Key Message 2

Maintain body weight in a healthy range

Key Message 2

Maintain body weight in a healthy range

1. Terminology

Body Mass Index (BMI)

BMI is body weight in kilogram divided by height, in meters squared.

Energy balance

Energy balance is achieved when calorie-intake (food intake) is balanced with calorie expenditure (through physical activity). Individuals gain weight whenever their calorie or energy intake exceeds their energy expenditure. Individuals lose weight when their energy expenditure exceeds their energy intake.

Involuntary weight loss

Involuntary weight loss (IWL) is unintentional weight loss which occurs due to psychological and medical conditions. It is associated with increased morbidity and mortality, especially in the elderly.

Waist circumference

Circumference around the waist is measured by placing a measuring tape around the trunk between the lower costal margin and the iliac crest. It is an indication of body fat located at the abdominal region and is an independent predictor of risk factors and morbidity of obesity-related diseases.

2. Introduction

The accelerated phase of industrialisation and urbanisation in recent decades has inevitably brought about changes in lifestyle of Malaysians. Changes in dietary habits and sedentary lifestyles are known to be associated with changes in health and increased prevalence of chronic diseases in the population.

Obesity is a major contributor to the global burden of diseases such as type 2 diabetes, heart disease, hypertension and certain types of cancers. It also drastically reduces quality of life. Obesity is costly in terms of absence from work and use of health resources besides posing numerous psychosocial problems such as depression, lowered self esteem, job discrimination and other forms of social stigmatisation.

On the other hand, a low body weight is also unhealthy because it increases the risk of other clinical conditions such as anaemia and low bone mass. It also leads to distortion of body image amongst teenagers and young adults and increase risk of eating disorders (for instance anorexia and bulimia). Hence, it is important for all Malaysians to maintain a healthy body weight range throughout life.

Body weight is regulated by energy needs and physical activity that are influenced by genetic and environmental factors as shown in Figure 2.1. The primary direct environmental factors that influence energy balance within individual's control are dietary energy intake and physical activity.

Key Message 2

For most Malaysians, food is plentiful, palatable, energy dense, easily accessible and well promoted while at the same time, increased use of labour-saving devices and technology is largely responsible for their sedentary lifestyle. Local studies reveal Malaysians lead largely sedentary lifestyle with physical activity level (PAL) within the sedentary range (Ismail, 2002) (Appendix 1). It is therefore essential that the public at large understand the under lying factors and take necessary actions to reverse the current trend of rising BMI among Malaysians.

The revision of the Malaysian Dietary Guidelines (NCCFN, 1999) is in line with the current concern of rising prevalence of overweight among Malaysians of all age-groups consistent with the Specific Objective 1 of the National Plan of Action for Nutrition of Malaysia (NPANM), 2006-2015 that is, to reduce overweight and obesity among Malaysians (MOH, 2006).

