

## **Physical Fitness: The Gateway to Preventive Health**

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### **Abstract**

The promotion of physical fitness provides individuals direct physiological and psychological benefits that will serve to enhance preventive health. These benefits include: reduction of mortality rates, reduction of blood glucose, improved quality of life in patients with chronic lung diseases, reduced risk of the development of atherosclerosis by increasing high-density lipoproteins, reducing systemic hypertension, reducing body fat, reducing insulin needs, and reducing platelet adhesiveness and aggregation. Physical activity reduces intraocular pressure, increases bone mineral density, and reduces the risk of the development of certain types of cancers. Physical activity reduces the severity of depression and anxiety and stabilizes mood. Individuals who are physically active are less likely to smoke, abuse addictive drugs, abuse alcohol, and are less likely to engage in destructive eating behaviors. This paper also will review the impact of a sedentary lifestyle on society, as well as discuss strategies to increase physical fitness participation.

### **Introduction**

We are currently in the early stages of a pandemic that may create enormous personal suffering and place enormous stress on our health care systems, to the point of having detrimental affects on the economies of countries throughout the world. This pandemic is not the consequence of a plague or any other disease process. This pandemic is man made. The changes in our lifestyle to a more sedentary existence, and the changes in our dietary consumption to a greater percentage of processed food has led individuals to increase their body weight to the point where overweight and obesity are common place in our society. There are many disease processes that result from being overweight and obesity including heart disease and Type II diabetes just to mention two. Since this condition was created by man, the solution to the problem lies in the hands of each individual. As a society we need to recommend changes in our dietary habits and promote physical activity to achieve a healthy lifestyle. This paper emphasizes the role of physical activity and physical fitness to alleviate this pandemic.

The components of physical fitness are also referred to as health fitness, since these components are closely related to improved health. The components of physical fitness include cardiorespiratory endurance, muscular endurance, muscular strength, muscular flexibility, and body composition. The promotion of physical fitness provides individuals direct physiological and psychological benefits that will serve to enhance preventive health. These benefits include reduction of mortality rates, reduction of blood glucose levels for the prevention of adult onset diabetes, and regulation of blood glucose levels in individuals who currently have diabetes, and enhancement of the ability of individuals who have chronic lung diseases to lead more

productive lives. Becoming more physically fit also reduces the risk of the development of atherosclerosis by helping to reduce the risk factors associated with the disease including: increasing high-density lipoproteins (HDL), reducing systemic hypertension, reducing percent body fat, reduction of insulin needs, reducing platelet adhesiveness and aggregation. Physical fitness also reduces the risk of the development of glaucoma by the reduction of intraocular pressure experienced as a result of exercise. Physical activity promotes a reduction in the risk osteoporosis and bone fractures by increasing bone mineral density, reducing the risk of the development of certain types of cancers, and decreasing the severity of depression, anxiety, and stabilizing mood. In addition to the direct effects resulting from physical fitness, individuals who are physically active appear to possess many lifestyle characteristics that enhance preventive health. For the sake of discussion, these behaviors will be referred to as “indirect benefits of physical fitness”. Studies have demonstrated that individuals who engage in an active lifestyle are less likely to smoke, less likely to abuse addictive drugs, less likely to abuse alcohol, and less likely to engage in destructive eating behaviors. In addition to providing the documentation that demonstrates how each of the above benefits serves to enhance preventive health, this paper will review the impact of a sedentary lifestyle on society; and will discuss strategies to increase physical fitness participation.

### **Direct Physiological Benefits Resulting From Physical Fitness**

*Reduction in all causes of mortality rates among physically active individuals.*

In the 1950’s researchers first acknowledged the relationship between physical activity and mortality rates from all causes (Morris & Heady 1953). In a long-term prospective follow-up study involving male subjects, the researchers determined that the relative risk of death from any cause was associated with physical activity. The researchers demonstrated that the greater the level of physical activity the lower the relative risk of death. The relationship between mortality rates and physical activity was further documented in the 1970’s by Paffenbarger & Hale (1975). In 2001, Kohl conducted a *meta-analysis* to determine the relationship between physical activity and death rates. His analysis concluded that physical activity reduced the risk of death resulting from cardiovascular disease in males and females. Kohl’s findings were substantiated by Macera et al. (2003), who also demonstrated a reduction in relative risk of death in males and females, who engaged in routine physical activity. Kohl further demonstrated a relationship between dose (number of Kcals expended as a result of physical activity) and death rates. The more an

individual is physically active, the lower the mortality rate. Erikssen et al. (1998) demonstrated that individuals with the highest levels of physical fitness at the beginning of the study, and who maintained or improved their physical fitness over the course of the study, had the lowest risk of premature death. In a later study, Erikssen (2001) demonstrated that a decrease in physical activity will cause an increase in all-cause mortality rates.

In summary, the studies reviewed in this paper demonstrate compelling evidence that improvements in physical fitness are associated with lower mortality rates from all-causes and specifically from cardiovascular disease in men and women. These studies indicate that even modest improvements in physical fitness (Meyers et al. 2002) produce significant benefits concerning mortality risk. To receive the greatest benefit from physical activity one should strive to achieve the highest degree of physical fitness and maintain that degree of physical fitness. Those so doing would have the lowest risk of premature death (Erikssen et al. 1998).

*Reduction in cardiovascular disease among physically active individuals.*

Cardiovascular disease (CVD) is the leading cause of death in the United States (CDC 2001). This disease was responsible for one million deaths in 2001, divided equally between males and females. Wannamethee et al. (2000) reported that physical activity reduces the risk of death in older men diagnosed with coronary disease. Blair et al. (1989) indicated that low levels of physical activity are associated with high risk for developing CVD. Conversely, high levels of physical activity are associated with low risk for developing CVD (Franco et al. 2005).

The mechanism that explains the beneficial effects of physical activity in the prevention of CVD is not clearly understood. Cross-sectional data indicate that highly physically active individuals have lower resting plasminogen activator inhibitor, implying that routine physical activity may improve the fibrinolytic profile (Szymanski et al. 1994). It has not been clearly demonstrated in longitudinal studies if an improved fibrinolytic profile is a direct result of physical activity or an indirect effect of increased physical activity resulting from a reduction in adipose tissue, which typically accompanies physical training. Mavri et al. (2001), clearly demonstrates that plasminogen activator inhibitor decreases after weight loss.

It is difficult to describe the mechanisms responsible for the reduction in the incidence of CVD resulting from physical activity without addressing the major modifiable-risk factors of the disease. These risk factors include: excess body fat, hypertension, enhanced lipid lipoprotein profiles (e.g., reduced triglycerides, decreased low-density lipoprotein, and increased high-

density lipoprotein), and improved glucose homeostasis and insulin sensitivity (Warbunton 2006). Fortunately, evidence indicates that physical activity has a positive impact on each of these risk factors. The author will address how physical activity impacts these variables later in the paper.

