CHAPTER 2

LITERATURE REVIEW

This chapter presents a review of the selected literature in six sections. The first section presents about metabolic syndrome including definition, clinical criteria, etiology and pathogenesis, and management of metabolic syndrome. The second section presents eating behavior, determines of food choice and intake, barriers to dietary and lifestyle change, and the appropriate tool for dietary assessment. The third section presents physical activity, factors that influence physical activity behaviors, barriers to physical activity, and method of physical activity assessment. The fourth section presents current lifestyle intervention for metabolic syndrome. The fifth section presents self-management, and application and clinical effectiveness of self-management. The last section presents conceptual framework.

Metabolic Syndrome

Definition

The metabolic syndrome is a constellation of risk factors of metabolic abnormality that is accompanied by increased risk for cardiovascular disease and type II diabetes (Visseren, 2008). These risk factors are characterized by a group of metabolic risk factors in one person, including abdominal obesity, lipid abnormalities (i.e., elevated levels triglycerides and low levels of high-density lipoprotein (HDL)

cholesterol), elevated blood pressure, and elevated plasma glucose (Churilla, & Zoeller, 2008; Grundy, 2006).

Clinical Criteria for Defining the Metabolic Syndrome

Several expert groups have developed criteria to define the metabolic syndrome. The most widely cited definitions are from the World Health Organization (WHO), the National Cholesterol Education Program (NCEP) Adult Treatment Panel (ATP) III, and International Diabetes Federation (IDF). The core components for each group include obesity, impaired glucose regulation, dyslipidemia, and hypertension (Reasner, 2007).

WHO first defined the syndrome in 1998 and called it the *metabolic syndrome*, a term that had been used by Zimmet in 1991 to describe this cluster of findings. The WHO criteria (1999) for the metabolic syndrome (Balkau & Charles, 1999) require the presence of diabetes mellitus (DM), impaired fasting glucose, impaired glucose tolerance, or insulin resistance and two additional factors from the followings: included obesity, hypertension, high triglycerides, and reduced HDL-C level.

In 2001, the NCEPATP III introduced alternative clinical criteria for defining the metabolic syndrome (NCEP, 2002). The ATP III criteria initially required the presence of three of five factors as the basis for establishing the diagnosis: abdominal obesity, elevated triglycerides, reduced HDL-C, elevated blood pressure, and elevated fasting glucose (IFG or type 2 diabetes mellitus). The NCEP ATP III criteria were updated in 2005 to correspond with the new American Diabetes Association (ADA) standard of a normal fasting glucose level of less than 100 mg/dL

and update waist criteria reasonable for Asians, i.e., between 94 and 101 cm in men or 80 and 87 cm in women (Grundy et al., 2005).

The latest criteria were proposed by the International Diabetes Federation (IDF) (Alberti, Zimmet, & Shaw, 2005) and are similar to the more commonly used NCEP ATP III definition, but require measurement of abdominal girth, which has different cutoff values based on ethnicity, and is seldom completed in a busy office setting. The WHO, NCEP ATP III, and IDF criteria for metabolic syndrome are summarized in Table 1, and ethnicity-specific waist circumference cut points are shown in Table 2.

Fedorowski, Burri, Hulthen, and Melander (2009) examined three criteria to define the metabolic syndrome from the WHO, NCEP ATP III and IDF. The result shown that only NCEP appear to have a sufficient predictive for the increase risk of myocardial infarction. The IDF definition was not found to be superior to these definitions for prediction of CVD events (Nilsson, Engstrom, & Hedblad, 2007). Thus, the definition used in this study is that of the NCEP ATP III because of its clinical simplicity. The diagnosis of the metabolic syndrome is made when three or more of the risk determinants shown below are present.

1. Abdominal obesity: A waist circumference ≥ 80 cm in women and ≥ 90 cm in men is a more appropriate definition of central obesity in an Asian population
2. Serum Triglyceride levels ≥ 150 mg/dL
3. Serum HDL levels: men < 40 mg/dL; women < 50 mg/dL
4. Blood pressure levels ≥ 130/85 mm Hg or on hypertensive medication
5. Fasting plasma glucose levels ≥ 100 mg/dL

Table 2-1

Comparison of WHO, NCEP ATP III, and IDF Definitions of the Metabolic Syndrome

Risk factors	WHO	NCEP ATP III	IDF
	DM*/IFG† or IGT‡ or IR# plus any ≥2 risk factors	Any ≥3 risk factors	Increased WC (ethnicity-specific) plus any ≥2 risk factors
Obesity	Waist-to-hip ratio >0.90 in men and >0.85 in women	WC ≥102 cm (40 in) in men or ≥88 cm (35 in) in women WC ≥90 cm (36 in) in men or ≥80 cm (32 in) in women for Asia population	WC criteria dependent on ethnicity
Triglycerides	≥150 mg/dL	≥150 mg/dL or drug treatment for reduced levels	≥150 mg/dL or drug treatment for reduced levels
HDL cholesterol	<35 mg/dL in men and <39 mg/dL in women	<40 mg/dL in men and <50 mg/dL in women or drug treatment for elevated level	<40 mg/dL in men and <50 mg/dL in women or drug treatment for elevated level
Blood pressure	≥140/90 mmHg	≥130 mmHg systolic or ≥85 mmHg diastolic or drug treatment for hypertension	≥130 mmHg systolic or ≥85 mmHg diastolic or drug treatment for hypertension
Fasting plasma glucose	IGT, IFG, or type 2 DM	≥100 mg/dL or drug treatment for DM	≥100 mg/dL or drug treatment for DM
Microalbuminuria	>30 mg albumin/g creatinine		

Note. *Criteria for the diagnosis of diabetes mellitus (DM): symptoms of DM plus casual plasma glucose level >199 mg/dL or fasting plasma glucose level >125 mg/dL or 2-hour plasma glucose level after75-gglucose load >199 mg/dL.

† IFG = impaired fasting glucose (fasting plasma glucose level, 100-125 mg/dL)

‡ IGT = impaired glucose tolerance (2-hour plasma glucose level after 75-g glucose load, 140-199 mg/dL

IR = insulin resistance

Table 2-2

Ethnicity-Specific Values for Waist Circumference

Ethnic group	Waist circumference (cm)
US American	Men: ≥102 Women: ≥88
European	Men: ≥94 Women: ≥80
South Asian	Men: ≥90 Women: ≥80
Chinese	Men: ≥90 Women: ≥80
Japanese	Men: ≥90 Women: ≥80
Native South and Central American	Use South Asian recommendations until more specific data are available
Sub-Saharan African	Use European data until more specific data are available
Eastern Mediterranean and Middle Eastern (Arab)	Use European data until more specific data are available

Etiology and Pathogenesis

The etiology of the metabolic syndrome has not been established definitively. Metabolic syndrome is now generally accepted that insulin resistance together with abdominal obesity is key features in the pathophysiology of the metabolic (Grundy et al., 2005). As a result of total body energy dysbalance, adipocytes in abdominal adipose tissue enlarge and start producing chemotactic factors, such as monocyte chemoattractant protein-1 (MCP-1) attracting monocytes/macrophages. Likewise, genetic variability in lipoprotein metabolism, blood pressure regulation and insulin sensitivity can influence the severity of metabolic risk factors that develop in response to obesity. For example, many

polymorphisms have been identified in genes regulating metabolic processes, and these have been reported to exacerbate the metabolic syndrome.

Disorders of adipose tissue. Most cases of the metabolic syndrome occur in people who are overweight or obese (Grundy, 2003). An excess of body fat is a reflection of overnutrition; the latter leads to accumulation of excess lipid in many tissues, the adipose tissue, muscle, liver and beta-cells of the pancreas. Excess lipid accumulation in adipose tissues appears to induce many of the biochemical changes that underlie the metabolic syndrome. First, an excess of fat in adipose tissue is accompanied by increased a release of several products into the circulation, notably, non-esterified fatty acids (NEFA), PAI-1 and proinflammatory cytokines. Releases of all of these factors appear to be greater in individuals in whom excess fat is located predominantly in the trunk and peritoneal cavity; this pattern of fat distribution is commonly called abdominal obesity. Increased release of NEFA from adipose tissue leads to accumulation of excess triglyceride in muscle and liver. Fat accumulation in muscle produces insulin resistance, whereas excess fat in the liver promotes atherogenic dyslipidemia (Grundy et al., 2005). Atherogenic dyslipidemia consists of an aggregation of lipoprotein abnormalities including elevated serum triglyceride and apolipoprotein B (apoB), increased small LDL particles, and a reduced level of HDL cholesterol (HDL-C). Increased release of PAI-1 and inflammatory cytokines from adipose tissue seemingly promotes a prothrom-botic state and proinflammatory state, respectively.

Finally, multiple mechanisms have been proposed whereby obesity raises the blood pressure. The impairments of endothelial function of microvascular structures have been demonstrated in obesity (Jonk et al., 2007). Obese subjects

showed blunted vasodilation in response to endothelium-dependent vasodilators in skin and resistance arteries, influencing increase of peripheral vascular resistance and blood pressure. As mentioned before, accumulation of excess subcutaneous fat in the trunk and/or excess visceral fat is associated with a worsening of the metabolic syndrome.

Insulin resistance. Insulin resistance is a generalized metabolic disorder in which the body cannot use insulin efficiently. Insulin resistance refers to the diminished ability of cells to respond to insulin in promoting the transport of the sugar glucose from blood into muscles and other tissues (Kim, Montagnani, Koh, & Quon, 2006). Factors that contribute to impaired insulin signal include obesity, inactivity, and aging (Whaley-Connell & Sowers, 2009).

Obese persons typically have increased insulin resistance. This is due in part to fat accumulation in muscle, which impairs glucose uptake. High levels of circulating cytokines also may interfere with insulin action. Genetic aberrations in insulin signaling pathways further may impair insulin action. When the latter are present, circulating insulin may not normally suppress triglyceride lipolysis in adipose tissue. The resultant high level of plasma NEFA will increase fat accumulation in liver and muscle. Both accumulations reduce sensitivity to insulin action. Patients with impaired fasting glucose (IFG) (≥110-125 mg/dL) and/or impaired glucose tolerance (IGT) (2-hour postprandial glucose 140-199 mg/dL) usually have insulin resistance and often exhibit the metabolic syndrome. When metabolic syndrome persons develop categorical hyperglycemia, i.e., fasting plasma glucose ≥126 mg/dL, the latter becomes an independent risk factor for CVD. In addition, some persons appear to have a genetic propensity to reduced insulin action. When this occurs,

failure to suppress adipose-tissue lipolysis by a genetic form of insulin resistance recapitulates the obese state, i.e., leads to an increased flux of NEFA and accumulation of fat in liver and muscle. This can worsen the metabolic syndrome.

Insulin resistance reduces insulin stimulation of endothelial cell nitric oxide (NO) production and increased NO destruction with resulting endothelial dysfunction and hypertension (Whaley-Connell & Sowers, 2009). It also reduces insulin stimulation of the activity of Na^+ -K^+ ATPase pump, which increases intracellular sodium (Na^+) (sodium retension). The reduced transmembrane Na^+ gradient causes decreased Na^+-Ca^{2+} exchange across the cell membrane, increase intracellular Ca^{2+}, and thereby causes vasoconstriction and hypertension (Lzzo, Sica, & Black, 2008). In addition, hyperinsulinemia has been postulated to raise blood pressure by sympathetic nervous and the renin angiotensin aldosterone system activation, and induction of vascular smooth muscle hypertrophy (Jonk et al., 2007).

Management of Metabolic Syndrome

The primary goals in the management of metabolic syndrome are to reduce risk for atherosclerotic disease and to prevent cardiovascular disease (Grundy et al., 2005). The risk factors include abdominal obesity, elevated plasma glucose and triglyceride level, decreased plasma HDL cholesterol, and elevated blood pressure. Comprehensive management of people with the metabolic syndrome incorporates a number of treatment modalities including lifestyle intervention, and pharmacological treatment (Grudy et al., 2005).

Lifestyle intervention. Lifestyle intervention is consistently regarded as the first-line treatment and the cornerstone of management of the metabolic syndrome

(Grudy et al., 2005). This recommendation, however, seems to have been built up exclusively on the assumption that, being key elements in the treatment of all components of the syndrome when they occur in isolation, lifestyle interventions promise to be an effective treatment for the metabolic syndrome as a whole (Giugliano, Ceriello, & Esposito, 2008).

The root causes of metabolic syndrome are an atherogenic diet, a sedentary lifestyle, and overweight or obesity (Giugliano et al., 2008). The main lifestyle interventions for the treatment of the metabolic syndrome include nutritional intervention, promotion of physical activity, and education. The main focus of a lifestyle intervention program for metabolic syndrome is to reduce the metabolic risk factors and improve adherence which are overweight and obesity especially abdominal obesity, physical inactivity and atherogenic diet.

Effective lifestyle change can reduce all of the metabolic risk factors. Currently, no randomized controlled trials specifically examining the treatment of metabolic syndrome have been published. Based on clinical trials, aggressive management of the individual components of the syndrome should make it possible to prevent or delay the onset of diabetes mellitus, hypertension, and cardiovascular disease (Deen, 2004). All patients diagnosed with metabolic syndrome should be encouraged to change their diet and physical activity habits as primary therapy. Weight loss improves all aspects of metabolic syndrome, as well as reducing all-cause and cardiovascular mortality (Grundy, 2003). Physical activity and dietary changes that can lower blood pressure and improve lipid levels will improve insulin resistance, even in the absence of weight loss.

Physical activity. Skeletal muscle is the most insulin-sensitive tissue in the body and, therefore, a primary target for impacting insulin resistance. Physical training has been shown to reduce skeletal muscle lipid levels and insulin resistance, regardless of BMI and waist circumference. The impact of exercise on insulin sensitivity is evident for 24 to 48 hours and disappears within three to five days (Holloszy, 2005). It induces improvement of insulin sensitivity and glucose uptake of skeletal muscles seem to be related to changes in insulin signaling in response to muscle contraction, such as increases translocation of GLUT4, glycogen synthesis activity, and glucose transporters to the cell surface, increases mitochondrial density in skeletal muscle, improves endothelial function, and alters muscle fiber type.

Regular physical activity prevents unhealthy weight gain and obesity. Evidence shows regular exercise related to decrease waist circumference and to decrease weight loss. Regular physical activity in the greatest amount of approximately 60 min per day over 3 months decreases waist circumference approximately 7.0 cm. and weight approximately 8.0 kg (Janiszewski, & Ross, 2007). Approximately 20 to 25 minutes of daily exercise is reported to reduce visceral fat by only 6% to 10%, which corresponded with a modest reduction in waist circumference (1.0-3.0 cm) and weight (1.4-1.8 kg) in overweight women and obese women with diabetes (Giannopoulou et al,. 2005).

Physical exercise decreases plasma triglyceride concentrations and increases plasma HDL cholesterol concentrations in relation to the degree of total energy expenditure (Thompson et al., 2003). Aerobic exercise in the amount of 30 to 60 minutes, 3 to 5 times per week, at a moderate intensity resulted in a mean increase

in HDL cholesterol levels of approximately 4% (0.05 mmol/L) and a decrease in triglyceride levels of approximately 12% (0.21 mmol/L) (Carroll & Dudfield, 2004).

Regular aerobic exercise has been shown to reduce blood pressure, the mechanism responsible for this remain largely unknown. Some evidence shows that exercise training is associated with a decrease in plasma nor-epinephrine levels, which may be responsible for the decrease in blood pressure (Mimura et al., 2005). Another postulated mechanism is that regular physical activity causes favorable changes in arterial structure, which would presumably reduce peripheral vascular resistance (Gates & Seals, 2006). Exercise training increase insulin sensitivity, which can decrease serum insulin and blood pressure (Schenk, Harber, Shrivastava, Burant, & Horowitz, 2009).

The main benefits of regular exercise training for patients with the metabolic syndrome relate to improve in muscle and liver insulin sensitivity, increased muscle glucose uptake, improved glycaemic control, improved lipid profile, reduced body weight, reduced blood pressure, positive effects on the thromboembolic state, and reductions in the overall cardiovascular risk.

Exercise prescription. People with metabolic syndrome should be encouraged to focus on improving their personal level of physical activity. The greatest health benefits occur when sedentary persons incorporate low to moderate-intensity exercise into their lifestyle (Deen, 2004). The goal for health care providers is to help patients find a level of activity that they can accomplish over the long-term. A combination of resistance and aerobic exercise is best, but any activity is better than none, and patients who have been sedentary need to start with walking and gradually increase duration and intensity.

The exercise prescriptions for people with metabolic syndrome are continuous or intermittent. Low (40% to 60% Heart Rate Reserve; HRR) to moderate (50% to 75% HRR) intensity aerobic exercise should be performed initially with goals of attaining energy expenditure goals (200-400 kcal per session) within reasonable time limits (45 to 60 min per session). Activities such as brisk walking, swimming, and cyclic are usually well tolerated by those with metabolic syndrome. Walking or light jogging for one hour per day will produce significant losses of abdominal (visceral) fat in men without caloric restriction (Slentz et al., 2004). Physical activity during the day (stair climbing, walking) is strongly encouraged.

