

**ABSTRACT**

Medical nutrition therapy remains the cornerstone in chronic disease management, apart from medication and regular physical activity. Various clinical practice guidelines and position papers from worldwide associations have incorporated specific nutrition recommendations in managing chronic diseases such as diabetes mellitus, hypertension, hyperlipidaemia, gout and chronic renal failure, which aim to prevent further complications or other co-morbidities arise from these chronic medical conditions. In addition, specific issues such as carbohydrate exchange, glycaemic index and glycaemic load for people with diabetes; DASH diet for hypertensive individuals, latest concerns on trans fat, the usage of plant sterol and soluble fibre in enhancing lipid lowering will also be addressed in this article.

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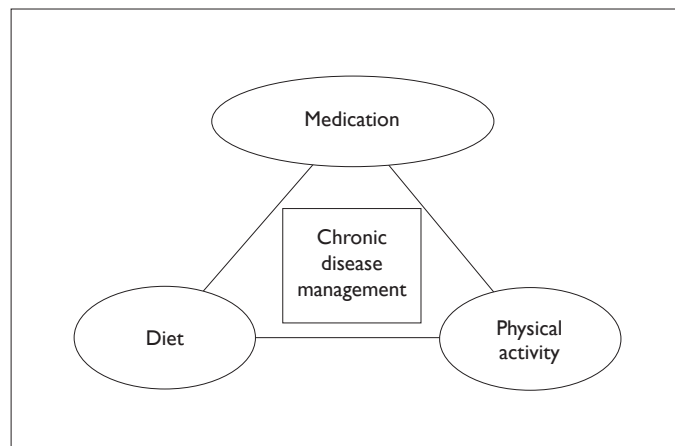
**INTRODUCTION**

The rapidly increasing worldwide prevalence of chronic diseases such as diabetes mellitus, hypertension and hyperlipidaemia as a result of population's progress to adopt an unhealthy eating pattern and sedentary lifestyle has led to a significant proportion of mortality and morbidity.

In view of this rising burden of chronic diseases, the Global Strategy for Diet, Physical Activity and Health was established by WHO in the year 2004<sup>1</sup> to promote primary prevention of chronic diseases via population-based approach. Hence, dietary component remains the cornerstone in chronic disease management for people who suffer from chronic diseases as well as for those who are at risk of developing diseases, apart from medication and physical activity as shown in Figure 1.1.

In terms of dietary component, various worldwide associations such as American Diabetes Association, American Heart Association, American Dietetics Association, British Dietetics Association, National Cholesterol Education Programme (NCEP) Adult Treatment Panel III, Dietitians Association of Australia and New Zealand Dietetics Association have acknowledged the importance of medical nutrition therapy as an integral part in chronic disease management and hence they have incorporated the principles and specific nutrition recommendations of medical nutrition therapy for specific chronic disease as part of the evidence-based clinical practice guidelines.

**Figure 1.1: Components of Chronic Disease Management**



The term “medical nutrition therapy” was introduced by American Dietetics Association<sup>2</sup> in 1994 to better articulate the nutrition therapy process. It is defined as the use of specific nutrition services to treat an illness, injury or a disease which involves two phases: (i) assessment of the nutritional status of the client; and (ii) treatment, which includes nutrition therapy, counseling and the use of specialized nutrition supplements. Furthermore, the position of American Dietetics Association states that medical nutrition therapy is effective in treating disease and preventing disease complications, resulting in health benefits and cost savings for the public. Therefore, medical nutrition therapy provided by dietetics professionals is an essential reimbursable component of comprehensive health care services<sup>3</sup>.

In short, medical nutrition therapy refers to the dietary management of patients with diet-related medical conditions in the form of assessment, education and counseling and recommendation of special nutrition supplements, in order to improve the patient's overall health status and to reduce healthcare cost involved in disease management. In terms of cost effectiveness of medical nutrition therapy in United States, it is estimated that by incorporating medical nutrition therapy component provided by a registered dietitian in management of patients with hyperlipidaemia could save cost of \$1,300 per patient per year and to help a patient with stage 1 hypertension decrease the dosage of medication for an estimated 5-year cost savings of more than \$9,003.

In this article, principles of medical nutrition therapy, nutrition recommendations and other relevant diet-related issues such as practical food tips, food myths as well as learning points for common chronic medical conditions such as diabetes mellitus, hypertension, lipid disorders and chronic renal failure will be highlighted and addressed respectively.

## 1.0 DIABETES MELLITUS

### 1.1 Medical nutrition therapy guidelines

The overall prevalence of diabetes mellitus accounts for about 8.2% of Singapore population aged 18-69 years according to the National Health Survey (NHS) 2004 of Ministry of Health (MOH), which showed a slight reduction compared to 9.0% from NHS 20004. In 2004, diabetes was the 8th leading cause of death in Singapore with 3.0%. of all deaths being attributable to diabetes alone<sup>4</sup>.

Type 2 diabetes is the more common form of diabetes, mainly occurring in elder persons and is associated with obesity among the population. In view of this, according to the clinical practice guidelines (CPG) for diabetes mellitus published by MOH in 2006<sup>5</sup>, medical nutrition therapy should emphasize on gradual weight loss (0.25 to 1.0kg/week) for overweight people with type 2 diabetes via diet and lifestyle modifications; whereas for type 1 diabetes, the main effort should be directed towards dietary manipulation and insulin therapy to improve glycaemic control.

Also, diet plan should be tailored to individual preference, physical activity level, cultural and ethnic practices; and dietary habits. Special attention on dietary requirements should be paid to patients with diabetes during their sick days, travel, exercise; pregnancy and lactation for female patients as well as youth and elderly persons.

Table 1.1 is a summary of medical nutrition therapy guidelines for people with diabetes of each specific nutrients and respective recommended daily intake according to CPG for diabetes mellitus 2006, MOH.

The nutrition recommendations and interventions for people with diabetes as published in the position statement of American Diabetes Association (ADA), Diabetes Care, January 2008<sup>6</sup> aim at all levels of diabetes prevention – primary, secondary and tertiary as shown in Table 1.2.

It has been shown by clinical trials that medical nutrition therapy decreases HbA1c (Glycosylated haemoglobin) by ~1.0%

in type 1 diabetes and 1-2% in type 2 diabetes. Meta-analysis of studies also report that medical nutrition therapy reduces LDL cholesterol level by 15-25mg/dl as well as support a role in lifestyle modification in managing hypertension. Hence, individuals who have pre-diabetes or diabetes should receive individualised medical nutrition therapy; and such therapy is best provided by a registered dietitian who is familiar with the components of diabetes medical nutrition therapy. (B)

A summary of major nutrition recommendations and interventions of medical nutrition therapy as stated in ADA position statement<sup>6</sup> is shown in Table 1.3.

**Table 1.1: Medical Nutrition Therapy Guidelines for People With Diabetes**

Nutrients	Daily Recommended Intake
Total carbohydrates	50% to 60% of total calories
Total protein	15% to 20% of total calories
Total fat	<30% of total calories
- Saturated fat	<10% of total calories
Total cholesterol	<300mg/day
Total dietary fibre	20-35g/day
Total sodium intake	<2,000mg/day
Alcohol	People with poorly controlled diabetes or overweight should abstain from alcohol.

**Table 1.2: Goals of Nutrition Therapy**

Levels of prevention	Goals of medical nutrition therapy
Primary	To prevent diabetes in those who are obese and pre-diabetes via healthy eating and regular exercise to achieve moderate weight loss.
Secondary	To prevent complications arise from diabetes for those who suffer from diabetes by achieving optimal glycaemic, blood pressure and lipid control.
Tertiary	To prevent morbidity and mortality by slowing down the progression rate of complications arise from diabetes.

**Table 1.3: Medical Nutrition Therapy in ADA Position Statement**

Components	Nutrition recommendations and interventions
Energy balance, overweight and obesity	<ul style="list-style-type: none"> <li>In overweight and obese insulin-resistant individuals, modest weight loss has been shown to improve insulin resistance. Thus overweight loss is recommended for all such individuals who have or are at risk of having diabetes. (A)</li> <li>For weight loss, either low carbohydrate or low fat calorie restricted diet may be effective in the short term (up to 1 year). (A)</li> <li>For patients on low carbohydrate diets, monitor lipid profiles, renal function and protein intake (in those with nephropathy), and adjust hypoglycaemic therapy as needed. (E)</li> <li>Physical activity and behaviour modification are important components of weight loss programmes and are most helpful in maintenance of weight loss. (B)</li> <li>Weight loss modifications may be considered in the treatment of overweight and obese individuals with type 2 diabetes and can help achieve a 5-10% weight loss when combined lifestyle modifications.</li> <li>Bariatric surgery may be considered for some individuals with type 2 diabetes and Body Mass Index (BMI) &gt;35kg/m<sup>2</sup> and can result in marked improvements in glycaemia. The long term benefits and risks of bariatric surgery in individuals with pre-diabetes or diabetes continue to be studied. (B)</li> </ul>
Preventing diabetes (primary prevention)	<ul style="list-style-type: none"> <li>Among individuals at high risk for developing type 2 diabetes, structured programmes that emphasize lifestyle changes that include moderate weight loss (7% body weight) and regular physical activity (150minutes/week), with dietary strategies including reduced calories and reduced intake of dietary fat, can reduce the risk for developing diabetes and are therefore recommended (A)</li> <li>Individuals at high risk for type 2 diabetes should be encouraged to achieve the USDA recommendation for dietary fibre (14g fibre/ 1,000kcal) and foods containing whole grains (one half of grain intake). (B)</li> <li>There is not sufficient, consistent information to conclude that low-glycaemic load diets reduce the risk for diabetes. Nevertheless, low-glycaemic index foods that are rich in fibre and other important nutrients are to be encouraged. (E)</li> <li>Observational studies report that moderate alcohol intake may reduce the risk for diabetes, but the data do not support recommending alcohol consumption to individuals at risk of diabetes. (B)</li> </ul>