*Reduction in cerebrovascular disease among physically active individuals.*

The relationship between physical activity and the reduction in cerebrovascular disease (stroke) is not as clear-cut as the relationship between physical activity and the reduction of cardiovascular disease. The highest prevalence of cerebrovascular disease is within the elderly population (Lu et al. 2005). Studies have demonstrated that physical inactivity is associated with an increase in cerebrovascular events (Katzmarzyk 2006, Miyachi et al. 2003, Arai 2004, Kato 2002). Physical inactivity is listed as a risk of cerebrovascular disease, as well as hypertension, smoking, alcohol consumption, and obesity, however, the exact mechanism by which physical activity reduces the risk of cerebrovascular disease is not known. Several investigators (Katzmarzyk 2006, Lu 2005, Miyachi et al. 2003) have hypothesized that the role physical activity plays in the reduction of cerebrovascular disease is that physical conditioning decreases the rate of decline of physical function and retards the aging process. This is thought to be critical because these researchers have demonstrated that an increase in arterial stiffness associated with age is reduced with physical activity. These researchers also recommend daily physical activity as a component of a patient's rehabilitation to prevent further determination of the disease state (Katzmarzyk 2006, Lu 2005, Miyachi et al. 2003).

*Reduction in systemic blood pressure among physically active individuals.*

In the year 2000, systemic hypertension, or simply referred to as hypertension, affected approximately 65 million adults in the United States. This accounts for approximately one-third of the American population. (Fields et al. 2004). Hypertension is defined as a "systolic blood pressure of 140 mm Hg or higher or a diastolic blood pressure of 90 mm Hg or greater" at rest (Brown et al. 2004). The risk factors associated with hypertension include: physical inactivity (Whitworth 2003, Chobanian et al. 2003), overweight and obesity, excess alcohol consumption, and excessive sodium intake (Appel et al. 2003). In this disease, like so many others diseases that can be influenced by lifestyle intervention, it is difficult to separate the beneficial effects of physical activity from other lifestyle interventions such as weight loss, since weight loss can be achieved through caloric restriction or increase in caloric output (physical activity). An ideal

scenario is to achieve weight loss through the combination of caloric restriction and caloric expenditure (Gillman et al. 2001, Pate et al. 1996). Regardless of the exact mechanism responsible for the reduction of blood pressure, physical activity is a recommended lifestyle strategy to effectively prevent and treat high blood pressure (Whelton et al. 2002, Whitworth 2003, Chobanian et al. 2003). The current federal guidelines established by the Surgeon General's Report on Physical Activity and Health (U.S. Department of Health and Human Services 1996) that recommends at least 30 minutes of moderate intensity physical activity on most days, (preferably all days of the week), or at least 20 minutes of vigorous physical activity on three days per week, appears to be sufficient to promote reductions in blood pressure (Brown et al. 2006, Ishikawa-Takata & Tanaka 2003). However, it should be noted that reductions in blood pressure of hypertensive patients was approximately 8 and 6 mm Hg for systolic and diastolic blood pressure readings, respectively. The reduction of blood pressure in individuals with normal blood pressure was 3 and 2 mm Hg for systolic and diastolic blood pressure readings, respectively (Fagard 2001). These blood pressure reductions are relatively small compared to typical blood pressure readings within hypertensive patients, therefore, one should not believe that physical activity alone is a panacea for the treatment and prevention of hypertension. However, if one were able to reduce his/her blood pressure through physical activity, less medication would be needed to get an individual's blood pressure readings within normal limits. This is desirable, because many prescriptive medications have adverse side effects. If one can lower blood pressure through physical activity, he/she will be required to take less medication, and, therefore be subject to less adverse side effects of the medication.

*Improvements in lipid profiles among physically active individuals.*

It is clearly documented that low levels of high-density lipoprotein cholesterol (HDL-C), and high levels of low-density lipoprotein cholesterol (LDL-C) are associated with increased risk of coronary disease (Corti et al. 1996, Superko 1996). One study reported that physical activity positively influenced HDL-C and LDL-C (Berg & Frey 1994). A more recent study indicated that physical activity had little effect on LDL-C and limited positive effect on HDL-C (Leon & Sanchez 2001). A recent study by LeCheminant et al. (2005), indicated a dose relationship between the intensity of physical activity and the effectiveness of physical activity to increase HDL-C. These researchers reported that high-intensity physical activity was more effective in increasing HDL-C than moderate-intensity physical activity. It is important to note that

moderate intensity physical activity significantly increased HDL-C but not to the same degree as high intensity exercise. These investigators also acknowledged that the elevation in HDL-C is also associated with a decrease in body fat percentage.

*Reduction in overweight and obesity among physically active individuals.*

Overweight is defined as a body mass index (BMI) between 25.0 and 29.9 kg/m<sup>2</sup>. Obesity is defined as a body mass index (BMI) of 30 kg/m<sup>2</sup> and higher (Seidell & Flegal 1997). An excess intake of energy (food), relative to energy expenditure, is the central cause for the development of obesity (Sarsan et al. 2006). The National Health and Nutritional Examination Survey in 1994 (Flegal et al. 1998) indicated that 54.9 percent of American adults are overweight or obese. Public health programs have aimed at decreasing the prevalence of overweight and obesity in the United States (Mokdad et al. 2001). Despite these programs, prevalence rates continue to increase, resulting in additional millions of Americans being overweight and obese (Gallagher et al. 2005). Statistics indicate that 61 percent of adult Americans are overweight or obese (Ziebland et al. 2002). The most recent statistics indicate that 64.9 percent of adult Americans are overweight or obese (CDC, 2006). The highest prevalence of obesity is found among non-Hispanic black women, Mexican-American women, Mexican-American men, the less educated, and low-income Americans (Grundy et al. 1999). Obesity is such an enormous problem, because obesity strongly impacts the incidence of Type II diabetes, heart disease, breast and colon cancer, kidney disease, and diseases of the digestive tract (Josefson 2001). The economic cost of obesity directly related to obesity is \$70 billion in 1995 (Grundy et al. 1999).

Exercise programs have been shown to enhance weight loss in non-obese populations (Jakicic et al. 2001, Saris et al. 2003). Recent guidelines recommend approximately 60 minutes of moderate-intensity physical activity performed daily (Saris et al. 2003). Studies investigating the effects of weight loss in obese populations are not as definitive. Sarsan et al. (2006) failed to demonstrate significant weight loss in a 12-week exercise program consisting of aerobic and resistance exercise. The most optimal approach to weight loss in obese adults is a program that combines mild caloric restriction with regular endurance exercise of moderate intensity, performed 45 to 60 minutes, at a frequency of 5 to 7 days per week (ACSM, 2006).