Walking is the most common form of physical activity in most countries. Evidence from epidemiological studies and randomized control trial suggest that brisk walking is effective in improving metabolic and cardiovascular risk factors and in decreasing the risk of CVD and mortality (Jakicic, Marcus, Gallagher, Napolitano, & Lang, 2003). Health care practitioners and physical activity guidelines recommend walking 10,000 steps per day as an easy way to give people a goal of increasing their activity (Tudor-Locke & Bassett, 2004). Advising sedentary women to walk 10,000 steps per day is more effective at increasing daily exercise than is asking them to walk 30 minutes on most days of the week (Hultquist, Albright, & Thompson, 2007). In addition to advising them to walk 10,000 steps per day, the wearing of a pedometer may help individuals monitor their performance and motivate patients to increase their daily physical activity.

Resistance and flexibility exercise should be prescribed based on the presence of metabolic risk factors. In general, resistance exercise is 8-10 exercise for major muscle groups, 2 times per week, 12-15 repetition maximum (RM), and one set

(Ehrman, Gordon, Visich, & Keteyian, 2009). Use of low-weight dumbbells, elastic exercise bands, or even heavy food containers can provide the needed weight for resistance training. People with metabolic syndrome should be encouraged to minimize sedentary activities (e.g., television viewing) during leisure time and to replace those activities with activities such as walking, gardening, household chores, resistance training, or any activity that requires continual movement.

Diet.

Dietary intake. A series of recent scientific statements recommend the modification of atherogenictic diets as a major lifestyle intervention to reduce metabolic risk factors (Grudy et al., 2005). Dietary intake is so critical for most people with metabolic syndrome. Dietary intake is related to most components of metabolic syndrome, however, the sustained benefits of the diets have yet to be demonstrated. Benefits seen at 6 months, for example, are greatly reduced by 1 year in most studies (Dansinger, Gleason, Griffith, Selker, & Schaefer, 2005).

Specific dietary change for people with metabolic syndrome must include reduction of saturated fat intake to lower insulin resistance, reduction of sodium intake to lower blood pressure, and reduction of high glycemic index carbohydrate intake to lower triglyceride level. The diet should include more fruits, vegetable, whole grains, monounsaturated fats, and low-fat dairy products (Bianchi et al., 2008). In obese people with metabolic syndrome, weight loss was associated with decreased caloric intake and low-carbohydrate diet (Bravata et al., 2003). Reduction of saturated fats may be useful to improve insulin sensitivity since the increased level of free fatty acid, and the saturated to unsaturated fatty acids proportion plays an

important role in the development and maintenance of insulin-resistance (Riccardi, Giacco, & Rivellese, 2004).

Carbohydrate

Carbohydrate may cause problems with triacylglycerol, HDL cholesterol,and insulin/glucose homeostasis, particularly in insulin-resistant individuals (Melanson, 2008). It is important to recognize that such problems may be associated with the excess consumption of the wrong carbohydrates such as simple sugars (i.e., table sugar), but not with complex carbohydrates. Large proportions of complex carbohydrates (such as potatoes, breads, corn, etc.) in the diet are recommended (Pitsavos et al., 2006). High carbohydrate with low–glycemic index (GI) diets are effective for weight loss, blood pressure reduction, stabilizing triglyceride levels during weight loss, improving blood glucose levels, and diabetic control (Josse, Kendall, & Jenkins, 2007). Low-GI foods have been proposed to assist in weight regulation and reduce postprandial blood glucose levels, improve blood lipids, so they reduce the defining features of the metabolic syndrome and risk factors for other chronic diseases. Studies of low-GI diets suggest that such diets improve insulin sensitivity by decreasing insulin requirements after a meal and improve glucose control over the longer term with lower circulating glycosylated proteins, apolipoproteins, and clotting factors (Rizkalla et al., 2004). Short-term trials of low carbohydrate diets has been shown to weight loss, reduced triacylglycerols, and increased HDL cholesterol (Stone & Saxon, 2005). Carbohydrate appropriate for the metabolic syndrome have been proposed to include approximately 45% to 60% of carbohydrates from dietary sources that are less processed and refined and that are low in added sugars (Melanson, 2008).

High fiber diets

High fiber diets have been associated with decreased incidence of metabolic disorder such as hypertension, diabetes, and obesity. Whole-grain intake has been inversely associated with the metabolic syndrome in middle-aged populations and older adult (Sahyoun et al., 2006). The consumption of whole grains has been associated with increased insulin sensitivity and lower body mass index. Increases in dietary fiber, up to 20-38 grams per day or even higher, have been tested with varying degrees of success (Reaven, 2005).

Fat

Fat is a general term used to refer to oils, fats and waxes. Usually the daily energy intake consists of 30% fat, but no more than 10% of these calories should come from saturated (animal) fats. The residual energy should be obtained from polyunsaturated or monounsaturated oils (Pitsavos et al., 2006). Saturated fats promote dyslipidemias and, consequently atherogenesis. The consumption of unsaturated fats, derived mostly from vegetable oils such as safflower, corn, olive and soybean oil, may be able to prevent serious disorders, such as atherogenesis, hypertension and consequently the metabolic syndrome.

Protein

Proteins will make up the balance of energy in the diet, after accounting for fats and carbohydrates. Generally, this comes out to be about 15% of total energy intake (Melanson, 2008). Diets that are much higher in protein may be risky, since they are associated with kidney distress in susceptible individuals, which would include individuals with metabolic syndrome.

Dietary patterns. Recently, evidence-based nutritional recommendations for treatment and prevention of metabolic syndrome have been proposed. According to NCEP ATP III diet has been provided 30% of energy from fat (< 7% from saturated fat), 55% from carbohydrates, and 15% from protein, with < 200 mg cholesterol/day. Food rich in dietary fiber is strongly recommended, with a total dietary fiber intake ranged from 20 to 30 g, and about half of them in their soluble form (NCEP, 2002). Vegetables, legumes, fruits, and whole-grain cereals represent the most appropriate sources of carbohydrates. Several studies have shown that high intake of dietary fiber is associated with enhanced insulin sensitivity and whole grain and cereal fiber intakes were associated with reduced risk of metabolic syndrome (Bianchi et al., 2008).

Diets rich in fruits, vegetables, low-fat dairy products, whole grains, poultry, fish and nuts, with decreased amounts of red meat, sweets, sugar, cholesterol, total and saturated fat, i.e., a diet very similar to Dietary Approaches to Stop Hypertension (DASH) diet, is likely to reduce risk from most metabolic factors in patients with the metabolic syndrome (Azadbakht, Mirmiran, Esmaillzadeh, Azizi, & Azizi, 2005). The DASH diet for people with metabolic syndrome has reduced calories and increased consumption of fruit, vegetables, low-fat dairy and whole grains, and it is lower in saturated fat, total fat, and cholesterol and restricted to 2,400 mg of sodium. It was associated with higher high-density lipoprotein (HDL) cholesterol levels, lower triglyceride levels, systolic blood pressure, diastolic blood pressure, weight, and fasting blood glucose. Moreover, moderate alcohol consumption can reduce systolic blood pressure., moderate alcohol intake has been associated with lower prevalence of metabolic syndrome, favorable influence on

lipids, waist circumference, and fasting insulin (Bianchi et al., 2008). Still, alcoholic beverages should be limited to no more than 2 drinks per day for men and 1 drink per day for women usually taken during meals. Greater alcohol consumption has been associated with high risk of overweight and obesity.

The Mediterranean diet is very similar to the DASH diet, can significantly improve all components of metabolic syndrome (Serra-Majem, Roman, & Estruch, 2006). These diets are rich in whole grains, fruit, vegetables, nuts, and omega-3 fatty acids but low in refined grains and saturated and trans fats that was associated with avoiding metabolic syndrome (Rumawas, Meigs, Dwyer, McKeown, & Jacques, 2009). Such diets advocate total fat to comprise 25% to 35% of total energy intake. Saturated fats, which have been shown to impair insulin sensitivity, should contribute < 7% of total energy intake. Accordingly, monounsaturated and polyunsaturated fats should contribute less than 20% and 10% of total energy intake, respectively. Artificial trans fats should be avoided, and dietary cholesterol should be minimized (<200 mg/day). Omega-3 fatty acids may have beneficial effects on plasma triacylglycerols and high-density lipoprotein (HDL) cholesterol. Their main food sources include fatty fish, canola oil, flax seed oil, walnuts, and soy. Consumption of the Mediterranean diet by people with metabolic syndrome has been associated with improvement of endothelial function and reduction of markers of systemic vascular inflammation. They may also help improve insulin sensitivity, fasting plasma glucose, waist circumference, reduce blood pressure, and decrease small low-density lipoprotein (LDL) and triglycerides, and higher high-density lipoprotein cholesterol. See table 3 for advising nutrition compositions of diet for people with metabolic syndrome.

Table 2-3

Nutrition Compositions of Diet for People with Metabolic Syndrome

Nutrition	Recommended intake
Saturated fat	Less than 7% of total calories
Trans fatty acid	Less than 1% of total calories
Polyunsaturated fat	Up to 10% of total calories
Monounsaturated fat	Up to 20% of total calories
Total fat	25%-35% of total calories
Carbohydrate	45%-60% of total calories
Fiber	20-38 g/day or even higher
Protein	10%-15% of total calories
Cholesterol	Less than 200 mg/day
Total energy calories	Balance energy intake and expenditure
Sodium	restricted to 2400 mg/day
Alcoholic beverages	no more than 2 drinks per day for men and 1 drink per day for women

Exercise training combined with nutritional intervention is the cornerstones of a lifestyle intervention program for metabolic syndrome and should therefore be a mandatory component of such a lifestyle intervention program.

Pharmacological management. Weight loss medications currently approved by the Food and Drug Administration (FDA) include sibutramine (Meridia) and orlistat (Xenical) for long-term use and phentermine for short-term use. Rimonabant represents a new class of drugs (selective endocannabinoid CBI receptor antagonist) that has shown to produce weight loss and improvements in metabolic syndrome components independent of weight loss. Besides pharmacological management is useful in the management of hyperlipidemia, insulin resistance, and

hypertension that may be associated with metabolic syndrome. Statin medications have been shown to lower LDL cholesterol and reduce the risk of cardiovascular disease events in patients with metabolic syndrome. Triglyceride lowering classes of drugs such as fibrates and nicotinic acid have also been reported to decrease the risk of cardiovascular disease events in patients with metabolic syndrome. Besides lowering plasma level of triglycerides, fibrate types of medications have also been shown to lower plasma levels of LDL cholesterol and increase plasma levels of HDL cholesterol. This effect is particularly beneficial in metabolic syndrome in which plasma HDL cholesterol levels are often below acceptable levels. See table 4 for commonly used medications in people with metabolic syndrome.

Table 2-4

Medications Commonly Prescribed for People with Metabolic Syndrome

Medications	Class and Primary effect	Other effects
Telmisartan, Irbesartan, Valsartan	Angiotensin II receptor blocker Blood pressure	↓ Exercise blood pressure ↓ Resting blood pressure
Lovastatin, Simvastatin, Pravastatin, Rosuvastatin	Statins Lipid lowering	↓ LDL cholesterol ↑ HDL cholesterol (some)
Gemfibrozil, Fenofibrate	Fibrates Lipid lowering	↓ Triglyceride ↑ HDL cholesterol
Niacin	Nicotinic acid Increase in HDL	↓ Total cholesterol ↓ LDL cholesterol ↓ Triglyceride
Omega-3-fatty acid	Fish oil	↓ Triglyceride ↑ Insulin resistance
Metformin	Oral antihyperglycemic	
Rimonabant	Selective CB1 endocanabenoid receptor antagonist Weight reduction	↑ Metabolic risk control independent of waist circumference

Eating Behaviors

For dietary change, there is a need for a greater understanding of the determinants that affect food choice and intake. This review shows the major influences on food choice and intake with a focus on those that are responsive to change.

Determines of Food Choice and Intake

Some of the other factors that influence food choice include: 1) Biological determinants such as hunger, appetite, and taste; 2) Economic determinants such as cost, income, availability; 3) Physical determinants such as access, education, skills (e.g. cooking) and time; 4) Social determinants such as culture, family, peers and meal patterns; 5) Psychological determinants such as mood, stress and guilt; 6) Attitudes, beliefs and knowledge about food; 7) Environmental factors such as such as package size, plate shape, lighting, variety, or the presence of others. Food choice factors also vary according to life stage and the power of one factor will vary from one individual or group of people. Intervention to modify food choice behavior will consider to the many factors influencing people's decisions on food choice.

Biological determinants.

Hunger and satiety. Physiological needs provide the basic determinants of food choice. Humans need energy and nutrients in order to survive and will respond to the feelings of hunger and satiety (satisfaction of appetite, state of no hunger between two eating occasions). The central nervous system is involved in controlling the balance between hunger, appetite stimulation and food intake.

The macronutrients such as carbohydrates, proteins and fats generate satiety signals of varying strength. The balance of evidence suggests that fat has the lowest satiating power, carbohydrates have an intermediate effect and protein has been found to be the most satiating (Stubbs, van Wyk, Jonnstone, & Harbron, 1996).

The energy density of diets has been shown to exert potent effects on satiety; low energy density diets generate greater satiety than high energy density diets. The high energy density of high fat and/or high sugar foods can also lead to 'passive overconsumption', where excess energy is ingested unintentionally and without the consumption of additional bulk. An important satiety signal may be the volume of food or portion size consumed. Many people are unaware of what constitutes appropriate portion sizes and thus inadvertently consume excess energy.

Palatability. Palatability is proportional to the pleasure someone experiences when eating a particular food. It is dependent on the sensory properties of the food such as taste, smell, texture and appearance. Sweet and high fat foods have an undeniable sensory appeal. It is not surprising then that food is not solely regarded as a source of nourishment but is often consumed for the pleasure value it imparts.

The influence of palatability on appetite and food intake in humans has been investigated in several studies. There is an increase in food intake as palatability increases, but the effect of palatability on appetite in the period following consumption is unclear. Increasing food variety can also increase food and energy intake because of testing new foods (Sorensen, Moller, Flint, Martens, & Raben, 2003). However, effects on long term energy regulation are unknown.

Sensory aspects. Taste is consistently reported as a major influence on food behavior. In reality 'taste' is the sum of all sensory stimulation that is produced

by the ingestion of a food. This includes not only taste but also smell, appearance and texture of food. These sensory aspects are thought to influence, in particular, spontaneous food choice. From an early age, taste and familiarity influence behavior towards food. A liking for sweetness and a dislike for bitterness are considered innate human traits, present from birth (Steiner, 1977). Taste preferences and food aversions develop through experiences and are influenced by our attitudes, beliefs and expectations (Clarke 1998).

Economic and physical determinants of food choice.

Cost and accessibility. There is no doubt that the cost of food is a primary determinant of food choice. Whether cost is prohibitive depends fundamentally on a person's income and socioeconomic status. Low income groups have a greater tendency to consume unbalanced diets and in particular have low intakes of fruit and vegetables (Irala-Estevez et al., 2000). However, access to more money does not automatically equate to a better quality diet but the range of foods from which one can choose should increase.

Accessibility to shops is another important physical factor influencing food choice, which is dependent on resources such as transport and geographical location. Healthy food tends to be more expensive when available within towns and cities compared to supermarkets on the outskirts (Donkin, Dowler, Stevenson, & Turner, 2000). However, improving access alone does not increase purchase of additional fruit and vegetables, which are still regarded as prohibitively expensive (Dibsdall, Lambert, Bobbin, & Frewer, 2003).

Education and knowledge. Studies indicate that the level of education can influence dietary behavior during adulthood (Kearney, Jearney, Dunne, & Gibney,

2000). In contrast, nutrition knowledge and good dietary habits are not strongly correlated. This is because knowledge about health does not lead to direct action when individuals are unsure how to apply their knowledge. Furthermore, information disseminated on nutrition comes from a variety of sources and is viewed as conflicting or is mistrusted, which discourages motivation to change (De-Almeida, Graca, & Lappalained, 1997). Thus, it is important to convey accurate and consistent messages through various media, on food packages and of course via health professionals.

Social determinants of food choice.

Influence of social class. What people eat is formed and constrained by circumstances that are essentially social and cultural. Population studies show there are clear differences in social classes with regard to food and nutrient intakes. Poor diets can result in under (micronutrients deficiency) and over nutrition (energy over consumption resulting in overweight and obesity); problems that face different sectors of society, requiring different levels of expertise and methods of intervention.

Cultural influences. Cultural influences lead to the difference in the habitual consumption of certain foods and in traditions of preparation, and in certain cases can lead to restrictions such as exclusion of meat and milk from the diet. Cultural influences are however amenable to change: when moving to a new country individuals often adopt particular food habits of the local culture.