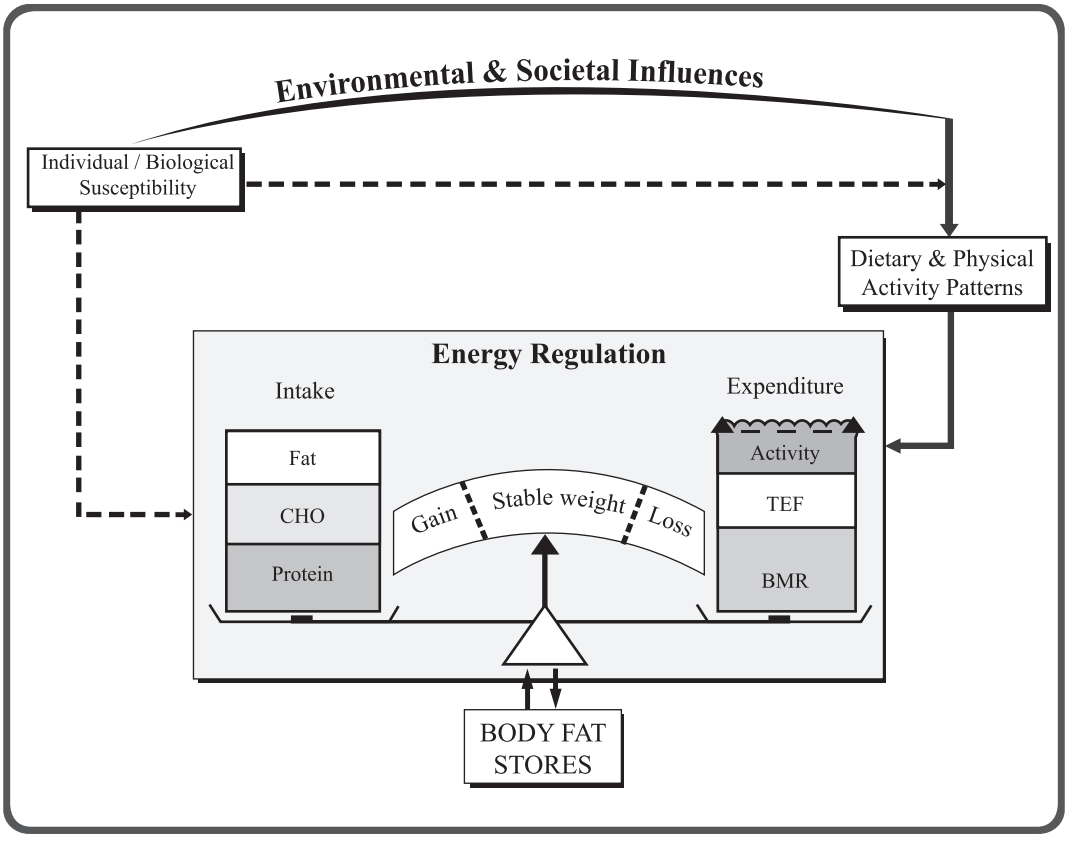

Figure 2.1. Influences on energy balance and weight gain : energy regulation

TEF - Thermic effect of food ; BMR - basal metabolic rate ; CHO - carbohydrate

Source: WHO (1998)

Key Message 2

3. Scientific basis

A high prevalence of overweight and obesity is of great public health concern because excess body fat leads to much higher risk of premature deaths and many serious disorders, including diabetes mellitus, hypertension, dyslipidaemia, cardiovascular disease, stroke, gall-bladder disease, respiratory dysfunction, gout, osteoarthritis and certain types of cancer as shown in Table 2.1 (WHO, 1998).

Hence, maintenance of a healthy weight range is important to minimise the risk of chronic diseases in adults. Maintaining a healthy weight throughout childhood may reduce the risk of becoming an overweight or obese adult. Adult individuals who are overweight or obese will benefit from modest amount of weight loss and the prevention of further weight gain is important. For overweight children and adolescents, the goal is to slow down weight gain while achieving normal growth and development.

Table 2.1 . Relative risks of health problems associated with obesity

Greatly increased (RR>3)*	Moderately increased (RR 2-3)*	Mildly increased (RR 1-2)*
- Non-insulin dependent diabetes mellitus (NIDDM) - Gall-bladder disease - Dyslipidaemia - Metabolic syndrome - Breathlessness - Sleep apnoea	- Coronary heart disease - Cardiac failure - Hypertension - Osteoarthritis (knees and hips) - Hyperuricaemia and gout	- Cancer (breast cancer in postmenopausal women, endometrial cancer, colon cancer) - Reproductive hormone abnormalities - Polycystic ovarian syndrome - Impaired fertility - Low back pain - Increased anaesthetic risk - Foetal defects associated with maternal obesity

* RR = relative risk
Source : WHO (1998)

Key Message 2

3.1 Definition of healthy body weight

a. Body Mass Index

One of the most commonly used indices of relative weight is the Body Mass Index (BMI) which is defined as body weight in kg divided by height, in meters squared.

BMI = weight (kg)/ height (m)^2

BMI is not a direct measure of body fat but it is more accurate at approximating body fat than is measuring weight alone. In children and adolescents, BMI is correlated with body fat, blood pressure, lipid levels and insulin levels (Gutin *et al.,* 1990; Zwiauer, Widham & Kerby (1990).

A Technical Committee initiated by the Malaysian Association for the Study of Obesity (MASO, 2005) recommends retaining the current WHO classification of BMI (WHO, 1998) for adults. However, the committee acknowledges the need to have the public health action points as recommended by WHO Expert Consultation 2004 (Table 2.2).

Table 2.2. Recommended BMI cut-off points for body weight classification and public health action for Malaysia

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

Source : [1] WHO (1998); [2] WHO Expert Consultation (2004)

Key Message 2

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

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

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

A low body weight (BMI < 18.5 kg/m^2) is associated with a low risk of chronic diseases. However, a low body weight is unhealthy because it increases the risk of other clinical conditions such as anaemia and low bone mass. It also leads to distortion of body image amongst teenagers and young adults and increase risk of eating disorders namely anorexia and bulimia. A low BMI is associated with greater mortality risk than that of normal individuals (Grabowski & Ellis, 2001). Hence, the healthy weight range for adults is defined as having a BMI range of 18.5 to 24.9 kg/m^2. The BMI, however, is not suitable for use in pregnant women.

As for children and adolescents, height and body composition is continually changing. For children aged 0 to below 5 years, it is recommended that the WHO 2006 growth reference chart of BMI-for-age for boys and girls be used. For children aged 5 to 19 years, the WHO 2007 (de Onis et al., 2007) is recommended for use in boys (Appendix 2) and in girls (Appendix 3). The cut-off points for overweight and obesity for older children (at age 19 years) are similar to the adult cut-off points based on this recent WHO 2007 growth charts (Table 2.3).

b. Waist circumference

Body fat located at the abdominal region is associated with greater health risk than peripheral fat. Excess abdominal fat is an independent predictor of risk factors and morbidity of obesity-related diseases such as type 2 diabetes, hypertension, dyslipidaemia and cardiovascular diseases (WHO, 1998). BMI has its limitation. It does not distinguish between weight associated with muscle mass and weight associated with fat mass.