Childhood obesity has become an epidemic problem worldwide. The evidence of the high prevalence of childhood obesity is alarming, because it has been documented that 80 percent of obese children become obese adults (Schonfeld-Warden & Warden 1979). Small imbalances

between energy intake and energy expenditure over a long period of time are responsible for childhood obesity (Rosenbaum et al 1997).

The effectiveness of physical activity to reduce body fat in obese children and adolescents is similar to the findings of training programs in obese adults. The majority of studies that investigate the influence of physical activity on the reduction of percent body fat or body weight loss in obese children and adolescents have not adequately controlled for dietary influences. Studies (Hills & Parker 1998, Watts et al. 2004) have demonstrated a combination of mild caloric restriction, with moderate physical activity was effective in decreasing body weight. Both of these studies demonstrated that the combination of physical activity with mild caloric restriction was more effective than caloric restriction alone.

*Regulation of blood glucose levels and the reduction of Type II Diabetes among physically active individuals.*

Some 15 million Americans are estimated to have diabetes. This accounts for about 5 percent of the American population (Harris et al., 1998). Two major types of diabetes exist. Insulin-dependent diabetes (Type I) develops predominantly in children and adolescents. This condition results from an immune-mediated process that leads to beta cell destruction. Lifestyle is thought to have little to do with the development of Type I Diabetes. Non-insulin dependent diabetes (Type II) is the most common form of diabetes and develops predominantly in adults (Knowler et al., 2001), however, there has been a dramatic increase in the incidence of Type II diabetes within the adolescent population. In the State of Ohio, Type II diabetes among African-Americans and Caucasians between the ages of 10 to 18 years accounted for 33 percent of all cases of diabetes (Fagot-Campagna 2000). Type II diabetes among youth is an emerging health concern that requires swift action on the part of the health-care community. Fortunately, evidence exists to suggest Type II diabetes can be prevented through lifestyle strategies that influence weight-related behaviors such as diet and physical activity in the form of moderate-intensity aerobic exercise (Knowler et al., 2001). Several recent studies have demonstrated that moderate-intensity resistance training in adults, children, and adolescents is effective in improving glycemic control and lowers fasting insulin levels in obese Type II diabetics (Baldi & Snowling 2003, Dusntan et al. 2006, Shail et al. 2006). A reduction in fasting insulin levels is critical, because studies have demonstrated a positive relationship between elevated fasting insulin levels and cardiovascular disease (Takahashi et al. 2006, Olson et al 2006, Avogaro

2006). To have a universal impact within the United States, school systems across the country need to place greater emphasis on health, nutrition, and physical activity within the academic curriculum.

*Reduction of cancer among physically active individuals.*

Interest in physical activity's influence on cancer has its origin in 1922 (Sivertsen & Dahlstromom 1922) when the first paper appeared in the literature concerning physical activity's role in cancer development. The investigators observed that death rates declined with increasing occupational physical activity demands. To date, numerous studies have investigated the relationship between physical activity and cancer prevention. Hypotheses to explain the link between physical activity and cancer development is related to hyperinsulinaemia. Giovannucci (1995) reported that insulin is a tumor-growth factor. He suggested that insulin resistance leads to cancer through the growth promoting effect of insulin on cancer tumors. Giovannucci (1995) pointed out that obesity and physical inactivity, which are the main determinates of insulin resistance and hyperinsulinaemia, appear to be the link between physical activity and cancer. Other than nonmelanoma skin cancer, the most commonly occurring cancers in men are prostate, lung, and colorectal; for women they were breast, lung, and colorectal cancers (Jemal et al. 2002).

When reviewing the studies investigating the influence of physical activity on the risk of developing colon cancer in men and women, Lee (2003) reported physical-activity reduced in risk of developing the disease ranging from 60 to 80 percent when compared to sedentary individuals. Samad et al. (2005) reviewed 47 studies that investigated the role of physical activity in the prevention of colon and colorectal cancer. Of the 47 studies reviewed by Samad et al., 40 demonstrated that physical activity reduced the risk of developing colorectal cancer in males.

The data concerning the role of physical activity and the development of rectal cancer are not as clearly defined as the role of physical activity in the prevention of colon cancer. Lee (2003) reported that physical activity reduced in the risk of developing rectal cancer from 70 to 150 percent when compared to sedentary individuals. Samad et al. (2005) reviewed 47 studies that investigated the role of physical activity in the prevention of colon and colorectal cancer. When rectal cancer was separated from colorectal cancer Samad et al. (2005) reported that only eight studies demonstrated a reduction in rectal cancer risk. Based on the sparse data concerning

the role of physical activity in the prevention of rectal cancer, Jemal et al. (2002) concluded insufficient data to firmly conclude that physical activity reduced the risk of the development of rectal cancer.

In 1992, Lee et al. demonstrated that men who expended > 400 kcal per week had a lower incidence of prostate cancer; however, these same investigators (Lee, et al. 2001) failed to replicate their findings. The researchers attempted to explain these inconsistent finding by attributing the differences to prostate-specific antigen (PSA) screening. In the first study, PSA screening was not widely used. In the follow-up, study PSA screening was commonly used. If physically active men were more likely to undergo health screening (including PSA ), this could lead to increased diagnosis of early prostate cancer among active men, skewing the results of their follow-up study. Studies have demonstrated that physically active men are more likely to undergo health screening.

Investigators studying the relationship between physical activity and the occurrence of lung disease have reported an inverse relationship between the level of physical activity and the risk of lung cancer (Lee et al. 1999, Thune & Lund 1997). These studies report a reduction in risk of developing lung cancer ranging from 25 to 29 percent in physically active individuals, compared to sedentary individuals.

Breast cancer is the most common cancer in women in the United States (Lee 2003, Biscego et al. 2006). Each year more than one million women worldwide are diagnosed with breast cancer (WHO 2001). Similar to other types of research concerning the relationship of physical activity and breast cancer, a review of studies indicate the risk of developing the disease decreases from 60 to 90 percent compared to sedentary individuals. The overall data demonstrate a reasonably clear pattern that physical activity reduces the risk of developing breast cancer (Lee 2003). The majority of the studies that reported a reduction in the risk of breast cancer quantified physical activity in reference to kcals expended per week. Although these studies did not investigate the decrease in risk for developing breast cancer related to weight reduction, since there is a direct relationship between physical activity and weight loss, weight loss may play an essential role in the reduction of breast cancer risk. Physical activity also plays an essential role in the recovery from breast-cancer surgical intervention. A study by Biscego et al. (2006) reviewed many studies to determine the safety of physical activity following surgical intervention in breast cancer patients. The authors were particularly concerned with initiation or

exacerbation of lymphedema. The researchers concluded that physical activity was safe. Other studies investigating the effectiveness of physical activity following surgical intervention have documented an improvement in muscular strength, muscular flexibility (Cheema & Gaul 2006), and cardiorespiratory endurance (Herrero et al 2006). These studies demonstrated that physical activity was associated with an improvement in quality of life.