Social context. Social influences on food intake refer to the impact that one or more persons have on the eating behavior of others, either direct (buying food) or indirect (learn from peer's behavior), either conscious (transfer of beliefs) or subconscious. Even when eating alone, food choice is influenced by social factors

because attitudes and habits develop through the interaction with others. However, quantifying the social influences on food intake is difficult because the influences that people have on the eating behavior of others are not limited to one type and people are not necessarily aware of the social influences that are exerted on their eating behavior (Feunekes, de Graff, Meyboom, & van Staveren, 1998).

Social support can have a beneficial effect on food choices and healthful dietary change (Devine, Connors, Sobal, & Bisogni, 2003). Social support from within the household and from coworkers was positively associated with improvements in fruit and vegetable consumption (Sorensen, Hunt, et al., 1998) and with the preparative stage of improving eating habits, respectively (Sorensen, Stoddard, & Macario, 1998). Social support may enhance health promotion through fostering a sense of group belonging and helping people to be more competent and self-efficacious (Berkman, 1995).

The family is widely recognized as being significant in food decisions. Research shows the shaping of food choices taking place in the home. Because family and friends can be a source of encouragement in making and sustaining dietary change, adopting dietary strategies which are acceptable to them may benefit the individual whilst also having an effect on the eating habits of others (Anderson et al., 1998).

Social setting. Although the majority of food is eaten in the home, an increasing proportion is eaten outside the home, e.g. in schools, at work and in restaurants. The venue in which food is eaten can affect food choice, particularly in terms of what foods are on offer. The availability of healthy food at home and 'away from home' increases the consumption of such foods. However, access to healthy

food options is limited in many work/school environments. This is particularly true for those with irregular hours or with particular requirements, e.g. vegetarian (Faugier, Lancaster, Pickles, & Dobson, 2001). With the majority of adult women and men in employment, the influence of work on health behaviors such as food choices is an important area of investigation (Devine et al., 2003).

Meal patterns. People have many different eating occasions daily, the motivations for which will differ from one occasion to the next. Most studies investigate the factors that influence habitual food choice but it may be useful to investigate what influences food choice at different eating occasions.

The effects of snacking on health have been debated widely. Evidence shows that snacking can have effects on energy and nutrient intakes but not necessarily on body mass index (Hampl, Heaton, & Taylor, 2003). However, normal weight and overweight individuals may differ in their coping strategies when snack foods are freely available and also in their compensatory mechanisms at subsequent meals. Moreover, snack composition may be an important aspect in the ability of individuals to adjust intake to meet energy needs.

Helping young adults to choose healthy snack choices poses a challenge to many health professionals. In the home, rather than forbidding unhealthy snacks, a more positive approach may be the introduction of healthy snack options over time. Moreover, healthy food choices outside the home also need to be made more readily available.

Psychological factors.

Stress. Psychological stress is a common feature of modern life and can modify behaviors that affect health, such as physical activity, smoking or food choice.

The influence of stress on food choice is complex not least because of the various types of stress one can experience. The effect of stress on food intake depends on the individual, the stressor and the circumstances. In general, some people eat more and some eat less than normal when experiencing stress (Oliver & Wardle, 1999).

The proposed mechanisms for stress induced changes in eating and food choice are motivational differences (reduced concern about weight control), physiological (reduced appetite caused by the processes associated with stress) and practical changes in eating opportunities, food availability and meal preparation. Studies also suggest that if work stress is prolonged or frequent, then adverse dietary changes could result, increasing the possibility of weight gain and consequently cardiovascular risk (Wardle, Steptoe, Oliver, & Lipsey, 2000).

Mood. Today it is recognized that food influences our mood and that mood has a strong influence over our choice of food. Interestingly, it appears that the influence of food on mood is related in part to attitudes towards particular foods. The ambivalent relationship with food – wanting to enjoy it but conscious of weight gain is a struggle experienced by many. Dieters, people with high restraint and some women report feeling guilty because of not eating what they think they should (Dewberry & Ussher, 1994). Moreover, attempts to restrict intake of certain foods can increase the desire for these particular foods, leading to what are described as food cravings. Women more commonly report food cravings than do men. Depressed mood appears to influence the severity of these cravings. Reports of food cravings are also more common in the premenstrual phase, a time when total food intake increases and a parallel change in basal metabolic rate occurs (Dye & Blundell,

1997). Thus, mood and stress can influence food choice behavior and possibly short and long term responses to dietary intervention.

Consumer attitudes, beliefs, knowledge and optimistic bias.

Consumer attitudes and beliefs. In both the areas of food safety and nutrition, our understanding of consumers' attitudes are poorly researched (Gibney, 2004). A better understanding of how the public perceive their diets would help in the design and implementation of healthy eating initiatives. The PanEuropean Survey of Consumer Attitudes to Food, Nutrition and Health found that the top five influences on food choice in 15 European member states are 'quality/freshness' (74%), 'price' (43%), 'taste' (38%), 'trying to eat healthy' (32%) and 'what my family wants to eat' (29%). These are average figures obtained by grouping 15 European member states results, which differed significantly from country to country. In the USA the following order of factors affecting food choices has been reported: taste, cost, nutrition, convenience and weight concerns (Glanz, Kristal, Tilley, & Hirst, 1998).

In the PanEuropean study, females, older subjects, and more educated subjects considered 'health aspects' to be particularly important. Males more frequently selected 'taste' and 'habit' as main determinants of their food choice. 'Price' seemed to be most important in unemployed and retired subjects. Interventions targeted at these groups should consider their perceived determinants of food choice.

Attitudes and beliefs can and do change; our attitude to dietary fat has changed in the last 50 years with a corresponding decrease in the absolute amount of fat eaten and a change in the ratio of saturated to unsaturated fat.

Optimistic bias. There is a low level of perceived need among European populations to alter their eating habits for health reasons, 71% surveyed believing that

their diets are already adequately healthy (Kearney et al., 1997). This high level of satisfaction with current diets has been reported in Australian (Worsley & Crawford, 1985), American (Cotugna, Subar, Heimendinger, & Kahle, 1992) and English subjects (Margetts, Thompson, Speller, & McVey, 1998). The lack of need to make dietary changes, suggest a high level of optimistic bias, which is a phenomenon where people believe that they are at less risk from a hazard compared to others. This false optimism is also reflected in studies showing how people underestimate their likelihood of having a high fat diet relative to others (Gatenby, 1996) and how some consumers with low fruit and vegetable intakes regard themselves as 'high consumers' (Cox et al., 1998). If people believe that their diets are already healthy it may be unreasonable to expect them to alter their diets, or to consider nutrition/healthy eating as a highly important factor when choosing their food. Although these consumers have a higher probability of having a healthier diet than those who recognize their diet is in need of improvement, they are still far short of the generally accepted public health nutrition goals (Gibney, 2004). It is also unlikely that these groups will be motivated further by dietary recommendations. Hence, future interventions may need to increase awareness among the general population that their own diet is not wholly adequate in terms of, for example fat, or fruit and vegetable consumption (Cox et al., 1998). For those who believe their diets to be healthy it has been suggested that if their beliefs about outcomes of dietary change can be altered, their attitudes may become more favorable and they therefore may be more likely to alter their diets (Paisley, Lloyd, Sparks, & Mela, 1995). Thus, a perceived need to undertake change is a fundamental requirement for initiating dietary change (Kearney et al. 1997).

Environmental factors. Environmental factors (such as package size, plate shape, lighting, variety, or the presence of others) that can influence the consumption volume of food more than most people realize (Wansink, 2004).

Portion size. Restaurant or foodservice have been increasing sizes more than current size, especially when foodservices introduce the new product, thereby making it harder for consumers to control the portion size. Consumers are gradually increasing portion size than consumption norms (Wansink & Van Ittersum, 2007). There is also found that fast-food chains offered portions that were 2-5 times larger than when their products were originally launched, supportive of increasing consumer expectations for portion sizes (Schwartz & Byrd-Bredbenner, 2006).

Dishware and utensil sizes. Dishware has increased in size, causing difficulty in estimating appropriate portion sizes. The vertical–horizontal illusion, which affects liquid portion sizes, gives the impression that a tall, slender glass holds more liquid than a short, wide glass. Wansink and Van Ittersum (2007) demonstrated that both children and adults consumed more when drinking from a short, wide glass than from a tall, slender glass, even though they perceived the opposite to be true. The size of plates, bowls, and spoons can contribute to a context effect known as the Delboeuf illusion (Wansink & Van Ittersum, 2007). The Delboeuf illusion is likened to the amount of empty space on a plate of food. For example, the same amount of food appears to be a smaller portion if it is served on large plate rather than a smaller plate.

Barriers to Dietary and Lifestyle Change

Focus on cost. Household income and the cost of food is an important factor influencing food choice, especially for low income consumers. The potential for food wastage leads to reluctance to try 'new' foods for fear the family will reject them. In addition, a lack of knowledge and the loss of cooking skills can also inhibit buying and preparing meals from basic ingredients. Education on how to increase fruit and vegetable consumption in an affordable way such that no further expense, in money or effort, is incurred has been proposed as a solution (Dibsdall et al., 2003). Efforts of governments, public health authorities, producers and retailers to promote fruit and vegetable dishes as value for money could also make a positive contribution to dietary change (Cox et al., 1998).

Time constraints. Lack of time is frequently mentioned for not following nutritional advice, particularly by the young and well educated (Lappalainen et al., 1997). People living alone or cooking for one seek out convenience foods rather than cooking from basic ingredients. This need has been met with a shift in the fruit and vegetables market from loose to prepacked, prepared and ready to cook products. These products are more expensive than loose products but people are willing to pay the extra cost because of the convenience they bring. Developing a greater range of tasty, convenient foods with good nutritional profiles offers a route to improving the diet quality of these groups.

The Appropriate Tool for Dietary Assessment

The appropriate tool for dietary assessment will depend on the purpose for which it is needed. The purpose may be to measure nutrients, foods or eating habits. Exploration of eating behaviors may be helpful to understand the process of achieving dietary change. Many different methods have been developed for the purpose of assessing dietary intake. These range from detailed individual weighed records collected over a period of 7 days or more to food frequency questionnaires, household survey methods and simple food lists.

In general the procedure for measuring energy and nutrient intake involves: 1) A report of all food consumed by an individual; 2) Identification of the foods such that an appropriate item can be chosen from standard food tables. A duplicate portion of the food may be chemically analyzed to find out the nutrient content; 3) Quantification of the portion size of each food item; 4) Determination of the frequency with which each food is eaten; 5) Calculation of the nutrient intake (portion size (g) x frequency x the nutrient content per g) (Rutishauser & Black, 2002).

Weighed Food Records. Food records, also called food diaries, require that the individual (or observer) report all foods and beverages consumed for a specified period. This also involves an individual or an investigator weighing each and every item of food and drink prior to consumption. A detailed description of the food and its weight is recorded in a specially designed booklet. Usually a space is left to record any leftovers so that the precise weight of food eaten can be calculated. Weighed records can be kept for one to seven days. The 7 day weighed record has often been taken as the ‘gold standard’ against which less detailed and demanding

methods can be compared. This method has strengths in widely used method and precision of portion sizes. It also has limitations such as high respondent burden, miss reporting, and food composition data limited. For example, to estimate intake of a food component found only in animal products, food records might be limited to foods containing meat, poultry, fish, eggs or dairy products (Food and Agriculture Organization, 2009).

Estimated Food Records. This is similar to the weighed food record method except that the quantification of the foods and drink is estimated rather than weighed. This estimation is carried out using household measures such as plate, cups or spoons; food photographs; and food models. The investigator converts these estimates into weights that can then be used to calculate food and nutrient intake. The strengths of this method are widely used method and lower respondent burden than weighed food diaries. The limitations of this method are miss estimation of portion sizes, miss reporting, expensive, and food composition data limited. An extended of this method found in The EPIC study which used a 7 day estimated food diary with portion sizes being recorded using household measures and color photographs (Leitz, Barton, Longbottom, & Anderson, 2002).

24 Hour Recall. The 24-hour dietary recall consists of a listing of foods and beverages consumed the previous day or the 24 hours prior to the recall interview. Foods and amounts are recalled from memory with the aid of an interviewer who has been trained in methods for soliciting dietary information. As a retrospective method it relies on an accurate memory of intake, reliability of the respondent not to under / misreport, and an ability to estimate portion size. This may be helped by the interviewer prompting the respondent to remember eating and drinking episodes by

time periods (e.g. starting on awakening), or linking to day time activities (e.g. arriving at work). In addition the interviewer may use prompts to assist the respondent to estimate portion sizes of the items consumed. The interviewer records the dietary information which at the end is checked for omission or errors and is then coded for analysis.

The interview is usually conducted face to face, but may also be conducted by telephone. In some situations, the recall is self-administered by the subject, but this approach may not yield sufficiently reliable data. A brief activity history may be incorporated into the interview to facilitate probing for foods and beverages consumed. This method can also be administered by telephone. The primary limitation of this method is that recording consumption for a single day is seldom representative of a person's usual intake due to day-to-day variation provides poor measure of individual intake. In addition, it has weakness include memory dependent, bias in recording "good/bad" foods, and estimation of portion sizes. An extended and more accurate version of this method is the Multiple Pass 24 hour recall (Reilly, Montgomery, Jackson, MacRitchie, & Armstrong, 2001).

Multiple Pass Recall. This method was developed to assess diet and nutrition in large population studies include National Health and Nutrition Examination Study (NHANES) and the Continuing Survey of Food Intakes by Individuals (CSFII). In the USA it has been used to assess the diets of children and adults. The diet is assessed over a period of three to five days during which the respondent is asked to recall and describe all food and drinks consumed in the 24 hour prior to the interview. Interviews can be a combination of face to face and telephone. The *multiple pass* refers to the steps involved during interview to allow revisiting and

checking of dietary information: in the *first pass*, a quick list of foods consumed is obtained; in the *second pass*, information about the 5 meal / snacks consumed (including time and place) are recorded. The *third pass* prompts for foods that may have been forgotten. Finally a review of the record and further details of foods consumed and portion sizes are completed. The method has been modified over the past five year with the specific aim to minimize under-reporting and the burden on respondents (Reilly et al., 2001). The strengths of this method are improved precision compared with 24 hour recall, low respondent burden, suitable for large scale surveys, and can be administered by telephone. The weaknesses are estimation of portion sizes, bias in recording "good/bad" foods, and memory dependent.

Food Frequency Questionnaires (FFQ). A food frequency questionnaire (FFQ), sometimes referred to as a "list-based diet history", consists of a structured listing of individual foods or food groupings (Haraldsottir, Holm, Astrup, Halkjoer, & Stender, 2001). For each item on the food list, the respondent is asked to estimate the frequency of consumption based on specified frequency categories which indicate the number of times the food is usually consumed per day, week, month or year. FFQs normally ask about intake within a given time frame (e.g. in the past 2-3 months, 1 year or longer) and therefore aim to capture habitual intake. FFQs are generally self-administered but may also be interviewer-administered. The number or types of food items may vary depending on the nutrients or foods of interest, as well as the number and types of frequency categories. FFQs may be unquantified, semi-quantified or completely quantified. The unquantified questionnaire does not specify serving sizes, whereas the semi-quantified tool provides a typical serving size as a reference amount for each food item. A quantified FFQ allows the respondent to indicate any amount

of food typically consumed. Some FFQs include questions regarding usual food preparation methods, trimming of meats, use of dietary supplements, and identification of the most common brand of certain types of foods such as margarines or ready-to-eat cereals. The answers to these questions are then incorporated into the calculation of nutrient intakes. FFQs are commonly used to rank individuals by intake of selected nutrients. Although FFQs are not designed for estimating absolute nutrient intakes, the method may be more accurate than other methods for estimating average intake of those nutrients having large day-to-day variability and for which there are relatively few significant food sources (e.g. alcohol, vitamin A and vitamin C). Brief FFQs may focus on one or several specific nutrients. Comprehensive FFQs designed to estimate a large number of nutrients generally include between 50 and 150 food items. The strengths of this method are low respondent burden, suitable for large scale surveys, can be self completed, and can be posted. The weaknesses of this method are estimation of portion sizes, possible over-reporting of 'healthy' foods, and requires to be validated in relation to reference method.

Diet histories. The meal-based diet history is designed to assess usual individual intake. It consists of a detailed listing of the types of foods and beverages commonly consumed at each eating occasion over a defined time period which is often a "typical" week. A trained interviewer probes for the respondent's customary pattern of food intake on each day of the typical week. The reference time frame is often the past month or the past several months, or may reflect seasonal differences if the time frame is the past year.

Food habit questionnaires. Food habit questionnaires are designed to collect either general or specific types of information, such as food perceptions and

beliefs, food likes and dislikes, methods of preparing foods, use of dietary supplements, social settings surrounding eating occasions. This type of information is frequently included along with the other four methods, but it may also be used as the sole data collection method. These approaches are commonly used in rapid assessment procedures (RAP). The questionnaires may be open-ended or structured, self- or interviewer-administered, and may include any number of questions depending on the information required.