- Preventing diabetes (primary prevention)
- No nutrition recommendation can be made for preventing type 1 diabetes. (E)
  - Although there are insufficient data at present to warrant any specific recommendations for prevention of type 2 diabetes in youth, it is reasonable to apply approaches demonstrated to be effective in adults, as long as nutritional needs for normal growth and development are maintained. (E)
- 
- Carbohydrate in diabetes management
- A dietary pattern that includes carbohydrate from fruits, vegetables, whole grains, legumes, and low fat milk is encouraged for good health. (B)
  - Monitoring carbohydrate, whether by carbohydrate counting, exchanges, or experienced-based estimation, remains a key strategy in achieving glycaemic control. (A)
  - The use of glycaemic index and load may provide a modest additional benefit over that observed when total carbohydrate is considered alone. (B)
  - Sucrose-containing foods can be substituted for other carbohydrates in the meal plan or, if added to the meal plan, covered with insulin or other glucose-lowering medications. Care should be taken to avoid excess energy intake. (A)
  - As for the general population, people with diabetes are encouraged to consume a variety of fibre-containing foods. However, evidence is lacking to recommend a higher fibre intake for people with diabetes than for the population as a whole. (B)
  - Sugar alcohols and non-nutritive sweeteners are safe when consumed within daily intake levels as established by the FDA. (A)
- Fat and cholesterol in
- Among individuals at high risk for developing type 2 diabetes, structured programmes that emphasize lifestyle changes that include moderate weight loss (7% body weight) and regular physical activity (150minutes/week), with dietary strategies including reduced calories and reduced intake of dietary fat, can reduce the risk for developing diabetes and are therefore recommended (A)
  - Individuals at high risk for type 2 diabetes should be encouraged to achieve the USDA recommendation for dietary fibre (14g fibre/ 1,000kcal) and foods containing whole grains (one half of grain intake). (B)
  - There is not sufficient, consistent information to conclude that low-glycaemic load diets reduce the risk for diabetes. Nevertheless, low-glycaemic index foods that are rich in fibre and other important nutrients are to be encouraged. (E)
  - Observational studies report that moderate alcohol intake may reduce the risk for diabetes, but the data do not support recommending alcohol consumption to individuals at risk of diabetes. (B)
  - No nutrition recommendation can be made for preventing type 1 diabetes. (E)
  - Although there are insufficient data at present to warrant any specific recommendations for prevention of type 2 diabetes in youth, it is reasonable to apply approaches demonstrated to be effective in adults, as long as nutritional needs for normal growth and development are maintained. (E)•
  - Limit saturated fat to <7% of total calories. (A)
  - Intake of trans fats should be minimised. (E)
  - In individuals with diabetes, lower dietary cholesterol to <200mg/day. (E)
  - Two or more servings of fish per week (with the exception of commercially fried fish fillets) provide n-3 polyunsaturated fatty acids and are recommended. (B)
- Protein in diabetes management
- For individuals with diabetes and normal renal function, there is sufficient evidence to suggest that usual protein intake (15-20% of energy) should be modified. (E)
  - In individuals with type 2 diabetes, ingested protein can increase insulin response without increasing plasma glucose concentrations. Therefore, protein should not be used to treat acute or prevent night time hypoglycaemia. (A)
  - High protein diets are not recommended as a method for weight loss at this time. The long term effects of protein intake >20% of calories on diabetes management and its complications are unknown. Although such diets may produce short-term weight loss and improved glycemia, it has not been established that these benefits are maintained long term, and long term effects on kidney function for persons with diabetes are unknown. (E)
- Alcohol in diabetes management
- If adults with diabetes choose to use alcohol, daily intake should be limited to a moderate amount (one drink per day or less for women and two drinks per day or less for men). (E)
  - To reduce risk of nocturnal hypoglycaemia in individuals using insulin or insulin secretagogues, alcohol should be consumed with food. (E)
  - In individuals with diabetes, moderate alcohol consumption (when ingested alone) has no acute effect on glucose and insulin concentrations but carbohydrate co-ingested with alcohol (as in a mixed drink) may raise blood glucose. (B)
- Micronutrients in diabetes management
- There is no clear evidence of benefit from vitamin or mineral supplementation in people with diabetes (compared with the general population) who do not have underlying deficiencies. (A)
  - Routine supplementation with antioxidants, such as vitamin E and C and carotene is not advised because of lack of evidence of efficacy and concern related to long term safety. (A)
  - Benefit from chromium supplementation in individuals with diabetes or obesity has not been clearly demonstrated and therefore cannot be recommended. (E)
- Nutrition intervention for type 1 diabetes
- For individuals with type 1 diabetes, insulin therapy should be integrated into an individual's dietary and physical activity pattern. (E)
  - Individuals using rapid-acting insulin by injection or an insulin pump should adjust the meal and snack insulin doses based on the carbohydrate content of the meals and snacks. (A)
  - For individuals using fixed daily insulin doses, carbohydrate intake on a day-to-day basis should be kept consistent with respect to time and amount. (C)

- For planned exercise, insulin doses can be adjusted. For unplanned exercise, extra carbohydrate may be needed. (E)
- Nutrition interventions for type 2 diabetes
- Individuals with type 2 diabetes are encouraged to implement lifestyle modifications that reduce intakes of energy, saturated and trans fatty acids, cholesterol, and sodium and to increase physical activity in an effort to improve glycaemia, dyslipidaemia, and blood pressure. (E)
  - Plasma glucose monitoring can be used to determine whether adjustments in foods and meals will be sufficient to achieve blood glucose goals or if medications need to be combined with medical nutrition therapy. (E)

Nutrition interventions for pregnancy and lactation with diabetes

- Adequate energy intake that provides appropriate weight gain is recommended during pregnancy. Weight loss is not recommended; however, for overweight and obese women with gestational diabetes (GDM), modest energy and carbohydrate restriction may be appropriate. (E)
- Ketonemia from ketoacidosis or starvation ketosis should be avoided. (C)
- Medical nutrition therapy for GDM focuses on food choices for appropriate weight gain, normoglycaemia and absence of ketones. (E)
- Because GDM is a risk factor for subsequent type 2 diabetes, after delivery, lifestyle modifications aimed at reducing weight and increasing physical activity are recommended. (A)

Nutrition interventions for older adults with diabetes

- Obese older adults with diabetes may benefit from modest energy restriction and an increase in physical activity; energy requirement may be less than for a younger individual of similar weight. (E)
- A daily multivitamin supplement may be appropriate, especially for those older adults with reduced energy intake. (C)

Treatment and controlling diabetes complications (tertiary prevention)

Microvascular complications

- Reduction of protein intake to 0.8-1.0g/kg body weight/day in individuals with diabetes and the earlier stages of chronic renal disease and to 0.8g/kg body weight/day in the later stages of chronic renal disease may improve measures of renal function (urine albumin excretion rate, glomerular filtration rate) and is recommended. (B)
- Medical nutrition therapy that favourably affects cardiovascular risk factors may also have a favourable effect on microvascular complications such as retinopathy and nephropathy. (C)

Treatment and management of cardiovascular disease (CVD) risk

- Target HbA1c is as close to normal as possible without significant hypoglycaemia. (B)
- For patients with diabetes at risk of CVD, diets high in fruits, vegetables, whole grains and nuts may reduce the risk. (C)
- For patients with diabetes and symptomatic heart failure, dietary sodium intake of <2,000mg/day may reduce symptoms. (C)
- In normotensive and hypertensive individuals, a reduced sodium intake (e.g., 2,300mg/day) with a diet high in fruits, vegetables, and low fat dairy products lowers blood pressure. (A)
- In most individuals, a modest amount of weight loss beneficially affects blood pressure. (C)

Hypoglycaemia

- Ingestion of 15-20g glucose is the preferred treatment for hypoglycaemia, although any form of carbohydrate that contains glucose may be used. (A)
- The response to treatment of hypoglycaemia should be apparent in 10-20 minutes; however, plasma glucose should be tested again in ~60 min, as additional treatment may be necessary. (B)

Acute illness

- During acute illnesses, insulin and oral glucose-lowering medications should be continued. (A)
- During acute illnesses, testing of plasma glucose and ketones, drinking adequate amount of fluids, and ingesting carbohydrate are all important. (B)

Remark:

Level of evidence	Description
A	<ol style="list-style-type: none"> <li>1. Clear evidence from well-conducted, generalizable, randomised controlled trials that are adequately powered, including:                             <ul style="list-style-type: none"> <li>- Evidence from a well-conducted multicentre trial</li> <li>- Evidence from a meta-analysis that incorporated quality ratings in the analysis</li> </ul> </li> <li>2. Compelling non-experimental evidence, i.e. the “all or none” rule developed by the Centre for Evidence Based Medicine at Oxford.</li> <li>3. Supportive evidence from well-conducted randomised controlled trials that are adequately powered, including:                             <ul style="list-style-type: none"> <li>- Evidence from a well-conducted trial at one or more institutions</li> <li>- Evidence from a meta-analysis that incorporated quality ratings in the analysis</li> </ul> </li> </ol>
B	<ol style="list-style-type: none"> <li>1. Supportive evidence from well-conducted cohort studies, including:                             <ul style="list-style-type: none"> <li>- Evidence from a well-conducted prospective cohort study or registry</li> <li>- Evidence from a well-conducted meta-analysis of cohort studies</li> </ul> </li> <li>2. Supportive evidence from a well-conducted case-control study</li> </ol>
C	<ol style="list-style-type: none"> <li>1. Supportive evidence from poorly controlled or uncontrolled studies, including:                             <ul style="list-style-type: none"> <li>- Evidence from randomised clinical trials with one or more major or three or more minor methodological flaws that could invalidate the results.</li> <li>- Evidence from observational studies with high potential for bias (such as case series with comparison to historical controls).</li> <li>- Evidence from case series or case reports</li> </ul> </li> </ol> <p>Conflicting evidence with the weight of evidence supporting the recommendation</p>
E	Expert consensus or clinical experience

### 1.2 Carbohydrate Counting and Carbohydrate Exchange

As stated in ADA position statement with Grade A evidence - “Monitoring carbohydrate, whether by carbohydrate counting, exchanges, or experienced-based estimation, remains a key strategy in achieving glycaemic control.” Hence, carbohydrate counting is a useful way for patients with diabetes who are on insulin treatment to match their carbohydrate amount intake to the rapid insulin dosage. People with diabetes are required to learn how to read the food products labelling and count their total amount of carbohydrate intake from each meal based on their daily allowance of total carbohydrate.

Carbohydrate exchange system is an alternative way of

**One Carbohydrate Exchange = 15 grams Carbohydrate**

carbohydrate counting which offers flexibility and variety of food choices for people with diabetes to adjust their insulin dosage especially for those who are on insulin pump. The standard one carbohydrate exchange is equivalent to 15 grams of carbohydrate.

Table 1.5 shows some examples of foods with respective serving portion which contains one carbohydrate exchange (15g carbohydrate)<sup>8</sup>.

Table 1.6 shows is a list of common hawker foods with its calories, amount of carbohydrate and estimated carbohydrate exchange.

**Table 1.5: One Carbohydrate Exchange**

Food Groups	Types of food	Serving portion
<b>Rice and alternatives</b>	Rice (White rice/ Brown rice)	2 heaped tablespoons or 1/3 cup (60g)
	Noodles/ Pasta	1/3 cup
	Breads	1 slice
	Plain crackers	3 pieces
	Thosai	½ piece
	Chapati	1 piece (~20cm diameter)
	Corn flakes	½ cup
	Weetbix	2 rectangular pieces
<b>Fruits and fruit juices</b>	Oatmeal, raw	3 heaped tablespoons
	Whole fruits e.g., apple, orange, pear, banana	1 small size
	Cut fruits e.g., watermelon, papaya, honeydew	1 wedge
	Small fruits e.g., grapes, longan, lychee, rambutan	About ¾ cup
<b>Starchy vegetables</b>	Unsweetened fruit juices	½ cup (125ml)
	Potatoes/ Sweet potato/ Yam/ Tapioca	½ medium size or ½ cup cooked
	Pumpkin	1 cup
<b>Meat and alternatives</b>	Corn cob, medium	½ cob
	Legumes (Lentils, chickpeas)	½ cup
	Baked beans, canned	½ cup
	Unsweetened soy bean milk	1 cup
	Milk	250ml or 1 cup
<b>Fats, oils, salt and sugar</b>	Plain low fat yoghurt	1 small tub
	Sugar	3 teaspoons
	Salt	Nil
	Fats, oils	Nil

Source: Carbohydrate Exchange List [www.diabeteskidsandteens.com.au/pdf/Pump\\_exchange\\_list.pdf](http://www.diabeteskidsandteens.com.au/pdf/Pump_exchange_list.pdf)

**Table 1.6: Carbohydrate Exchange in Hawker Foods**

Food item	Serving size	Per serving Energy (kcal)	Estimated CHO Exchange
Fried meehoon, plain	1 plate	250	3.0
Fried vegetarian meehoon, plain	1 plate	549	5.5
Chee Cheong Fan, plain	1 roll	133	2.0
Porridge, peanut and pork	1 bowl	211	1.5
Roti prata, with onion	1 piece	304	2.0
Nasi lemak	1 packet	494	5.0
Chwee Kway	1 small	56	1.0
Lontong	1 plate	466	3.0
Lor Mai Kai	1 whole	322	4.0
Beef Horfun	1 plate	697	6.0
Chicken rice	1 plate	607	5.0
Char Siew Rice	1 plate	605	4.0
Nasi Briyani	1 plate	619	7.0
Penang fried kway teow	1 plate	510	4.0
Lor mee	1 bowl	383	4.0
Kway Chap	1 portion	703	5.5
Laksa lemak	1 bowl	591	4.0
Mee goreng	1 plate	500	4.0
Mee siam	1 plate	694	6.0
Mee rebus	1 plate	571	5.5

Source: Singapore Food Composition Table 2004, Health Promotion Board.