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

Key Message 2

Waist circumference is a convenient measurement which is unrelated to height and correlates with BMI. For Malaysians, the MASO/AMM/MEMS (2004) Clinical Practice Guidelines proposed waist circumference cut-off points as recommended by the WHO/IASO/IOTF (2000) as shown in Table 2.4. Ideally, the goal for adults would be to maintain body weight within normal BMI and to have waist circumferences below the cut-off points recommended according to gender.

Table 2.3. Interpretation of Z-scores for BMI-for-age

Z-score	0 to 5 years[1]	5 to 19 years[2]
Above 2 SD	Overweight	Obese
Above 1 SD	At risk of overweight	Overweight
0 (median)	Normal	Normal
Below -1SD	Normal	Normal
Below -2SD	Thinness	Thinness
Below -3SD	Severe thinness	Severe thinness

Source : [1]WHO (2006); [2]WHO (2007)

Table 2.4. Waist circumference cut-off points

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

Source: WHO/IASO/IOTF (2000)

Key Message 2

3.2 Weight maintenance

Weight maintenance is achieved when calorie intake (food intake) is balanced with physical activity (Figure 2.2). Individuals gain weight whenever their calorie or energy intake exceeds their energy expenditure. If one is overweight or obese, it is going to take both an increase in exercise and a reduction in caloric intake in order to maintain a healthy weight.

Consuming a balanced diet that meets nutrient needs and prevents weight gain is desirable. The amount of calories consumed must be within the individual's requirement. Energy requirement is determined by age, gender and physical activity level.

There are no optimal proportions of carbohydrate, protein and fat in the diet for weight maintenance (IOM, 2002). However, to promote a healthy diet and meet nutrient needs, the Recommended Nutrient Intake (RNI) for Malaysia (NCCFN, 2005) has recommended intake of 55% to 70% energy from carbohydrates, 10% to 15% energy from proteins and limit energy from fats between 20% to 30%.

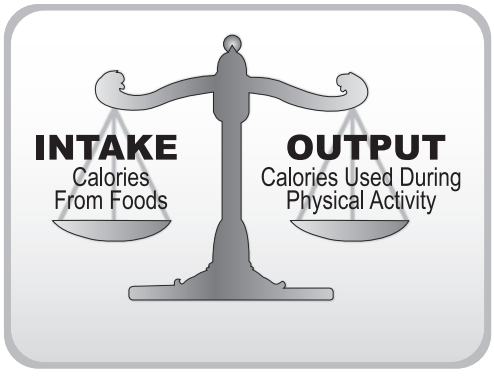

Figure 2.2. Energy intake must equal energy output for weight maintenance

Consuming high calorie or energy dense foods or meals may contribute to excessive calorie intake. The caloric content or energy density of a food (kcal/100g) depends on its content of fat, carbohydrate, protein and water. Fat contributes significantly to the caloric content of foods because it provides twice the calories per gram compared to carbohydrate and protein. High sugary foods also increase the calorie content of foods and drinks. Eating foods with lower calories may be helpful to reduce energy intake to maintain weight. The calorie content of some local foods is shown in Appendix 4.

More calories are consumed when a large portion size is served rather than a small one. Individuals should limit the portion size eaten, especially foods that are energy-dense to help control calorie intake. Besides diet, regular physical activity is important to maintain weight in the healthy range.

3.3 Weight gain

Individuals who are severely underweight or have chronic energy deficiency (CED) often have a poor nutrition status and prone to infections, anaemia, low immune status, low bone mass and difficulty to recover from illnesses.

The basic principle of weight gain is simple i.e. to consume more calories than expended. Similar to weight loss, weight gainers need to set realistic targets. It means eating an extra 500 to 1000 calories per day to gain ½ to 1 kg per week. However, one has to ensure that any weight gain should not exceed the recommended healthy weight range according to their height (BMI 18.5 to 24.9). Some individuals may gain weight faster than others especially if there is a genetic predisposition to obesity.

Key Message 2

It is important to eat consistently and have more frequent meals. Eat at least three main meals and one to three additional snacks. Skipping meals will cause missing out of important calories and other nutrients needed to accomplish the goal.

Eating a larger than normal portion of food will help increase energy intake. For example, having a bigger bowl of breakfast cereal, two instead of one sandwich for snacks, a bigger serving of rice at lunch or dinner, drinking a bigger glass of fruit juice or milk and eating a larger piece of fruit. Individuals who wish to gain weight should select foods with a higher calorie density as shown in Appendix 4. Beverages such as juices and milk-based beverages are simple ways to increase caloric intake.

Strengthening exercises (weight lifting, push-ups) help stimulate muscular development so that any weight gain is not fat gain. Exercise tends to stimulate the appetite in the long term and increases thirst. This will help individuals to eat and drink more.

One common misconception is that the best way to build muscle or "bulk up" is to eat a high-protein diet. Adequate protein intake is essential for muscle growth. However, most of the calories needed to fuel muscle growth come from carbohydrates and fat. Hence, eating a balanced proportion of carbohydrates (55% to 70%), protein (10% to 15%) and fats (20% to 30%) but at increased total calories is recommended for weight gain.