Household Food Surveys. A number of surveys aim to collect information about dietary intake at the household level such as market research surveys relating to food purchases trends (Ransley et al., 2001). Such data are useful for comparing food availability among different communities, geographic areas and socioeconomic groups, and for tracking dietary changes in the total population and within population subgroups. However, these data do not provide information on the distribution of foods among individual members of the household. The strengths of this method are suitable for large scale surveys and designed for monitoring diet trends at the population level. The weakness is the data not reflected at the individual level.

National food supply data. Food supply data at the national level, such as food balance sheets or food disappearance data provide gross estimates of the national availability of food commodities (Food and Agriculture Organization, 2009). These data may also be used to calculate the average per capita availability of energy and the macronutrients. A major limitation of national supply data is that they reflect food availability rather than food consumption. Other uses, such as animal feed and industrial applications, as well as losses due to cooking or processing, spoilage and other sources of waste are not easily accounted for. Despite these limitations, national

food supply data are useful for tracking trends in the food supply and for determining availability of foods that are potentially good sources of nutrients or of food groups targeted for dietary guidance. Food supply data are not useful for evaluating individual adherence to dietary reference values and for identifying subgroups of the population at risk of inadequate nutrient intakes.

Table 2-5

Summary Dietary Assessment Methods

Type of method	Strengths	Limitations
Food record	Does not rely on memory Easy to quantify amounts Open-ended May alter intake behavior	High participation burden Miss reporting Food composition data limited Requires literacy
24-h dietary recall	Little respondent burden No literacy requirement Can be administered by telephone	Seldom representative of a person's usual intake Relies on memory Requires skilled interviewer Difficulty to estimate amounts Does not alter intake behavior
Food frequency questionnaire	Low respondent burden Suitable for large scale surveys Can be self completed Relatively inexpensive Preferable method for nutrients with very high day variability	Relies on memory Requires complex calculations To day to estimate frequencies Estimation of portion sizes Requires literacy Limited flexibility for describing foods Possible over-reporting Does not alter intake behavior
Diet history (meal-based)	No literacy requirement Open-ended	Relies on memory Requires highly trained Interviewer Difficulty to estimate amounts Does not alter intake behavior

Table 2-5 (continued)

Type of method	Strengths	Limitations
Food habit	Rapid and low cost Open-ended	May rely on memory Questionnaires May require a trained interviewer Does not alter intake behavior
Household Food Surveys	Suitable for large scale Surveys Monitoring diet trends at the population level	Not reflected at the individual level.
National food supply data	Reflect food availability Tracking trends in the food supply	Not reflect food consumption Not useful for evaluating individual adherence to dietary

In summary, to measure food intake by using one method, it is possible to miss out some data. Combined methods different types of dietary assessment methods may improve accuracy and facilitate interpretation of the dietary data. In this study, Estimated Food Records and Food Frequency Questionnaires will be used for dietary assessment.

Physical Activity

Currently, the well-known benefits of physical activity, most adults, older adults, and elderly lead a relatively sedentary lifestyle and are not active enough to achieve these health benefits. It is critically important to understand the factors that influence participation in physical activity for promoting appropriate activities and preventing were barriers to activity. Before describe the factors that influence participation in physical activity, we will describe the term usually use in the field of physical activity.

Terms

The terms "physical activity" and "exercise" have often been used interchangeably

Physical activity. Physical activity is any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a basal level. Among the ways physical activity can be categorized is according to mode, intensity, and purpose (President's Council on Physical Fitness and Sports, 1996). With regard to classification by "purpose," physical activity frequently is categorized by the context in which it is performed. Commonly used categories include occupational, leisure-time or recreational, household, self-care, and transportation or commuting activities. In some studies, sports participation or "exercise training" is assessed and analyzed separately from other leisure-time activities.

Exercise. Exercise is a subcategory of physical activity that is "planned, structured, and repetitive and purposive in the sense that the improvement or

maintenance of one or more components of physical fitness is the objective" (Caspersen, Powell, Christenson, 1985). Exercise and exercise training frequently are used interchangeably and generally refer to physical activity performed during leisure time with the primary purpose of improving or maintaining physical fitness, physical performance, or health.

Other Terms that Describe Additional Types of Physical Activity or Exercise are Defined

Active living. Active living is a way of life that integrates physical activity into daily routines. The goal is to accumulate at least 30 minutes of activity each day. Individuals may do this in a variety of ways, such as walking or cycling for transport; exercise for pleasure and fitness; participating in sports (both organized and informal); playing in the park; working in the garden; taking the stairs; and using recreational facilities (WHO, 2006).

Leisure-time physical. Leisure-time physical activity is an individual's discretionary time or time left after completion of work, traveling, domestic chores and personal hygiene (Armstrong, & Bauman, 2000).

Lifestyle activities. Lifestyle activities are any nonstructural form of physical activity performed that is not intended to constitute a structured period of exercise (Donnelly et al., 2009).

Light exercise. U.S. Department of Health and Human Services (2008) defined light exercise as exercise or other activities that caused a light increase in the heart rate or breathing of respondents or it refers to the physical activity requiring much energy or intensity as <3.0 Metabolic Equivalents (METs).

Moderate exercise. U.S. Department of Health and Human Services (2008) defined moderate exercise as exercise or other activities that caused a moderate increase in the heart rate or breathing of respondents or it refers to the physical activity requiring much energy or intensity as 3.0 to 6.0 Metabolic Equivalents (METs).

Vigorous exercise. U.S. Department of Health and Human Services (2008) defined vigorous exercise as hard exercise or other activities that made one breathe heavily and made the large increase in the heart rate or it refers to the physical activity requiring much energy or intensity as ≥6.0 Metabolic Equivalents (METs).

Energy expenditure. Energy expenditure is an estimate of the energy costs of physical activity derived from reports, observation or indirect objective assessments of people's activity levels.

METs (Metabolic Equivalence). Metabolic Equivalence is a unit used to estimate the metabolic cost (oxygen consumption) of physical activity. One MET is defined as the energy expenditure for sitting quietly, which for the average adults is 1 kilocalorie body weight in kg-1hr-1or 3.5 ml of oxygen body weight in kg-1min-1. MET are used as an index of the intensity of activities (Ainsworth et al., 2000).

Factors that Influence Physical Activity Behavior

The factors that influence physical activity are categorized into three parts

Demographic and Biological factors. The prevalence of regular physical activity varies according to demographic characteristics.

Age. The topic of aged difference in physical activity was studied by many investigators. Those studies were revealed that activity levels tend to decline with

age. For example, the proportion of the population aged 15 years and over who met physical activity guidelines (ie were physically active for at least 30 minutes a day on five or more days over the last week), as measured by the 2006/2007 New Zealand Health Surveys (2009), founded that was highest for age groups under 35 years and lowest for age groups over 65 years. Only for those aged 75 years and over were the proportions significantly lower than the rate for all ages. It is similar in Thailand, a survey by the Institute of Nutrition, Mahidol University (2007) explored the level of physical activity per day in Thai people and revealed that the prevalence of exercise decreased with age. Between the ages of 30 and 34 have higher engaged in physical activity and above 60 year of age have lower engaged. The decrease activity should be the decline of biological. Many of the physiological changes with ages such as the cardiovascular system, the respiratory system, and the muscular system may more appropriately be associated with sedentary lifestyles. These changes include loss of flexibility, decreased bone and muscle mass, and decreased ability of the cardiac and respiratory systems to adapt to more intense physical activity (Skinner, 2006). Ageing is likely to have some effect on the physiological ability to participate in some forms of activity (Slingerland et al., 2007). However, few studies have attempted to determine all types and intensities of physical activity depend on age. Older adults differ from younger adults and children in the type and intensity of activities in which they engage. They spend a higher percentage of their day performing low intensity activities and a lower percentage performing high intensity activities (Westerterp, 2008). Investigator will provide a rationale for designing interventions to counter these specific trends.

Gender. There is evidence that physical activity behavior in males and females are different. Men presented higher activity levels of total activity and moderate to vigorous intensity physical activity than women (Azevedo et al., 2007), similarly in Thailand (Institute of Nutrition, Mahidol University, 2007). However, when light and moderate activities are included in the determination of regular leisure time physical activity levels, the gender difference diminishes or disappears (King et al., 1992). The role of the domains evaluated on the differences in physical activity level across the sexes; men were more likely to practice sports and exercise, while females were more likely to perform daily walking and biking (Abel, Graf, & Niemann, 2001). Difference in sex determines various types, intensities, and characteristics of physical activity. In person with metabolic syndrome, the physical activity-metabolic syndrome association is similar in men and women, indicating that both men and women benefit from participating in regular physical activity (U.S. Department of Health and Human Services, 2008). Studies using self-reports of physical activity or objective measures of fitness, it appears that no sex differences exist in regard to the benefits of physical activity in preventing metabolic syndrome.

Socioeconomic status. Socioeconomic status was estimated considering educational levels and work activities. A strong association between socioeconomic level and leisure-time physical activity was found (Azevedo et al., 2007). People from lower socioeconomic groups engage in physical activity during leisure time less often than higher socioeconomic groups. For both genders, the lower the socioeconomic level, the higher the rate of inactivity (Varo et al., 2003). An explanation for this finding relies on the lack of appealing public places for physical activity practice. Individuals are tempted to search for structured activities (e.g.

sports at clubs and gym at fitness clubs), all of which require an investment of money. Moreover, individuals of lower socioeconomic status have less knowledge about exercise-related issues, which may contribute to their negative lifestyle (Domingues, Araujo, & Gigante, 2004). Another important issue is that individuals of low income are not more likely to be sedentary just because they have less money or less knowledge on physical activity benefits. These subjects also have different attitudes to their own health and body (Marmot, 2000). This association might also be observed, particularly low and middle income, where a considerable amount of activities are performed during activity plan.

Educational difference is one of variables that influence physical activity. Low education individuals were related decline in physical activity. Lower educated respondents experienced statistically significant higher to decrease physical activity, compared with respondents with higher vocational schooling or a university degree (Droomers, Schrijvers, & Mackenbach, 2001). Low perceived control, material problems, and poor health experienced by lower educated people are responsible for education difference in decrease physical activity (Shaw, & Spokane, 2008).

Marital status. Marital status is related to physical activity level. Studies examining the association between marital status and physical activity behavior produced mixed findings. Some studies reported a positive association between marital status and physical activity participation, others reported none. Pettee, Brach, and Krista (2006) examined the influence of marital status on physical activity levels. Married men reported higher levels of exercise participation than single men, while married women reported lower levels than single women. King, Kiernan, Ahn, and Wilcox (1998) examined the effects of marital transitions on changes in physical

activity in a cohort of men and women from the Stanford Five-City Project. The transition from a single to a married state resulted in significant positive changes in physical activity relative to individuals remaining single.

Childless. Change in physical activity was significantly different between those who remained childless and those who had a child. The effect of having a child on physical activity was greater in males. The change for males who remained childless was significantly lower than the change in males who had a child. Females' physical activity also decreased (Hull, 2007). It is possible that the challenges and demands of having a child place more time constrictions on parents than for most single or married people

Injury history. Injury is a common reason for stopping regular exercise. In a cohort study of community adult aged 20 to 85 years with activity level, approximately 25% reported a musculoskeletal injury over 1 year and one third of injured adult stopped exercising (Hootman et al., 2002).

Disease and illness. Decreases in physical activity are often preceded by poor subjective health (Kaplan, Strawbridge, Cohen, & Hungerford, 1996). Conditions which are known to be associated with decreased physical activity include obesity, hypertension, diabetes, back pain, poor joint mobility and psychosocial problems (U.S.Department of Health and Human Services, 2008). Deteriorating health can reduce an older adult's ability to exercise (Schutzer, & Graves, 2004). The frail elderly is associated with a decline in physical functioning and an inability to carry out activities of daily living. Functional limitations are typically manifested in restrictions or difficulty in walking, lifting, or carrying, and rates of limitation in function appear to be exacerbated by sedentary behavior (McAuley et al., 2006). In a

relatively recent investigation of community-dwelling elderly, health problems and pain emerged as the most common barrier to exercise (Cohen-Mansfield, Marx, & Guralnik, 2003). Perceived poor health and fears of injury can act as a barrier to physical activity uptake.

Exercise history. Prior history of physical activity should positively influence future physical activity behavior by promoting and shaping self-efficacy for exercise and by developing physical activity skills. Exercise history is generally predictive of future exercise behavior (Dishman & Sallis, 1994). Childhood exercise history, however, is inconsistently related to physical activity in adulthood (Hoftstetter, Hovell, Sallis, 1990). Childhood physical activity experiences are also only modestly predictive of adult self-efficacy and exercise behavior. The perception of the exercise experience as a child may be as important as the amount of childhood exercise.

Psychological, cognitive, and emotional factors. Studies have identified positive association of physical activity with intention, self-efficacy, perceived benefits of physical activity, but negative associations with perceived barriers to physical activity (Pan et al., 2009).

Knowledge. The lack of knowledge and understanding of the relationship between exercise activity and health is an especially relevant barrier, as many lived through a time period when exercise was not valued or deemed necessary. Many elderly feel they already receive enough exercise in their activities of daily living (O'Neill & Reid, 1991). Poor awareness of the role of exercise in disease prevention is seen. Sedentary behavior can be related to limited educational opportunities. Knowledge of and belief in the health benefits derived from exercise actually seem to

be more helpful in motivating initial involvement in an exercise program (Schutzer & Graves, 2004). Receiving more information on exercise benefits or physician recommendation was related increasing physical activity.

Motivation. The motivation of activity in sport and exercise has increased the physical activity participation (Winninger, 2007). The research on motivation has emphasized differences both by age and gender in the motives that energize athletic activity. In addition it has been shown that both intrinsic and extrinsic motives can underlie participation and are differentially associated with levels of participation and satisfaction.

Motivators for participation in physical activity may also influence people's activity choices. Motives differ by gender. Women are more likely to say that social factors and release of tension are major benefits of physical activity, whereas men tend to describe the benefits of activity in terms of fitness and health (Sherwood & Jeffery, 2000). Frederick & Ryan (1993) found that people who participated in individual sports were more motivated by interest and enjoyment whereas those involved in fitness activities were more motivated by physical appearance. Adults' motive for participation in physical activities has identified several reasons. Most studies confirm that fitness benefits are among the main reasons, other motives for participation in physical activity include weight control, competition, sheer enjoyment, physical appearance, self-presentation, coping with stress and/or anxiety, relaxation, social contact, and fun (Trembath, Szabo, & Baxter, 2002). Indeed, the optimal motivation for participation in physical activity is most likely to occur when the providers are able to identify and address the needs of the participants.

Self-efficacy. Exercise self-efficacy is the strongest and most consistent predictor of exercise behavior. Self-efficacy predicts both exercise intention and several forms of exercise behavior. Self-efficacy is an individual's belief in his/her capability of executing the courses of action necessary to satisfy situational demands. It is theorized to influence the activities that individuals choose to approach, the effort expended on such activities, and the degree of persistence demonstrated in the face of failure or aversive stimuli (Bandura, 1998). Exercise self-efficacy is the degree of confidence an individual has in his/her ability to be physically active under a number of specific/different circumstances, or in other words, efficacy to overcome barriers to exercise (DuCharme & Brawley, 1995). Self-efficacy is thought to be particularly important in the early stages of exercise (McAuley et al, 2006). In the early stage of an exercise program, exercise frequency is related to one's general beliefs regarding physical abilities and one's confidence that continuing to exercise in the face of barriers will pay off. Self-efficacy is increased by success, and when a sense of expertise and competence is developed (Bandura, 1998). Individuals with greater self-efficacy are more likely to adhere to exercise programs with sufficient regularity to reach a point where the behavior has become, to a certain extent, habitual.

Social support. Social support and social networks, the characteristics of the social-environment, such as companionship encouragement, assistance from friends/family members/ others, tangible aid and service from community, and advice, suggestions and information from professionals, have all been shown to have positive influences on physical activity; while social inequality including income inequality and racial discrimination may have negative impacts on physical activity behavior (McNeill, Kreuter, & Subramanian, 2006). Other dimensions of the social environment

such as social cohesion, social capital and neighborhood are also related to physical activity behavior. Supportive physical environments were also associated with higher PA level (Pan et al., 2009). Some examples of the supportive physical environments are available, accessible and convenient physical activity facilities, presence of sidewalks and bike paths, safe streets, good lighting of streets, aesthetics, and good urban design (high density, greater connectivity, mixed land use, and inclusion of walking/bike paths and green spaces in community development, etc.). Social support from family and friends has been consistently and positively related to regular physical activity. People are more likely to be active when they have the social support and encouragement of family, friends, co-workers and others (McNeill et al., 2006).

Prompts. Research suggests that behavior may be influenced by prompts, for example reminders such as hints or telephone calls or starting a physically active occupation. Other examples of prompts are to establish set routines for physical activity, such as walking the dog or accompanying the children on their walk to school, or by transporting yourself in a physically active way (Hemmingsson, Page, Fox, & Rossner, 2001).