The following example illustrates the calculation of total carbohydrate daily allowance (assuming 50% of total calories) and the distribution of carbohydrate exchanges based on 1800 kcal requirement:

Total carbohydrate allowance per day = 50% x 1800kcal = 900kcal divided by 4kcal = 225g

Total carbohydrate exchange per day = 225g divided by 15g carbohydrate = 15

Distribution of carbohydrate exchanges per day based on 50% of 1800kcal:

Mealtime	Breakfast	Snack	Lunch	Snack	Dinner	Snack	Total
*CHO Ex.	4	1	4	1	4	1	15

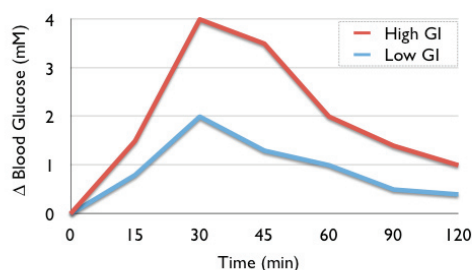
\*CHO Ex. – Carbohydrate exchange

### 1.3 Glycaemic Index (G.I) and Glycaemic Load (G.L)

The Glycaemic Index (G.I) is a measure of the effects of carbohydrate on blood glucose levels. The G.I of a food is defined by the area under the 2 hour blood glucose response curve (AUC) following the ingestion of a fixed portion of carbohydrate (usually 50g). Then, the AUC of the particular test food is divided by the AUC of the standard reference food (either white bread or glucose) with the same amount of 50g carbohydrate and multiplied by 100. The average G.I value of a test food is calculated from data collected in 10 human subjects and the result gives a relative ranking for each test food<sup>9</sup>.

Various studies have shown that low G.I foods produce small fluctuations in blood glucose and insulin levels, and

**Figure 1.2: Blood Glucose Changes in Response to High and Low G.I. Food**



**Table 1.7: Low, Medium and High Glycaemic Index (G.I.) Foods**

Low G.I (Below 55)	Medium G.I (56 to 69)	High G.I (Above 70)
<b>Breads</b> • 100% stone ground whole wheat • Heavy mixed grain	<b>Breads</b> • Whole wheat • Rye • Pita	<b>Breads</b> • White bread • White bagel • Kaiser roll
<b>Cereal</b> • All Bran TM • Bran buds with psyllium • Oatmeal • Oat bran	<b>Cereal</b> • Grapenuts TM • Shredded wheat TM • Quick oats	<b>Cereal</b> • Bran flakes • Corn flakes • Rice Krispies TM • Cheerios TM
<b>Grains</b> • 100% stone ground whole wheat • Heavy mixed grain • Pumpernickel	<b>Grains</b> • Whole wheat • Rye • Pita	<b>Grains</b> • Short grain rice
<b>Other</b> • Sweet potato • Yam • Legumes	<b>Other</b> • Potato, white • Sweet corn • Pop corn • Black bean soup • Green pea soup	<b>Other</b> • Baked potato • French fries • Rice cakes • Soda crackers

Source: Adopted from International Table of Glycemic Index and Glycemic Load values. Am J Clin Nutr. 2002;76: 5-76

hence lower glycaemic response which are beneficial for people with diabetes to improve their glycaemic control after ingestion of low G.I foods. The following are some benefits of low G.I foods<sup>10</sup>:

- Help people to lose and control weight.
- Increase the body's sensitivity to insulin.
- Improve diabetes control by slowing down the absorption rate of blood glucose.
- Reduce the risk of heart disease.
- Reduce blood cholesterol level.
- Help to manage symptoms of polycystic ovary syndrome (PCOS).
- Reduce hunger and keep you fuller for a longer period.
- Prolong physical endurance.

The classifications of G.I value of certain foods are divided into three ranges as shown in Table 1.7<sup>11</sup>: High G.I – Above 70; Medium G.I – 56 to 69; Low G.I – Below 55:

However, various factors can affect the G.I value of a particular food as well such as:

- Form and structure of carbohydrate.
- Texture of foods – size, ripeness, softness, viscosity.
- Food processing – duration of process, temperature, pressure.
- Nutrient content of the food – protein, fat, fibre.
- Ingestion of a mixed diet versus single food component.
- Species of foods.

Hence, low G.I foods should be used as a complementary therapy as part of healthy eating for people with diabetes to improve their glycaemic control.

The Glycaemic Load (G.L) is defined as a function of a food's glycaemic index (G.I) and its total available carbohydrate content. Therefore,  $G.L = G.I \times \text{Total carbohydrate (g)}$ . Example using apple: The G.I of apple = 0.38 and its carbohydrate content = 15g, therefore the G.L of one apple =  $0.38 \times 15 = 6$ ; whereas G.L of two apples =  $0.38 \times 6 \times 2 = 12$ . The G.L of a meal can be lowered by: (i) choosing a lower G.I foods, (ii) reduce carbohydrate amount or; (iii) both ways.

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**1.4 Sweeteners**

Generally, there are three categories of sweeteners as shown in Table 1.8. Artificial sweeteners are sugar substitutes for people with diabetes who require sweetness for their beverages, desserts and pastries. At present, only 5 categories of artificial sweeteners are approved by United States Food and Drug Administration (USFDA)<sup>12</sup> which are safe for human consumption in moderation. However, there is no evidence to show that consumption or usage of artificial sweeteners in long term will lead to weight loss or improved glycaemic control for people with diabetes.

**1.5 Common food myths for people with diabetes**

**Myth #1: People with diabetes should consume little amount of starchy foods such as rice, noodles, bread as these foods raise blood sugar level.**

Fact #1: Starchy foods such as rice, noodles and bread are the main source of carbohydrate which is used as the first fuel for the body. There is no evidence to show that people with diabetes should consume little amount of these starchy foods

**Table 1.8: Sweeteners**

Nutritive (4kcal/g)	Low calories (2kcal/g)	Artificial sweeteners
• Glucose	• Sugar alcohols:	• Saccharin (Sweet n Low ®)
• Dextrose	- Mannitol	• Aspartame (Equal ®)
• Maltose	- Sorbitol	• Acesulfame K (Sunette ®)
• Sucrose	- Xylitol	• Sucralose (Splenda ®)
• Fructose	- Isomalt	• Neotame
• Lactose	- Maltitol	

to improve blood sugar control. By doing so, this will tend to predispose the risk of low blood sugar level especially for those who are on insulin regimen. Indeed, they should be conscious with the amount of starchy foods (total carbohydrate) intake for each meal. The recommended intake of starchy foods is 5 to 7 servings daily.

**Myth #2: People with diabetes should avoid eating fruits with sweet taste.**

Fact #2: Fruits are rich in fibre, vitamins, minerals and antioxidants which are beneficial to health and prevent the risk of cardiovascular disease. People with diabetes should consume variety of fruits but in moderation; regardless sweet or sour taste because all fruits contain fructose (fruit sugar). The recommended intake of fruits is 2 servings daily and a serving at a time for people with diabetes. A serving of fruit can also be a healthy snack option to replace unhealthy options such as potato chips, ice cream or chocolate which are high fat and sugar content.

**Myth #3: People with diabetes should only consume special “diabetic foods”.**

Fact #3: “Diabetic foods” or foods which are “suitable for diabetics” tend to be lower in carbohydrate content and replaced with higher fat content which in turn it does not make a significant difference in terms of calories content compared to the conventional food products. Therefore, “diabetic” foods can only be an option but not a necessity for people with diabetes. People with diabetes need not to rely only on “diabetic foods” to improve their blood sugar control.

**Myth #4: People with diabetes should consume a different diet from the rest of family members.**

Fact #4: There is no special diet or so called “diabetic” diet for people with diabetes. Current scientific evidence shows that people with diabetes should eat a similar diet as their family members provided all having a healthy dietary pattern which is low in fat especially low in saturated fats, low in salt, low in sugar, and rich in fibre.

**Myth #5: People with diabetes should consume a high protein diet to control blood sugar level.**

Fact #5: People with diabetes who consume a high protein diet especially from animal source such as meat, fish and poultry may end up having a higher amount of total calories intake because animal protein are naturally higher in fat content and due to the usual high fat cooking method for meat dish. This may lead to further weight gain along with increased insulin resistance which result in poorly controlled diabetes. Hence, people with diabetes need not to consume a high protein diet. The recommended intake of protein foods per day is 2 to 3 servings.

2.0 HYPERTENSION

2.1 Medical nutrition therapy guidelines

Hypertension is an important risk factor of coronary heart disease and cerebrovascular disease, in which together accounted for 29% of total deaths in Singapore year 2004. Based on National Health Survey 2004, the prevalence of hypertension among adult population aged 30 to 60 years old in Singapore is 24.9% (1 in 4 persons); in which it is more common among males (29.5%) than females (20.4%). Among the ethnic groups, Chinese has the highest prevalence of hypertension (25.6%), followed by the Malays (22.7%) and Indians (21.6%)<sup>13</sup>. Table 2.1 shows the prevalence of hypertension according to ethnic groups for each gender.

**Table 2.1: Prevalence of Hypertension by Ethnic Group and Gender**

Prevalence %	Males	Females	Average
Normal	70.5	79.6	75.1
Hypertension	29.5	20.4	24.9
Chinese	31.1	20.2	25.6
Malay	21.8	23.5	22.7
Indian	25.5	17.3	21.6

According to the Clinical Practice Guidelines for Hypertension published by MOH in 2005<sup>14</sup>, management of hypertension through lifestyle modifications and non-pharmacological therapy should be instituted wherever appropriate in ALL hypertensive individuals. These modifications include:

- Smoking cessation.
- Weight reduction.
- Moderation of alcohol consumption (for those who drink).
- Reduction intake of salt.
- Reduction of intake of cholesterol and saturated fats.
- Maintenance of adequate intake of dietary potassium.
- Increased physical activity.

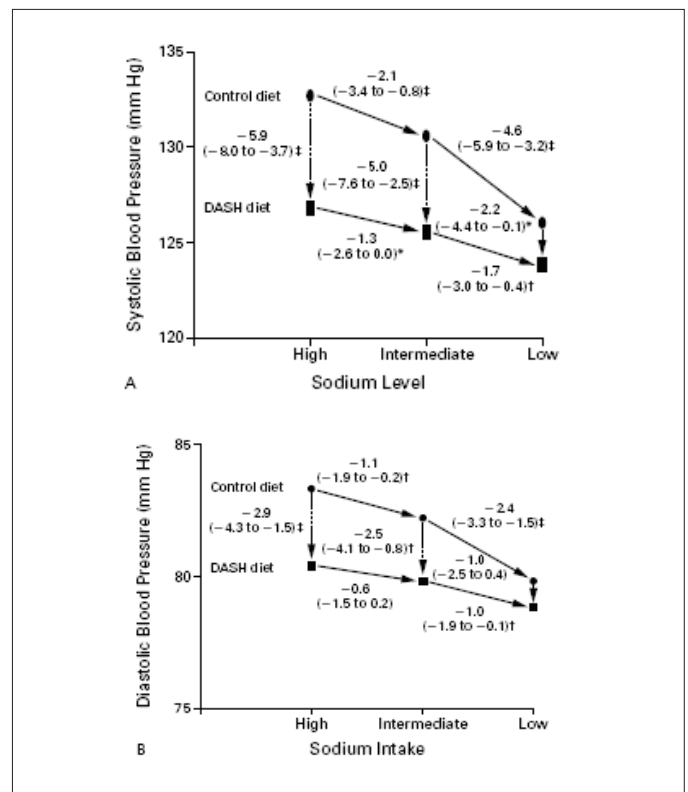
The scientific statement on Dietary Approaches to Prevent and Treat Hypertension from American Heart Association (AHA) published in Hypertension 2006<sup>15</sup> supports the concept that there are multiple dietary factors affect blood pressure of an individual. Well established dietary modifications and its recommendations that lower blood pressure are summarized in Table 2.2.