Studies have also investigated the appropriateness of physical activity during chemotherapy intervention in cancer. A study by Quist et al. (2006) reported that high-intensity resistance training and aerobic exercise were well tolerated by chemotherapy patients at all stages of intervention. Physical training resulted in an increase of muscular strength and aerobic fitness. The study also demonstrated an increase in body weight of 1 percent following training. Since weight loss is a critical side-effect of chemotherapy treatment, weight gain is a critical benefit resulting from physical activity during chemotherapy treatments.

*Reduction of osteoporosis and bone fractures among physically active individuals.*

Osteoporosis results from a reduction in bone mineral density (BMD). The loss of BMD contributes to loss of mechanical strength and to bone fragility, leading to the susceptibility of bone fractures (Borer 2005). The most recent statistics indicate that 1.5 million Americans experience bone fractures each year, resulting in \$17 billion in healthcare costs (U.S. Department of Health and Human Services 2004). Studies demonstrate that immobilization in the form of bed rest (Whedon 1984), or exposure to hypogravity of outer space (Collet et al. 1997), lead to massive loss of bone minerals at a rate of one percent per week (Krolier & Toft 1983). Osteoporosis development is attributed to inadequate accumulation of peak bone mass prior to attainment of skeletal majority (Newton-John & Morgan) or to excessive bone loss during aging (Albright et al., 1941). The two questions related to physical activity are whether exercise influences peak bone density before bone maturity occurs and if physical activity reduces the loss of BMD after skeletal maturity, which occurs around age 16, or approximately 3 years after the onset of menarche (Tanner 1981).

Studies investigating the effect of physical activity on BMD before skeletal maturing in females indicate that virtually all modes of weight-bearing activities increase BMD. Studies have demonstrated that activities such as jumping (Fuchs et al. 2001), aerobics (Morris et al. 1997), weight training (Morris et al. 1997, Nichols et al. 2001), and gymnastics (Helge &

Kanstrup 2002) all increased BMD. Non-weight bearing activities such as swimming (Taaffe et al. 1995) have not demonstrated an increase in BMD following participation in the activity.

Studies investigating the effect of physical activity on BMD in older adult females demonstrate that BMD is increased with weight-bearing activities, while other studies indicate that BMD is maintained as a result of training. Activities such as walking (Kohrt et al. 1979, Hatori et al. 1993) and weight training (Nelson et al. 1994, Kerr et al. 2001) have demonstrated that older women experience an increase in BMD resulting from participating in these activities. Hartard et al. (1996) and Mandalozzo and Snow (2000) demonstrated that BMD remained unchanged as a result of weight training. Martin and Notelovitz (1993) reported that BMD remain unchanged following one year of aerobic training in females. Orwoll et al. (1999) also demonstrated that swimming which is a non-weight bearing activity, failed to increase BMD in older adult females. The results of these studies, although not conclusive, indicate that weight-bearing physical activity will increase BMD in older adult women or will at least maintain BMD through the aging process.

*Physical activity helps people with arthritis live more effectively.*

Arthritis is a chronic degenerative disease that affects the joints within the body (Skinner 1995). This painful disease often significantly compromises an individual's quality of life and independence (Marks & Allergrante 2005). The two major forms of arthritis are osteoarthritis (OA) and rheumatoid arthritis (RA). Any disease that affects the integrity of the joint falls under the heading of arthritis. Given this definition, there are more than 100 diseases that fall under the heading of arthritis. An example of a disease that falls under the heading of arthritis is fibromyalgia; a condition associated with chronic widespread pain (including the joint), fatigue, poor sleep, anxiety, depression, significant disability, and loss of employment (Hammond & Freeman 2006). In this review, the author will limit his discussion to OA and RA for the sake of practicality.

OA is the most common form of arthritis. The condition affects as many as 80 percent of the adult population over the age of 65 years (Brandt 2000); there is no known cure or prevention of arthritis. Treatment of this condition is not always amenable to surgery (Peat et al. 2001), and treatment with medications is not always advantageous because drug intervention is associated with deleterious gastrointestinal effects and joint-cartilage destruction (Brandt 2000). Therapies such as exercise and weight loss can provide considerable therapeutic benefits to

patients without any undue side effects (Marks & Allegrante 2005). The benefits of exercise for people with OA are extensive. Marks and Allegrante provide an extensive list of benefits of exercise for people with OA. Some selected benefits include: better weight control, decreased stiffness of joints, decreased swelling of joints, improved flexibility, increased joint range of motion, improved joint stability, improved strength and balance, reduced fatigue, reduced medication usage, decreased pain, and improved psychological outlook on life. The adverse effects of exercise reported by Marks and Allegrante during the performance of exercise include pain, fatigue, and exacerbation of symptoms. According to Carr (2001), one of the main barriers to achieving the benefits of exercise for individuals with OA, is the low rate of adherence to prescribed treatment interventions. Increasing exercise adherence is the main challenge for achieving the benefits associated with exercise. To increase exercise adherence with people with OA the following recommendations have been made: structure exercise to meet individual capabilities (Cox 2003), improve the knowledge concerning the benefits of exercise for individuals with OA (Belza 2002), provide exercise as a social setting (Ready 1996), provide supervised exercise classes or one-to-one supervision (Kettunen & Kujala 2004), provide pool exercise as a mode of exercise (Cox 2003), and recommend contracting and goal setting (Rosenstock 1988).

RA is the second most common form of arthritis, although the etiology is completely different from that of OA. RA is a chronic, progressive, autoimmune disease of unknown etiology. For whatever reason, the immune system recognizes the synovial lining of the joint as foreign, triggering inflammation and all the destructive consequences associated with joint inflammation such as joint-capsule destruction. RA is associated with many of the same complications and benefits resulting from exercise (Skinner 1995). Treatment of RA with surgery or medications is associated with the same problems that were cited with the treatment of OA. Similar exercise recommendations for OA are appropriate for RA.