Physician advice. Physicians play a key and pivotal role in promoting exercise behavior. Patients respect their physician's advice, they are more likely to change their levels of activity as a result of conversations with their physicians (Balde, Figueras, Hawking, 2003). However, physicians are not regularly counseling their patients about exercise. Previous studies of older adults found that 22% to 48% reported having received advice regarding physical activity from their physician (Damush, Stewart, Mills, King, & Ritter, 1999). Physician or healthcare provider

advice had a powerful impact on physical activity level. People who received advice reported to increase physical activity (Glasgow, Eakin, Fisher, Bacak, & Brownson, 2001). Common barriers cited for lack of physician intervention include: lack of time during the office visit, limited reimbursement for preventive counseling, and the lack of training and perceived effectiveness as a behavioral counselor (Calfas et al., 1996).

Perceived Health Benefits Regarding Physical activity. Perceived benefits can positively influence the participation in physical activity (Buckworth & Dishman, 1999). The most important to motivate people to participate in physical activity are perceived reasons or benefits for taking part in physical activity. The top three reasons for participation in physical exercise were 'to maintain good health', 'to release tension' and 'to get fit'. 'To control weight' was not perceived to be important in motivating subjects to participate in physical activity. The 'to release tension' variable was regarded as more important for younger and middle aged participants (Zunft et al., 1999).

Perceived Barriers to Physical activity. Perceived barriers can negatively influence the participation in physical activity (Buckworth & Dishman, 1999). The remaining perceived barriers to increase one's physical activity were not regarded as being as important. On observation of the EU average, there was the most frequently perceived barrier cited for not increasing participation in physical activity (Zunft et al., 1999). However, assessment and problem solving to overcome barriers could result in positive outcomes (Yuh-Min, 2010).

Environment factors.

Physical environment. The physical environment can also present as a potential barrier to exercise behavior. Environments with available and convenient

resources used both for exercise and physical activity performance. The availability of physical activity facilities and programs in respondent's community compose places to safely walk (including sidewalks, walking trails and so on); places to safely ride a bike (such as designated bike lanes or special paths); publicly owned multi-purpose recreation trails; facilities, places and programs that are designed specifically for doing physical activity and sports (including fitness centers, pools, arenas, tennis or racquet ball courts, etc), other places that could be used for PA (such as school gym used after hours or public places where kids can skateboard), such as sidewalks, parks, recreation centers, and fitness facilities, make it easier for people to be exercise (Schutzer, & Graves, 2004). Conversely, environments with high crime decrease the likelihood of people becoming more active. In 1996, data from the Behavioral Risk Factor Surveillance System (BRFSS) were analyzed in selected states (Centers for Disease Control and Prevention, 1996). The results indicated older adults, especially for whom walking was the preferred exercise modality, performed greater levels of physical activity when they perceived higher levels of safety in their neighborhoods.

Natural environment. The natural environment in and around the city also influences participation in physical activity. Weather, especially extreme heat and cold and icy conditions, inhibits participation in outdoor activities such as walking, cycling and playing at the park. Poor air quality makes being active outdoors more difficult (WHO, 2006). Access to safe, freshwater lakes and rivers and ocean beaches opens up a host of opportunities for swimming, boating and other activities that attract both residents and visitors to a city. The topography and geography of a city and its surroundings (such as the presence of hills or mountains) influence the types of activities and sports that people can enjoy. Green forests and hilly landscapes provide

opportunities for hiking, exploring nature, camping and winter activities such as cross-country and downhill skiing, snowboarding and sledding (WHO, 2006).

Barriers to Physical Activity

The most significant barriers to activity for the participants seem to be the lack of time and motivation, lack of access, the lack of self-confidence, the feeling of unease about exercising in public and the cost factor. Particularly, perceived lack of time is the most common cited barriers to participation in physical activity (European Opinion Research Group, 2003). Addressing these barriers is critical to engaging people in physical activity.

Time. Time constraints are the most frequent barriers to exercise, reported by both sedentary and active individuals (Sherwood & Jeffery, 2000). To maintain exercise adherence, regular exercisers have to become adept at dealing with time as a barrier. The time barrier may be a particular problem for certain population subgroups. For example, Schmitz et a. (1999) reported that becoming a parent is associated with reductions in physical activity for mothers. Time spent caring for children may be interfering with attempts to maintain physical activity levels.

Access. Another environmental barrier that has received some attention in the determinants literature is access to exercise facilities. One way of assessing this has been to examine whether the distance between individuals' homes and exercise facilities is correlated with exercise behavior (Sherwood & Jeffery, 2000). It appears that there is a modest relationship between access to facilities and physical activity. Access to exercise facilities may be related to exercise levels for some individuals but not for others, depending on activity preference. For those individuals who prefer

exercises such as walking or running, which can be done anywhere, access to facilities may be less relevant. Additionally, for those who exercise with home equipment, which include stationary bikes, treadmills, and even exercise videos, access to facilities may also not affect exercise adherence. Regardless, the extent to which environments are conducive to physical activity (i.e. walking/biking paths, safe streets) likely has a strong impact on population activity levels. One recent study examining the association between neighborhood safety and sedentary behavior in a population-based sample found that there was a lower prevalence of physical activity among persons who perceive their neighborhoods as unsafe. Better measurement of environmental resources for physical activity and strategies for improving access to physical activity facilities are needed.

Summary

Physical activity is a complex and dynamic process involving an intricate series of behaviors. Identification of the variables affecting physical activity behavior is essential to determine the interventions associated with the greatest participation and maintenance of physical activity behaviors. The factors that determine the physical activity need to be understood in developing programs to increase physical activity.

Method of Physical Activity Assessment

Physical activity assessment is important to identify current levels and changes within the population, and to assess the effectiveness of interventions

designed to increase activity levels. Method of activity in adult and older adult are problematic since there is no valid method of assessing activity levels that is feasible for using in a large filed studies. Physical activity is complex behaviors and should be determined in many dimensions including type of physical activity, intensity, duration, frequency, and energy cost of specific activity. The methods of assessing physical activity include self-report, direct observation, a variety of mechanical and electronic monitors. The following sections provide a brief review of the instruments available

Self-report. Self-report are the most commonly employed procedures to measure physical activity and can involve recall or daily methods and can be interviewed or respondent-based (Kohl, Fulton, & Caspersen, 2000). A number of different self-report methods have been used in epidemiological research to assess physical activity. Self-report instruments can vary according to the time frame within which the responders are asked to record their activities (past day, week, month, year, or lifetime), the dimensions of physical activity that are recorded (type, intensity, frequency, duration), the mode of administration (personal interviews, telephone interviews, self-administered, mail surveys), the conditions under which the physical activities are performed (occupation, household, transportation, and leisure), and the scoring system used to summarize the data collected on various activities. Based on the above-mentioned characteristics, self-report instruments may be grouped into four general categories: physical activity records (diaries and logs), recall questionnaires, quantitative history questionnaires and global self-report questionnaires (Keim, Blanton, & Kretch, 2004).

Self-report techniques are the instruments of choice for assessing physical activity levels in large-scale epidemiologic studies. These measures are frequently used due to their practicality, easy to administer, convenience, low cost, low participant burden, and can provide information on the types of activities performed (Dishman, Washburn, & Schoeller, 2001).

The main advantage of self-report techniques is useful for gaining insight into the physical activity levels of populations that they do not influence usual physical activity patterns (Valanou, Bamia, & Trichopoulou, 2006). However, because these methods rely on subjects' memory, they are prone to misrepresentation, particularly socially desirable responding. Moreover, participants may misinterpret the questions and may also have difficulty in accurately recalling the time or intensity of the physical activity performed. The above-mentioned limitation is very important, especially when studying the physical activity behavior of older people or young children (Murphy, 2009). Overall, most studies indicated gross overestimation of physical activity energy expenditure and rates of inactivity by self-reports. The self-report methods are often wrought with issues of recall and response bias (e.g. social desirability, inaccurate memory) and the inability to capture the absolute level of physical activity.

As self-report methods possess several limitations in terms of their reliability and validity (Shephard, 2003), objective or direct measures of physical activity are commonly used to increase precision and accuracy and to validate the self-report measures. Some measures also include calculations to estimate energy expenditure based on the duration and frequency of reported activity participation (Stewart et al., 2001). However, there are some disadvantages to using self-report

measures such as recall bias, and in older adults in particular, self-report may also be influenced by fluctuations in health status and mood, depression, anxiety, or cognitive ability (Rikli, 2000). In addition, self-report physical activity measures designed for younger adults have been shown to be inaccurate when given to older adult samples, particularly underestimating the performance of light and moderate intensity activities (Washburn, 2000).

Physical activity diaries and logs. Physical activity diary methods involve the participant to keep a record of their physical activity for a typical time period. It is considered to be the tool for collecting habitual activity. The participants require keeping track of the activities they perform and also record the time period they perform those activities. Total recording period for both diaries and logs is short, usually 1–7 days with sampling intervals as often as every minute and as infrequent as every 4 h. Data collected in a diary or log can either be expressed as minutes engaged in certain intensity categories of physical activity (e.g., light, moderate, and heavy) or as energy expenditures (Kcal, METs) by multiplying time spent in a given activity by the energy cost assigned to the activity. There are various forms of diary which have been used to assess physical activity. Physical activity logs differ from diaries in that not all activities performed during a day are recorded (Haskell & Kiernan 2000), but the duration of time participants spend in broad categories of activity (e.g., sitting, standing, walking) is recorded instead.

The main advantage of physical activity diaries and logs is that they provide details about the diverse range of physical activity that individuals encounter in their everyday lives. In addition, bouts of activities performed during the day can

be quantified. Difficulties in recalling past activities are eliminated by providing the participants record their activities as instructed (Matthews, 2002).

Disadvantages of diaries include the intensive effort, cooperation and motivation that are required by the participants. In addition, the short time frame of data collection makes the representativeness of the recorded physical activity patterns questionable. A related issue is that the procedure of filling in the diary or log may influence participants to change their normal activities during the monitoring period (Valanou et al., 2006). Furthermore, because logging activities is tedious, the longer the period of data collection, the less accurate the results may be. This method contributes to a very high error percentage in estimating physical activity expenditure (Pennathur, Magham, Contreras, & Dowling, 2003). It is also being boring and time-consuming method. Therefore, participant's cooperation must be needed to complete their physical activity information in the diary. In addition, the utility of these instruments is especially problematic in children and the elderly because of cognitive limitations (Valanou et al., 2006). As usually, people always forget to recall all entries or make recording error. Moreover, a large volume of data obtained by this method also takes time and costs more expense for processing and interpreting. Finally, regarding the scoring of data collected by the above methods, it has been mentioned that using published values of activity intensity may not provide accurate estimates of energy expenditures, but they seem to be adequate for rank-ordering individuals according to overall physical activity levels.

Recall questionnaires. Recall questionnaires are typically short and simple. Usually, they consist of 5-15 questions (items) that take 5-15 min to be completed by the participant. Recall questionnaires allow the quantification of

physical activity patterns in the recent past (e.g., past week or month). Moreover, data can be collected by means of personal or telephone interviews or through mail questionnaires. The questionnaires either collect specific details about physical activity levels of the study participants, or provide a more general quantification of their usual physical activity patterns. Scoring systems vary among recall questionnaires, ranging from simple ordinal scales (e.g., 1-5, low to high physical activity) to unitless summary indices (e.g., exercise unities) or to a summed score of continuous data (e.g., MET-min day^{-1}) (Lamonte & Ainsworth, 2001). These measures generally succeed in classifying the study population into general categories of physical activity as well as in providing a quantification of the most apparent characteristics of physical activity patterns. Recall questionnaires share the same advantages and constraints with the self-report instruments previously mentioned. But they are also limited in their ability to capture seasonal variation in physical activity. The above methods serve as a valuable tool in descriptive epidemiology studies designed to detect the most apparent physical activity patterns of the population under study.

Quantitative history questionnaires. Quantitative history questionnaires are the most comprehensive physical activity questionnaires. They consist of 15-60 items and may take from 15-60 min to complete. Due to their length, they are usually interviewer-administered. They are very detailed and typically reflect the volume (frequency, intensity, and duration) of physical activity performed under various conditions, including occupation, household, transportation and recreational activities. In this way, detailed information about the physical activity energy expenditure, as well as patterns of physical activity observed during the course of the previous day,

week, month, year, or even lifetime can be acquired. Physical activity scores are usually expressed as a continuous variable (e.g., Kcal kg^{-1} $week^{-1}$), which allows for categorical evaluation of dose- response effects on health parameters based on recommended energy expenditure cutpoints (e.g., $\geq$ 14 Kcal kg^{-1} $week^{-1}$). A disadvantage of this method is the large cost required for implementation, ensuring quality control, and processing the collected data. An additional problem is the large burden imposed on responders in order to remember, in detail, activities performed in the past (Shephard, 2003). Despite these limitations, quantitative history questionnaires are considered appropriate for surveys aiming to detect the dose-response relationship between physical activity and health and for monitoring physical activity levels of a population.

Global self-report questionnaires. Global Self-report Questionnaires ask the responders to provide a generic classification of their usual activity patterns performed during a specific time period (e.g., 1 year), and usually for a specific domain (e.g., leisure or occupation). Using this approach, individuals self-assess their physical activity relative to other persons in general or to those of a similar age and sex. Global Self-report Questionnaires are brief, 1-4 items, and thus provide less detail than the other self-report techniques. Because of their brevity, they only attempt to assess global physical activity patterns such as active vs. nonactive or low, moderate, or high activity levels (Lamonte & Ainsworth, 2001). An important limitation of global self-report questionnaires is that they do not capture information about the types, intensity, and patterns of activities.

Direct observation. The direct observation method is based on observing physical activity behavior of population under study. The essential of this approach is

to classify physical activity behavior performed under free-living conditions into distinct categories that can be quantified and analyzed in greater detail (Valanou et al., 2006). This technique has several advantages over other technique. It provides various data such as behavioral information, type of activities, frequency of performance, time per activity, and when, where and with whom it occurs. Unlike other methods, with have to deal with complicated equipment, behavioral observation and time/motion analyses need only activity record. This method can also be used to assess the physical activity in people who have trouble recalling or unable to give details of their physical activity. However, one drawback to observation is that well-trained observers are required for ensuring accurate data recording and analyzing. Therefore, the method is tedious and accuracy probably decrease as the observation period lengthens. Another limitation of direct observation is that the subjects may alter their usual activity when they know that they are being observed. Observation is a boring and time-consuming job; observer has to be patient, observant in order to gather information as much as he/she can. As a result, observers may get incorrect data from their observation. Also, observations are confined to relatively short periods and may not reflect habitual physical activity.

Observation can be used only in small group of population. It requires little inference or interpretation and therefore has high validity. Overall, high reliability scores have been reported, but these vary for different instruments. There were many observation systems to be used including difference observation frequency, data analysis, and equations to estimate energy expenditure in individual group of subjects. Recently, new technology such as video recorders or camcorders can be used to observe their subjects by watching subjects more correctly. These new technologies

allow observers to observe their subjects by watching subjects in media as many times as they want, which give more accuracy than normal observation (Duke, Huhman, & Heitzler, 2003).

Motion sensors. Motion sensors, such as pedometer, actometer, and accelerometer, have been developed to provide more objective information on body movement. They can assess free-living activity such as housework and climbing stairs which, similar to structured exercise, has been shown to have health benefits.

Accelerometer. Accelerometer provides information on the amount, frequency, and duration of physical activity (Plasqui & Westerterp, 2007). Data can be obtained about daytime and nighttime activity patterns and activity intensity (including estimates of energy expenditure) as they occur in people's daily lives. The most commonly used accelerometers have piezo-electric sensors. Piezo-electric sensors measure acceleration due to movement. It enhances durability and repeatability of the monitors. Among these newer generation accelerometers, some have a rechargeable battery as opposed to coin cell batteries which may reduce supply costs for researchers. Another important enhancement among some of the newer generation accelerometers (such as the Actiwatch Spectrum) is the skin conductance features that can help researchers distinguish sedentary activity from not wearing the monitor. Given that older adults generally engage in many sedentary activities, this feature will increase the accuracy of overall physical activity estimates. However, the main disadvantage of using accelerometer is the need to be attentive to their calibration. The recalibration should be done when changing the placement of electric sensors. In addition, the output of an accelerometer depends on the position at which it is placed. Monitors record acceleration in different axes or planes of

movement. The placement of electric sensors should be changed according types of activity in which people participate. So, the output of monitors depends on placement and is activity-specific.

Accelerometers can be used to approximate energy expenditure, however, they do not capture the full energy cost of certain activities, such as walking while carrying a load or walking uphill, because acceleration patterns do not change under these conditions (Welk, 2002). Physical activity may also be underestimated depending upon the placement of the monitor. Other limitations include the financial cost of monitors, staff time to process and analyze data, and problems with monitor placement when data are collected over a number of days (Dale, Welk, & Matthews, 2002). In addition, although raw activity counts are frequently reported in studies, they are not easily interpretable.

In summary, accelerometers are being increasingly used in studies of physical activity, however the use of these monitors requires some specialized knowledge and up-to-date information on technological innovations. The use of accelerometers requires a basic understanding of the type being used, rationale for their placement, and attention to calibration when needed.