3.4 Weight reduction

There is strong evidence that weight loss promotes lower blood pressure, lipid levels and glucose levels in overweight and obese individuals with hypertension, dyslipidaemia or diabetes (DPP, 2002; Tuomilehto *et al.,* 2001; Wing & Hill, 2001). Individuals who are overweight or obese should attempt to lose weight by 5% to 10% of their initial body weight. The benefits of 5% to 10% weight loss are shown in Appendix 5. With success, further weight loss can be attempted, if indicated, through further assessment.

A reasonable timeline for 5% to 10% weight loss is three to six months, with a safe weight loss of ½ to 1 kg per week. This usually means a reduction of calorie intake by 500 to 1000 kcal/ day. A sound long term weight loss plan includes a reduction in calorie intake, intake of the recommended amounts of nutrients and increased physical activity. Several large-scale intervention studies attest that a calorie-controlled diet, balanced in macronutrients, and physical activity is the best first choice for weight loss (DPP, 2002; Tuomilehto *et al.,* 2001; Wing & Hill, 2001).

When it comes to weight loss diets, it is calories that count. A systematic review has shown that the macronutrient composition of diets are not as important as overall calorie deficit (Bravata *et al.,* 2003) in inducing weight loss. The weight loss diet should have a balanced proportion of carbohydrates (55% to 70%), protein (10% to 15%) and fats (20% to 30%). Diets that provide very low or very high amounts of protein, carbohydrates or fat are likely to provide low amounts of some nutrients and are not advisable for long term use. Although these diets have been shown to result in weight reduction, the maintenance of the weight lost ultimately will depend on change in lifestyle.

High sugary foods and drinks are high in calories as well. Limit intake of such foods to reduce energy intake. Individuals on a weight loss diet should limit portion size of

foods eaten, especially foods that are energy dense to help reduce calorie intake. Fats are the most concentrated source of energy, hence limiting high fat foods will help reduce calorie intake. A meta-analysis has also shown that a reduction of 10% energy from fats in the diet is effective to induce weight loss of between 2 to 4.5 kg in two to 12 months (Astrup *et al.,* 2000).

Bulk up the diet by choosing foods high in dietary fibre and low in fat and calories such as whole grain cereals, vegetables and moderate amount of fruits. Modify food preparation methods to lower fat such as steaming, grilling, stir-frying and clear soups, rather than deep-frying. Besides a reduction in calorie intake, increasing physical activity is essential for successful weight loss and to avoid weight regain.

3.5 Self-monitoring

Several studies have shown that self-monitoring is an important behavioural approach towards better control of body weight. Overweight and obese individuals who practise daily self-weighing have been found to successfully lose weight and able to maintain the weight loss over a longer period of time compared to those who do not weigh themselves frequently (Linde *et al.,* 2005; Wing & Phelan, 2005; Carels *et al.,* 2008). Individuals who monitor their weight regularly (either on a daily or weekly basis) are able to notice small weight changes (gain or loss) (Wing & Phelan, 2005). This helps them to adopt the necessary behaviour change (diet and/or exercise) crucial to prevent further weight gain or losses. Hence, individuals should monitor and weigh themselves at least once a week to maintain a healthy body weight. Children should be monitored on their weight and height attainment once every six months (WHO, 2007).

3.6 Special groups

Children and adolescents

Children and adolescents require adequate energy intake for proper growth but too much calories and too little physical activity can lead to obesity. Persistent obesity in childhood is associated with other lifestyle related diseases that may persist in adulthood. These include cardiovascular diseases, non-insulin dependent diabetes mellitus (now occurring in children), osteoarthritis, breast and alimentary cancers, skin disorders, aggravation of rheumatic diseases and asthma and other respiratory diseases.

Childhood obesity increases the risk of childhood hyperinsulinaemia, hypertension and dyslipidaemia (Ludwig, 2007). Moderately higher adiposity during adolescence has been associated with premature death in younger and middle-aged adults in the US (van Dam *et al.,* 2006).

Overweight children are likely to be obese as adults. Evidence from a systematic review showed that children with overweight or obese parents have a higher risk of obesity. Campbell *et al.,* (2001) reported 79% of 10 to 14 year old children with at least one obese parent were obese; regardless of whether the parental obesity is of genetic or environmental origin.

Young children who are overweight or obese should maintain weight or gain weight slowly rather than lose weight. However, older children who are obese may benefit from weight loss. Inculcating healthy eating habits and encouraging physical activity and lifestyle changes are better than restricting diet. Parental involvement is important for successful weight management of the child. Consultation with a health care professional about weight management

strategies is important to ensure appropriate management of other health conditions.

Pregnant and lactating women

Weight gain rather than weight maintenance and weight loss is indicated for pregnant women. The amount of weight gain is advocated according to pre-pregnancy BMI of the mothers. Appendix 6 shows the recommended weight gain for pregnant mothers. Weight gain should be closely monitored in overweight and obese women and should not exceed 10 kg throughout pregnancy (IOM, 1990). Appropriate weight gain should be monitored by a health care professional. Pregnant adolescents should try to achieve upper limits of the recommended range of weight gain based on pre-pregnancy weight status (IOM, 1990). Moderate weight reduction is safe for lactating mothers and does not compromise the weight gain nor health of the infant (ACOG, 2002). Breastfeeding will aid weight loss in mothers.