*Improving health through physical activity in patients with Chronic Obstructive Pulmonary Diseases.*

Asthma, chronic bronchitis, and emphysema are conditions that fall under the heading of “chronic obstructive pulmonary diseases” (COPD) [Skinner 1995]. Asthma is defined as a clinical syndrome resulting from reversible obstruction and increased bronchial constriction, responsive to a variety of stimuli within the environment (Varray 2006). Environmental

conditions such as allergens in the air and external stimuli such as cigarette smoking or hyperventilation (Bundgaard et al. 1981) are known to impact the disease. Prevalence and severity of asthma are rising in industrial countries (Basagana et al. 2004). Chronic bronchitis is characterized by progressive and permanent airflow restriction resulting from thickening of the mucosa, which occurs as a result of chronic irritation. Pulmonary emphysema is characterized by abnormal enlargement of the alveoli, resulting in less surface area for gas exchange. Destruction of alveoli is linked to  $\alpha_1$ -antitrypsin, which functions to antagonize the action of serine elastase, that degrades elastic tissue in the walls of the alveoli (Nowak & Handford 1999). This results in the alveoli losing their elastic properties. COPD is the leading cause of morbidity and mortality worldwide (Varray 2006).

Individuals diagnosed with COPD-type diseases are more likely to be sedentary (Bar-Or 1985). Several psychological studies indicate that the symptoms associated with COPD have a tendency to make COPD patients sedentary. These studies report that COPD patients fear that exercise will worsen the disease, have a lack of knowledge concerning exercise capacity, are overprotection, and have poor social interactions. When individuals with COPD become sedentary, they become more de-conditioned, which results in more symptoms of the disease, and this strengthens fears, making them less likely to engage in physical activity. This is a vicious cycle that must be interrupted by health-care professionals.

Because physical activity does little, if anything, to improve the function of the respiratory system, some have questioned the appropriateness of promoting physical activity for COPD patients (Butcher & Jones 2006). Individuals with this perspective believe that the only way to increase exercise capacity is to improve lung function, which is not possible with exercise training. They also believed that if dyspnea occurs during exercise, it is an indication that exercise is worsening the condition (Varray 2006). Individuals' with this perspective have too narrow a perception of the benefits of exercise participation.

Studies failed to demonstrate that physical activity cures or prevents COPD; however, studies clearly demonstrate that exercise training is beneficial for patients with COPD (American Thoracic Society 1999). Gigliotti et al. (2003) demonstrated a positive effect of exercise training on exercise capacity. Based on the perception that exercise has no direct effect on respiratory function, improvements in exercise capacity seem impossible; however, if one considers that peripheral adaptations also influence exercise capacity, one clearly can see how exercise capacity

can be increased, even if respiratory function is not altered. Even though exercise training has no direct effect on respiratory function, exercise does provide indirect benefits to pulmonary function. Researchers demonstrated a significant decrease in ventilatory rate at a given work rate (Gigliotti et al. 2003). The decrease in ventilatory rate is critical in the prevention of exercise-induced asthma, because this trigger of asthma is not due to exercise but to hyperventilation during exercise (Bundgaard et al. 1981). The decrease in ventilatory rate is also an indication of improved ventilatory efficiency that could be a result of increased strength of respiratory muscles (McArdle et al. 2000). Petersen and McElhenney (1965) reported fewer and less severe asthmatic attacks. Huang et al. (1989) reported fewer wheezing days, fewer days needing medication, decreased hospitalizations, and decreased school absenteeism in asthmatics who engaged in physical activity.

Researchers have demonstrated that exercise training reduces symptoms of dyspnea during exercise (Casaburi 2003), which allows for a greater attainment of maximal exercise capacity. Studies also have demonstrated a significant decrease in submaximal heart rate at a given work rate (Vogiatzis et al. 2002). Studies in COPD patients indicate that oxidative enzymes in peripheral muscles were increased (Mercken et al. 2005).

Because there is documentation that exercise training has beneficial effects for COPD patients, one must question the most efficient mode and intensity of exercise that is necessary to elicit these effects. COPD patients have low exercise capacities, ranging from 0.5 to approximately 1.6 L/minute (Carter et al. 2003), and their abilities to exercise at high levels, when compared to the individuals not affected by COPD, is limited. Casaburi et al. (1991) indicated that that even low-intensity exercise produces physiological training effects. Neder et al. (2000) found that patients with COPD are able to sustain work rates at much higher levels (82 percent compared to healthy subjects 68 percent) when work rate is expressed as a percentage of their maximum exercise capacity. COPD patients, even with a significantly diminished capacity for exercise training, can develop a significant training effect.

A study was conducted comparing high-intensity training (80%), versus low-intensity training (50%) in COPD patients. The study was conducted over an eight week period. The results indicated that only the high-intensity group reduced submaximal heart rate and ventilation. These are critical variables because they indicate improvements in exercise and respiratory efficiency (Casaburi, 1993).

*Reduction of Gallstone disease among physically active individuals.*

Gallstone disease results from hypomotility of the gallbladder, which results in incomplete and infrequent emptying of its contents, allowing for crystal formation (Utter 2001). This has been identified as a key factor in the development of gallstones (Portincasa, et al. 1995). Gallbladder emptying is measured in terms of ejection fraction, or the percentage of contents ejected from the gallbladder. Typical values range from 64 to 83 percent in normal subjects (Glassbrenner et al. 1994). Under normal physiological conditions, meal consumption is the normal stimuli for promoting gallbladder emptying (Utter 2001). Exercise has been demonstrated to increase gallbladder emptying. Thirty-four percent of cases of symptomatic gallstones in men could be prevented if individuals would engage in vigorous exercise for 30 minutes, five days a week (Leitzmann et al. 1998). Researchers theorized that the reduction in gallbladder disease could be a result of greater emptying of gallbladder contents. Utter et al. (2000) also hypothesized that because exercise increased high-density lipoprotein cholesterol (HDL-C) levels, and HDL-C is inversely associated with gallstone prevalence (Petitti et al. 1981), exercise plays an indirect role in the prevention of gallstone disease.

*Physical activity helps people with Chronic Kidney Disease live more effectively.*

To date, no studies have investigated the role of physical activity for the prevention of chronic kidney disease (CKD). Many individuals with CKD are sedentary. O'Hare et al. (2003) reports that 35 percent of CKD patients almost never exercise, 22 percent engage in physical activity one or less times per week, 23 percent exercise two to five times a week, and 20 percent engage in physical activity almost daily. These statistics are lower than the statistics for the average population. The inactivity seen in CKD patients is associated with increased mortality in patients with end-stage renal disease (O'Hare et al. 2003). Many patients with CKD are also burdened with other chronic diseases such as diabetes mellitus (45%), hypertension (79%) (United States Renal Data System 2003), and patients with CKD have a higher prevalence of cardiovascular disease than the general population (Sarnak et al. 2003).