2.2 Dietary Approaches to Stop Hypertension (DASH) Diet

There was a landmark DASH study<sup>16</sup> done in the United States with recruitment of 412 subjects with stage 1 hypertension who were randomly assigned either to a control group to consume a typical American diet or to a DASH group to consume a DASH diet; and followed each type of diet at 3 different levels of sodium (high, intermediate and low) for an intervention period of 30 days in a crossover design.

The results from this study showed that subjects who consumed a DASH diet tend to have a lower blood pressure readings compared to those subjects who consumed the typical American diet at the same sodium level intake. Moreover, by reducing sodium intake from high to low level had led to reduction of blood pressure readings for both types of diet. Hence, by combining DASH diet with low sodium level intake to even greater reduction of blood pressure readings for both systolic and diastolic pressures. The results are summarised in the following Figure 2.1:

**Figure 2.1: Sodium and Blood Pressure**



**Table 2.2: Recommended Lifestyle Modifications That Lower Blood Pressure**

Lifestyle modification	Recommendation
Weight loss	For overweight or obese persons, lose weight, ideally attaining a BMI <25kg/m <sup>2</sup> ; for non-overweight persons, maintain desirable BMI <25kg/m <sup>2</sup> .
Reduced salt intake	Lower salt (sodium chloride) intake as much as possible, ideally to ~65mmol/d sodium (corresponding to 1.5g/day of sodium or 3.8g/day sodium chloride)
DASH-type dietary patterns	Consume a diet rich in fruits and vegetables (8 to 10 servings/ day), rich in low fat dairy products (2 to 3 servings/day) and reduced in saturated fats and cholesterol.
Increased potassium intake	Increase potassium intake to 120mmol/day (4.7g/day), which is also the level provided in DASH-type diets
Moderation of alcohol intake	For those who drink alcohol, consume <2 alcoholic drinks/day (men) and <1 alcoholic drink/day (women).



A DASH dietary pattern is a diet rich in fruits, vegetables, low fat dairy products; and includes wholegrains, poultry, fish and nuts; and contains less amounts of red meat, sweets and sugar-containing beverages. Hence, the DASH diet emphasize on the following nutrients:

- Low in fat, especially low in saturated fats
- Low in cholesterol
- Moderate protein
- High in fibre
- High in calcium, magnesium and potassium.

Table 2.3 shows the food sources based on the key nutrients of a DASH diet. Daily nutrient goals for a 2,100kcal eating plan<sup>17</sup> used in DASH study are shown in Table 2.4. According to National Heart, Lung, and Blood Institute (NHLBI), when the nutrient goals translated to food based, the recommended serving sizes of each food group for a 2,000kcal DASH eating plan<sup>17</sup> are shown in Table 2.5.

### 2.3 Sources of Sodium

It has been well known that reduction of sodium intake from diet helps to lower blood pressure especially for individuals with hypertension, the daily recommendation of sodium intake established by Singapore Health Promotion Board (HPB) is less than 2,000mg per day which is equivalent to less than one teaspoon of salt intake per day.

Based on the survey published by HPB in 2004<sup>18</sup>, the average daily intake of sodium among Singaporeans was about 3,500mg/day and the source of sodium in Singapore diet mainly comes from cooked food 82%, followed by processed food 17% and fresh food 1%. Other than table salt as the main source of sodium, there are other sources of sodium found in seasonings, processed food and some common local dishes<sup>7</sup> as shown in Table 2.6.

**Table 2.3: Key Nutrients of a DASH Diet**

DASH Diet	Food Sources
<b>Low in fat, especially saturated fats</b>	<ul style="list-style-type: none"> <li>• Lean and skinless meat and poultry.</li> <li>• Low-fat dairy products</li> <li>• Bean and bean products such as tofu, soybean milk, tempeh and lentils.</li> <li>• Food products with minimal amount of palm oil or coconut milk.</li> </ul>
<b>Low in cholesterol</b>	<ul style="list-style-type: none"> <li>• Plant products such as fruits, vegetables and bean products.</li> <li>• Lean meat.</li> <li>• Egg white.</li> </ul>
<b>Moderate in protein</b>	<ul style="list-style-type: none"> <li>• Lean and skinless meat and poultry.</li> <li>• Fish and seafood</li> <li>• Bean and bean products</li> <li>• Low-fat dairy products</li> <li>• Various kinds of nuts</li> </ul>
<b>High in potassium and magnesium</b>	<ul style="list-style-type: none"> <li>• All kinds of fruits and vegetables</li> </ul>
<b>High in calcium</b>	<ul style="list-style-type: none"> <li>• Low-fat dairy products</li> <li>• Soy bean products such as calcium fortified soy bean milk, beancurd.</li> <li>• Sardine fish, anchovies</li> </ul>
<b>High in fibre</b>	<ul style="list-style-type: none"> <li>• All fruits and vegetables</li> <li>• Legumes such as red beans, green beans,</li> <li>• Oats, oat bran</li> <li>• Wholegrain products such as wholemeal bread.</li> </ul>

**Table 2.4: A 2,100kcal DASH Eating Plan**

Nutrient	Daily goal	Nutrient	Daily goal
Total fat	27% of total calories	*Sodium	2,300mg
Saturated fat	6% of total calories	Potassium	4,700mg
Protein	18% of total calories	Calcium	1,250mg
Carbohydrate	55% of total calories	Magnesium	500mg
Cholesterol	150mg	Fibre	30g

\* 1,500mg sodium was shown to further lower blood pressure when combined with DASH.

**Table 2.5: A 2,100kcal DASH Eating Plan**

Food group	Recommended servings	Definition of one serving
Grains	6 to 8 daily	1 slice of bread 1 oz dry cereal ½ cup cooked rice, pasta or cereal
Vegetables	4 to 5 daily	1 cup raw vegetable ½ cup cut-up raw or cooked vegetable ½ cup vegetable juice
Fruits	4 to 5 daily	1 medium fruit ½ cup dried fruit ½ cup fresh, frozen or canned fruit ½ cup fruit juice
Fat free or low fat dairy products	2 to 3 daily	1 cup milk or yoghurt 1½ oz cheese
Lean meats, poultry and fish	6 or less daily	1 oz cooked meats, poultry or fish 1 egg
Nuts, seeds and legumes	4 to 5 weekly	1/3 cup or 1½ oz nuts 2 tbsp or ½ oz seeds ½ cup cooked legumes (dry beans and peas)
Fats and oils	2 to 3 daily	1 tsp soft margarine 1 tsp vegetable oil 1 tbsp mayonnaise 2 tbsp salad dressing
Sweets and added sugars	5 or less weekly	1 tbsp sugar 1 tbsp jelly or jam ½ cup sorbet, gelatine 1 cup lemonade


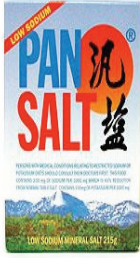

**Table 2.6: Sodium Content of Common Foods**

Food category	Food item	Quantity	Sodium content (mg)
Seasonings	Salt	1 tsp	2,000
	Stock cube	1 tsp	920
	Salt substitute	1 tsp	865
	Monosodium Glutamate (MSG)	1 tsp	615
	Light soya sauce	1 tsp	365
	Reduced-salt soya sauce	1 tsp	185
	Dark soya sauce	1 tsp	200
	Chilli sauce	1 tsp	60
	Tomato sauce	1 tsp	50
	Processed	Chicken curry, canned	1 can
Salted egg		1 medium	350
French fries		1 regular serving	200
Potato crisps		1 packet	180
Carbonated soft drink		1 can	40
Local dishes	Mee goreng	1 plate	1,800
	Nasi briyani with chicken	1 plate	1,660
	Dry fishball noodles	1 bowl	1,650
	Fried Kway Teow	1 plate	1,460
	Chicken rice	1 plate	1,290

### 2.4 Salt substitutes

There are two widely used commercial salt substitutes known as Pansalt<sup>®19</sup> and LoSalt<sup>®20</sup> with reduced sodium content compared to normal salt but taste like normal salt. Both have shown some benefits in blood pressure control for individuals with hypertension. However, both should be used sparingly. Since their sodium content is lower and replaced with higher content of potassium, hence these salt substitutes are not suitable for patients with renal impairment, high serum potassium level or those with cardiac arrhythmia. Table 2.7 shows the comparison of sodium content between normal table salt, Pansalt<sup>®</sup> and LoSalt<sup>®</sup>.

**Table 2.7: Sodium Content of Table Salt and Salt Substitutes**

Table Salt	PanSalt <sup>®</sup>	LoSalt <sup>®</sup>
		
Sodium Content		
98 to 100% NaCl	56% NaCl; 28%KCl	66% less sodium

## 3.0 HYPERLIPIDAEMIA

### 3.1 Medical Nutrition Therapy Guidelines

Coronary heart disease remains the second leading cause of death in Singapore according to National Health Survey 2004 and hyperlipidaemia, particularly high LDL-cholesterol level is a major risk factor of coronary heart disease<sup>21</sup>. NHS 2004 showed that the prevalence of high LDL-cholesterol among Singapore residents aged 18 to 69 years was 19.8%; in which male (22.4%) had a higher prevalence than females (17.3%). Among the ethnic groups, the prevalence was highest in Malays (24.4%), followed by Indians (22.6%) and Chinese (18.8%)<sup>21</sup>. Prevalence of high LDL-cholesterol rose sharply with age in both genders. The survey also showed that females tended to have a lower prevalence of high LDL-cholesterol than males in age groups between 18 and 49 years old but the trend was reversed in those females above 50 years old mainly due to menopause as one of the contributing factors<sup>21</sup>. Table 3.1 shows the prevalence of high LDL-cholesterol among Singapore residents aged 18 to 69 years by genders and ethnic groups<sup>21</sup>.

**Table 3.1: Prevalence of High LDL-Cholesterol Among Singapore Residents**

Prevalence %	Males	Females	Average
Chinese	20.9	16.8	18.8
Malay	29.6	19.2	24.4
Indian	25.8	19.3	22.6

According to the Clinical Practice Guidelines for Lipids published by MOH in 2006<sup>22</sup>, medical nutrition therapy for hyperlipidaemia (especially high LDL-cholesterol) emphasizes intake of fruits, vegetables, grains, cereals as well as skinless, poultry, fish, lean meats and low fat dairy products. For individuals with hypertriglyceridaemia, in addition to the above measures, it is important to restrict the intake of simple carbohydrates such as glucose and alcohol. Table 3.2 below shows the nutrition recommendations for hyperlipidaemia.

Nutrition recommendations as stated in Therapeutic Lifestyle Changes (TLC) for hyperlipidaemia published in Adult Treatment Panel (ATP) III by National Cholesterol Education Programme (NCEP)<sup>23</sup> is summarized in the follow Table 3.3 below; in which these recommendations were adopted by Singapore CPG for Lipids 2006.

Comparison of nutrition recommendations for NCEP TLC diet and Singapore CPG for Lipids is shown in Table 3.4.

Alternatively, evidence-based best practice guideline for the assessment and management of cardiovascular risk developed by New Zealand Guidelines Group (NZGG)<sup>24</sup> in 2003 advocates cardio-protective dietary patterns by using a food-based approach as summarized in Table 3.5.

