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An examination of factors affecting weight and health in exercising adults

Cynthia West Dupuis

AN EXAMINATION OF FACTORS AFFECTING WEIGHT AND HEALTH IN EXERCISING ADULTS

by

Cynthia West Dupuis, M.S.

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Supervisor of Dissertation Research

Head of Department

Psychology & Behavioral Sciences
Department

Recommendation concurred in:

Advisory Committee

Approved:

Director of Graduate Studies

Dean of the College

Approved:

Dean of the Graduate School

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ABSTRACT

Obesity is a significant problem in American society with approximately 65% of the population classified as overweight and the obesity rate exceeding 30% of all American adults. Obesity is associated with widespread physical and mental health problems which lead to increased healthcare costs, increased work absenteeism, and decreased work productivity. The factors of genetics and diet have been studied extensively by researchers in relation to weight gain and health. Physical exercise also has been established as a factor that affects weight and health, but exercise programs of all types suffer from an average attrition rate of approximately 50%. The additional factors of personality and sleep have been researched in relation to obesity, with certain personality factors and sleep quality found to affect weight gain and health. These factors most often are studied in isolation and the continued attrition from exercise regimens and continued rise in obesity indicates that obesity and its contributing factors are not fully understood. The proposed study is designed to explore the contributions of personality, compliance with an exercise regimen, and sleep in relation to weight gain and health. This study will add to the obesity literature by developing and testing a research-based model of contributors to obesity and health. This model then could guide future interventions designed to reduce obesity.

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DEDICATION

To my husband, Mike, and children

Taylor, Caitlin, and Dane, for their encouragement and sacrifices.

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CHAPTER 1

INTRODUCTION

The study of body weight and health is a broad area of research in both the medical and psychological literature. Studies have explored body weight and health in general and have increased our understanding of the physical complications associated with being overweight, with increased body weight linked to poorer health. Researchers also have identified contributors to body weight and health to include genetics, diet, and physical exercise.

Researchers have concluded that genetics contributes to 30-50% of overweight and obesity cases (Armstrong & Reilly, 2002; Dietz, 2001; Loos, Beaunen, Fagard, Derom, & Vlietinck, 2001). There also is a strong relationship between an individual's diet and physical health. Specifically, low dietary calcium, low consumption of fruits and vegetables, and high consumption of sugar and sugar-added beverages all have been associated with higher rates of obesity and poorer health (Cummings, Parham, & Strain, 2002; Harnack, Stang, & Story, 1999; Parikh & Yanovski, 2003). Researchers also have identified a sedentary lifestyle as related to higher body weight and poor health in several research studies (Bergman & Auerhahn, 1985; Bray, 1985; Bray & Born, 2004; Fox & Hillsdon, 2006; Gammon, John, & Britton, 1998; Haskell, Montoye, & Orenstein, 1985; Litt, Kleppinger, & Judge, 2001; Martin, Dubbert, & Cushman, 1990). Conversely, compliance with an exercise regimen has been related to improved physical and psychological health (Blair, Jacobs, & Powell, 1985; Folsom, 1985; Whyte, 2008). Researchers have demonstrated that active adults have had positive changes in fitness measures and fewer chronic degenerative diseases than inactive males and females (Morris, Pollard, Everitt, & Chave, 1980; Paffenbarger, Hyde, Wing, & Steinmetz, 1984; Salonen, Puska, & Tuomilehto, 1982).

Multiple programs have been implemented to address the influence of factors such as diet and exercise on weight gain, obesity, and health. However, participation in these programs has met with non-compliance, and the prevalence of obesity has continued to rise (Epperson, Bushway, & Warman, 1983; Kirscht & Rosenstock, 1979; Litt et al., 2001; Sachs, 1982; Ward & Morgan, 1984). Research has subsequently turned to the examination of variables that may affect an individual's compliance to exercise and diet as known contributors to obesity.

Personality is one construct that has been researched in relation to compliance with exercise regimens. These studies have found certain personality constructs, such as self-motivation and behavioral decision-making, to be predictors of adherence (Dishman, 1994; Edmunds, Ntoumanis, & Duda, 2007; Rhodes, Martin, & Taunton, 2001). Conversely, constructs such as Type A personality (time urgency, irritation), stress, and general mood disturbances have been identified by researchers as obstacles to exercise adherence (Belisle & Sherbrooke, 1987; Klonoff, Annechild, & Landrine, 1994).

Other research has demonstrated that the variables of stage of change, self-efficacy, and psychological well-being may be particularly important in determining an individual's compliance (Jones, Harris, Waller, & Coggins, 2005). Referring to Prochaska's Transtheoretical Model (Prochaska & DiClemente, 1983), these researchers found that exercisers in the Preparation or Action stage (versus the Precontemplation or Contemplation stage) demonstrated the most adherence to an exercise regimen. These researchers also found that individual's with higher self-efficacy and better psychological well-being were associated with more compliance with an exercise regimen (Jones et al.). However, the researchers noted that self-efficacy and stages of change predicted exercise compliance in healthy samples, but were less relevant with beginning exercisers or those with poorer overall mental health (Jones et al.).

Recent research has turned to the examination of additional factors which may be related to obesity and health. Sleep research has demonstrated that poor sleep quality, including insufficient sleep duration, is associated with weight gain and adverse effects on normal physiological health (Gangwisch, Malaspina, Boden-Albala, & Heymsfield, 2005; Hasler, Buysse, Klaghofer, Gamma, Ajdacic, Eich, et al., 2004; Kripke, Garfinkel, Wingard, Klauber, & Marler, 2002; Prinz, 2005/2006; Taheri, Lin, Austin, Young, & Mignot, 2004; Taylor & McFatter, 2003). In addition to physical health, these factors also are associated with decreased psychological health (Blagrove & Akehurst, 2001; Gau, 2000; Gray & Watson, 2002; Harrison & Horne, 2000; Sicard, Jouve, & Blin, 2001; Sujoldzic & De Lucia, 2007).

Moreover, sleep has been linked to personality in the literature. In one study, Jenkins (2005) found that poor sleep quality was associated with lower emotional stability, rule consciousness, tough-mindedness, as well as higher vigilance, apprehension, tension, abstractedness, and anxiety. Other studies found that poor sleep quality was connected to increased tension, negative mood states, and negative self-evaluations (Bonnet, 1985; Friedman, Lewak, Nichols, & Webb, 2001; Gau, 2000; Gray

& Watson, 2002; Lacks & Morin, 1992; Pilcher & Huffcutt, 1996; Verlander, Benedict, & Hanson, 1999). Further, hostility, stress, and worry have been related to sleep disturbances in a number of studies (Hicks & Garcia, 1987; McCann & Stewin, 1987; Paulsen & Shaver, 1991; Weller & Avinir, 1993).