Elderly

Advancing age is associated with a decrease in the basal metabolic rate and reduced physical activity level. Hence a tendency towards overweight and obesity develops. Promotion of moderate physical activity and controlling calorie intake will help weight maintenance.

Nevertheless, involuntary weight loss (IWL) is commonly observed in elderly population. It is an important indicator of significant decline in health and function, resulting in a higher risk for infection, depression and death. Some of the consequences of IWL include anaemia, decreased cognition, oedema, falls, hip fractures, immune dysfunction, infections, muscle loss and osteoporosis (Alibhai, Greenwood & Payette, 2005). Sarcopenia, the loss of skeletal muscle mass is common in the elderly. Muscle loss can be the result of negative nitrogen balance that occurs with normal aging and with inadequate protein intake, which is commonly observed among the elderly.

Therefore, weight loss should be closely monitored in the elderly to ensure adequate energy intake and prevention of malnutrition.

4. Current status

Available data suggests that the prevalence of overweight and obesity in Malaysia have matched that of developed countries. The National Health and Morbidity Survey, NHMS II (IPH, 1997) reported a prevalence of 16.6% overweight and 4.4% obesity in adults and that both urban and rural populations are equally affected (Lim *et al.,* 2000). A survey (MANS) on adult Malaysians (Azmi *et al.,* 2007) revealed an increase in prevalence of overweight and obesity, 27.0% and 12.0%, while the recent NHMS III survey (IPH, 2008) reported, 29.1% and 14.0%, respectively (Figure 2.3).

Two cross-sectional surveys conducted in 2002 (Ismail *et al.,* 2003) recalculated using WHO (2007) classification and a recent survey in 2008 (Ismail *et al.,* 2009) on children aged 6 to 12 years in Peninsular Malaysia revealed an increase prevalence in overwieght from 11.0% to 12.8% and obesity from 9.7% to 13.7%, respectively (Figure 2.4).