**Table 3.2: Nutrition Recommendations for Hyperlipidemia**

Nutrient	Recommended daily intake
Total fat	20% to 30% of total calories
Saturated fat	Less than 7% of total calories
Trans fat	Less than 1% of total calories
Polyunsaturated fat	6% to 10% of total calories
Monounsaturated fat	Up to 10% of total calories
Carbohydrate	50% to 60% of total calories (mainly from complex carbohydrate)
Protein	About 15% of total calories
Dietary fibre	20 to 30g daily
Fruits and vegetables	2 + 2 servings daily (>400g/day)
Cholesterol	Less than 200mg daily
Total calories	Balance energy intake and expenditure to maintain desirable weight or prevent weight gain.

**Table 3.3: Therapeutic Lifestyle Change (TLC) for Hyperlipidemia**

Nutrient	Recommended daily intake
Total fat	Less than 30% of total calories
Saturated fat	Less than 7% of total calories
Trans fat	Recommendation is not established yet but must be kept at minimal level.
Polyunsaturated fat	Up to 10% of total calories
Monounsaturated fat	Up to 10% of total calories
Carbohydrate	50% to 60% of total calories
- Sucrose	Up to 10% of total calories
Protein	About 15% of total calories
Dietary fibre	20 to 30g daily
- Soluble fibre	2 to 10g daily
Plant sterol	2 to 3g daily
Cholesterol	Less than 200mg daily
Total calories	Balance energy intake and expenditure to maintain desirable weight or prevent weight gain.

**Table 3.4: NCEP TLC Diet and Singapore CPG for Lipids Diet Compared**

Nutrient	Recommended daily intake	
	NCEP ATP III TLC Diet	Singapore CPG for Lipids
Total fat	Less than 30% of total calories	20% to 30% of total calories
Saturated fat	Less than 7% of total calories	Less than 7% of total calories
Trans fat	Recommendation is not established yet but must be kept at minimal level.	Less than 1% of total calories
Polyunsaturated fat	Up to 10% of total calories	6% to 10% of total calories
Monounsaturated fat	Up to 10% of total calories	Up to 10% of total calories
Carbohydrate - Sucrose	50% to 60% of total calories Up to 10% of total calories	50% to 60% of total calories (complex carbohydrate)
Protein	About 15% of total calories	About 15% of total calories
Dietary fibre - Soluble fibre	20 to 30g daily 2 to 10g daily	20 to 30g daily Nil
Fruits and vegetables	NA	2 + 2 servings daily (>400g/day)
Plant sterol Cholesterol	2 to 3g daily Less than 200mg daily	NA Less than 200mg daily
Total calories	Balance energy intake and expenditure to maintain desirable weight or prevent weight gain.	Balance energy intake and expenditure to maintain desirable weight or prevent weight gain.

**Table 3.5: Cardio-Protective Food-Based Approach**

Food Group	Recommended servings	Examples of one serving
Vegetables	At least 3 to 4 daily	½ cup cooked vegetables 1 cup raw green vegetable or salad 1 tomato or small carrot
Fruits	At least 3 to 4 daily	1 medium apple, pear, orange, nectarine, small banana ½ cup stewed, frozen or canned fruit in natural or 'lite' juice 2 to 3 small apricots or plums 10 to 15 grapes, cherries, strawberries 1 cup of other berries 3 prunes, dates or figs 1 tbsp raisins, sultanas 6 to 8 halves of dried apricots 180ml 100% fruit juice
Breads, cereals and grains and starchy vegetables	At least 6 daily	1 medium slice of whole grain bread or ½ bread roll 30g of other breads such as pita, naan, corn tortilla, wraps ½ cup bran cereal or 2/3 cup wheat cereal or ½ cup cooked porridge or 1/3 cup muesli or 3 crispbreads ½ cup cooked pasta or 1/3 cup cooked rice 1 small potato ½ kumara 1/3 cup yams ½ cup corn ½ parsnip 1 small round of taro

**MEDICAL NUTRITION THERAPY FOR CHRONIC DISEASES**

Low fat dairy products	At least 2 to 3 daily	<p>1 glass (250ml) trim or low fat milk</p> <p>1 pottle low fat yoghurt</p> <p>1/3 cup cottage cheese</p> <p>½ cup low fat cottage cheese</p> <p>¼ cup quark or ricotta</p> <p>2 tbsp parmesan cheese or 3 tbsp grated cheddar cheese</p> <p>2 cm cube cheddar cheese</p> <p>3 cm cube standard camembert, brie, edam, feta, mozzarella</p>
Fish, seafood	1 to 2 weekly	<p>2 small, 1 large fillet of cooked fish</p> <p>½ cup tuna</p> <p>1 cup mussels</p> <p>1/3 cup salmon or ½ can sardines</p>
Dried peas, beans, soy products (legumes)	4 to 5 weekly	<p>1 cup cooked dried beans, chickpeas, lentils, dhal</p> <p>½ cup tofu or tempeh</p> <p>1 glass (250ml) fortified soy milk</p>
Skinned chicken, very lean meats	Limit 1 to 1.5 daily	<p>2 slices trimmed meat or chicken (100 to 120g)</p> <p>½ cup lean mince or casserole (125g)</p> <p>1 small lean steak (100g)</p> <p>1 small chicken breast (120g)</p> <p>2 small drumsticks or 1 leg, skinned</p>
Eggs	3 eggs weekly	1 egg
Liquid oils, unsaturated margarines and spreads (including plant-sterol fortified spreads), or avocado	3 or more daily	<p>1 tsp soft table margarine or oil</p> <p>2 tsp light margarine (50% to 60% fat)</p> <p>2 tsp mayonnaise or vinaigrette (50% to 60% fat)</p> <p>3 tbsp reduced-fat mayonnaise or dressing (10% fat or less)</p> <p>1 tbsp avocado</p>
Nuts, seeds	Up to 30g daily	<p>1 dsp nuts or pumpkin seeds</p> <p>1 dsp peanut butter</p> <p>1 tbsp sunflower or sesame seeds</p>
Confectionary and added sugar	Up to 1 for those on weight control, with DM, with high triglycerides; up to 3 for those who are lean and active, normal triglycerides and no DM	<p>1 tbsp sugar, jam, syrup or honey</p> <p>2 tbsp all-fruit jam spreads</p> <p>6 jet planes</p> <p>180ml fruit juice or soft drink</p> <p>Small cup reduced fat ice-cream or frozen yoghurt</p> <p>2 fruit slice biscuits</p>
Added salt	Limit to 1 daily	<p>1 tsp seasoning paste</p> <p>1/6 stock cube</p> <p>1/8 tsp stock powder</p> <p>1/3 tsp gravy mix</p> <p>1 tbsp liquid seasoning</p>
High salt foods	Limit to less than 4 daily	<p>30g lean ham or pastrami</p> <p>1 tbsp pickles</p> <p>1 tsp marmite or vegemite</p> <p>1 tsp soy sauce</p> <p>20 to 30g cheese</p> <p>½ cup canned/ packet soup</p> <p>50g canned or smoked salmon or tuna</p> <p>30g other smoked fish or sardines</p>
Alcoholic drinks (for those who drink)	Limit to 3 drinks for men and 2 drinks for women	<p>1 glass (300ml) ordinary strength beer</p> <p>1 glass (60ml) fortified wine (sherry, martini, port)</p> <p>1 pub measure (30ml) spirits (whisky, gin, vodka)</p> <p>1 glass (100ml) of table wine</p>
Non-alcoholic drinks	6 to 8 drinks daily	<p>1 glass (250ml) water</p> <p>1 cup (180ml) "diet" soft drink</p> <p>1 glass (250ml) trim or low fat milk</p> <p>1 cup tea, coffee or cocoa</p> <p>1 cup (180ml) vegetable juices</p>

### 3.2 Dietary fat

Dietary fat is a calorie-dense nutrient (9kcal/g) which comprise of a group of fatty acids having a chemical structure of carbon chain bonded with hydrogen atoms. Dietary fat has the following main functions to our body:

1. Main energy storage in our body.
2. Helps in transportation and absorption of fat soluble vitamins A, D, E and K.
3. Maintain the structural and functional integrity of all cell membranes.
4. Essential nutrient for growth and development for infants and children.
5. A source of essential fatty acids such as omega-3 and omega-6 which cannot be produced in our body and must be obtained from foods.
6. Fat deposits act as cushion for body organs as well as insulation to regulate body temperature.

Generally, there are four different types of dietary fats as follows:

#### (i) Saturated fat

Saturated fat consists of a group of fatty acids with no double bond in its carbon chain and has the maximum number of hydrogen atoms attached to its carbon chain, hence its smoking point is higher compared to unsaturated fats (mono- and poly) and it remains in solid form under room as well as chilled temperatures. Examples are lauric acid (C12:0), myristic acid (C14:0), palmitic acid (C16:0) and stearic acid (C18:0).

#### (ii) Trans fat

Trans fat or known as hydrogenated fat which is formed from unsaturated fats by adding hydrogen atoms to transform its structure from cis- to trans-form through a process called hydrogenation. It has a lower smoking point compared to saturated fat due to its double bonds attached to carbon chain and it remains liquid under room temperature and solid or liquid under chilled temperature. Example is trans-oleic acid (elaidic acid).

#### (iii) Monounsaturated fat

Monounsaturated fat makes up of a group of fatty acids with one double bond in its chain, its smoking point is lower than saturated fat but higher than polyunsaturated fat. It is solid under chilled temperature but in liquid form under room temperature. Example: oleic acid (C18:1).

#### (iv) Polyunsaturated fat

Polyunsaturated fat is a group of fatty acids with more than one double bonds attached to its carbon chain. Polyunsaturated fat has the lowest smoking point and remains liquid under room and chilled temperature.

Table 3.6 is a summary of different types of fatty acids, their respective structure, example and food source.

**Table 3.6: Characteristics of Fatty Acids**

Characteristic	Saturated fat	Trans fat	Monounsaturated fat	Polyunsaturated fat
Double bond	Nil	One or more than one	One	More than one
Room temperature	Solid	Liquid	Liquid	Liquid
Chilled temperature	Solid	Solid or liquid	Solid	Liquid
Structure	$\begin{array}{c} \text{H} \quad \text{H} \\   \quad   \\ -\text{C} - \text{C}- \\   \quad   \\ \text{H} \quad \text{H} \end{array}$	$\begin{array}{c} \text{H} \\   \\ -\text{C} = \text{C}- \\   \\ \text{H} \end{array}$	$\begin{array}{c} \text{H} \quad \text{H} \\   \quad   \\ -\text{C} = \text{C}- \end{array}$	$\begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\   \quad   \quad   \quad   \quad   \\ -\text{C} = \text{C} - \text{C} - \text{C} = \text{C}- \\   \\ \text{H} \end{array}$
Example of fatty acids	Lauric (C12:0) Myristic (C14:0) Palmitic (C16:0) Stearic (C18:0) Arachidic (C20:0)	Elaidic (trans- oleic)	Oleic (C18:0)	Linoleic (C18:2) Linolenic (C18:3) EPA (C20:5w3) DPA (C22:5w3) DHA (C22:6w3)
Effect on Lipid Profile	Raise total cholesterol and LDL cholesterol levels.	Raise LDL-cholesterol level and lower HDL-cholesterol level.	Lower total cholesterol and LDL cholesterol levels. Raise HDL cholesterol level.	Omega 3: Lower risk of heart disease by reducing triglycerides level and blood clotting. Omega 6: Lower total and LDL cholesterol levels.
Major food source	Animal: Animal fats, fatty meat, poultry skin, ghee, lard, beef tallow, full cream dairy products.	Animal: Minimal amount found in ruminant animals	Animal: Nil	Animal: Omega 3: Marine fish: Salmon, sardine, mackerel. Omega 6: Nil
	Plant: Coconut oil, coconut milk, palm oil, and products made with coconut milk such as egg jam (kaya) and kueh; products made with palm oil such as condensed milk and non-dairy creamer.	Plant: Hydrogenated margarine, vegetable shortenings, cakes, pastries, French fries, biscuits, cookies.	Plant: Vegetable oils: Canola oil, 100% peanut oil, olive oil. Most nuts: Peanuts, almond nuts, cashew nuts and hazelnuts. Avocados	Plant: Omega 3: Vegetable oils: Soy bean oil, canola oil. Walnuts. Food products fortified with omega 3. Omega 6: Vegetable oils: Soy bean oil, sunflower oil, corn oil. Seeds: sunflower seeds, sesame seeds



### 3.3 Special concerns on Trans Fat

Trans fat is formed from a process known as hydrogenation, in which hydrogen atoms are added during the process under high temperature and high pressure to convert liquid oil to solid fat. The purpose of hydrogenation is to increase the shelf life of products which are rich in unsaturated fats and increase the melting point of cooking oil which can sustain high temperature and suitable for deep frying.