Other researchers have noted a link between poor sleep quality and extraverted personalities. Although some researchers have found that poor sleep quality is associated with extraverted personalities (Gray & Watson, 2002), other researchers have coupled poor sleep quality with introverted personalities (Monroe, 1967). When poor sleep quality was defined as sleep deprivation of 29 to 35 hours, Blagrove and Akehurst (2001) found that sleep loss significantly correlated with extraverted and neurotic personalities. These conflicting findings suggest that the relationship between certain aspects of personality and sleep quality is unclear and warrant further investigation.

Other studies have related personality to body weight and health status. Researchers indicated a relationship between obesity and the personality traits of anxiety, hostility, immaturity, self-gratification, aloofness, self-consciousness, and lack of persistence (Polivy, Herman, & McFarlane, 1994; Van den Bree, Przybeck, & Cloniger, 2006; Westenhoefer, 1991). Dube, LeBel, and Lu (2005) found that both positive and negative mood states also can trigger food consumption, thereby increasing weight gain.

Studies have established unique linkages between the factors of personality, compliance, and sleep to obesity and health status. Additionally, relationships have been established between certain personality factors and compliance and sleep. However, the continued attrition from exercise regimens and continued rise in obesity indicates that obesity and its contributing factors are not fully understood. The current study seeks to address this deficit through the identification of the relative importance of personality, compliance with an exercise regimen and sleep, on obesity and health status.

Statement of the Problem

Approximately 65% of Americans meet the BMI (Body Mass Index) requirement to be classified as overweight, with the obesity rate exceeding 30% of Americans (National Center for Health Statistics [NCHS], 2002). The prevalence rates of obesity among adult American males increased from 27.5% in 1999 to 2000, to 31.1% to 2003-2004 (Ogden et al., 2006). The obesity prevalence rates for adult American females were identified as 33% from 1999 to 2004 (Ogden). These statistics convey an alarming number of obese individuals in the United States.

Obesity often leads to widespread health problems such as heart disease, high blood pressure, and diabetes (Haslam & James, 2005; NCHS, 2002), as well as increased risk for hypertension, orthopedic disorders, and gall bladder diseases (Barlow & Dietz, 1998; Bray, 1985). These health problems lead to increased healthcare costs as well as loss of work time and productivity (United States Department of Health and Human Services [USDHHS], 2001; Hasler et al. 2005). Further, there are at least 300,000 U.S. deaths a year associated with obesity, with obesity identified as the second leading cause of preventable deaths in the United States (USDHHS).

In response to this obesity pandemic, the Surgeon General has recommended a reduction in weight of obese individuals, reporting that even a 10% weight reduction can reduce the risk of heart disease, certain kinds of cancer (e.g., Type 2 cancer), stroke, arthritis, breathing problems, psychological disorders (e.g., depression) and can decrease an adult's lifetime medical costs (USDHHS). Researchers have responded by examining factors that contribute to obesity and poor health.

Genetics and diet are factors that have been studied extensively and found to influence weight and health (Armstrong & Reilly, 2002; Dietz, 2001; Greene-Finestone, Campbell, Evers, & Gutmanis, 2005; Loos et al., 2001; United States Surgeon General [USSG], 2002; Videon & Manning, 2003; Wilkinson, Mickle, & Goldman, 2003). However, the contributions of these factors to weight gain are often studied in isolation and they alone cannot account for the increase in obesity rates and associated poor health. The benefits of exercise in weight control and improvement in overall heath also are well documented, with the number and variability of exercise programs continuing to increase in American society. However, exercise programs of all types suffer from an average dropout rate of 50% and the prevalence of obesity continues to rise (Litt et al., 2001; Sachs, 1982).

The continued rise in obesity rates suggests that obesity and contributors to obesity are not fully understood. Research is needed to address this short-fall. Therefore, the current study will explore the contributions of personality, compliance with an exercise regimen, and sleep in relation to weight gain and health. This research could add additional information to the obesity literature by testing a model of potential contributors to weight and health status. Such a model could serve as a guide for future interventions to reduce the escalating prevalence of obesity.

Justification

Research in the area of obesity is needed to help move understanding and discussion beyond simple verification of the correlation between obesity and independent factors associated with health status and weight gain. Further obesity research is warranted to clarify the relationship among the contributors to this problem.

The current study will add to the obesity literature by developing and testing a research-based model using data gathered by participant surveys, body composition measurements, and exercise logs. The model can provide knowledge of individual characteristics that are associated with health status and obesity, adding to the existing obesity knowledge base.

In addition to verifying previous research on contributors to obesity, the model can identify new factors as contributors to obesity and health. Personality and sleep are constructs that have been linked to weight and compliance with exercise regimens, but the interplay among these variables and obesity is not fully understood. The results of this research may provide a preliminary framework for identifying and explaining the relationship of these possible contributors to obesity and health status.

The practical implications of the findings of this study are they may guide future research that tackles the problem of obesity. Further, the model can contribute to the formulation of a strategy for individualized treatment to enhance compliance with exercise programs, help combat America's obesity problem in adults, and improve individuals' overall health and life expectancy (Centers for Disease Control and Prevention [CDC], 2004a).

Literature Review

This chapter reviews selected findings from the literature. The first section introduces obesity and health status. The second section provides a comprehensive examination of personality, compliance, and sleep as constructs related to weight gain and overall health status. The third section examines research that has demonstrated relationships with the constructs of personality and exercise compliance as well as personality and sleep. The final section presents a model of the possible direct and indirect effects of the constructs of personality, compliance with an exercise regimen, and sleep shown to influence obesity and overall health status.

Obesity and Health Status

The National Institute of Health (NIH) uses the terms "overweight," "obesity," and "extreme obesity" to categorize different body composition measures of individuals with above average weight (NIH, 1998). Body composition is a statistical estimation of the percentage of fat, bone, and muscle calculated by anthropometric and densitometry methods. In general, higher body compositions of fat are associated with poorer health status.

Anthropometric Methods of Measurement

Anthropometric methods are based on measurements of height, weight, waist-to-hip and waist only circumferences, and skinfolds. These methods are used to estimate body composition. BMI, circumference, and skinfold are the three anthropometric methods.

BMI is the first anthropometric method of measuring body composition. BMI is calculated by dividing body weight in kilograms by height in meters squared (kg/m^2), assessing weight relative to height (NIH, 1998). As a standard way of classifying body composition in individuals BMI defines being overweight as between 25 and 30, with these individuals at risk of becoming obese. A BMI greater than 30 indicates obesity, while a BMI greater than 35 is considered extremely obese (NIH). A BMI measurement does not distinguish among body fat, muscle mass, or bone. Individuals who have excessive muscle mass could have high BMI measurements due to the weight of the muscle mass, yielding deceptive results (CDC, 2004a). Because of the relatively large standard error of estimating fat percentage from BMI ($\geq$5% fat), other methods of body composition assessment often are used to predict body composition (Lohman, Houtkooper, & Going, 1997).