Pedometer. Pedometers (step counters) are inexpensive compared to accelerometer. They are easy to use and can provide participants with feedback about their performance which may be an appealing feature for use in physical activity intervention studies.

Pedometers store movement as steps and accelerometers as counts. Movement can then be converted into energy expenditure using prediction equations. Pedometers are small devices with a spring mechanism that register movement in a

vertical direction; they are usually worn on the waistband in the midline of the thigh. Only walking or running-related activities are registered. They are used to count steps over a period of time, which may also be converted to distance walked when an average stride length is entered.

The main advantages of pedometers are that they are generally small and low in cost. However, the pedometers have limited application for measuring habitual activity for several reasons. First of all, they are not sensitive to activities other than walking. Since distinctions cannot be made between walking, running and climbing stairs, it is assumed that a person expends the same effort and therefore expends equal amounts of energy in each step (Bassett et al., 2000). Secondly pedometers do not provide any temporal information about activity patterns, as they do not store data over a specified time interval (Melanson & Freedson, 1996). Studies examining the validity of these devices report that they are accurate for reporting number of steps but they tend to over- and under-report total physical activity levels. There has also been an observed, low level of accuracy at recording very slow and very fast walking speeds (Bassett et al., 2000). For frail older adults, pedometers may not be an optimal method for assessment as accuracy is reduced at slow speeds (Le Masurier & Tudor-Locke, 2003). Pedometer accuracy is also reduced for people who have variable gait patterns (Cyarto, Myers, & Tudor-Locke, 2004). Some pedometers have piezoelectric components and have improved accuracy at slow speeds over traditional pedometers (Foster et al., 2005). For example, the Stepwatch-3 activity monitor is an ankle-worn pedometer with a piezoelectric component that also can measure physical activity patterns and is more accurate than other pedometers at slow speeds. However, it is also more expensive and requires a docking station and software.

Although the limitations of pedometers make them less suitable for assessing habitual physical activity patterns, they are potentially very useful in walking intervention studies where participants can be given specific pedometer step goals that can be self-monitored very easily (Crouter, Schneider, Karabulut, & Bassett, 2003).

Doubly-labeled water (DLW). Doubly-labeled water is considered the gold standard to measure energy expenditure over time. The principal of this method is based on the metabolism of labeled hydrogen and oxygen in human body. Doubly-labeled water consists of a known concentration of the stable isotopes of hydrogen (deuterium) and oxygen (oxygen-18) is consumed by the participants according to body size. The concentration of stable isotopes is more than natural existing and the isotopes distribute themselves to be equilibrium to body water. The labeled water is gradually excreted from body as water in from of sweat, urine, and pulmonary water vapor. The oxygen leaves as water and carbon dioxide. An isotope ratio mass spectrometer is used to determine the differences between elimination rates of the two isotopes relative to the normal body condition levels of carbon dioxide production estimates during the measurement period (Pennathur et al., 2003). This process is used in laboratory and the process of distribution takes about 5hrs. This method measures total energy expenditure over prolonged periods and high reliability and validity. However, this technique is expensive, requires specific expertise and specialized equipments, thus the sample size is usually small in studies that use this method. Therefore it is not feasible in many clinical studies or in larger field and epidemiological studies (Murphy, 2009). Moreover, this technique cannot differentiate the frequency, duration and intensity of interesting physical activity for studying.

This method is used as criterion method for other assessment validations (Pennathur et al., 2003).

Heart rate monitoring. Heart rate is a measure of an individual's response to physical activity by providing an indication of the relative stress placed on the cardiorespiratory system during movement (Janz, 2002). Heart-rate monitors are usually small lightweight units that are low cost, easy to use and consist of a chest-strap transmitter and a small receiver watch. Recording data can collect in a certain period of time ranging from minutes to days without disturbing the participants. Their storage capacities range from several hours to 3-4 days and thus provide information about duration, frequency, and intensity of the activity as well as total energy expenditure.

Although this method can be used to show activity pattern classify by frequency, intensity, and duration of activity, it cannot show the type of physical activity. There are other factors that can change heart rate without associated changes in VO2, for example, emotional stress, high ambient temperature, high humidity, and dehydration, total amount of muscles, type of the muscle group, and type of muscle contraction, fatigue, physical fitness, caffeine, posture and illness (Freedson & Miller, 2000). The result of heart rate monitoring is more accurate at higher levels of physical activity, because at low levels of physical activity the interpretation of heart rate data is confounded by the fact that heart rate responses reflect not only physical activity, but also metabolic status, posture, temperature, and emotional status. Therefore, using heart rate may result in energy expenditure overestimation.

There is other way to assess the data from heart rate monitor such as a percentage of the maximum heart rate (HRmax) which can be used to prescribe

exercise intensity. To estimate the maximum heart rate simply subtracts age from the number 220. Physical activity at > 80% of the maximum heart rate is considered vigorous intensity, at 60%-70% of the maximum heart rate as moderate intensity, and at 40%-60% of the maximum heart rate as low intensity. This monitor is inexpensive and can also provide information about activity intensity. Moreover, total energy expenditure estimates from heart rate provide an acceptable estimation of total energy expenditure of group (Molnar & Livingsone, 2000).

Summery

Each of these methods has advantages and limitations. The development and selection of the most preferable method depend on dimension of activity, group of subjects and trade off between advantages and disadvantages of individual method. No one method can be used for all purposes and the combination methods might be the better choice, all of which are summarized in Table 2-5. In this study, self-report and pedometer will be used to assess physical activity.

Table 2-6

Comparison of Common Methods Used in Measuring Physical Activity Levels: Advantages and Disadvantages

Methods	Advantages	Limitations
Self-report	Low-cost Convenience Suitable for large-scale studies Easy to administer Provide information about physical activity level and type of activities	More subjective Not capture activity patterns throughout the day Involve recall
Direct observation	More details Suitable for people who have trouble recalling or unable to give details High validity and reliability Provide information about type and pattern	Well-trained observers Alter usual activity Boring and time-consuming
Pedometer	More objective Light, small Suitable for large-scale studies Simple Inexpensive Provide information with feedback about performance Provide information about level of physical activity Provide information about total energy expenditure	Not accurate if speed is too fast or too slow Not appropriate for wet activity Difficult to control in Weekend Not provide information pattern
Pedometer	More objective Light, small Suitable for large-scale studies Simple Inexpensive Provide information with feedback about performance Provide information about level of physical activity Provide information about total energy expenditure	Not accurate if speed is too fast or too slow Not appropriate for wet activity Difficult to control in Weekend Not provide information pattern

Table 2-6 (continued)

Methods	Advantages	Limitations
Doubly-labeled water	More objective High reliability and validity Provide information about total energy expenditure	Use in Laboratory Take time in process Expensive Requires specific expertise Requires specialized equipments Not suitable for large-scale studies Not provide information about the frequency, duration and intensity
Heart rate monitors	Low cost Easy to use Provide information about activity intensity Provide an estimation of total energy expenditure	Not show the type of physical activity Overestimation

Current Lifestyle Intervention for Metabolic Syndrome

Lifestyle interventions including healthy eating behaviors, physical activity, and weight reduction are the initial therapies recommended as the treatment of the metabolic syndrome (Grundy et al., 2005). This recommendation, however, seems to have been built up exclusively on the assumption that, being key elements in the treatment of all components of the syndrome when they occur in isolation, lifestyle interventions promise to be an effective treatment for the metabolic syndrome as a whole. The concept of intensive multifactorial intervention is based on the fact that metabolic syndrome represents a clustering of risk factors and each of its components should be involved in development of disease. In this context, the implementation of therapeutic strategies targeting may simultaneously affect several components of the syndrome (Korantzopoulos, Elisaf, & Milionis, 2007). Metabolic

risk factors of people with metabolic syndrome are complex. They are hard to control by using traditional health education or simples approach such as general advice, and giving the prescribed regimen.

Most people with metabolic syndrome need to manage lifestyle risk factors by changing eating behavioral and increasing physical activity. However, Lifestyle interventions have been studied mostly in the field of obesity, diabetes, hypertension, and dyslipdemia. Little studies in people with metabolic syndrome have been conducted. Strategies of lifestyle modification for the prevention and treatment of metabolic syndrome should be needed.

The example of reviews of lifestyle intervention for people with metabolic are showed in Table 2-8.

Table 2-7

Studies on Metabolic Syndrome Lifestyle Interventions

Author	Design, Subject	Intervention	Main outcomes
Bihen et al., 2009	prospective, non-controlled, 46 men and 49 women, aged 45 to 60 years, who presented with the metabolic syndrome,	-6-month study was to determine the impact of lifestyle interventions involving patients' behavior in collaboration with their general practitioners (GPs). -Each patient received a copy of the national French recommendations (PNNS) leaflet, containing guidelines aimed to balance dietary intake and increase daily physical activity. -1 hour face-to-face interventional session with each patient to present the lifestyle-modification goals, to recommend lifestyle modifications (the first) -contacted each patient's GP by phone to advise and to reinforce these lifestyle modifications (at 3 months)	-The percentage of patients presenting with the metabolic syndrome decreased by 52.4% after 6 months. -achieved by increases in physical activity, and changes in food consumption (lower intakes of snacks, salt, sweets, fat and starchy foods). -Hypertension, triglycerides, and waist circumference decreased

Table 2-7 (continued)

Author	Design, Subject	Intervention	Main outcomes
Pettman et al., 2009	RCT, parallel gr., 153 obese adults with MetS were randomised to intervention or control	-Active lifestyle intervention, 2hr per week for 16 weeks group-based lifestyle intervention, provided with education practical strategies and group-based support to achieve diet and physical activity modifications based on Australian national guidelines -Anthropometric, cardio-metabolic, physical fitness, and diet assessments were undertaken at baseline and 16 weeks. (experienced in adult training and self-management programs), -No initial dietary or lifestyle consultations were conducted, and no individual counseling was provided.	-greater improvements in weight, BMI, body fat mass and percent abdominal fat mass and waist circumference systolic, diastolic and mean arterial blood pressure; total cholesterol and low-density lipoprotein cholesterol; physical work capacity (PWC) and handgrip strength - Energy intake and % energy from saturated fat decreased in both groups - Dietary glycemic index (GI) decreased more in intervention

Table 2-7 (continued)

Author	Design, Subject	Intervention	Main outcomes
Matsuo et al., 2009	104 men who have abdominal obesity and MetS. - indirect intervention (36) - direct intervention in men (34) - no intervention (34)	-a 14 week indirect lifestyle intervention in spouse of LSI participants and direct in men. -dietary modifications with a physical activity program	-improvement of MetS components within the direct and indirect gr.
Oh et al., 2008	RCT, 32 rural women with MetS	*A 4-week therapeutic lifestyle modification:* consisting of health screening, education, exercise, diet, and counseling. -Control group: received a booklet with basic education for MetSyn	Intervention group showed significant reductions in body weight, waist circumference, and triglyceride levels compared with the control group at 4 weeks No group interacted effect on systolic blood pressure, fasting glucose, HDL, or LDL

Table 2-7 (continued)

Author	Design, Subject	Intervention	Main outcomes
Andersson et al. (2007)	-RCT, 2 x 2 factorial intervention study -137 men (40–49 years)	-four intervention groups:diet alone (n=34), exercise alone (n=34), the combination of the diet and exercise intervention (n=43) or control (n=26). 1-year intervention: Dietary counseling was given together with the spouse at the start, and then to the participants alone after 3 and 9 months. -The exercise program entailed supervised endurance-based exercise, such as aerobics, circuit training, and fast walking/ jogging, three times per week by supervised training sessions	14 participants (32.6%) in the combined diet and exercise group (as compared with control) had the MetSyn after 1-year intervention. In the diet-only group, 22 participants (64.7%) and in the exercise-only group 26 participants (76.5%) had the. MetSyn following the intervention

Table 2-7 (continued)

Author	Design, Subject	Intervention	Main outcomes
Bo et al., 2007	RCT, 375 adults aged 45-64 years in northwestern Italy	*First arm:* lifestyle intervention carried out by trained professionals (n=169), participated in at least 3 meetings, received detailed verbal and written individualized recommendations, 5 sessions of 60 min covering diet (prescribed) , exercise (individualized advice), and behavior modifications (counseling and practical lifestyle tips) *Second arm:* standard unstructured information given by family physicians (n=166)	A lifestyle intervention by trained professionals was effective in reducing total saturated fat intake and increase polyunsaturated fat/fiber intake and increase exercise level, decrease weight, waist circumference, and high sensitivity C-reactive protein, reducing the prevalence of MetS. The usual care by family physicians was ineffective at modifying progressive metabolic deterioration

Table 2-7 (continued)

Author	Design, Subject	Intervention	Main outcomes
Tonstad et al., 2007	RCT, 51 mild hypertension patients (intervention=31)	*Intervention group*: Nurse-led lifestyle counseling , scheduled for monthly meeting with the nurse for 6 month (initial session for 60 min and subsequent sessions for 30 min). Intervention based on behavioral self-management and the transtheoretical stages of change model (smoking, dietary habit, and physical activity) *Control group*: brief advice by primary physician, visit for care during the study and recalled for final evaluation after 6 month	Nurse-led lifestyle counseling reduced waist circumference, triglyceride concentration, and the number of risk factors of the MetS but did not reduce blood pressure.

Table 2-7 (continued)

Author	Design, Subject	Intervention	Main outcomes
Sullivan, Ghushchyan, Wyatt, Wu, & Hill, 2007	-Intervention trial without control group, -67 patients with MetS	The Pritikin program involves the use of a very low fat, low sodium, high fiber diet and regular exercise, attended for 12-15 days; Brief treatment	Improved most CHD risk factors: body mass index decreased by 3%; systolic and diastolic blood pressure, and serum glucose and LDL decreased by 10%-15%; serum triglyceride decreased by 36%; and 37% of subjects no longer met NCEP III criteria for the MetS. However, HDL decreased by 3%.
Villareal et al., 2006	6-mo RCT -27 obese (BMI>30) older (age>65)	*Intervention:* low caloric diet and Ex therapy (n=17), 26 wk : weekly behavioral therapy group meeting (goal setting, self-monitoring, stimulus control techniques, problem-solving skills, identification of high risk situations and relapse prevention were used to modify eating habits), exercise program was supervised by physical therapist. (90-min sessions, 3d/wk) *Control:* no therapy	Lifestyle intervention decrease all multiple metabolic CHD risk factors (weight, waist circumference, plasma glucose, serum triaglycerol, blood pressure, number of component of MetSyn, serum free fatty acid, C-reactive protein, and interleukin6.

From review of the literature, lifestyle modifications for promoting healthy diet and exercise behaviors reduced to a greater extent the prevalence of the metabolic syndrome components have been mostly facilitated by recommendation of lifestyle change, general oral and written lifestyle advice, counseling, prescribing dietary or/and exercise regimens, education, dissemination of education materials, and monitoring of the components of metabolic syndrome. There is no evidence regarding the use of several conceptual theories and models of health behavior change among people with metabolic syndrome. There is also no study regarding the use of self-management program. In addition, there is no study providing metabolic syndrome management program for Thai metabolic syndrome people. All of studies in Thailand involve prevalence of metabolic syndrome and appropriate criteria for Thai people of metabolic syndrome.

The effectiveness of lifestyle intervention for people with metabolic syndrome significantly decreased the prevalence of metabolic syndrome, abdominal obesity, and elevated blood glucose during the first year, when the intervention was at its most intense. During the subsequent years, there were some relapses (Ilanne-Parikka et al., 2008). Among the issues explored in the relevant literature of the duration and type of interventions were within the 4 wk for 6 months, possibly supplemented by face to face, telephone call, and e-mail contacts, have been shown to induce changes in diet and physical activity and thus changes in metabolic syndrome parameters. In contrast, one counseling session at the beginning of the intervention, including an individualized dietary plan and individually focused dietary goals, followed by two more sessions after 3 and 9 mo proved to be ineffective in helping individuals to proceed to the appropriate changes (Anderssen, Carroll, Urdal, &

Holme, 2007). 32.6% of participants in the combined diet and exercise group (as compared with control) had the metabolic syndrome after 1-year intervention.

Self-Management

Self-management concept is widely used for health behavior and disease management. It is a multidimensional, complex phenomenon that can be conceptualized as affecting individuals, spouse, or families across all developmental stages. It extends the responsibility of the individual with the chronic illness beyond the ideals of compliance and adherence to managing an ongoing condition within the context of his or her daily lives (Grey, Knafl, & McCarkle, 2006). For the majority of chronic conditions, this involves addressing multiple behavioral risk factors (i.e., physical activity, diet, smoking and alcohol), as well as monitoring and managing the signs of symptoms of disease, taking medications appropriately, maintaining regular contact with health care providers, and managing emotional and social consequence (Wagner, 2001).