However, trans fat becomes a public concern in recent years as it was shown to raise LDL-cholesterol and meanwhile to lower HDL-cholesterol levels; which in turn further increase the risk of cardiovascular disease<sup>25</sup>. Hence, World Health Organisation (WHO) recommended daily intake of trans fat should be less than 1.0% or less than 2g per day from a 2000kcal diet<sup>26</sup>.

In the United States, the average daily intake of trans fat among American adults is about 5.8g or 2.6% of total calories; and the major sources of trans fat are bakery products, pastries, cookies, animal products and margarine<sup>27</sup>. Starting from 1st of January 2006, food manufacturers in the United States are required by USFDA to list the amount of trans fat in nutrition label of their food products, but they are not banned from using trans fat in their food products<sup>28</sup>.

On the other hand, in Singapore, the average daily intake of trans fat among Singapore residents is about 1.0% of total calories intake which is lower than American's intake; and the major sources are biscuits (38%), bakery products (26%), commercial fast foods (23%) and hydrogenated margarine (3.0%)<sup>18</sup>. According to National Nutrition Survey 2004 published by Health Promotion Board, there was about 17% of Singapore residents exceeded the recommended intake<sup>18</sup>.

So far there is no legislation established in Singapore to

mandate trans fat labeling because the trans fat intake among majority of Singapore population is well within the WHO's recommended intake of 1.0% of daily calories. Health Promotion Board (HPB) has been actively engaging food manufacturers to voluntarily list the trans fat content in their food products, working with food ingredient suppliers to develop reduced fat shortenings used in bakery products and also working closely with Agri-Food and Veterinary Authority of Singapore (AVA) to develop guideline for appropriate nutrition claims to be made on food products containing negligible or no trans fat<sup>29</sup>.

In view of 84% of Singapore residents who have excess intake of saturated fat, we should be more concerned with limiting saturated fat intake. However, both saturated fat as well as trans fat increase LDL cholesterol, hence it is recommended to reduce daily intake for both types of 'bad' fats.

### 3.3 Soluble fibre

Numerous studies<sup>30,31,32,33</sup> have shown that soluble fibre lowers LDL-cholesterol level and it increases the effectiveness of dietary management of hyperlipidaemia with the combination of lipid lowering drugs. The overall mechanisms of soluble fibre in lowering LDL-cholesterol level remain undefined. Some proposed mechanisms are as follows<sup>32</sup>:

1. Some soluble fibres bind bile acids or cholesterol during the intraluminal formation of micelles. The resulting reduction in the cholesterol content of liver cells leads to up-regulation of the LDL receptor and thus increased clearance of LDL-cholesterol.
2. Inhibition of hepatic fatty acid synthesis by products of fermentation.
3. Its viscosity interferes with bile acid absorption from the ileum; in response, LDL-cholesterol is removed from the blood and converted into bile acids by the liver to replace the bile acids lost in the pool.
4. Changes in the composition of the bile acid pool accompanying ingestion of some viscous fibres dampen cholesterol synthesis.
5. Slowing synthesis, as do the 'statin' drugs, could have favorable impact on blood cholesterol concentrations.
6. Binds and increases bile acid loss.
7. Alters lipoprotein synthesis.

In 2002, US Food and Drug Administration (USFDA) has approved the dosage of soluble fibre intake to be 8g daily for any health products which claim to reduce cardiovascular risk<sup>34</sup>. Hence, the recommended intake of soluble fibre by NCEP ATP III TLC diet is 2 to 10g daily in the management of hyperlipidaemia.

Food sources which are rich in soluble fibre are normally obtained from plant origin including variety of fruits and vegetables, oatmeal, oat bran, legumes such as dhal, lentils, red beans, green beans, and peas; barley, psyllium husk. The following Table 3.7 shows the soluble content of some plant foods.

**Table 3.7: Soluble Fibre Content of Plant Foods**

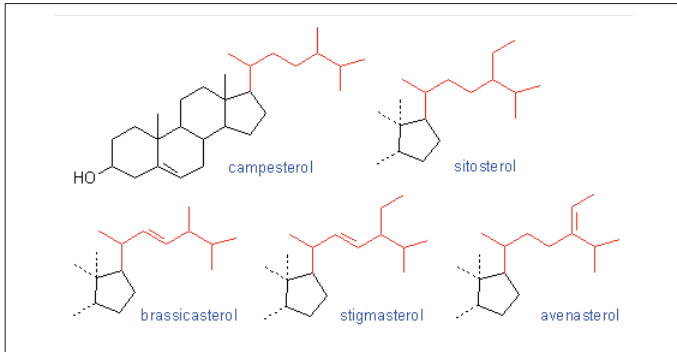
Food category	Food item	Portion size	Soluble fibre (g)
Fruits (Raw)	Apple	1 medium	1.2
	Orange	1 medium	1.8
	Grapefruit	½ medium	1.1
	Grapes	1 cup	0.3
	Prunes	6 medium	3.0
Vegetables (Cooked)	Brussel sprouts	½ cup	2.0
	Broccoli	½ cup	1.1
	Spinach	½ cup	0.5
	Zucchini	½ cup	0.2
Grains	Oatmeal (dry)	1/3 cup	1.3
	Oat bran (dry)	1/3 cup	2.0
	Cornflakes	1 ounce	0.1
	Brown rice (cooked)	½ cup	0.4
	Whole wheat bread	1 slice	0.4
	White bread	1 slice	0.2
Legumes	Kidney beans	½ cup	2.0
	Pinto beans	½ cup	2.0

Source: Mahan, L.K & Escott-Stump, S (Eds). (2000). Krause's food, nutrition and diet therapy (10th ed).

### 3.4 Plant sterol

Plant sterols or known as ‘plant cholesterol’ are found in all foods of plant origin. They have a chemical structure which is similar to that of cholesterol but contain one or two methyl or ethyl groups in the molecule’s side chain as shown in Figure 3.1 below.

**Figure 3.1: Chemical Structure of Plant Sterols**



These sterols in plants function as structural components of the cell membrane, in which they influence the permeability and fluid exchange in the cell.

Plant sterols in foods compete with cholesterol absorption in the intestines, mainly during the building of micelles by reducing the solubility of cholesterol. Despite increased endogenous cholesterol synthesis, the concentration of serum cholesterol is reduced due to a concurrent increase in LDL receptor synthesis, which occurs in response to the decreased intestinal cholesterol absorption. Plant sterols reduce serum cholesterol even if there is no cholesterol in the diet, since the uptake of both endogenous cholesterol from the bile and exogenous cholesterol from the diet are inhibited<sup>35</sup>.

Plant sterols affect LDL cholesterol but not HDL cholesterol or triglycerides levels<sup>36</sup>. According to a recent meta-analysis of 41 studies, the addition of 2g of plant sterols intake per day (which is equivalent to 25g of plant sterol enriched margarine) reduces LDL cholesterol by 10%. The effect levels not with higher doses of more than 3g daily<sup>37</sup>. There were no side effects reported from a 1-year study of 100 subjects consuming 1.8 to 2.6g of plant sterol daily<sup>38</sup>. Hence, NCEP TLC Diet

recommended 2 to 3g of plant sterol intake daily to reduce the cardiovascular risk<sup>23</sup>.

Based on a recent European Prospective Investigation into Cancer and Nutrition (EPIC) population study<sup>39</sup> in Norfolk, England, an inverse relationship was found between intake of natural plant sterols from habitual diet and both total and LDL cholesterol among 22,000 men and women in the age range of 39 to 79 years. An increased intake of 200mg of naturally occurring plant sterols would lower serum cholesterol by about 3% in men. Table 3.8 indicates the plant sterol content of natural foods.

Apart from plant sterols found naturally in certain plant foods, commercial food products enriched with plant sterol such as margarine, yoghurt and milk are also available. The following Table 3.9 shows a comparison between regular and plant sterol enriched versions of margarine and milk powder:




**Table 3.8: Plant Sterol Content\* in a Selection of Foods**

Food Category	Sterol content ^(mg/100g edible portion)
<b>Fruits and Vegetables</b>	
Broccoli, frozen	44
Green peas, frozen	25
Orange	24
Apple	13
Cucumber	6
Tomato	5
<b>Cereals</b>	
Wheat bran	200
Wholemeal bread	53
Rolled oats	39
Wheat bread	29
<b>Fats and Oils</b>	
Corn oil	912
Rapeseed (canola) oil	668
Liquid margarine	522
Sunflower oil	213
Olive oil	154
Spreadable butter	153

\* Analyzed at the Department of Clinical Nutrition, the Sahlgrenska Academy at the University of Goteborg.

^ Total plant sterols are the sum of beta-sitosterol, campesterol and stigmasterol, together with beta-sitostanol and campestanol.

**Table 3.9: Plant Sterol Enriched Margarine and Milk Powder**

Commercial food products enriched with plant sterol						
	Logicol	Logicol Lite	Flora ProActiv	Flora ProActiv Light	Omega Plus	Omega Plus Acticol
Per 100g						
Energy (kcal)	595	429	569	357	429	393
Total fat (g)	67.0	49.0	64.0	39.0	14.4	9.4
Saturated fat (g)	16.5	13.0	Max. 23.0	Max. 9.2	4.2	2.31
Trans fat (g)	0.5	0.4	Max. 0.9	Max. 0.4	NA	NA
Monounsaturated fat (g)	33.8	22.0	Min. 30.0	Min. 12.0	10.2	2.74
Polyunsaturated fat (g)	16.2	10.0	Min. 40.0	Min. 16.0		3.46
Calcium (mg)	NA	NA	NA	NA	1740	1600
Plant sterol (g)	8.0	8.0	8.0	8.0	Nil	1.9

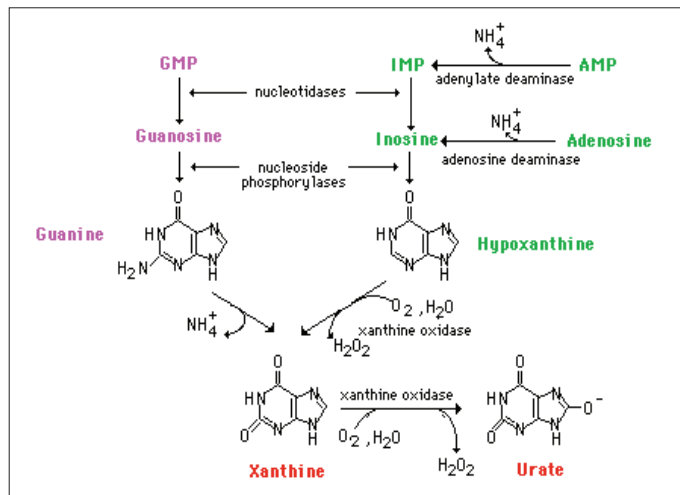
### 4.0 GOUT

Gout occurs when there is building up of monosodium urate crystals in synovial fluid of joints and other tissues. It causes sudden attacks of swollen, hot and painful joints. There are 4 stages of gout<sup>40</sup> attacks as summarized in Table 4.1 below:

**Table 4.1: Stages of Gout Attacks**

Stages	Symptoms
Asymptomatic	Plasma uric acid increases without symptomatic pain.
Acute	Short duration of attack phase.
Intercritical/ Interval	After first attack, symptom-free interval that may last for months or years.
Chronic	Attacks become more frequent and become polyarticular (a few joints) at one time. This may lead to development of kidney stones, or even kidney damage due to the formation of large tophi.