Circumference, a second anthropometric method of measuring body composition, is used in the estimation of overweight, obesity, and extreme obesity. One circumference measurement, waist-to-hip ratio (WHR), is defined as the circumference of the waist divided by the circumference of the hips (Heyward & Wagner, 2004). This simple method yields an accuracy prediction of 2.5 – 4% of the actual body composition with equations available for both genders and different age groups Health risks increase with higher WHR measurements. Examples of health risks include increased risk of hypertension, Type 2 diabetes, coronary artery disease, and premature death (Folsom, 1985; Heyward & Wagner).

The waist circumference often is used alone as an indicator of health risk due to the relationship of abdominal obesity to various diseases. The Expert Panel on the Identification, Evaluation and Treatment of Overweight and Obesity in Adults provides a classification of disease risk based on both BMI and waist circumference (NHLBI, 1998). Furthermore, a new risk stratification scheme for adults based on waist circumference has also been proposed (Bray & Born, 2004), and can be used alone or in conjunction with BMI to evaluate chronic disease risk (NHLBI).

Skinfold is a third type of anthropometric measurement of body composition, proposing that the amount of an individual's subcutaneous fat is proportional to the total amount of body fat. Approximately one-third of the total fat is located subcutaneously (Heyward & Wagner, 2004). The exact proportion of subcutaneous-to-total fat varies with sex, age, and ethnicity and therefore, regression equations are used in the conversion of skinfold measurement to percent body fat. The accuracy of predicting fat percentage from skinfolds is approximately plus or minus 3.5% (Heyward & Wagner).

Densitometry Methods of Measurement

Body composition also can be estimated from a measurement of whole-body density known as densitometry methods of measurements. In densitometry methods, the body is divided into two components: the fat mass (FM) and the fat-free mass (FFM). Obtaining the ratio of body mass to body volume (density), body mass is measured simply as body weight, while body volume is measured by hydrodensiometry (underwater) weighing, bioelectrical impedence (electrical current) analysis, and by plethysmography (air displacement).

The hydrodensiometry technique of measuring body composition is based on the principle that when a body is immersed in water, it is buoyed by a counterforce equal to the weight of the water displaced (Going, 1996). Body volume is thus calculated as the loss of weight in water, with bone and muscle tissue more dense than water, and fat tissue less dense. Therefore, a person with more FFM for the same total body mass weighs more in water and has a higher body density and lower percentage of body fat (Going). This method of body composition measurement yields an accuracy prediction of 2.0-2.5% of the actual body composition (Heyward & Wagner, 2004).

Bioelectrical impedance analysis estimates body composition by measuring the resistance the electrical flow encounters as it travels through the water found in muscle and fat. Because muscle contains approximately 70% to 75% water and fat contains approximately 10% to 20%, the current circulates through muscle with less resistance than through fat. The electrical charge then is measured to obtain body volume (Kyle et al., 2004). Accuracy is similar to skinfold measurement (3.0%-3.5%) in predicting body composition (Heyward & Wagner, 2004). Body volume also can be measured by a technique known as plethysmography. This method of measuring body composition estimates body volume by air displacement rather than water displacement. This technique uses a closed chamber plethysmograph that measures body volume by changes in air pressure in the chamber (Dempster & Aitkens, 1995; Going, 1996; Lohman et al., 1997). The plethysmograph method yields the lowest error rate (1-2%) of all body composition measures (Heyward & Wagner, 2004).

Once the body density has been determined by hydrodensiometry, bioelectrical impedance, or plethysmography, percent body fat can be calculated by one of two prediction equations. These equations are used to estimate percent body fat from body density derived from the two-component model for body composition, with both equations providing comparable estimations (Brozek, Grade, & Anderson, 1963):

$$\%\text{ fat} = 457/BD - 414.2 \qquad (1)$$

$$\%\text{ fat} = 495/BD - 450 \qquad (2)$$

Each densitometry method assumes a slightly different density of FM and FFM. The plethysmography method assumes a 21 to 30% FM for men is considered overweight and a 31 to 40% FM for women is considered overweight. Further, a FM >30% for men and >40% for women is considered obese (American College of Sports Medicine [ACSM], 2006). Researchers propose that ongoing research of the densitometry methods of measuring body composition will likely increase the accuracy of the estimate of percent body fat when applied to different populations (ACSM) and this research is currently on-going.

Prevalence and Trends

Studies have examined the prevalence and trends of overweight and obesity in the US population. Flegal and colleagues used data obtained from the 1988-1994 and 1999-2000 National Health and Nutrition Examination Surveys (NHANES) to examine the frequency and trends of obesity (Flegal, Carroll, Ogden, & Johnson, 2002). The NHANES provided height and weight data obtained from adult US males and females, defining overweight as a BMI of 25 to 29, obesity as a BMI of 30 to 39, and extreme obesity was defined as a BMI of 40 or greater. Flegal compared the age-adjusted prevalence of overweight, obesity, and extreme obesity of the participants in the years 1988 to 1994 and 1999 to 2000. Outcomes indicated that the age-adjusted prevalence of obesity was 30.5% in 1999 to 2000 compared with 22.9% in 1988 to 1994. The prevalence of overweight also increased during the 1999 to 2000 period from 55.9% to 64.5%. Extreme obesity also increased in the population, from 2.9% in 1988 to 1994 to 4.7% in 1999 to 2000 (Flegal et al).

Gender differences also were noted, with the percentage of overweight females rising from 25.4% in 1988-1994 to 33.4% in 1999-2000, with an increase from 20.2% to 27.5% for males in these same years. Increases in obesity also occurred in 1999-2000 for both males (from 20.2% to 27.5%) and females (from 25.4% to 33.4%) in all age groups and for Caucasians, African Americans, and Mexican Americans. Racial/ethnic groups did not differ significantly in the incidence of obesity or overweight for males. Among females, the obesity and overweight percentages were highest among African American females. More than half of African American females aged 40 years or older were obese and more than 80% were overweight (Flegal et al., 2002).

In 2006, Flegal and colleagues published the most recent prevalence and trend study of obesity and extreme obesity in US adult males and females. Overweight was defined as a BMI of 25 to 29, obesity as a BMI of 30 to 39, and extreme obesity as a BMI of 40 or higher. Results indicated that the age-adjusted frequency of obesity was 32.2% in 2003 to 2004 compared to 30.5% in 1999 to 2000 (Flegal, Carroll, & Ogden, 2006). Among males, the percentages increased from 1999 to 2000 (27.5%) and 2003 to 2004 (31.1%). Among women, no significant increase was observed from 1999 to 2000 (33.4%) and 2003 to 2004 (33.2%). The percentage of extreme obesity in 2003 to 2004 was 2.8% in males and 6.9% in females (Flegal).