Key Message 2

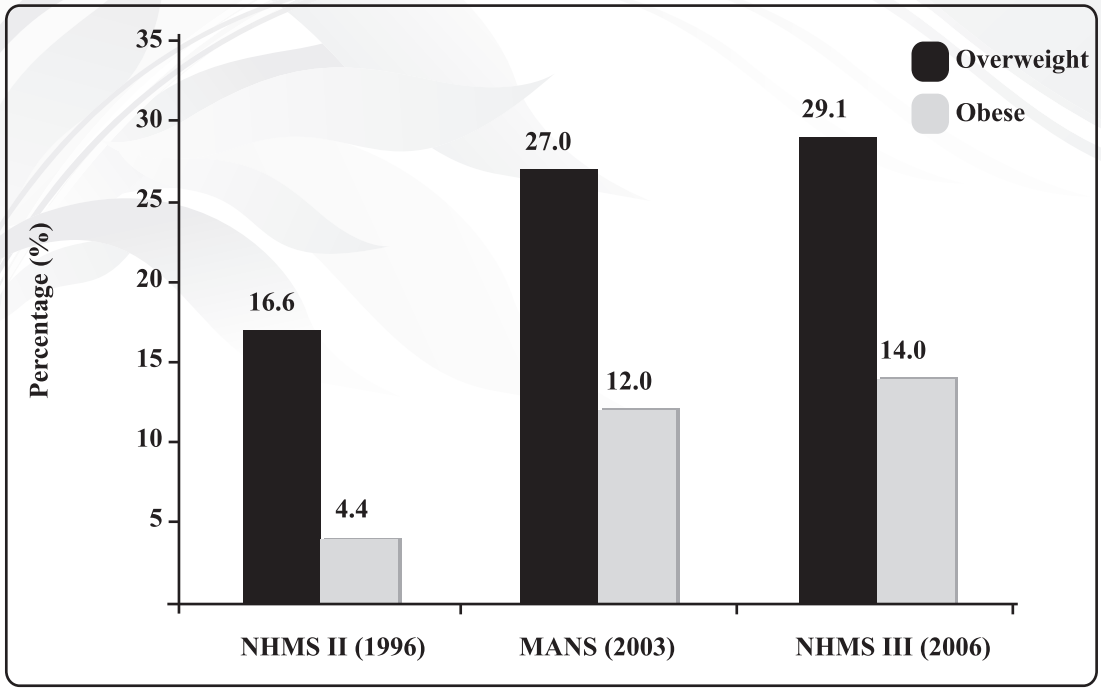

Figure 2.3. Prevalence of overweight and obesity in Malaysian adults

Key Message 2

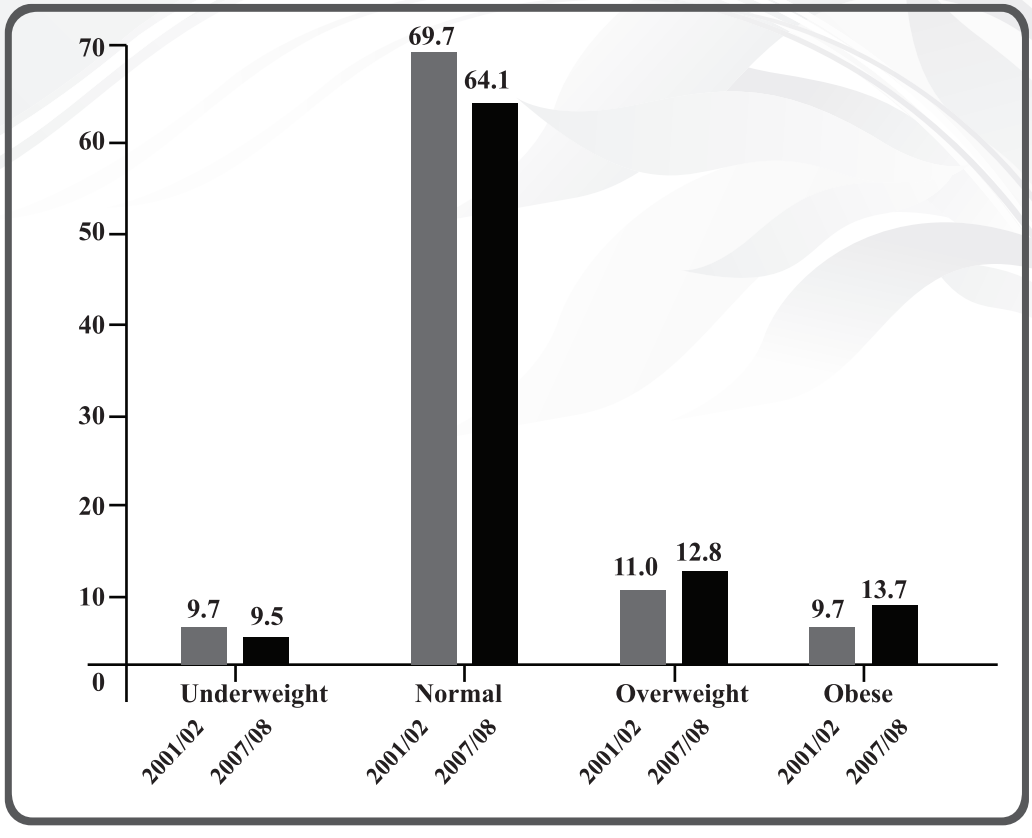

Figure 2.4. Prevalence of overweight and obesity in children age 6 to 12 years in Peninsular Malaysia

Key Message 2

5. Key recommendations

Key recommendation 1

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

How to achieve

1. Eat according to calorie recommendations by age, sex and physical activity level.
2. Be physically active everyday.
3. Reduce sedentary activities.

Key recommendation 2

Weigh yourself regularly, at least once a week.

How to achieve

1. Use a suitable weighing scale.
2. Weigh in light clothing and without shoes.
3. Weigh yourself at the same time of the day, preferably before breakfast.

Key recommendation 3

If you are an adult, prevent gradual weight gain over time.

How to achieve

1. Reduce intake of high calorie foods.
2. Eat smaller portions of high calorie foods.
3. Increase physical activity to increase daily energy expenditure.

Key Message 2

Key recommendation 4

If overweight, aim for a slow and steady weight loss.

How to achieve

1. Set a realistic weight loss goal of ½ to 1 kg per week.
2. Decrease calorie intake without sacrificing other nutrients.
3. Increase daily physical activity to 90 minutes gradually.

Key recommendation 5

If underweight, increase energy intake as recommended.

How to achieve

1. Eat three main meals and one to three snacks in a day.
2. Choose foods with higher calorie content.
3. Eat larger portions of food.

Key Message 2

References

ACOG (American College of Obstetricians and Gynecologists) Committee opinion No 267 (2002). Exercise during pregnancy and post-partum period. *Obstetrics and Gynecology* 99:171-173.

Alibhai SM, Greenwood C & Payette H (2005). An approach to the management of unintentional weight loss in elderly people. *CMAJ* 172(6):773-780.

Astrup A, Grunwald GK, Melanson EL, Saris WHM & Hill JO (2000). The role of low fat diets in body weight control. A meta-analysis of *ad libitum* dietary intervention studies. *Int J Obes* 24: 1545 -1552.

Azmi MY, Junidah R, Siti Mariam A, Safiah MY, Siti Haslinda MD, Tahir A (2007). Malaysian Adult Nutrition Survey 2003 (MANS). Vol. 13. Nutritional status of adults aged 18 to 59 years. Ministry of Health Malaysia, Putrajaya.

Bravata DM, Sanders L, Huang J, Krumholz HM, Olkin I, Gardner CD & Bravata DM (2003). Efficacy and safety of low carbohydrate diets. *JAMA* 289(14):1837-1850.

Campbell K, Waters E, O'Meara S & Summerbell C (2001). Interventions for preventing obesity in children (Cochrane review). *Cochrane Database Syst Rev 1*: CD 001871.

Carels RA, Young KM, Carissa C, Clayton AM, Spencer A & Hobbs M (2008). Can following the calorie restriction recommendations from the Dietary Guidelines for Americans help individuals lose weight? *Eat Beh* 9(3):328-335.

