preparations, and choose foods with less salt

Key recommendation 1:
Reduce your salt intake and use less salt and sauces in cooking

Key recommendation 2:
Prepare and choose foods and sauces with less salt

Key Message 9

Practice exclusive breastfeeding for the first six months and continue breastfeeding until two years while giving nutritious, complementary foods from six months of age

Key recommendation 1:
Practice exclusive breastfeeding for the first six months and continue breastfeeding until two years

Key recommendation 2:
Introduce safe, nutritious, complementary foods at six months of age

Key recommendation 3:
Encourage, protect, support and promote breastfeeding

Key Message 10

Prepare and consume foods and beverages that are clean and free from contaminations

Key recommendation 1:
Keep clean

Key recommendation 2:
Separate raw and cooked foods

Key recommendation 3:
Cook foods thoroughly

Key recommendation 4:
Keep foods at safe temperatures

Key recommendation 5:
Use safe water and raw materials

Key Message 11

Read and understand food labels to make healthier choices

Key Recommendation 1:
Read food labels and make healthier food choices.

Participants of the National Dietary Guidelines Consensus Workshop

October – November 2018

Key Message 1

Enjoy a wide variety of nutritious foods daily within the recommended amount

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Key Message 2

Maintain calorie intake balanced with regular physical activity to keep body weight in a healthy range

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Base meals on rice, bread, potatoes, pasta, noodles or other starchy carbohydrates, with at least half from wholegrains

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Key Message 5

Eat fish, poultry, lean meat, legumes, nuts and other proteins in moderation

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Key Message 6

Limit intake of fatty foods and use the recommended cooking oil sparingly

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Key Message 7
Reduce intake of sugary foods and beverages

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Key Message 8

Reduce salt and sauces in cooking and food preparations, and choose foods with less salt

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Key Message 9

Practice exclusive breastfeeding for the first six months and continue breastfeeding until two years while giving nutritious, complementary foods from six months of age

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Key Message 10

Ensure food and beverages are prepared hygienically, as well as clean and safe to consume

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