In 2003 to 2004, significant differences in obesity prevalence varied when race/ethnicity were considered. Approximately 30% of Caucasians adults were obese as were 45.0% of African American adults and 36.8% of Mexican Americans. Among adult males, no differences were found between racial/ethnic groups in the 2003 to 2004 data. However, Mexican American and African American females were significantly more likely to be obese compared with Caucasian females. Older adults were more likely to be obese than their younger counterparts. In 2003 to 2004, there was no significant difference in the prevalence of obesity in adults between the genders (Flegal et al., 2006).

Complications

The continued upward trend of the number of overweight and obese American adults is a significant problem. Being overweight and obese affects adults of all ages, races, and ethnicities. The effects are associated with physical complications that affect physical health. The effects also are associated with mental complications that affect an individual's mental health.

Physical Functioning

A review of the literature reveals that obesity negatively affects an individual's physical health. Some of the physical health problems include (a) musculoskeletal conditions, (b) low back pain, (c) digestive disease, (d) metabolic complications, and (e) pulmonary complications.

As the most common and most heavily researched health problem associated with obesity, musculoskeletal conditions affect more than 25 million Americans (Anderson & Felson, 1988). Osteoarthritis (OA) is the most frequent and is the leading cause of disability among older Americans (Guccione). Typically involving joint pain and tenderness, OA limits movement. The course of the disease varies, but it is often progressive and the effects irreversible. OA of the knee is the most disabling instance, resulting in loss of mobility.

Research conducted through the NHANES demonstrated that adults in the United States with ≥ 30 BMI have a four-fold prevalence of knee OA than those with < 30 BMI (Anderson & Felson, 1988). Similarly, longitudinal studies demonstrate that increased BMI in both young and middle aged adults increases risk of subsequent knee OA (Felson, Anderson, Naimark, Walker, & Meenan, 1988). Obesity also has been strongly associated with knee OA across race/ethnicity and sex (Manninen, Riihimaki, Heliovaara, & Makela, 1996). The American College of Rheumatology provides weight loss guidelines for overweight persons with knee OA, recognizing the relation between the two

(American College of Rheumatology Subcommittee on Osteoarthritis, 2000). The relationship between obesity and OA can, in part, be explained by the elevated joint pressure caused by excess weight (Bray, 1985). This elevated pressure exacerbates intradiscal pressures and mechanical stress of spinal structures, reducing flexibility and creating and exacerbating back pain (Barry, 1986).

As a second physical factor associated with weight gain and obesity, LBP (low back pain) is one of the most common chronic pain conditions (Gureje, Von Korff, Simon, & Gater, 1998). Untreated, LBP can cause significant personal suffering as well as notable economic consequences at both the societal and individual level (Stewart, Ricci, Chee, Morganstein, & Lipton, 2003). Symptoms of chronic LBP often present as pain that varies in intensity over time (Violante et al., 2004) and is defined as acute (lasting < six weeks), subacute (six weeks to six months), or chronic (> six months). While many individuals with LBP recover quickly, LBP typically follows a recurrent course, with exacerbations occurring over time (Andersson, 1999).

Several recent reviews have addressed the relationship between LBP and obesity. Garzillo and Garzillo (1994) found evidence of a relationship between LBP and BMI > 29, with incidents of LBP increasing as BMI increases. Mirtz and Greene (2005) reviewed studies of obesity and LBP and concluded that, while current data do not provide clear proof for a causal relationship between the factors, results suggest that individuals with a BMI ≤ 30 are at minimal risk of developing LBP; those with a 30 to 40 BMI are at moderate risk, and individuals with a BMI >40 are at high risk of developing LPB.

The association between obesity and digestive disease, as a third physical problem, also has been documented (Leijd, 1980). In one study, the incidence of digestive disease increased to 40% above the expected level in persons 15% to 35% overweight and increased almost 150% in those 25% or more overweight, with increased mortality rates (Lew & Garfinkel, 1979). Digestive disease, primarily of the gallbladder, was ranked next to diabetes in degree of detrimental effect of excess weight in one study (Rimm, Werner, Van Yserloo, & Bernstein, 1975). Sturdevant and colleagues also found that body weight of men without gallstones was significantly lower than that of men with gallstones (Sturdevant, Pearce, & Dayton, 1973). Researchers noted that the subsequent increased cholesterol production and secretion associated with obesity provided one explanation for this increased risk of gall bladder complications (Garn & Sturdeetal, 1973).

Research has associated metabolic complications such as coronary heart disease with overweight and obesity. Until recently the relation between obesity and coronary heart disease was viewed as indirect (Lew & Garfinkel, 1979). Although most of the comorbidities relating obesity to coronary heart disease have increased as BMI increased, they also are related to body fat distribution. Long-term longitudinal studies, however, indicate that obesity also independently predicts coronary atherosclerosis (Garrison & Castelli, 1985; Manson et al., 1995). This relation exists for both males and females with minimal increases in BMI. For example, in a 14-year prospective study Manson and colleagues found that middle-aged females with a BMI of 23 or 24 had a 50% increase in risk of nonfatal or fatal coronary heart disease, and males aged 40 to 65 years with a BMI between 25 and 28 had a 72% increased risk (Manson).

Congestive heart failure is a second metabolic complication that is common in obese persons and has been related to systemic hypertension (Messerli, 1982). However, abnormalities in left ventricular mass and function also have occurred in the absence of hypertension and may be related to the severity of obesity (Duflou et al., 1995). In a study by Van Itallie (1985), the researchers found that when hypertension was present, the occurrence was approximately three times more common in obese individuals than in normal-weight individuals. The relationship between congestive heart failure, hypertension, and obesity has been postulated as cause-and-effect; when weight increases blood pressure and the risk of congestive heart failure increases (Reisin et al., 1983).

Many abnormalities have been noted in pulmonary functioning in obese persons. Studies on breathing mechanics show increased oxygen consumption and decreased carbon dioxide associated with breathing because of the extra work required to move the mass of the obese chest (Bray, 1985). Researchers also have found that the increased oxygen is not well dispersed once inside the lung of the obese, often leading to areas of the lungs that are inadequately ventilated (Rochester & Enson, 1974). This can lead to an inadequate supply of oxygenated blood, or hypoxemia (Bray).

General Mental Health

Research has evidenced a relationship between obese individuals and general mental health, often referred to as psychological well-being. For example, in a study of young adults, Sujoldzic and De Lucia (2007) found that a lower BMI was associated with a higher level of body satisfaction and overall psychological well-being. Other researchers found that obesity was related to impaired quality of life, body-image disparagement, low self-esteem, stigmatization, and binge eating in young adults (Sarlio-

Lahteenkorva, Stunkard, & Rissanen, 1995). The psychological burden of obesity often begins in childhood. Once obese children become young adults they receive less higher education, earn less money, and marry less often than their counterparts who are not obese (Gortmaker, Must, Perrin, Sobal, & Dietz, 1993; Sobal & Stunkard, 1989).