Deurenberg-Yap M, Chew SK, Lin VFP, van Staveren WA & Deurenberg P (2001). Relationships between indices of obesity and its comorbidities in multi-ethnic in Singapore. *Int J Obes* 25: 1554–1562.

DPP (Diabetes Prevention Program Research Group) (2002). Reduction in the incidence of Type 2 Diabetes with lifestyle intervention and metformin. *N Eng J Med* 346:393-403.

de Onis ME, Onyango AW, Borghi E, Siyam A, Nishida C & Siekmann J (2007). Development of a WHO growth reference for school-aged children and adolescents. Bulletin of the World Health Organization 85:660–667.

Grabowski DC & Ellis JE (2001). High body mass index does not predict mortality in older people: analysis of the Longitudinal Study of Aging. *J Am Geriatric Soc* 49(7): 968-979.

Gutin B, Basch C, Shea S, Contento I, DeLozier M, Rips J, Irigoyen M & Zybert P. (1990). Blood pressure, fitness and fatness in 5 and 6 year old children. *JAMA* 264(9):1123-1127.

IOM (Institute of Medicine) (1990). Nutrition during pregnancy. National Academics Press, Washington DC.

Key Message 2

IOM (Institute of Medicine) (2002). Dietary References Intakes: energy, carbohydrate, fibre, fat, fatty acids, cholesterol, protein and amino acids. National Academy Press, Washington DC.

IPH (Institute of Public Health) (1997). The Second National Health and Morbidity Survey (1996). Vol. 14: Nutritional Status. Ministry of Health Malaysia, Kuala Lumpur.

IPH (Intitute of Public Health) (2008). The Third National Health and Morbidity Survey (NHMS III) 2006. Vol. 2. Ministry of Health Malaysia, Putrajaya.

Ismail MN (2002). The nutrition and health transition in Malaysia. *Pub Health Nutr* 5(1A):191-195.

Ismail MN, Norimah AK, Poh BK, Ruzita AT, Nik Mazlan M & Nik Shanita S (2003). Nutritional status and dietary habits of primary school children in Peninsular Malaysia. UKM/Nestle Report. Department of Nutrition and Dietetics, UKM, Kuala Lumpur.

Ismail MN, Ruzita AT, Norimah AK, Poh BK, Nik Shanita S, Nik Mazlan M, Roslee R, Nurunnajiha N, Wong JE, Nur Zakiah MS & Raduan S (2009). Prevalence and trends of overweight and obesity in two cross-sectional studies of Malaysian children, 2002 - 2008. Scientific Conference on Obesity MASO 2009, Kuala Lumpur.

Ko GTC, Chan JCN, Cockram CS & Woo JY (1999). Prediction of hypertension, diabetes, dyslipidaemia or albuminuria using simple anthropometric indexes in Hong Kong Chinese. *Int J Obes* 23: 1136–1142.

Lim TO, Ding LM, Zaki M, Suleiman AB, Fatimah S, Siti S, Tahir A & Maimunah AH (2000). Distribution of body weight, height and body mass index in a national sample of Malaysian adults. *Med J Mal* 55(1):108-128.

Linde JA, Jeffrey RW, French SA, Pronk NP & Boyle RG (2005). Self-weighing in weight gain prevention and weight loss trials. *Ann Beh Med* 30(3):210-216.

Ludwig DS (2007). Childhood obesity-The shape of things to come. *N Eng J Med* 357:2325-2327.

MASO/AAM/MEMS (2004). Clinical practice guidelines on management of obesity. Report of the Malaysian Association for the Study of Obesity, Academy of Medicine Malaysia and Malaysian Endocrine and Metabolic Society, Kuala Lumpur.

MASO (2005). Strategy for the prevention of obesity-Malaysia. Malaysian Association for the Study of Obesity (MASO). Kuala Lumpur.

MOH (2006). National Plan of Action for Nutrition of Malaysia (2006-2015). Ministry of Health Malaysia, Putrajaya.

NCCFN (National Coordinating Committee on Food and Nutrition) (1999). Malaysian Dietary Guidelines. Ministry of Health Malaysia, Kuala Lumpur.

Key Message 2

NCCFN (National Coordinating Committee on Food and Nutrition) (2005). Recommended Nutrient Intakes for Malaysia. A Report of the Technical Working Group on Nutritional Guidelines. Ministry of Health Malaysia, Putrajaya.

SIGN (1996). Obesity in Scotland: Integrating prevention with weight management. Scottish Intercollegiate Guidelines Network, Edinburgh.

Tee ES, Ismail MN, Nasir MA & Khatijah I (1997). Nutrient Composition of Malaysia Foods. Institute of Medical Research, Kuala Lumpur.

Tuomilehto J, Lindstrom J, Eriksson JG, Valle TT, Hamalainen H, Ilanne-Parikka P, Keinanen-Kiukaanniem S, Laakso M, Louheranta A, Rastas M, Salminen V & Uusitupa M (2001). Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Eng J Med* 344:1343-1350.

van Dam RM, Willet WC, Manson JE & Hu FB (2006). The relationship between overweight in adolescence and premature death in women. *Ann Intern Med* 145:91-97.

WHO (1998). Obesity : Prevention and managing the global epidemic. Report of a WHO Consultation on Obesity. World Health Organization, Geneva.