**Figure 4.1: Purine Metabolism**



Gout is often associated with hyperuricaemia (high serum uric acid level). Uric acid is an end product of purine metabolism, in which it has no physiologic role in human body. The building up of uric acid level in body is due to lacking of uricase enzyme in human body which converts uric acid into more water soluble allantoin.

Hyperuricaemia occurs can be due to overproduction or underexcretion of uric acid as a result of multiple contributing factors<sup>41</sup> as summarized in Table 4.2.

In the 5th century, Hippocrates has already attributed gout to excessive intake of food and wine. In terms of dietary

**Table 4.2: Causes of Hyperuricaemia**

Overproduction of Uric Acid	Underexcretion of Uric Acid
• High alcohol intake	• Renal insufficiency
• Obesity	• Acidosis due to starvation or
• Purine rich diet	diabetic ketoacidosis
• Primary idiopathic high uric acid	• Hypothyroidism
• Abnormality of enzymes that regulate purine metabolism	• Drugs such as Sinemet, Nicotinic acid, diuretics

management of gout, there are four major areas should be emphasized as follows:

- (i) **Adequate fluid intake**  
Adequate fluid intake of 8 to 12 cups daily is important in helping to increase uric acid excretion via urine. Sources of fluid include plain water (recommended 50% of total intake daily), juices, soup and milk.
- (ii) **Avoid alcohol intake**  
Numerous studies have shown that alcohol intake increases the serum uric acid level. For example, in 1980, Rodnan et.al<sup>42</sup> showed that alcohol, whether alone or taken together with purine-rich diet produces greater effects on serum uric acid than a high purine diet. There were various mechanisms explaining alcohol increases uric acid level as follows:
  - (1) Acute excessive alcohol intake may lead to temporary lactic acidemia and reduced uric acid excretion.
  - (2) Chronic alcohol ingestion stimulates purine production in the body.
  - (3) High purine content in beer forms readily absorbed guanosine which is a precursor of uric acid.
  - (4) Alcohol may impair response to allopurinol therapy for patients with gout.

- (iii) **Consume a healthy and balanced low purine diet**  
The breakdown of purine produces uric acid. One third of purine load in human body obtained from diet and the rest of two-third is derived from endogenous production. A study done by Emmerson et.al<sup>43</sup> in 1990s showed that an isocaloric diet restricted in purine content produces a lowering of uric acid excretion and serum uric acid production. Hence, a lower purine intake may be helpful in lowering uric acid among patients with gout and large tophi despite on uric acid lowering drug therapy. The following Table 4.3 shows the purine content of foods, categorized into low, moderate and high level of purine<sup>44,45,46</sup>.

A recent Health Professionals Follow-up study done by Choi et.al<sup>47</sup> showed that increased intake of meat particularly meat, lamb and pork; and all types of seafood such as shrimp, scallops increased risk of gout but there was no association between intake of purine-rich vegetables such as beans, mushrooms and peas and the risk of developing gout. Also, there was an inverse relationship between intake of low fat dairy products and risk of gout.

- (iv) **Maintain healthy body weight, avoid drastic weight loss**  
Overweight individuals with gout are strongly encouraged to lose weight gradually 0.5 to 1.0kg weekly by practicing a healthy eating pattern, as being overweight can result in building up of uric acid in the body. Individuals should abstained from practicing fasting or following a high protein diet to lose weight as these practices may worsen gout symptoms.

**Table 4.3: Low, Moderate, and High Purine Foods**

<b>Food group</b>	<b>Low (0-50mg/100g) Take in moderation</b>	<b>Moderate (50-150mg/100g) Limit intake</b>	<b>High (&gt;150mg/100g) Avoid intake</b>
Rice and alternatives	Rice, porridge, white bread, refined cereals, noodles, pasta, potatoes, cornbread, French toast	Whole grain breads and whole grain cereals – Limit to 2/3 cup serving raw daily Oatmeal – Limit to 1/4 cup serving raw daily Wheat bran, wheat germ	Nil
Fruits	Most fresh fruits, including juices	Nil	Nil
Vegetables	Most vegetables	Asparagus, cauliflower, spinach, mushrooms, green peas – Limit to 1/2 cup serving daily	Nil
Meat and alternatives	Eggs, all nuts, peanut butter	Meat, fish, poultry, shellfish, dried peas, beans, lentils and legumes, beancurd and beancurd products – Limit to 1 to 2 servings daily	All kinds of internal organs such as liver, kidneys, sweetbread, lungs, heart, brain. Anchovies, sardines, mackerel, herring, scallops, mussels.
Soups and broths	Vegetables broths	Meat soups and broths	Meat gravies, meat extract
Beverages	Fruit juices, coffee, tea, cocoa drink, Chinese tea	Sugary soft drinks	All kinds of alcoholic drinks
Dairy products (Choose low fat or non-fat version)	All kinds of dairy products such as milk, yoghurt.	Nil	Nil
Fats and oils (Limit usage)	All	Nil	Nil
Miscellaneous	Herbs and spices, condiments, garnishes	Nil	Yeast supplements

**5.0 CHRONIC RENAL FAILURE (PRE-DIALYSIS STAGE)**

**5.1 Definition, stages and causes of chronic renal failure**

Chronic renal failure is an irreversible progressive loss of renal function over a period of months or years through stages of damage. Overall, there are 5 stages of chronic renal failure<sup>48</sup> as classified in Table 5.1 based on decreased glomerular filtration rate (GFR), with or without kidney damage.

There are multiple contributing factors to chronic renal failure<sup>49</sup> as summarized in the Table 5.2.

**5.2 Some facts about Chronic Renal Failure in Singapore<sup>50</sup>**

The prevalence of chronic renal failure in Singapore is on the rise. According to MOH survey, there were 3,401 patients on dialysis by December 2004, in which 79% were on hemodialysis whereas the remaining 21% were on peritoneal dialysis. This figure represented a 54% increase since end of year 1998, when there were 2,209 patients on dialysis. Moreover, there were 564 new cases of renal failure in 1998 whereas in 2003, the number of new cases increased by 20% with 675 new cases over a 5-year period. In terms of death rate among patients on dialysis, there was 9.4% in 1998, in which cardiac causes and infections accounted for 29.4% and 16.7% of deaths respectively.

Diabetes is the leading cause of chronic renal failure among the contributing causes and the number of new cases due to diabetes is increasing as well. In 1998, diabetes caused 47% of total new cases of renal failure; whereas in 2003, the figure increased by 20% over a 5-year period which caused up to 56%

of new cases of renal failure. Meanwhile, the number of dialysis patients due to diabetic nephropathy has doubled over the past 5 years from 1998 to 2003. In 1998, there were 571 patients with diabetes on dialysis; whereas by end of 2003, there were 1,147 patients on dialysis. Hence, preventing and treating diabetes under optimal control remain as the paramount strategy in reducing the number of new cases on dialysis.

**5.3 Medical nutrition therapy for Chronic Renal Failure<sup>51</sup>**

In terms of medical nutrition therapy for patients with chronic renal failure, there are three objectives need to be fulfilled as follows:

- (i) To maintain good nutrition status and ensure adequate nutrients intake.
- (ii) To reduce morbidity and mortality rate as a result of Protein Energy Malnutrition (PEM).
- (iii) DO NOT restrict the nutrients in the renal diet more than what is necessary in order to maintain good nutrition state.

**5.3.1 Energy requirement**

The objective of providing sufficient energy based on individual’s requirement is to prevent protein energy malnutrition (PEM) among patients with chronic renal failure, in which this may lead to loss of lean muscle mass, poor appetite, altered taste perception and increased risk of other complications and mortality.

For patients with Stage 1 or Stage 2 chronic renal failure, recommended energy requirement should be based on individual needs, taken into consideration their energy input versus energy output, gender, age, weight, height, physical

activity as well as stress factor. As for the advanced stages (Stage 3 and 4), younger patients below 60 years should consume at least 35kcal/kg body weight/day with moderate protein restriction in order to engender neutral nitrogen balance and maintain serum albumin level; whereas for individuals above 60 years, the recommended daily energy requirement should be kept between 30 to 35kcal/kg body weight/day as this group of individuals are more sedentary.

**5.32 Protein requirement**

Protein is an essential nutrient for patients with chronic renal failure to prevent loss of lean muscle mass. However, by having high protein intake may lead to kidneys overloaded with protein waste products. Hence, there is a need to restrict protein intake at certain level for patients with advanced stage of chronic renal failure.

For Stage 1 and Stage 2 chronic renal failure, patients are not required to restrict their daily protein intake provided the

total protein intake does not exceed the normal requirement, which is 1.0g/kg body weight/day. As for patients with Stage 3 and Stage 4 chronic renal failure, a low protein diet is warranted to prevent kidneys from being overloaded and the recommended protein requirement is 0.75 to 1.0g/kg body weight/day; in which more than 50% of total protein intake should come from high biological value (HBV) protein. HBV protein contains all kinds of essential amino acids which are found in animal proteins such as meat, fish, poultry, eggs and soy protein from plant origin.

In terms of protein requirement calculation, protein exchange system is useful to offer flexibility and variety of protein food choices to patients.

One Protein Exchange = 7 grams Protein

One protein exchange is equivalent to 7g protein and the serving portion of one protein exchange is shown in Table 5.3:

**Table 5.1: Stages of Chronic Renal Failure**

Stage	GFR (ml/min/1.73m2)	With kidney damage		Without kidney damage	
		With HTN*	Without HTN	With HTN	Without HTN
1	> 90	1	1	"HTN"	"Normal"
2	60-89	2	2	"HTN with decreased GFR"	"Decreased GFR"
3	30-59	3	3	3	3
4	15-29	4	4	4	4
5 (End stage)	<15	5	5	5	5

\* HTN – Hypertension (Co-morbidity)

**Table 5.2: Contributing Factors to Chronic Renal Failure**

Diseases in which kidney involved	Urinary tract obstruction	Conditions which often cause renal failure	Systemic diseases
Glomerulonephritis	Prostatic enlargement	Malignant hypertension	Benign essential hypertension
Interstitial nephritis	Urethral structure	Periarteritis nodosa	Atherosclerosis
Renal calculi	Bladder neck obstruction	Lupus erythematosus	Embolism
Congenital nephritis	Neurogenic bladder	Analgesic drug abuse	Gout
Polycystic disease	Malignancy	Potassium deficiency	Diabetes
Renal hypoplasia		Hypercalcemia	Heart failure
Renal tubular acidosis		Cystinosis	
		Primary oxaluria	
		Lead or cadmium poisoning	

**Table 5.3: One Protein Exchange**

Animal protein	Serving size	Plant protein	Serving size
Meat, fish, poultry	1 ounce (30g) or		
1/3 palm size	Soy beancurd (Tofu)	1/2 cup or 4 ounces	
Shellfish	1 ounce (30g)	Soy bean milk	1 cup (250ml)
Fishball	4 to 5 fishballs	Legumes	1/2 cup
Egg	1 whole egg	Tempeh	1/4 cup
Milk	1 cup (250ml)	Nuts and seeds	1 ounce (30g)
Yoghurt	3/4 cup		
Cheese	1 ounce (30g)		
Peanut butter	1 tablespoon		



**5.33 Sodium restriction**

For patients at any stages of chronic renal failure, with or without hypertension, they should restrict their sodium intake to less than 2,000mg per day, which is less than one teaspoon of salt per day. This is because having too much sodium from diet will lead to increase in blood pressure, which in turn further deteriorates kidney function and also causes fluid retention along with swollen lower limbs among patients with chronic renal failure. Food sources which are rich in sodium are stated in Section 2.3 - Hypertension.