Culturally bound definitions of desirability and attractiveness play an important role in the formation of body image and thus affect psychological well-being. Because of the high value Western society places upon appearance, self-esteem is enhanced for those who are judged attractive and is challenged for those who are deemed unattractive. The Western culture's perception of thinness is often associated with competence, success, control, and sexual attractiveness, while obesity is associated with perceptions of laziness, self-indulgence, and lack of will power (Hasler et al., 2005). In a study by Hasler and colleagues (2005), a positive relationship between dieting behavior and disturbed psychological functioning was demonstrated. Other research has indicated that repeated loss and gain of weight (weight cycling) may be even more negatively related to health and well-being than a high but stable weight (Lissner, Odell, & D'Agostino, 1991).

Factors Affecting Obesity and Overall Health Status

Compliance

Compliance refers to a particular kind of response – acquiescence – to a particular kind of communication – a request. Whether proffered explicitly or implicitly, the target of the request recognizes that he or she is being urged to respond in a certain way (Cialdini & Goldstein, 2004). To foster a more collaborative and proactive approach, some researchers and clinicians have suggested using the terms adherence or alliance, rather than compliance (Frank, Kupfer, & Siegel, 1995), though the terms are presently used interchangeably throughout the literature. Further, researchers state that although compliance may be encouraged, it is still voluntary and within the individual's control (Cohen, Ross, Bagby, Farvolden, & Kennedy, 2004).

Compliance with an exercise regimen. Some researchers have focused on the ways in which compliance has been applied to exercise regimens (Blissmer & McAuley, 2002; Calfas, Sallis, Oldenburg, & Ffrench, 1997; Clarke & Eves, 1997; Jones, Harris, & Waller, 1998; Naylor, Simmonds, Riddoch, Velleman, & Turton, 1999; Steptoe, Rink, & Kerry, 2000; Vancouver, Thompson, & Williams, 2001). These studies have specifically examined the predictors of compliance. Existing theories and research examining the predictors of compliance in exercise regimens and other health behaviors have suggested that the variables of stage of change, self-efficacy, and psychological well-being may be particularly important because of their influence on compliance.

Originally developed in the early 1980's by Prochaska and DiClemente (1983), the Stage of Change Model (SCM) has been used as a popular approach in health promotion. This model is based on the theory that people follow a number of stages in the adoption and maintenance of health behaviors: Precontemplation, Contemplation, Preparation, Action, and Maintenance. In the Precontemplation stage of change, the individual has not yet acknowledged there is a problem or behavior to be changed. Essentially unaware of the existence of a problem behavior, the individual in this stage has no intention of changing behavior in the foreseeable future. The Contemplation stage involves acknowledgment of a problem but with uncertainty of the desire to change, and therefore, no effort to change. In the Preparation stage, the individual has the intention to change but has not established a specific goal. This stage involves getting ready to change. The actual changing of the behavior begins in the Action stage of the model. An individual in this stage makes changes in behavior and alters his or her environment in order to support the modification of a behavior. As the final stage of the model the Maintenance stage involves maintaining the behavior change for some period of time. In this stage, people strive to consolidate the gains made during the Action stage. Prochaska and colleagues reported that a person must be beyond six months of successful behavior change to be considered in this stage (Prochaska & DiClemente).

The SCM proposes that an individual progresses through different stages, at varying rates, to successful behavioral change. Each stage involves a different set of issues that relate to behavioral change. Progression through the stages involves a spiral process in which one can relapse and recycle through earlier phases. This spiral process is more common than a steady, linear process. An individual who is able to ultimately change behavior will show overall progress, with setbacks being smaller and less time spent in previous stages (DiClemente et al., 1991).

The SCM has been applied to compliance to an exercise regimen. Individuals who begin an exercise program in the Precontemplation or Contemplation stages have given limited or no thought to exercising and the problem of obesity and health. Therefore, they are less likely to adhere than those in the Preparation stage; the latter individuals have already intended to exercise and have given exercise, obesity and health issues considerable thought. However, the model's application to adherence to exercise has been criticized and research using the model as a basis to design interventions in primary care has yielded inconsistent results. For example, Marcus et al. (1998) and Calfas and colleagues (1997) found that an intervention based on the SCM was effective in increasing activity. However, Naylor and colleagues (1999) compared a stage-matched with a non stage-matched intervention and found no significant difference between the two. Similarly, Blissmer and McAuley (2002) found no difference between a stage-matched intervention and an action oriented intervention. Finally, Steptoe and colleagues (2000) found that baseline stage was associated with increased physical activity at four months but not at 12 months, suggesting stage of change may have immediate rather than long-term impact.

Another construct researched in relation to compliance, self-efficacy, refers to the degree to which an individual believes he or she is capable of carrying out a behavior (Bandura, 1977). According to this theory, increasing self-efficacy will result in increased effort and time devoted to the task. In the context of the SCM, researchers have suggested compliance to tasks is affected by self-efficacy at different stages of change (Marcus, Selby, Niaura, & Rossi, 1992; Sarkin, Johnson, Prochaska, & Prochaska, 2001). In one study, Armstrong and colleagues found that participants in the Precontemplation stage demonstrated lowered self-efficacy than contemplators (Armstrong, Sallis, Hovell, & Hofstetter, 1993). Other researchers have demonstrated that individuals in the Maintenance stage show the highest self-efficacy when compared to individuals in other stages of change (Marcus et al). Self-efficacy has also been shown to predict progression between stages and is now incorporated into most theoretical approaches to predicting health behavior (Plotnikoff, Hotz, Birkett, & Courneya, 2001).

While the bulk of evidence supports the importance of self-efficacy in predicting health behavior (Bandura & Locke, 2003), some researchers have voiced criticisms concerning the self-efficacy component of the stage model in the context of an exercise regimen. For example, Clarke and Eves (1997) found no variations of self-efficacy between stages of change, suggesting that it may be an unreliable predictor in this context. Similarly, although stage-matched interventions have shifted stage of change they have not always produced associated increases in self-efficacy (Calfas et al., 1997). In a study by Naylor and colleagues (1999), the researchers examined the effectiveness of SCM counseling for exercise delivered in primary care centers. These researchers found that significant changes in stage of change did not result in concomitant changes in self-efficacy (Naylor et al.).