WHO/IOTF/IASO (2000). The Asia–Pacific Perspective. Redefining Obesity and its Treatment. Hong Kong. World Health Organization, International Obesity Task Force, International Association for the Study of Obesity.

WHO (2006). WHO Child Growth. Standards: Length/height-for-age, weight-for-age, weight-for-length, weight for-height and body mass index-for-age: methods and development. World Health Organization, Geneva.

WHO Multicentre Growth Reference Study Group (2007). WHO Child Growth Standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age. World Health Organisation, Geneva.

WHO Expert Consultation (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet* 363:157-63.

Wing RR & Hill J (2001). Successful weight loss maintenance. *Annu Rev Nutr* 21:323-341.

Wing RR & Phelan S (2005). Long-term weight loss and maintenance. *Am J Clin Nutr* 82(suppl): 222-225.

Zwiauer K, Widhalm K & Kerbi B(1990). Relationship between body fat distribution and blood lipids in obese adolescents. *Int J Obes Relat Metab Disord* 14:271-277.

Zhou BF (2002). Predictive values of body mass index and waist circumference for risk factors of certain related diseases in Chinese adults study on optimal cut-off points for body mass index and waist circumference in Chinese adults. *Biom Environ Sci* 15: 83-95.

Appendices

Appendix 1. Basal metabolic rate (MJ/day), total daily energy expenditure (MJ/day) and Physical Activity Level (PAL) of Malaysian

Subjects	Age (year)	Male BMR	Male TDEE	Male PAL	Female BMR	Female TDEE	Female PAL
Adolescent	12 - 14	5.08	7.89	1.55	4.80	7.09	1.48
Adolescent	16 - 18	5.76	8.64	1.50	5.02	7.64	1.52
Young adult	18 - 30	5.85	9.40	1.61	4.77	7.58	1.59
Adults	30 - 60	5.66	9.53	1.68	4.79	8.17	1.70
Elderly	> 60	4.92	7.35	1.50	4.37	6.74	1.54
Armed forces	20 - 30	5.74	12.08	2.10	NA	NA	NA
Elite athlete	20 - 30	6.84	14.91	2.18	5.39	10.67	1.98

Moderately Active - PAL = 1.75 (WHO, 1998)
PAL - Physical activity level ; **TDEE** - Total daily energy expenditure
BMR - Basal metabolic rate
Source : Ismail (2002)

Appendix 2 . BMI cut-off points for 5 to 19 years' boys (z-scores)

Age	-3SD	-2SD	-1SD	Median	1SD	2SD	3SD
5.1	12.1	13.0	14.1	15.3	16.6	18.3	20.2
6.0	12.1	13.0	14.1	15.3	16.8	18.5	20.7
7.0	12.3	13.1	14.2	15.5	17.0	19.0	21.6
8.0	12.4	13.3	14.4	15.7	17.4	19.7	22.8
9.0	12.6	13.5	14.6	16.0	17.9	20.5	24.3
10.0	12.8	13.7	14.9	16.4	18.5	21.4	26.1
11.0	13.1	14.1	15.3	16.9	19.2	22.5	28.0
12.0	13.4	14.5	15.8	17.5	19.9	23.6	30.0
13.0	13.8	14.9	16.4	18.2	20.8	24.8	31.7
14.0	14.3	15.5	17.0	19.0	21.8	25.9	33.1
15.0	14.7	16.0	17.6	19.8	22.7	27.0	34.1
16.0	15.1	16.5	18.2	20.5	23.5	27.9	34.8
17.0	15.4	16.9	18.8	21.1	24.3	28.6	35.2
18.0	15.7	17.3	19.2	21.7	24.9	29.2	35.4

Source : WHO (2007)

Appendix 3 . BMI cut-off points for 5 to 19 years' boys (z-score)

Age	-3SD	-2SD	-1SD	Median	1SD	2SD	3SD
5.1	11.8	12.7	13.9	15.2	16.9	18.9	21.3
6.0	11.7	12.7	13.9	15.3	17.0	19.2	22.1
7.0	11.8	12.7	13.8	15.4	17.3	19.8	23.3
8.0	11.9	12.9	14.1	15.7	17.7	20.6	24.8
9.0	12.1	13.1	14.4	16.1	18.3	21.5	26.5
10.0	12.4	13.5	14.8	16.6	19.0	22.6	28.4
11.0	12.7	13.9	15.3	17.2	19.9	23.7	30.2
12.0	13.2	14.4	16.0	18.0	20.8	25.0	31.9
13.0	13.6	14.9	16.6	18.8	21.8	26.2	33.4
14.0	14.0	15.4	17.2	19.6	22.7	27.3	34.7
15.0	14.4	15.9	17.8	20.2	23.5	28.2	35.5
16.0	14.6	16.2	18.2	20.7	24.1	28.9	36.1
17.0	14.7	16.4	18.4	21.0	24.5	29.3	36.3
18.0	14.7	16.4	18.6	21.3	24.8	29.5	36.3
19.0	14.7	16.5	18.7	21.4	25.0	29.7	36.2

Source : WHO (2007)