The term self-management differs across authors and programs of research. Historically, self-management has been used to refer to 3 different phenomena; namely a process, a program, or an outcome. *The process* of self-management refers to the use of self-management skills to manage chronic conditions or risk factors. These processes generally include activities such as goal-setting; self-monitoring and reflective thinking; decision-making; planning for and engaging in specific behaviors; self-evaluation; and management of physical, emotional, and cognitive responses associated with health behavior change. For example Lorig and Holman's definition of self-management is a daily process by which an individual with a chronic illness or

condition engages in activities that protect and promote health, monitoring and managing of symptoms and signs of illness, managing the impacts of illness on functioning, emotions and interpersonal relationships and adhering to treatment regimes with the desired outcomes of improved health status and/or slowed deteriorations (Lorig & Holman, 2003).

Self-management also is defined as *programs* or interventions that are designed by healthcare professionals with the intent of preparing persons to assume the responsibility for managing their chronic illnesses or engaging in health promotion activities. For example, the Kheirabadi and colleague's definition of self management as a practical program in the form of educational charts about symptoms of disease which teach the patients some skills needed to carry out specific medical regimens specific to the disease (Kheirabadi, Keypour, Attaran, Bagherian, & Maracy, 2008).

Self-management likewise has been used to describe *outcomes* as individual's ability to manage chronic conditions and to achieve engaging in the self-management process such as Barlow's definition of self-management which refers to the individual's ability to manage the symptoms, treatment, physical and psychosocial consequences and life style changes inherent in living with a chronic disease (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002). Some author defined self-management as the tasks that individuals must undertake to live well with one or more chronic conditions. These tasks include having the confidence to deal with medical management, role management, and emotional management of their conditions (Institute of Medicine, 2003). In addition self-management is defined as behaviors

which performed to manage conditions have a substantial influence on the outcomes (Glasgow, Wilson, & McCau, 1985).

In addition the term patient self-management, self-management education, and self-management support often are used interchangeably; they do not have the same meaning.

Self-management is the ability of the patient to deal with all that chronic illness entails, including symptoms, treatment, physical and social consequences, and lifestyle changes. With effective self-management, the patient can monitor his or her condition and make whatever cognitive, behavioral, and emotional changes are needed to maintain a satisfactory quality of life (Barlow et al., 2002). The ability of individuals to manage their chronic illness is dependent on the severity of the condition, the treatment regimen, the course of the disease, the individual characteristics, and the environment in which the individual will manage their disease (Grey et al., 2006).

The term *self-management education* is often used interchangeably with patient education. *Patient education* generally refers to knowledge-based instructions for a specific disease. It as a method of providing information has been associated with outcomes such as increased knowledge, increase satisfaction, or change in readiness to engage in health behaviors; whereas *self-management education* is the ongoing process of facilitating the knowledge, development of self-management skills, and ability necessary for managing chronic conditions and enhancing health behavior change (Funnell et al., 2009; Ryan, & Sawin, 2009). Self-management education differs from traditional patient education in what is taught, how problems are formulated, the relation of what is taught to the disease, and the theory underlying

the goal (Bodenheimer, Lorig, Holman, & Grumbach, 2002). The theory underlying *patient education* is that increasing a patient's knowledge about a disease leads to behavioral change that improves clinical outcomes. An underlying theory of *self-management education* is that self-efficacy, or the patient's belief in his or her own ability to accomplish a specific behavior or achieve a reduction in symptoms, leads to improved clinical outcomes. Patient education typically is given by a health care professional; while self-management education can be taught by health care professionals, office support staff, peer leaders, and other patients.

Self-management support is defined as the systematic provision of education and supportive interventions by health care staff to increase patients' skills and confidence in managing their health problems and enhancing behavioral change such as develop patient problem-solving skills, improve self-efficacy, and support application of knowledge in real-life situations that matter to patients (Green & Glasgow, 2006). Self-management support expands the role of healthcare providers from delivering information to include helping patients build confidence and make choices that lead to improved self-management and better outcomes. Healthcare providers serve as transition coaches, teaching persons about their conditions and enhancing their skills to manage their illness and communicate with members of the healthcare team. The overall goal of self-management support was to identify strategies that can be used by communities to help patients manage their condition(s) while leading active and productive lives. The focus was on evidence-based self-management programs that include goal setting, problem solving, symptom management, and shared decision making and are applicable for a diverse population (Institute of Medicine, 2003).

Moreover, there appear different approaches of self-management have been proposed over the years. Beyond these differences, self-management is informed by a set of principles that are best described as empowering the person to proactively and confidentially manage their condition. The popular self-management approaches as following;

The Creer and Colleagues Approach

Creer, Renne, and Christian (1976) believed that self-management occurs when a person with chronic disease is actively involved in managing their disease. Creer and Holroyd (2006) state that self-management emphasis on the patient's active role in decision-making and the patient's involvement in defining the problems. Individuals with chronic illness certainly accept responsibility for the management of their illness, including responsibility for executing complex medication regimens that may include acute (as needed) and daily (maintenance) medications, lifestyle changes that often involve modifying a number of difficult-to-change behaviors (e.g., diet and exercise), monitoring symptoms, and taking different actions depending on self-monitoring results. The last of these includes assuming responsibility for managing the effects of chronic disease on emotions, family, work, social relationships, and finances.

Creer (2000) defined self-management as:

Self-management is a procedure where patients change some aspect of their own behaviors. It involves processes including (a) goal selection, (b) information collection, (c) information processing and evaluation, (d) decision making, (e) action, and (f) self-reaction. Successful mastery and performance of self-management skills

results in following outcomes: (a) changes in mortality and mobility indices of the disease; (b) improvement in quality of life experienced by patients and those around them; and (c) the development of self-efficacy beliefs on the part of patients that they can make a contribution to the management of their disorder, in part through their becoming partners with their physicians and other health care providers to control the chronic disease or disorder.

Later in 2006, Creer and Holroyd used Barlow's definition of self-management (Barlow et al., 2002) which refer to the individual's ability to manage the symptoms, treatment, physical and psychosocial consequences and life style changes inherent in living with a chronic disease. This definition is consistent with the Standford model of chronic disease self-management education (Bodenheimer, Lorig, et al., 2002).

As Creer and Holroyd's framework (2006), the effective management of chronic disorders requires that patients: (1) possess the motivation, confidence and skills necessary to manage their condition; (2) are effective problem solvers, capable of self-monitoring and adjusting self-management behaviors in response to objective (e.g. blood glucose) and subjective (e.g. symptoms) information about their condition; and (3) can successfully adapt self-management strategies to the constraints imposed by the unique social (e.g. competing time demands of single motherhood, disruption of social systems produced by divorce) and environmental (e.g. stressful workplace, lack of access to safe exercise facilities) factors that comprise the context of their daily life. The healthcare system, the physician–patient relationship and the structure of physician–patient consultation need to reinforce one another in achieving these

essential tasks of chronic disease management. Self-management is thus associated with particular types of decision-making and physician–patient relationship.

The Corbin And Strauss Approach

Corbin and Strauss (1988) defined self-management as three set of tasks. The first set of tasks involves the medical management of the condition such as taking medication, adhering to a special diet, or using an inhaler. The second set of tasks involves maintaining, changing, and creating new meaningful behaviors or life roles. For example, people with back pain may need to change the way they garden or participate in favorite sports. The final task requires one to deal with the emotion of having a chronic condition, which alters one's view of the future. Emotions such as anger, fear, frustration, and depression are commonly experienced by someone with a chronic disease. If someone uses the Corbin and Strauss framework, then self-management programs must include content that addresses all three tasks: medical or behavioral management, role management, and emotional management.

The Kate Lorig Approach

Kate Lorig and colleagues work at Stanford University has conceptualized self-management programs. Her work is based on Corbin and Strauss' framework of medical management, role management, and emotional management. She defined self-management as the tasks individual must undertake to live with one or more chronic condition. These tasks include having the confidence to deal with the medical management, role management and emotional management of this condition. Lorig

and colleagues have focused primarily on chronic conditions rather than health promotion or risk and protective factors. Their self-management programs are based on the perceived needs and experiences of persons actually living with a condition. They provide people to attend a group course and learn skills from trained leaders and each other. The emphasis is on peer support and role modeling.

In the early 1980s, Lorig, Lubeck, Kraines, Seleznick, and Holman (1985) developed and evaluated self-management programs for people with chronic conditions as the Stanford Self-management Program at the Stanford Patient Education Research Center. Some of these such as the Arthritis Self-Management Program, the Spanish Arthritis Self-Management Program, the Positive Self-Management Program (for people with HIV/AIDS), and the Back Pain Self-Management Program (developed for Group Health Cooperative of Puget Sound) are condition specific, then the Chronic Disease Self-Management Program (CDSMP) was developed (Lorig et al., 1999).

Through the years, this self-management concept has been used with patients living with a variety of chronic diseases and has been evaluated in a range of settings. Programs based on the model address continuous use of medication, behavior change, pain control, coping with emotional reactions, learning to interpret changes in the disease and its consequences, and use of medical and community resources. Participants generally experience a reduction of symptoms, improved physical activity, and significantly less need for medical treatment. An important element for participants in this group-based approach is learning from each other, and the principal reason for benefit is increased participant confidence in their ability to cope with their disease (Lorig et al., 1999).

Lorig and Holman (2003) defined self-management as a daily process by which an individual with a chronic illness or condition engages in activities that protect and promote health, monitoring and managing of symptoms and signs of illness, managing the impacts of illness on functioning, emotions and interpersonal relationship and adhering to treatment regimes with the desired outcomes of improved health status and/or slowed deterioration.

The Chronic Disease Self-Management Program (CDSMP) is a community-based patient self-management education course that was developed by Lorig and colleagues. Three principal assumptions underlie the CDSMP are (1) patients with different chronic diseases have similar self-management problems and disease-related tasks; (2) patients can learn to take responsibility for the day-to-day management of their disease(s); and (3) confident, knowledgeable patients practicing self-management will experience improved health status and will utilize fewer health care resources. Other assumptions that shaped the program were that: (1) patient self-management education should be inexpensive and widely available; (2) trained lay persons with chronic conditions could effectively deliver a structured patient education program; and (3) such lay instructors would be acceptable to both patients and health professionals. The positive role models, who are lay leaders with similar backgrounds and disease problems, are increase patients' self-efficacy or confidence in their ability to manage their disease.

Self-management requires that the patient/family have an active and central role in their care. Interventions that support self-management need to be based on the patient's/family's perceived concerns and problems. Six core self-management skills are: (1) problem solving; (2) decision making; (3) accessing appropriate resources; (4)

forming a partnership with healthcare providers; (5) taking action toward health goals; (6) self-efficacy. There were three primary classifications of out- come variables: health behaviors, health status, and health service utilization.

The 5As Glasgow's Approach

Russell Glasgow offer approach for the health professional to promote and motivate health behavior change, assist people to manage chronic condition, and support people to self-manage. Glasgow suggests Assess, Advise, Agree, Assist, and Arrange as an approach to self-management support for assisting healthcare providers and others in guiding patients and families who are coping with chronic conditions, to develop goals and action plans for behavioral change (Glasgow et al., 2003). Glasgow has extended the framework of the 5 A's as a structure for planning and implementing ongoing services to support patients' self-management at multiple levels.

Underlying the 5 A's (Glasgow et al., 2002) is a simple framework of behavior change and self-management that encompasses 4 essential features: (1) collaborative identification of goals between the patient and interventionist and confidence in patient ability to change the behaviors; (2) identification of barriers and strategies to address barriers and supports for goal attainment in the patient's social environment; (3) learning of skills to achieve the objectives; and (4) systematic follow-up and support. Each of these actions informs the development of a personal action plan, which is referred to manage or/and to modify behaviors. Thus, for behavior change to occur, a goal or objective must have been chosen (preferably by the person whose behavior is to change), necessary skills must be present or acquired,

and incentives and opportunities must exist for the behavior to be performed. In addition, health behavior intervention can be effective if patients address factors that impact patients' ability to manage their chronic conditions or enhance behavioral change in the context of their real world environments (Riley, Glasgow, & Eakin, 2001).

Table 2-8

Comparison of Popular Self-management Approach

	Self-management Approach			
	Creer	Corbin and Strauss	Lorig	Glasgow
Emphasis on	- the patient's active role in decision-making - the patient's involvement in defining the problems - responsibility for the management of their illness	- three sets of task; medical management, role management, emotional management	- self-management education for having the confidence to deal with the medical management, role management and emotional management of this condition.	- self-management support for managing chronic condition or behavioral change

Table 2-8 (continued)

	Self-management Approach			
	Creer	Corbin and Strauss	Lorig	Glasgow
Achieve self-management behavior based on	- physician–patient relationship - types of decision-making	- content that addresses all three tasks	- the perceived needs - ability to cope with chronic conditions - experiences of persons actually living with a condition - learning from each other or role model with similar backgrounds and disease problems	- collaboration between healthcare provider and patient - identification of barriers and strategies to address barriers - systematic follow-up - motivation and support from healthcare provider
Leader in group	-	-	- Lay person with similar backgrounds and disease problems - trained leaders	- healthcare profession
Cue to action			- peer support and role modeling	- motivation

Summary

In this study, self-management with Glasgow approach will be used as the theoretical framework. This approach fits the investigator's purpose which needs to explore the effective program that can guide healthcare provider to enhance people to self-manage. This approach is clear and accessible to use for enhancing the likelihood of behavior change in people living with chronic disease. It acknowledges the expertise of the person in living with their condition and all information given to the person is based on what they request at the time. This approach has also been generalized to address multiple setting, behaviors, and behavior change levels and emphasizes the important of collaborative management of chronic disease. It can be integrated with self-management concept, concept of patient empowerment, and motivational interviewing, which promote collaborative goal setting and identification of specific barriers to be adopted or changed behaviors. Emphasis is placed on patient choice and the importance of individual relevance. To successful behavior change program, this approach guide to encourage people to identify barriers that may obstruct goal accomplishment and strategies or action plans for avoiding or overcoming these barriers. Follow-up support is a key component of encouraging long term maintenance of health behaviors.

Self-Management with 5 A's Model

Self-management with 5 A's models was developed by Russel Glasgow and colleagues in 1995. Glasgow brought 5 A's construct include assess, advise, agree, assist, and arrange which adapted from tobacco cessation interventions, combined

with self-management concept for implement in clinical practice settings. The 5 A's model may help to address specific barriers to self-management and implementation of problem solving strategies in behavioral change program. The 5 A's construct is strategies which increase health care providers' involvement in self-management support for enable people to achieve self-management behavior. Self-management with 5 A's models help people have the skill and confidence to effectively manage behavioral change and are responsible to act their own role in behavioral management and are responsible for the choices they make. Self-management strategies consist of problem-solving skills, goal setting, action planning, collaboration, self-efficacy improvement, supportive application of knowledge and skills in real-life situations, and specific plan for follow-up. Self-management with 5 A's models show in figure 1.

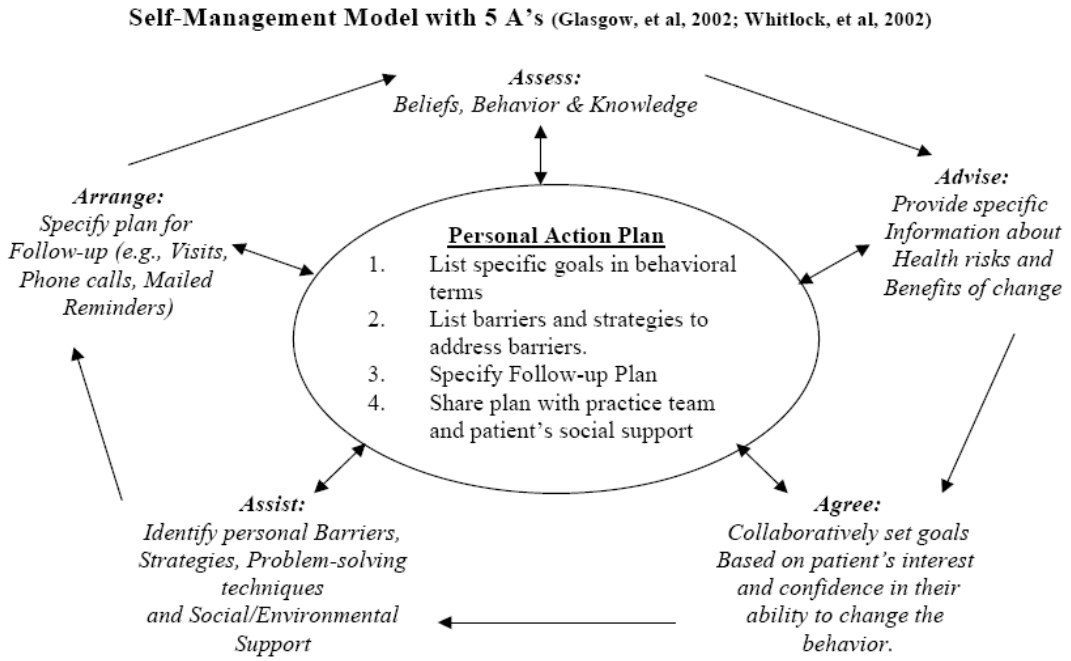

Figure 1. Self-management model with 5As

The content of each step in the 5 A's construct necessarily varies from behavior to behavior, but clinical intervention targeting any behavior change can be described with reference to these 5 As components (Glasgow et al., 2002; Whitlock, Orleans, Pender, & Allan, 2002).