Other research suggests that in certain circumstances high self-efficacy may actually be counterproductive. Vancouver and colleagues (2001) found a strong positive correlation between self-efficacy and performance measured at the beginning of participation in an exercise routine. However, across time, while performance is positively associated with subsequent self-efficacy, self efficacy is negatively associated with subsequent performance. The researchers suggested that high self-efficacy may lead people to estimate that they will reach their goal sooner and thus allocate fewer resources to the task, which is the opposite of Bandura's prediction. Consistent with this account, Stone (1994) found that high self-efficacy led to overconfidence in ability to perform cognitively complex tasks and less resource allocation. Vancouver argued that this effect may be expected for tasks with ambiguous information concerning the performance necessary to reach goals (Vancouver, Thompson, Tischner, & Putka, 2002). This appropriately describes the state of an inexperienced exerciser who soon will begin an unfamiliar behavior.

The implications of Vancouver and Stone's research are that individuals who are high in self-efficacy may have overly ambitious expectations in terms of the goals they set and the ease with which they will achieve them. Polivy and Herman (2002) further supported this implication by proposing that people with high self-efficacy often attach themselves to goals that are not realistically possible and which inevitably fail. They suggest that hubris leads to false hope and is distinct from realistic confidence and optimism which are arguably conducive to success (Armor & Taylor, 1998).

Some support for the view that false hopes may exist amongst participants in an exercise regimen is provided by Jones and colleagues (1998). These researchers examined the individual case studies of participants and found that individuals with high self-efficacy also had highly unrealistic expectations of the changes they would achieve. The study further suggested that those who had greater and more unrealistic expectations of change over a 10-week exercise prescription scheme were least likely to finish.

A third variable studied in relation to compliance is psychological well-being. Following a review of studies of self-control, Muraven and Baumeister (2000) surmised that individuals may have a limited amount of energy available for self-change efforts and mental stress may decrease this available energy. This theory posits that poor initial psychological well-being may have an impact on confidence and self-efficacy. Thus poor psychological well-being at the outset may be associated with attrition. This theory was examined by Baumeister in a study of participants' self-control efforts (food restraint) and subsequent performance on tests of cognitive abilities. The researchers concluded that the mental energy required during food restraint directly led to deficits in subsequent self-control operations, suggesting that attrition may result from an initial depletion of energy or motivation that affects an individual's initial psychological well-being (Baumeister, Bratslavsky, Muraven, & Tice, 1998).

Where depressed or stressed individuals often fail to complete an activity, some researchers suggest that attempting to reach an unattainable and unrealistic goal may contribute to the maintenance of the depression. In a study by Kuhl and Helle (1986), the researchers induced unfulfillable intentions through unrealistic instructions: a clean-up task and a memory-span assessment. Results indicated that the tendency to encode unrealistic intentions was associated with a personal history of depressive episodes as well as maintenance of the depression. This suggests that failure to achieve high goals may be particularly harmful for patients suffering from stress and minor psychological symptoms.

Compliance and obesity/health status. Research on compliance with an exercise regimen has demonstrated that sedentary persons weigh more than actives ones, associating exercise with a lower BMI (Blair et al., 1985; Folsom, 1985). In adults, active males and females have positive changes in fitness measures and fewer chronic degenerative diseases than inactive males and females (Morris et al., 1980; Paffenbarger et al., 1984; Salonen et al., 1982). The physical benefits of compliance with an exercise regimen have been associated with a decrease in several musculoskeletal conditions. Skeletal maturation continues long after linear bone growth ceases, so that peak bone mass is not achieved until the third decade of life. Skeletal deterioration during the fourth decade of life in females is accelerated by the loss of estrogens at menopause. Peak bone mass that is achieved during the third decade is considered a major determinant of the development of clinical osteoporosis later in life (Birge & Dalsky, 1989). Thus, osteoporosis may be as much a condition of childhood as of the older adult. Physical activity appears to be a determinant of peak bone mass, the subsequent maintenance of that bone mass and skeletal integrity (Birge & Dalsky). Thus, physical activity is an inhibitor of the development of osteoporosis (Haskel et al., 1985; Siscovick, LaPorte, & Newman, 1985).

Osteoporosis is a serious problem in the elderly and is a major cause of morbidity and mortality. In males, bone loss occurs at a rate of approximately 0.4% per year, beginning at approximately age 50. The cumulative effects usually do not cause difficulties in males, however, until about the eighth decade of life. In females, bone loss begins at an earlier age, between 30 and 35 years, and occurs at a more rapid rate. From an initial rate of bone loss of about 1% per year, the rate increases to 2-3% per year following menopause (Mazess, 1979).

Other studies have noted the benefit of physical exercise in the prevention of musculoskeletal conditions. Studies of elderly cross-country runners and other athletic individuals have demonstrated thicker bone mineral content in persons who exercise regularly as compared with those who do not (Jones, Priest, Hayes, Tichenor, & Nagel, 1977; Montoye, Smith, & Fardon, 1980). In a three-year study of 86 middle-aged females, the researchers found that regular exercise for 45 minutes three times a week was associated with increases in the bone mineral content compared to a control group of 62 females who made no change in their activity level. At the end of the study period, those in the control group were found to have lost bone mass while those in the exercise group had not (Smith, Smith, Ensign, & Shea, 1984).

The benefits of exercise also are demonstrated in studies of metabolic conditions, with cardiorespiratory fitness being one such documented benefit. In a study by De Vries (1970), males (aged 52 to 88) were enrolled in a program of regular exercise three times weekly, lasting one hour per session. At the conclusion of the study, the exercise group showed significant improvements in minute ventilation, vital capacity, systolic and diastolic blood pressure, and work capacity. Further, in a study by Bortz (1980), primary and secondary preventions of coronary heart disease manifestations were found in subjects who participated in physical exercise. Consistent with these data on coronary heart disease are a number of other studies that have observed lower rates of coronary heart disease in active individuals at similar or lower levels of energy expenditure than in sedentary individuals (Cassel, 1971; Shapiro, Weinlatt, Frank, & Sager, 1969; Taylor, Sallis, & Needle, 1985; Zukel et al. 1959).

In a 1996 report the Surgeon General declared that the cardiovascular and respiratory function benefits of regular exercise include increased oxygen uptake, decreased minute ventilation, decreased myocardial oxygen cost, decreased heart rate and blood pressure, increased capillary density in skeletal muscle, increased exercise threshold for the accumulation of lactate in the blood, and increased exercise threshold for the onset of disease symptoms such as angina and ischemic depression (United States Department of Health and Human Services [USDHHS], 1996). Also, Kesanieme and colleagues noted in a study that regular exercise resulted in a reduction in coronary artery disease risk factors such as reduced resting systolic/diastolic pressures, increased serum high-density lipoprotein cholesterol and decreased triglycerides, reduced total body fat and intra-abdominal fat, reduced insulin needs, and improved glucose tolerance (Kesanieme, Danforth, & Jensen, 2001).