Studies investigating the physiological effects of physical activity are sparse. The few studies that have attempted to determine the effectiveness of exercise to improve aerobic capacity have indicated that, on average, one can expect a 15 percent increase in maximal oxygen consumption, the typical value used to quantify aerobic capacity. Because CKD patients are typically sedentary and have significantly lower aerobic exercise capacities, even with a 15

percent improvement in aerobic capacity, their aerobic capacities are far below their age-predicted levels. The duration of the studies conducted on CKD patients are relatively short (8 weeks to 6 months). Longer studies may yield greater improvements in aerobic capacity; however, an average improvement of 15 percent is a significant improvement when one considers where the patient started. Studies need to be conducted to determine the impact of increased exercise capacity in CKD patients on quality of life, self-esteem, depression, anxiety, and other scales that provide insight to the overall effectiveness of an aerobic exercise program.

Muscular strength is an important determinant of one's ability to live independently (Potter et al. 1995). Patients receiving treatment for CKD (dialysis) are weak, even when compared to healthy sedentary individuals (Fahal et al. 1997). The lack of muscular strength probably has a great deal to do with the inactivity statistics that were stated earlier for CKD.

Castaneda et al. (2001) reported that a resistance-training program in CKD patients, which was conducted for 12 weeks that required subjects to lift 80 percent of their one-repetition maximum (1-RM), increased 1-RM strength by 32 percent. The control group experienced a 13 percent decline during the same period. Once again, even with these improvements, the CKD patients are far below their age-predicted levels; however, this study demonstrates that improvements are possible with CKD patients.

Patients with CKD, especially those on dialysis treatment, are more susceptible to musculo-skeletal injury, resulting from hyperparathyroidism and bone disease, which frequently accompany CKD (Johansen 2005). The risk of injury to CKD patients may be minimized by predicting 1-RM strength (Berger 1961), rather than measuring 1-RM strength, which is typically required to write an exercise prescription. Risk of musculo-skeletal injury can also be reduced by beginning training at a low intensity (40-50% of 1-RM) and gradually increasing the resistance as tolerated. The short-term risk of musculo-skeletal injury may be offset by the reduced likelihood of an injury resulting from a fall, following physical training (Copley & Limberg 1999).

*Improving health through physical activity in elderly individuals.*

Aging places individuals at risk for developing many diseases; the most predominant is cardiovascular disease. Regular physical activity at low to moderate intensity is associated with improvements in risk factors associated with cardiovascular disease (Lee et al. 2001). This

discussion of how physical activity improves health will focus on how physical activity reduces the risk factors associated with cardiovascular disease.

Body fat increases with advancing age (Stevens et al. 1998). Body fat accumulated in the torso region is closely associated with an increased risk of morbidity and premature mortality (Stevens et al. 1998). Physical activity can induce a preferential loss of fat within the torso region of the body (Korht et al. 1992).

Advancing age in sedentary individuals is associated with unfavorable changes in plasma lipid and lipoprotein levels. These abnormal levels have been identified as risk factors related to cardiovascular disease (National Cholesterol Education Program 1994). Routine physical activity increases HDL-C. LDL-C levels are reduced through regular physical activity, but only when physical activity is accompanied by significant reduction in body weight. Fortunately, as reported earlier, one would expect a reduction in body weight when individuals increase their physical activities (Saris et al. 2003).

Elevated fasting plasma insulin levels, impaired glucose tolerance, and lower insulin sensitivity have been associated with an increased risk of cardiovascular diseases (Cefalu et al. 1998). Routine physical activity is associated with lower fasting insulin levels and improved glycemic control (Baldi & Snowling 2003, Dunstan et al. 2006, Shail et al. 2006).

Arterial blood pressure increases with advancing age (Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure 1997). Regular physical activity reduces resting blood pressure in older adults (Ishikawa et al. 1999).

It should be noted that the benefits of physical activity reverse rapidly upon the cessation of routine exercise (Holloszy & Kohrt 1995). For this reason, aerobic exercise should be prescribed with the intention of making the exercise enjoyable, so to enhance long-term compliance. The aerobic recommendations include a gentle warm-up because older adults are more prone to exercise-induced musculoskeletal injuries and cardiac events. The exercise intensity should consist of moderate intensity activities (40 to 60%) of aerobic capacity (Mazzeo & Tanaka 2001). Walking is the most preferred mode among older adults (Booth et al. 1997). The minimal duration of aerobic activity is 30 minutes per exercise session. Older adults should be encouraged to increase their exercise duration rather than exercise intensity. An exercise duration of 60 minutes should be an optimal target. If an individual is not capable of exercising continuously for an extended period of time, one can perform multiple short bouts of exercise.

The total volume of exercise is more important than the duration of a single bout of exercise. The minimal frequency of aerobic exercise is 3 days per week, but the ideal exercise frequency is most days of the week (Mazzeo & Tanaka 2001).

Resistance training is also recommended for older adults. Aging is associated with a decline in musculoskeletal strength, which has been linked to decline in functional capacity, a loss of mobility, and an increased risk of physical frailty. Older adults can expect a 2- to 3-fold increase in strength, resulting from resistance training, which can be accomplished in a relatively short period of time (3 to 4 months). The initial increase in strength is likely a result of neural adaptations allowing for greater muscle fiber recruitment. Beyond the initial improvements in strength, muscle hypertrophy likely allows for additional strength gains (Mazzeo & Tanaka 2001).

Benefits of increased muscular strength include: reduction in resting heart rate (McCarthy et al. 1997), increase in stroke volume at rest and exercise (Ekblom et al. 1973), decline in resting systolic and diastolic blood pressure (Harris & Holly 1987), and improved resting glucose levels and insulin sensitivity (Yki-Jarvinen et al. 1984). Increases in muscular strength enhance mobility, balance, and independent living (Evans 1999).

The American College of Sports Medicine, (ACSM 2006) recommends older adults should exercise with a resistance between 40 to 60% of 1-RM strength. They should perform one set of lifts, consisting of 12 to 16 repetitions per set. ACSM recommends a total body training program which requires the performance of 8 to 10 lifting techniques incorporating all the major muscle groups within the body.

### **Direct Psychological Benefits Resulting from Physical Fitness**

#### *Reductions in stress experienced by physically active individuals.*

The concept of stress is a difficult term to evaluate. Stress is an individual state characterized by the combination of displeasure and arousal. A circumstance to one individual may be perceived as uncomfortable (displeasure), but will stimulate arousal in another. An example of this would be making an oral presentation to a large group of individuals. A person uncomfortable with making presentations may find this experience displeasurable, while another individual may be stimulated by the audience, and find the experience stimulating (arousal). In this discussion, the author will be concerned with negative (displeasure) stress. Terms used to describe negative stress are typically tense, nervous, impatient, anxious, and sleeplessness. Several studies have

demonstrated that physical activity is associated with stress reduction (Schnohn et al. 2005, Kull 2002, Salmon 2001). Although Schnohn et al. observed the lowest stress level were in individuals participating in high-intensity physical activity, the largest reductions in stress were observed in sedentary individuals who performed low intensity physical activity. These results imply that the greatest gains in the reduction of stress are when individuals who are classified as sedentary, progress to low levels of physical activity such as walking at an average speed of two to four miles per hour.