**5.34 Potassium restriction**

Hyperkalaemia normally occurs among patients with chronic renal failure when there is building up of potassium level in the blood as a result of under excretion of potassium from the malfunctioned kidneys. Serious hyperkalaemia may lead to abnormalities of heart muscle and hence irregular heartbeat or even death.

In terms of dietary management, potassium intake is not usually restricted at any stage of chronic renal failure. This is because most of the foods with high potassium content such as fruits and vegetables are rich in other nutrients and antioxidants as well, in which the nutrients are beneficial for patients with chronic renal failure. Restriction of high potassium foods intake or a low potassium diet should be commenced only if the serum potassium level is more than 6.0mmol/l. Table 5.4 shows some examples of foods with potassium content categorized into low, moderate and high levels.

**5.35 Phosphate restriction**

Phosphate is involved in homeostasis with calcium and vitamin D metabolism. In advanced stage of chronic renal failure, deposits of calcium phosphate in bone tissue due to hyperphosphatemia, excess parathyroid hormone (PTH) and alteration of vitamin D metabolism all contributing to the development of bone disease or osteodystrophy.

In terms of management, phosphate binders such as calcium carbonate or calcium acetate are normally used to reduce phosphate level. Low phosphate diet with restriction of 800 to 1000mg/day should be commenced only when the phosphate level is more than 1.49mol/l or with abnormal result of high PTH level. Table 5.5 shows some foods with high phosphate content:

**5.36 Fluid restriction**

For patients with chronic renal failure at any stage, restricting fluid should be on individual basis and subjective to the degree of oedema and hypertension. Apart from fluid restriction, reducing sodium intake should also be emphasized to patients with chronic renal failure who appear oedemateous. Generally, the amount of fluid restriction daily as determined by doctors would be 800ml, 1200ml or 1500ml, which is subjective to the degree to oedema. Table 5.6 shows the sources of fluid obtained from daily intake. Table 5.7 is a summary of recommendations for respective nutrients in chronic renal failure management<sup>51</sup>.

**Table 5.4: Potassium Content in Foods**

Food group	Potassium content		
	Low	Moderate	High
Vegetables	Beans, beans sprouts, beetroot, cabbage, brinjal, cucumber, onions, lettuce.	Asparagus, cauliflower, carrots, ladies finger, peas, tomato, lentils	Most green leafy vegetables: Kailan, spinach. Starchy vegetables: sweet potato, potato, tapioca, yam. Lotus root.
Fruits	Apple, guava, pear, pineapple, watermelon, grapefruit, persimmon.	Chiku, duku, langsat, mango, orange, papaya, peach, plum, lychee, strawberries.	Banana, grapes, jackfruit, kiwi, avocado, cherries, dried fruits.
Beverages	Special made nutrition supplement such as Suplena	NA	All kinds of fruits and vegetables juices. Cocoa drinks. Alcoholic drinks.
Miscellaneous		NA	Herbal medicine such as ginseng, chicken essence, condensed milk, evaporated milk, non-dairy creamer, chocolates, salt substitute.

Source: FJ Zeman. Chapter 9. The Urinary System, Clinical Nutrition and Dietetics (2nd ed).

**Table 5.5: High Phosphate Foods**

Food group	Examples of high phosphate foods
Dairy products (Limit to one serving daily)	Cheese, milk, yoghurt
Whole grain products	Oatmeal, oat bran, muesli
Dried food products	Anchovies, dried/ salted fish, dried shrimps
Meat and alternatives	Sardines, chicken bones, chicken feet, egg yolk, organ meat, legumes, nuts and seeds
Miscellaneous	Chocolate, cocoa drinks, carbonated drinks

Source: FJ Zeman. Chapter 9. The Urinary System, Clinical Nutrition and Dietetics (2nd ed).

**Table 5.6: Sources of Fluid from Daily Intake**

Liquid form	Semi-solid form	Hidden source
Plain water, fruit juice, mineral water, soft drinks, beverages such as Milo,	Porridge, jelly, yoghurt, ice-cream.	Gravy, ice cube, custard
milk, yoghurt drink, soup, water taken with medication.		

**Table 5.7: Summary of Recommendations for Respective Nutrients in Chronic Renal Failure Management**

Nutrient	Stages of Chronic Renal Failure (Pre-Dialysis)			
	Stage 1	Stage 2	Stage 3	Stage 4
Energy	Based on individual's needs (energy input versus energy output), age, gender, weight, height, physical activity and stress factors.	Based on individual's needs (energy input versus energy output), age, gender, weight, height, physical activity and stress factors.	For individuals below 60 years: At least 35kcal/ kg IBW/day.  For individuals above 60 years: 30 to 35kcal/ kg IBW/day.	For individuals below 60 years: At least 35kcal/ kg IBW/day.  For individuals above 60 years: 30 to 35kcal/ kg IBW/day.
Protein	1.0g/kg IBW/ day	1.0g/kg IBW/ day	0.75 to 1.0g/kg IBW/day, >50% HBV	0.75 to 1.0g/kg IBW/day, >50% HBV
Sodium	Less than 2,000mg/day if hypertensive and chronic renal failure is progressive	Less than 2,000mg/day if hypertensive and chronic renal failure is progressive	Less than 2,000mg/day if hypertensive and chronic renal failure is progressive	Less than 2,000mg/day if hypertensive and chronic renal failure is progressive
Potassium	Not usually restricted, if K+ is >6.0mmol/l, limit intake to 1.0mmol/kg IBW/day	Not usually restricted, if K+ is >6.0mmol/l, limit intake to 1.0mmol/kg IBW/day	Not usually restricted, if K+ is >6.0mmol/l, limit intake to 1.0mmol/kg IBW/day	If K+ is >6.0mmol/l, limit intake to 1.0mmol/kg IBW/day
Phosphate	If PO4 > 1.49mmol/l, then restrict to 800 to 1000mg/day and/or binders	If PO4 > 1.49mmol/l, then restrict to 800 to 1000mg/day and/or binders	If PO4 > 1.49mmol/l, then restrict to 800 to 1000mg/day and/or binders	If PO4 > 1.49mmol/l, then restrict to 800 to 1000mg/day and/or binders
Fluid	Individualised based on degree of oedema and hypertension	Individualised based on degree of oedema and hypertension	Individualised based on degree of oedema and hypertension	Individualised based on degree of oedema and hypertension

Source: FJ Zeman. Chapter 9. The Urinary System, Clinical Nutrition and Dietetics (2nd ed).

Moving forward, preventive nephrology<sup>52</sup> which aims for good diabetes control with HbA1c<7.0%, good blood pressure control <130/80mmHg, good lipids control as well as early detection of chronic diseases through ongoing health screening are important strategies in retarding progression of kidney damage and preserve remaining kidney function.

**CONCLUSIONS**

It is known that similar nutrition recommendations are useful to improve different chronic disease conditions, in which the healthy diet pyramid way of eating remains the fundamental way of healthy eating which emphasizes on variety, balanced and moderation; together with lots of fruits, vegetables, whole grains intake as part of daily diet. In order to achieve the target goals as established by medical nutrition therapy guidelines for each chronic disease, it requires individuals to make lifelong modifications by adopting a healthy lifestyle through regular exercise and healthy eating practice at any stage of diseases, with or without medication prescription.

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## LEARNING POINTS

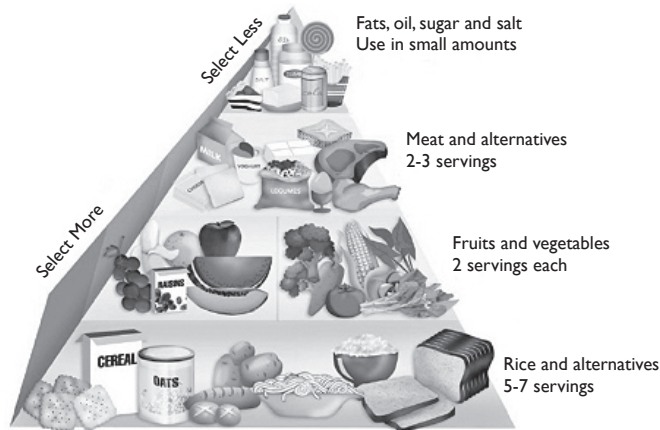
- **Diabetes mellitus – emphasize on healthy eating for people with diabetes and encourage weight loss for those who are overweight; in addition, to incorporate carbohydrate counting by using carbohydrate exchange concept to help people with diabetes to plan their diet.**
  - **Hypertension – emphasize on cutting down daily intake of sodium together with DASH diet principles to further lower high blood pressure.**
  - **Hyperlipidaemia – emphasize on cutting down saturated fat and trans fat intake from diet, replaced with unsaturated fat, and incorporate soluble fibre and plant sterol to enhance lipid (LDL cholesterol) lowering effect.**
  - **Gout – emphasize on adequate fluid intake, abstain from alcohol, reduce purine intake and maintain healthy body weight to improve gout condition.**
  - **Chronic renal failure – emphasize on providing adequate energy and nutrients especially to those who are at risk of developing malnutrition; for advanced stage of renal failure, protein restriction may be warranted to prevent kidneys from overloaded; sodium restriction should be commenced at any stage of renal failure whereas potassium and phosphate restriction should be commenced only if the levels exceed the acceptable level, i.e., 6.0mmol/l and 1.49mmol/l respectively.**
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**APPENDIX**

**The Singapore Healthy Diet Pyramid**

The Healthy Diet Pyramid way of eating as shown below includes every basic food groups and respective recommended daily servings to improve their glycaemic control and to achieve weight loss for overweight patients.

**Figure 1 (Annex) Singapore Healthy Diet Pyramid**



The Healthy Diet Pyramid way of eating consists of four levels and four basic food groups which conveys three main messages:

- Eat a **variety** of foods
- Eat a **balanced** diet
- Eat all foods in **moderation**

**Table 1 (Annex): What is a “Serving”?**

<b>Food Group</b>	<b>Examples of ONE serving</b>
<b>Rice and Alternatives</b> <i>Eat 5 to 7 servings daily</i>	½ *bowl of rice (100g) ½ *bowl of noodles or beehoon 2 slices of bread (60g) 4 pieces of cream crackers or plain biscuits (40g)
<b>Fruits</b> <i>Eat 2 servings daily</i>	1 small apple, orange, pear or mango (130g) 1 wedge of papaya, watermelon or pineapple (130g) 4 small seeds of jackfruit or rambutan (80g) 10 grapes or longans (50g) 6 lychees or dukus (70g) ¼ cup dried fruit (40g) ½ cup canned fruit, drained (100g) 1 cup of pure fruit juice (250ml)
<b>Vegetables</b> <i>Eat 2 servings daily</i>	150g raw leafy vegetables 100g raw non-leafy vegetables ¾ **mug cooked leafy vegetables ¾ **mug cooked non-leafy vegetables
<b>Meat and Alternatives</b> <i>Eat 2 to 3 servings daily</i>	1 palm-sized of meat, fish or poultry (90g) 5 medium size of prawns 3 whole +eggs 2 ***glasses of milk 2 slices of cheese (40g) 2 small blocks soft beancurd (170g) ¾ cup of cooked pulses (peas, beans, lentils) (120g)

**Foot notes:** \* 1 bowl = 1 rice bowl; \*\* 1 mug = 250ml; \*\*\* 1 glass = 250ml; + The protein content of 3 whole eggs is equivalent with other meat and alternatives, but egg yolks are high in cholesterol. Thus, eat no more than 4 egg yolks per week.

Source: HPB ABC's of Healthy Eating booklet.