Research also has found psychological benefits due to compliance to an exercise regimen. Active males and females were found to have experienced less depression, anxiety, and stress than sedentary counterparts (Taylor et al., 1985). Physical exercise also has been associated with improved self-confidence and better academic records in studies of young adults (Bortz, 1980; Tucker, 1982). In studies of adults of all ages, exercise has been associated with enhanced feelings of well-being, enhanced work, recreational, and sports performances, as well as enhanced independent living in the elderly (Kesaniemi et al., 2001; USDHHS, 1996).

The American College of Sports Medicine (ACSM, 2006) noted that if the appropriate type of exercise is performed at the proper intensity, duration, and frequency, sedentary persons of all ages will achieve significant improvements in physical fitness and psychological health. Further, exercise is recommended by many mental health counselors to guide individuals to a lifestyle of optimal health and well-being in which the body and mind are integrated for a balanced and fulfilling life (Myers, Sweeney, & Witmer, 2000; Okonski, 2003). Compliance with an exercise regime, as one life task, can play an important role in helping people obtain wellness and a healthy lifestyle because of its physical and psychological benefits.

Sleep

Sleep is a necessary part of the human condition, often delayed or shortened to fit an individual's lifestyle. Most humans require approximately eight hours of sleep every 24 hours to function at an optimal level. The brain is very active during sleep with numerous neurons emitting electrical discharges of varying frequencies. Higher frequencies are indicative of higher levels of brain activity. When in an awakened state, brain waves consist almost entirely of alpha and beta wave activity (Carlson, 2004). Alpha waves are regular, medium frequency waves (8 to 12 Hz) produced by the brain when the person is resting quietly. Beta waves are irregular, mostly low amplitude waves (13 to 30 Hz) that occur when a person is engaged in mental processing or is physiologically aroused. Researchers have identified five distinct stages of sleep: Stage 1, Stage 2, Stage 3, Stage 4, and Rapid Eye Movement (REM) activity (Hobson, 1995).

Stages of sleep. Stage 1 sleep usually begins as the person becomes drowsy and the eyes begin to close, persisting only a few minutes after sleep onset. During this stage, theta waves (3.5 to 7.5 Hz) become visible on the electroencephalogram (EEG; Carlson, 2004). Stage 1 is a transition between sleep and wakefulness. Sleepers tend to be easily awakened during Stage 1, and if aroused during this stage, individuals may deny being asleep (Hobson, 1995).

Following approximately 10 minutes in Stage 1 sleep, an individual will enter Stage 2 sleep. During this stage, sleep deepens and the body temperature lowers. Stage 2 is characterized by the presence of sleep spindles and K complexes (Carlson, 2004). Sleep spindles are short EEG wave bursts that occur between two and five times a minute, while K complexes are sudden sharp waves. Researchers have suggested that these two types of wave bursts are involved in keeping a person asleep, with a more intense stimulus required to produce arousal at this stage (Bowersox, Kaitin, & Dement, 1985). A healthy adult will generally spend 10 to 25 minutes in Stage 2 before entering the next stage of sleep, known as Stage 3 (Carskadon & Dement, 2000).

Stage 3 is characterized by the emergence of slow, high amplitude waves (less than 3.5 Hz) called delta waves. During this stage, delta waves increase and K complexes and sleep spindles decrease. Stage 3 typically lasts for several minutes and leads into stage four. Stages 3 and 4 often are called slow wave sleep (SWS) due to the prevalence of delta waves and are the deepest levels of sleep. During Stages 3 and 4, slow and steady wave activity is present throughout the brain. This is often referred to as synchronous sleep (Carskadon & Dement, 2000). Once the delta waves comprise more than half of the brain activity, the person has entered Stage 4 sleep.

Stage 4 sleep is composed of more than 50% delta waves. When individuals are awakened during Stage 4, the sleeper will usually be confused and can easily fall back to sleep without remembrance for the awakening (Bonnet, 2000). The individual will usually cycle back through Stages 3 and then 2 before entering the final stage of sleep known as REM (rapid eye movement) sleep (Carskadon & Dement, 2000).

The final stage of sleep is characterized by REM, irregular heartbeats, heightened sexual arousal, blood pressure changes, and vivid dreaming (Carskadon & Dement, 2000). Beta activity is present, and is characterized by fast, irregular, low-voltage brain waves that indicate substantial brain activity. Although the person is completely asleep, brain wave activity is similar to wakefulness or activity during Stage 1 sleep (Carlson, 2004). Concurrently, muscles are paralyzed during REM by the inhibition of neural activity in the brain stem, apparently to protect the sleeper from acting out dreams that could produce injury (Carskadon & Dement).

Alternating between periods of REM and non-REM sleep throughout the night, the typical complete sleep cycle for an adult takes approximately 90 minutes to complete

(Carlson, 2004). During each cycle REM will last approximately 20 to 30 minutes, but progressively increases within each cycle as the night progresses. As the amount of REM sleep progresses, the amount of Stages 1 and 2 becomes less (Carlson). Consequently, individuals will cycle through four to five REM sleep periods during a typical eight-hour night of sleep.

The amount of time spent in each sleep stage is further influenced by age. From early adolescence to age twenty, there is a 40% reduction in REM sleep, with the same amount of overall sleep (Carskadon & Dement, 1987). By age 80, very little SWS is exhibited in most humans with greater amounts of Stage 1 and Stage 2 sleep. REM sleep has not been shown to change significantly in healthy adults. The amount of REM sleep at night also correlates with intellectual functioning (Prinz, 1977). Older adults with conditions of dementia have a marked decline of REM sleep (Prinz, Peskind, & Vitaliano, 1982).

Physiological processes of sleep. Research has defined four main physiological processes that directly affect the sleep-wake cycle: the autonomic nervous system (Parmaggiana, 1994), homeostatic drive for sleep (Cohen & Albers, 1991), circadian rhythm (Refinetti, 2000), and body temperature (Campbell & Zulley, 1989). Interference with any of these processes can lead to sleep difficulties.

The autonomic nervous system, composed of the sympathetic and parasympathetic systems, controls arousal reactions to both environmental and internal stimuli. The sympathetic system activates the human body in response to a stressor or anticipated danger and the parasympathetic system calms the body. Sleep is associated with increased parasympathetic and decreased sympathetic functioning (Parmaggiana, 1994). Stimulation of the parasympathetic activating systems in the brain produces behavioral signs such as a slower heart rate, lower blood pressure, and constriction of the pupils. Both imagined and real environmental stressors can trigger the activation of the sympathetic nervous system. Therefore, frustrations associated with transitory difficulties falling asleep or concerns people develop as they are trying to fall asleep may significantly affect a person's ability to fall or stay asleep (Parmaggiana).