*Reductions in depression experienced by physically active individuals.*

Cross-sectional studies reported more depressive symptoms in sedentary individuals (Hassmen et al. 2000, Stephens 1988), compared to individuals who are physically active. An experimental design has also demonstrated that a 16-week intervention program indicated that exercise was effective in reducing depression in older adults (Blumenthal et al. 1999). Acute exercise has also demonstrated an improvement in affective behavior (Hale 2002, Bahrke & Morgan 1978, Raglin & Morgan 1987). Studies have demonstrated a dose-response gradient of exercise-induced affective changes in behavior (Arent et al. 2005, Dunn et al. 2001). Their findings support a curvilinear dose-response relationship between exercise intensity and affective response, with moderate intensity training, resulting in immediate, large, and enduring affective benefits, compared to high or low-intensity exercise.

Researchers have attempted to relate the influence of exercise on affective response to physiological mechanisms. Although this relationship has not been clearly established, several hypotheses have been suggested. Solomom and Corbit (1973) suggested that the stress induced by exercise causes an overshoot of vagal stimulation or a rebound response to sympathetic activation in an attempt to return to homeostasis. This mechanism could explain the effect of acute exercise on the affective state but would do little to explain the long-term benefits of physical activity on affective state. Schulkin et al. (1998) report that hormones such as cortisol, released during exercise, may influence the central nervous system, which could positively affect the affective state. It has been suggested that distraction from daily problems could be an explanation of the acute psychological effects induced by exercise (ACSM, 2006); however these mechanisms, which could explain the acute effect of exercise on the affective state, would do little to explain the long-term effect of exercise on the affective state. It may be possible that exercise can directly influence the psychological state of an individual, which is hard to quantify.

One hypothesis might be that the performance of exercise is interpreted as an accomplishment that could increase self-esteem and improve psychological health.

*Improvements in life satisfaction experienced by physically active individuals.*

Individuals who are sedentary report less energy, increased complaints of pain interfering with usual activities, inadequate sleep/rest, greater feelings of sadness and depression, and reported dissatisfaction with life, compared to physically active individuals (Surkan et al. 2005). The effects of physical activity on psychological health appear to subside when physical activity is reduced (Lampinen et al. 2000).

*Improvements in cognitive health experienced by physically active older adults.*

Physical activity has been shown to influence cognitive function in older adults (McNeil LeBlanc Joyner 1991). Cross-sectional studies also suggest that aerobically active older adults demonstrate better fluid intelligence and working memory than those who are sedentary (van Boxtel Langeral Houx Jolles 1996). Animal research studies have reported that older animals demonstrate an increased thickness in the cerebral cortex (Diamond 1993, Sirevaag & Greenough 1987). Two hypotheses attempt to explain this relationship between physical activity and cognitive function. The depression-reduction hypothesis states that, because depression interferes with optimal cognitive health and physical activity decreases depression, as was demonstrated earlier in this paper, physical activity indirectly improves cognitive health. The other hypothesis to explain the influence of physical activity on cognitive health is the social-stimulation hypothesis, which postulates that participating in physical activities can foster relationships which promote cognitive function. Therefore in addition to promoting physical activity in older adults, one should promote group physical activities classes. Vance et al. (2005) provide partial support for the social-stimulation hypothesis and the depression-reduction hypothesis in older adults.

**Physical Fitness Influence on other Healthy Lifestyle Behaviors**

Studies indicate that individuals who are physically active demonstrated other healthy life-style behaviors. The following section will address healthy life-style behaviors that accompany physically active life-styles.

*Reductions in cigarette smoking in physically active individuals.*

Individuals engaged in physical activity are less likely to smoke cigarettes than those who are not (Theodorakis 2005). Pate, Heath, Dowda, and Trost (1996) found that cigarette smokers were

likely to perform less physical activity compared to more physically active individuals. Videmsek, Karpljuk, and Debeljak (2000) reported less smoking habits in adolescents participating in sports activities. Physical activity apparently has a strong inhibiting effect on cigarette smoking (Leonard, 1998). McCaul, Baker, and Yardley (2004) attempted to further clarify physical activities' influences on cigarette consumption by dividing physical activity into different categories. The researchers had seven categories for physical activity that included: no physical activity, high-intensity team, medium-intensity team, low-intensity team, high-intensity individual, medium-intensity individual, and low-intensity individual. Researchers found that the intensity of the activity regardless if the activity was in a team setting or an individual setting influenced smoking behaviors. They reported that high-intensity individuals and medium-intensity team activities were negatively associated with cigarette smoking.

In individuals who currently smoke, walking was demonstrated to reduce cravings for cigarette smoking (Taylor Katomeri & Usser 2006). As one would expect, individuals who are inactive and smoke have an increased risk for a decline in healthy status as compared to those who are physically active and nonsmoking (Haveman deGrott & van Staveren 2003).

*Reductions in marijuana use in physically active individuals.*

The influence of physical activity on marijuana use follows the same general trend as was seen in the relationship between cigarette smoking and physical activity. Marijuana use was negatively associated with high-intensity and medium-intensity team activities, as well as high-intensity and medium-intensity individual activities ( McCaul, Baker, & Yardley, 2004). This relationship might be the result of inhaled substances such as cigarette and marijuana, which impede physical activity performance by compromising the cardiovascular system. The cardiovascular system becomes compromised as a result of carbon monoxide binding with hemoglobin at the expense of oxygen, thereby inhibiting oxygen transport. If this hypothesis was true, this would imply that participation in physical activity directly influences one's choice concerning whether or not to engage in behaviors thought to have a negative influence on one's health.

*Reductions in alcohol consumption in physically active individuals.*

The literature is sparse concerning the relationship between physical activity and alcohol consumption. Leonard (1998) indicated that physical activity had a modest inhibitory effect on alcohol consumption. McCaul, Baker, and Yardley (2004) reported a positive relationship between physical activity and alcohol consumption.