Assess. Assessment is the first steps of self-management with 5 A's model. It includes assessing beliefs, knowledge, current health behaviors, behavioral health risk, and factors affecting choice of behavior change goals/methods, identifying in need of some intervention for a given behavior, identifying barriers and readiness to change the behavior, and presence of medical/physiological factors defining treatment options. Adequate assessment can help the clinician consider patient priorities and medical risks, particularly among those with multiple behavioral risks. Assessment strategies enhance intervention appropriateness and effectiveness. Assessment collects patient information to identify risk factors and is typically used to produce an individuated feedback report to promote health, sustain function, and prevent disease. Personalized feedback can be biological (laboratory or physiological test results), normative (compared with results for others of the same age, race, and gender), or compared with one's previous scores. Assessment is enhanced by selecting assessment tools designed to maximize the accuracy of self-report information. This step helps to create better understanding of patients' perspective and social environment in which people need to conduct self-management activities, to identify barriers and strategies to address barriers, and to refine initial self-management goals and action plan. Glasgow defined barriers as challenge of social, personal, environmental, and economic obstacles to a specified behavior or their desired goal status on that behavior (Glasgow, Whitlock, Valanis, & Vogt, 2000).

Advise. Effective health care provider advice has several important elements. Health care provider advice establishes behavioral issues as an important part of health care and enhances the patient's motivation to change. Such advice is most powerful when personalized by specifically linking the behavior change to the patient's health concerns, past experiences, family, or social situation, and tempering it with the individual's level of health literacy. Health care provider advice primarily gives the cue to action, while other health professionals and media provide the details. In this scenario, the clinician is a uniquely influential catalyst for patient behavior change and is best supported by a coordinated system to accomplish and maintain that change. Feedback from current or previous assessments can help personalize health risks and health benefits as well as enhances motivation for change. Well delivered advice supports the patient's self-determination. The health care provider's advice is delivered matters by a warm, empathetic, and nonjudgmental style elicits greater cooperation and less resistance, particularly for patients not currently interested in change. A respectful, individualized approach first considers patient interest in change before warning about health risks or trying to convince the patient to take action. Helpful health care provider advice also emphasizes the provider's confidence in the patient's ability to change the behavior (building self-efficacy), and reassures the patient that there are multiple ways to approach successful change and sources to support the behavior change once it is undertaken. Acknowledging a patient's previous success in making changes can also boost the patient's confidence. Even considering all these elements, advice messages can be compactly constructed and short (30 to 60 seconds), particularly when coupled with additional assistance.

Agree. Agreement occur both health care provider and patient where behavior change is to be considered or undertaken. When both agree that change is warranted, they then collaborate to define behavior-change goals or methods. Treatment decisions are based on clinician-patient agreement after considering treatment options, consequences, and patient preferences. Shared decision-making is specifically recommended for preventive services that involve conflicting or highly individualized risk-benefit trade-offs. Similarly, a collaborative approach that emphasizes patient choice and autonomy is critical in behavioral change, where the patient retains ultimate control. Patient involvement in decision-making about behavior change offers important benefits, even when decisions involving competing risks and benefits are not the overriding concern. Patients who are actively involved in health care decisions have a greater sense of personal control, an important factor for successful behavior change. Also, patient involvement in decisions promotes choices based on realistic expectations and patient values, which are important determinants of patient adherence or compliance. Actively engaging a patient's agreement before proceeding with further behavioral counseling can also prevent resistance. Agreement considers the multiple treatment or intervention options available to help the patient achieve selected behavior change goals. Moreover, for each of these changes, patients can often choose, based on preference and perceived need for the more intensive skill training and higher levels of social support that clinic-based and face-to-face counseling provide. Agreement is needed about which behavior change(s) to tackle first.

Assist. In providing assistance, health care provider offers additional treatment to address barriers to changes, increase the patient's motivation and self-

management skills, and/or help the patient secure the needed supports for successful behavior change. Effective behavioral change interventions seek to teach self-management skills and engage problem-solving/coping skills, thereby enabling the patient to undertake the next immediate step(s) in the targeted behavior change. Health care provider may provide assistance through referral to other health care staff within the clinic or outside in the larger health care system or community. Assistance techniques vary according to the behavior and the individual patient's needs but include problem-solving skills training and social/environment support to replace the problem behavior with new behaviors and to tackle environmental and physiological barriers to change. Assistance can include direct support from the health care provider/team, guidance in efforts. Assistance also consists of a motivational intervention to bolster confidence and readiness. If the patient is ready to take action, then further behavioral counseling is provided, along with adjunctive medication or medical devices, if appropriate. Assistance may increase knowledge, self-confidence, and motivation.

Arrange. Arranging follow-up challenges us to reconceptualize behavioral risk factors as chronic problems that change over time. No matter how intensive the initial assistance, some form of routine follow-up assessment and support through repeat visits, telephone calls, or other contact is generally deemed necessary in behavior change interventions. Follow-up contacts provide the opportunity to evaluate and adjust the behavior change plan and goals. Follow-up also allows for support of behavior-change maintenance and relapse prevention for those who have already made some significant behavior change. In general, follow-up is best scheduled within a relatively short time period (e.g., 1 month), although the timing

can be geared to provide support for a specific event (such as calling a few days after a set quit-smoking date). After initial intervention follow-up, future contacts are often spaced at successively longer intervals to provide needed support and continuity in a gradually reduced manner. Follow-up will occur seems to be a powerful motivating factor, communicating that the behavior change is important and that follow-up assistance will be available if needed.

Application and Clinical Effectiveness of Self-Management

Self-management program for chronic illness becomes increasingly widespread, and the number of clinical trials continues to increase such as asthma, arthritis, hypertension, cancer, heart failure, chronic obstructive pulmonary disease, etc., but rarely in field of metabolic syndrome. Self-management can provide benefits for patients in terms of knowledge, self-efficacy, behavioral change, adhering to treatment regimes, health status, quality of life, and well-being. However, chronic disease self-management programs probably have a beneficial effect on some (but not all) physiologic outcomes (Chodosh et al., 2005). Cochrane reviews of self-management interventions concluded that there was insufficient evidence to establish the effectiveness of interventions for making practice recommendation (Coster & Norman, 2009).

Self-management programs for chronic illness were designed and showed effectiveness in varying population in control of many chronic conditions. From Cochrane reviews of self-management intervention (Coster & Norman, 2009; Gibson et al., 2009), recommend that patients be educated about their condition, obtain regular medical review, monitor their condition at home with either peak flow or

symptoms and use a written action plan about how to respond to the results of self-management, and how to adjust their medication.. These results showed that asthma sufferers, who were educated about their asthma self-management, visited the doctor regularly and who used a written action plan had fewer visits to the emergency room; less hospital admissions; better lung function; improvement in peak expiratory flow; fewer symptoms; and used less rescue medication.

The meta-analyses have focused on the effectiveness of diabetes self-management education (DSME) intervention elements in 50 RCTs (Fan & Sidani, 2009). The interventions targeting improved self-management behaviors, with a focus on the reduction of foot ulceration, improvement of blood glucose control, diet, and weight, increasing treatment adherence, and promoting general self-care. The results indicate that DSME interventions may improve knowledge, self-care behaviors and metabolic control in adult patients with type II diabetes. Mixed educational and specific behavioral change strategies were found to be most effective in increasing knowledge and achieving metabolic control. Education techniques included group sessions covering basic knowledge and problem-solving skills, combined with individual sessions with an educator; this format appeared to be effective for increasing knowledge and improving metabolic control outcomes. Face-to-face interventions were most effective for enhancing knowledge and metabolic control. Phone contact appeared to be an effective method for delivering DSME and supporting patients, particularly with respect to improving self-management behavior and metabolic control. The dose of DSME intervention appeared to be significantly associated with more sessions and total contact hours appeared to be more effective with respect to knowledge and metabolic control. Incorporating booster sessions also

enhanced the effectiveness of DSME interventions in helping patients maintain the desired changes.

In the most recent update of the Cochrane Database of Systematic Reviews (Coster & Norman, 2009), it was demonstrated that self-management programs help patients manage chronic obstructive pulmonary disease (COPD). They might improve patient knowledge, quality of life and reduce the frequency of hospital admissions.

A systematic review and meta-analysis of self-management of oral anticoagulant therapy appeared better than conventional management. Self-management was associated with a reduced risk of death, major complications, and with increasing time within therapeutic INR target range (Christensen, Johnsen, Hiortdal, & Hasenkam, 2007).

The systematic review of self-management intervention on health outcomes of patients with heart failure demonstrates that self-management interventions decrease hospital readmissions, both all-cause and HF-related (Jovicic, Holroyd-Leduc, & Straus, 2006). There was no significant effect on mortality or on health related quality of life. However, health behaviors, such as regular weighing and monitoring of symptoms, increased in patients who were enrolled in self-management programs. The decrease in all-cause readmission may be partly due to the decrease in HF-readmissions.

Chodosh et al. (2005) conducted meta-analysis in chronic disease self-management program for older adults. They found evidence of statistically significant and clinically important benefits for measures of blood glucose control and blood pressure reduction for chronic disease self-management programs aimed at patients with diabetes and hypertension, respectively. Regarding arthritis, the

statistically significant effects on the physiologic outcomes of pain and function are clinically trivial, a result identical to a recent meta-analysis of the effect of chronic disease self-management programs on osteoarthritis and rheumatoid arthritis.

Conceptual Framework

The conceptual framework guiding the intervention for this study was a self-management with five A's model based on the work of Glasgow et al (2002). It provided a relevant framework along with clear processes to enhance people for changing behaviors. *Self-management support* has been defined as the systematic provision of education and supportive interventions by health care staff to increase patients' self-management skills and confidence in managing their health problems and enhancing behavioral change. Self-management skills included problem solving, goal and action plan setting, self-monitoring, collaborative, and self-confidence. In addition, self-management support provided the application of information in real-life situations that matter to patients. The intervention titled the Self-management Support Program for People with Metabolic Syndrome (SSPPMS) was developed within the five A activities consist of (1) *Assess*: assessment of knowledge, barriers to change eating behaviors and physical activity, confidence to change those behaviors, problem solving ability and target of those behaviors; (2) *Advise*: provision of information about health risks and benefits to healthy eating and physical activity and support to change eating behaviors and physical activity; (3) *Agree*: collaboration between patients and health care providers on setting realistic goals based on patient's interest and confidence in their ability to change eating behaviors and physical activity, and enhance confidence to change those behaviors; (4) *Assist* patients'

adjustment of goals and action plans, identify barriers, choose strategies or skills, offer social or environment support and increase confidence by using motivational interviewing techniques; and (5) *Arrange*: specify a plan for follow-up, ongoing support and maintenance healthy eating behaviors and physical activity. In conjunction with the program, a motivational interviewing technique has been used to assist people to increase self-confidence.

Through the dynamic process of the program, the patients will be equipped with knowledge and skills required for self-management of proper eating and adequate physical activity. The acquired knowledge focuses on what to eat and how to increase their physical activity. It also covers solving their daily encountered problems, and be capable of monitor their own behaviors effectively. To meet their need in the management of eating behaviors and physical activity, they work with nurse in goal setting and action planning, and self-confidence enhancing. It anticipates that these provisions will lead them to healthy eating behaviors and physical activity.

Healthy eating behaviors including the consumption of low carbohydrate, low protein, low fat, low cholesterol, low sugar and low sodium, but high in vegetables and fruits as well as whole grain, help reducing weight circumference, reducing blood pressure, reducing blood sugar, and reducing triglyceride level. Adequate physical activity also improve weight circumference, reduce blood sugar level, reduce triglyceride level, and reduce blood pressure, and increase HDL cholesterol. Carbohydrate is directly influencing blood sugar and triglyceride level. For excessive sugar intake, it will be converted to triglycerides in the blood causing high plasma triglyceride level. Then, surplus triglycerides will be mostly accumulated in adipose tissues of the abdomen. Fat and cholesterol, after

consumption, it will metabolize to triglyceride. Thus, intake of food high in fat and cholesterol will result in increased plasma triglyceride level which indirectly increases waist circumference. Vegetables and fruits, containing high fibers, are barriers to the absorption of fat and cholesterol in the body. Hence plasma triglyceride level does not increase. Sodium is related to the function of endothelial blood vessels, proper amount of sodium intake regulates smooth muscle of the endothelial vascular contraction. High sodium consumption will activate excitability of smooth muscle of the endothelial vascular resulting in high frequency of its contraction, thus high blood pressure ensues.

Regular moderate-intensity physical activity improves blood sugar level by improving insulin sensitivity and increasing metabolism for energy as well as improves triglyceride level. Regular physical activity increases heart muscle contraction leading to pump blood with less effort, decreases arteries resistance, and lows blood pressure as a consequence. In addition, moderate intensity physical activity increases energy expenditures and burns off body fat deposited around the abdomen resulting in decreases waist circumference. It also affects HDL cholesterol metabolism by increasing the rate of HDL synthesis, thus raising HDL cholesterol.

Therefore, it is anticipated that improvement of both eating behaviors and physical activity should be effective in achieving the specified metabolic outcomes. The conceptual framework for this study is showed in Figure 2.

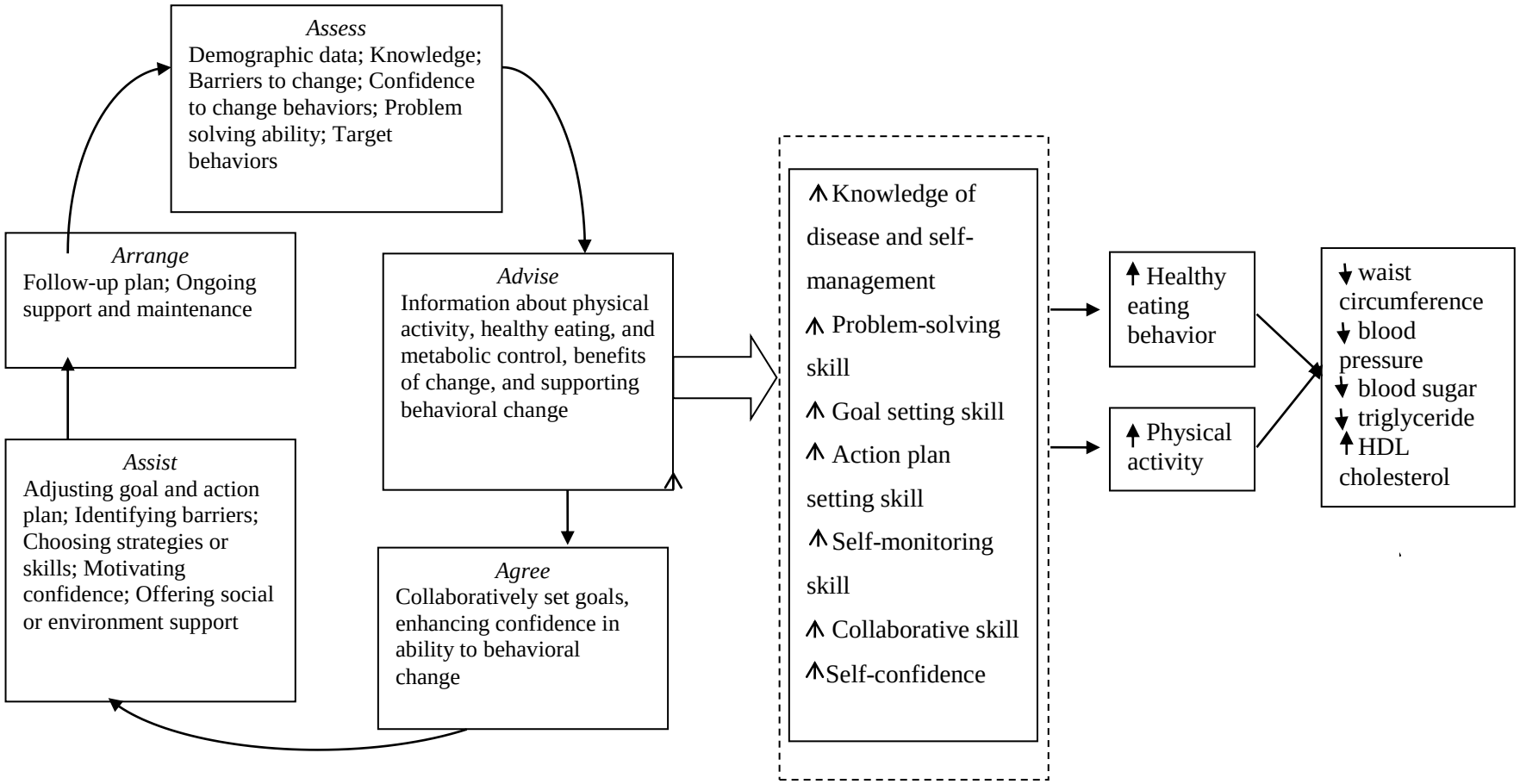

Figure 2. Conceptual framework