*Healthy eating behaviors in physically active individuals.*

Exercise and dietary behaviors are critical components of a healthy life-style (ADA, Position of the ADA, 2000). Research indicates that participation in physical activity influences food choices. Individuals who have been exercising consistently for six months, report consuming adequate servings of fruit and dairy products as compared to inactive individuals (Tucker, & Reicks, 2002). These researchers conclude that physical activity may serve as a potential gateway relationship between exercise and dietary behaviors. Their theory is based on the Transtheoretical Model (TTM), states positive behaviors in one phase of an individual's life can influence the life-style choice in another phase of one's life. The TTM has been successfully applied to smoking cessation programs (Rimer et al. 1994). The TTM model also showed that physical activity can influence dietary choices such as avoiding high-fat foods and increasing consumption of fiber in one's diet (Nigg et al. 1999). Given the direct physiological and psychological benefits resulting from physical activity, as well as the indirect benefits resulting from physical activity, exercise appears to be the cornerstone on which a preventive health program can be developed.

**Trends in exercise adherence.**

Despite the documented health benefits associated with physical activity, the majority of American adults remain inactive. The National Center for Health Statistics (2002) reported that the percentage of adults aged 18 years and over who meet the Surgeon General's Report on Physical Activity and Health (U.S., Department of Health and Human Services 1996), is between 30 and 32 percent during the preceding 5 years. The Surgeons General's report recommends that one should participate in moderate activity at least 30 minutes a day for five days a week or vigorous activity for 20 minutes a day at least three days per week. The direct cost of the lack of physical activity, in 1995 dollars is approximately \$24 billion or 2.4 percent of the U.S. health care expenditures.

A study by Morrow et al. (2004) investigated American adults' knowledge of exercise recommendations. Surprisingly, their study revealed that the majority of American adults (approximately 80%) were familiar with current exercise guidelines. Because only 30 to 32 percent of American adults meet minimum exercise guidelines, the majority of Americans are not following the recommendations of the Surgeon General's Report on Physical Activity and Health (1996). Apparently, knowledge of exercise recommendations in itself is not sufficient to

motivate American adults to exercise. Barriers to exercise participation may result from a lack of knowledge of the health benefits associated with physical activity; however, one must ask, “why would the general adult population within the United States be aware of the exercise guidelines if this knowledge was not important to them”? Other barriers to exercise must be prevalent, and the list of these barriers could possibly be endless. One possible barrier to exercise participation could be knowledge of specific issues concerning exercise such as how to quantify moderate/vigorous exercise, how to warm up/cool down, how to exercise safely, how to monitor exercise intensity, how to perform resistance training, how to stretch prior to and following training, and so on. Other frequently reported obstacles to exercise include: motivation to exercise, where and how to exercise, and how does one find the time to exercise. The elimination of these barriers may be critical in encouraging individuals to participate in physical activity.

*Strategies to motivate individuals to participate in physical fitness activities.*

Exercise adherence is increased if a support group (physician, family, friends) encourages exercise participation. Studies demonstrate that moderate intensity exercise is more effective in increasing exercise compliance, as compared to high-intensity exercise (Gordan Kohl & Blair 1993). Moderate-intensity exercise minimizes injuries and complications during the activity. The mode of exercise (i.e., walking, jogging, swimming, cycling) should be selected primarily based on an individual’s interest. One mode of exercise is not necessarily superior to another mode of exercise; however, issues such as the physical stress one may experience with jogging compared to less physically stressful activities such as walking, cycling, or swimming may influence the decision of which exercise is selected. For some individuals, group exercise is more effective in increasing exercise compliance (ACSM 2006). If practical, the use of a personal trainer is more effective in increasing exercise compliance than exercising alone. Other individuals are most likely to exercise if they do not depend on others (i.e., class, or a personal trainer) to exercise. The key is to determine which exercise delivery system is most effective, and to determine the preference for each individual.

When prescribing an exercise program, remember that the aerobic exercise prescription is only one component of an exercise program. The physical activity pyramid (Leon & Norstrom 1995) emphasize that a complete exercise program should encourage individuals to be as active as they can during their daily life, in addition to performing structured physical activity.

Examples of how one can increase physical activity are to walk when possible instead of taking a vehicle, walk up a flight of stairs instead of taking an escalator or an elevator, or to park at the far end of a parking lot and walk to your entrance. In addition to the aerobic exercise prescription, the physical- activity pyramid also recommends that individuals participate in recreational activities three to five times per week, perform resistance and stretching exercises two to three days per week, participate in leisure activity two to three times per week. The Physical Activity Pyramid recommends limiting watching television or playing computer-generated games. Incorporating these different types of physical activity is essential to burning significant kilocalories necessary to receive preventive health benefits.

Individuals who engage in physical activities should have some feedback that their efforts are resulting in health benefits. Direct feedback concerning health benefits resulting from physical activity require medical evaluations which may be cost prohibitive, and months to observe physiological adaptations such as changes in lipid profiles. Individuals may lose their motivation to exercise between these observations. A fairly new strategy to motivate individuals to be physically active is the use of pedometers to measure the number of steps an individual takes per day (Spiller Robertson & Take 2000, DeSa 2001). Pedometers represent a simple and affordable method to evaluate the number of steps and the distance traveled per day. Current guidelines recommend individuals take 10,000 steps per day (Spilner & Robertson 2000). Studies have demonstrated that taking 10,000 steps per day is an amount of exercise that is associated with indicators of good health (Hatano 1993). Individuals who took 10,000 steps per day had less fat (Todor-Locke et al. 2001) and lower blood pressure than those who did not take 10,000 steps per day (Hatano 1993). A study designed to quantify the typical steps taken per day was conducted by Tudor-Locke & Bassett (2004). The investigators quantified the following preliminary indices to classify pedometer-determined physical activity in healthy adults. Sedentary individuals take > 5,000 steps per day. Low activity individuals take between 5,000 to 7,499 steps per day, excluding aerobic exercise. Somewhat active individuals take between 7,500 to 9,999 steps per day, excluding aerobic exercise. Active individuals take 10,000 to 12,500 steps per day excluding aerobic exercise. Highly active individuals take between 12,500 steps per day excluding aerobic exercise (Tudor-Locke & Bassett 2004). The philosophy proposed by Tudor-Locke and Bassett coincides with the philosophy of the physical activity

pyramid, which states that the aerobic exercise prescription in itself is insufficient to promote health. A pedometer provides individuals with a daily goal to achieve.

A second motivator for physical activity is a weight scale that also provides feedback concerning body composition. The Tanita Model 301 is a relatively inexpensive scale that provides accurate body weight and body composition (Cicar et al. 2006). This scale is essential because body weight may be misleading because weight loss may be the result of water loss, not the assumed fat loss, and weight gain may be the result of fat gain not the desired muscle gain. A scale that provides information concerning weight loss/gain and body composition allows individuals to determine if weight change is desirable. These simple techniques may help motivate individuals to become physically active.

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