The homeostatic drive is a second physiological process that directly affects the sleep-wake cycle. The longer people remain awake the sleepier they become (Carskadon & Dement, 2000). Sleep deprivation results in shorter sleep onset and more rapid entry into deep sleep. In people without sleep disorders, the amount of time it takes to fall asleep (sleep latency) indicates the need for sleep. While the autonomic nervous system can influence the ability to fall asleep by affecting levels of arousal (Parmaggiana, 1994), the homeostatic processes play an important role in the tendency to fall asleep. Entering a state of relaxation after a night of sleep deprivation, however, does not ensure eight hours of restful sleep outside the normal sleep-wake schedule (Parmaggiana). Timing that is consistent with the circadian rhythm or sleep-wake cycle is an additional factor required for good sleep (Cohen & Albers, 1991; Gillette & McArthur, 1996).

The circadian sleep/wake cycle follows an approximate 24-hour cycle. The normal sleep period begins several hours after dark and continues into the daylight portion of the day (Boivin, Duffy, Kronauer, & Czeisler, 1994). External cues, such as light, resynchronize the human internal clock to a 24-hour cycle, daily resetting the sleep/wake cycle. Studies have shown that after maintained periods of constant darkness, circadian rhythms in humans and other animals can be reset with a brief period of bright light (Aschoff, 1979).

Body temperature rhythm is a fourth process associated with sleep. Individuals tend to fall asleep easier when body temperature rhythm is close to the bottom of its curve (Campbell & Zulley, 1989). Because muscular activity, a primary source of body heat, is reduced during sleep, the production of body heat is also reduced. Whereas, the shivering response to cooler temperatures remains inactive during sleep, the sweating response continues and promotes cooling. During sleep, a general body temperature decline occurs due to these processes (Hobson, 1995). During REM sleep, temperature control is basically lost and relies on arousal or the environment to sustain stable body temperature. Further, heat control neurons in the hypothalamus are rested during REM sleep.

Studies have indicated that prolonged sleep deprivation generally results in a significant body temperature reduction (Horne, 1988). Extreme sleep deprivation studies with rats indicate that animals will die when deprived of sleep for prolonged periods resulting from complications due to their inability to conserve body heat (Rechtschaffen, Gilliland, Bergmann, & Winter, 1983). While the exact association between sleep and thermoregulation is undetermined, studies indicate that body temperature is associated with the sleep/wake cycle and that sleep appears essential for body temperature maintenance.

Function of sleep. Although the precise purpose of sleep is unclear, theories have been proposed to explain its function. Such theories include neurotransmitter replenishment, nervous system development, and memory reinforcement and consolidation (Hobson, 1995).

The first of these theories, the neurotransmitter replenishment theory, posits that neurons continuously fire throughout a person's waking hours. However, these neurons may possess a limited quantity of neurotransmitters than can be depleted. In contrast, neural activity slows during sleep, with most neurons exhibiting a slight decrease in activity while others stop firing altogether. This is exhibited particularly during REM sleep. Norepinepherine and Serotonin are released by specific neurons, known as aminnergic neurons, which cease to fire. These enzymes are believed to play an important roll in attentive learning and memory. According to replenishment theories, aminnergic neurons continue to produce new neurotransmitters while inactive during sleep (Hobson, 1995). After enough time in REM sleep, these neurons create reserve neurotransmitters to help us remain cognitively adept for our wakeful periods.

Developmental theories have emerged as a second purpose of sleep. These theories suggest that one of the primary functions of sleep (specifically REM sleep) is the development of the nervous system (Hobson, 1995). Infants spend up to 80% of their sleep in REM during their first weeks of life – more than three times the amount of adults. Because of the prominence of REM in infancy, developmental theorists postulate that REM sleep allows the brain to rehearse future behaviors and increase the strength of neural pathways for future use. Developmental theories are further supported by the fact that consistently across species, the amount of REM sleep at birth is greater than at any other time in life with a decreasing and leveling off in adulthood. In general, developmental theories suggest that brain stimulation during REM sleep aids in brain development. However, these theories fail to explain the function of REM sleep in adults.

Learning theorists have proposed a third purpose of sleep. This theory states that the primary function of sleep is to consolidate and reinforce memory. While research has shown that learning cannot occur during sleep, lack of sleep appears to hinder daytime learning (Hobson, 1995). Although the precise mechanism for memory organization is unknown, it is believed that memory is distributed throughout the brain. As new information is obtained, new neural pathways are created, with the neurons increasing in synaptic strength. Therefore, fewer impulses are needed for the firing of the post-synaptic neuron (Hobson). As neural pathways strengthen, a new protein structure is created that allows new information to be permanently stored in the brain. These altered neural pathways are activated during REM sleep, which could explain why REM sleep is crucial to learning and memory. Additionally, the learning and memory centers of the brain (the cortex and neo-cortex) are active during REM sleep, and thus can reinforce both newer and older memories. Although there are few stimuli during REM sleep, the brain is aroused and ready to process information. The brain, therefore, begins to process information that is stored in memory (Hobson).

Sleep and obesity/health status. Research has indicated that sleep difficulties have made a serious impact on various aspects of human functioning (Pilcher & Walters, 1997; Simonds & Carlos, 2005). These studies examined the effects of sleep quality on an individual's ability to function. Sleep quality is generally defined by the number of nighttime awakenings (including the amount of time required to return to sleep), sleep latency (the amount of time required to fall asleep), a feeling of fatigue/restfulness upon awakening in the morning, sleep duration (the amount of time in a sleeping state) and a general satisfaction with the sleep received (Pilcher).

Studies of sleep quality and obesity often have focused on the relationship of sleep quality and eating behaviors. Hicks and colleagues (1986) found that college students with poor sleep quality were more likely to stray from eating three meals per day and were more likely to snack than those with good sleep quality. More recently, Tanaka and colleagues (2002) showed that junior high school students who were poor sleepers were less likely to eat breakfast and had poorer overall dietary habits than the good sleepers. Specifically, this line of research suggests that sleep quality relates to eating behavior, and thus weight gain/obesity.

A new line of obesity research has related a specific aspect of sleep quality, sleep duration, to weight gain and obesity. Evidence from laboratory studies with animals and humans indicate a link between sleep deprivation and an increased body weight (Gangwisch et al., 2005). Further, based on results from a longitudinal study, Kripke and colleagues (2002) found consistent increases in BMI among individuals who habitually slept less than seven hours a night. Along these lines, Hasler and colleagues (2004) found results in a 13-year longitudinal study that indicated as the amount of sleep per night decreased, BMI increased. Finally, Taheri and colleagues found that individuals who slept less than the recommended eight hours a night showed increased BMI, which was proportional to the amount of decrease in sleep time (Taheri et al., 2004).

The results of the preceding studies indicate that sleep durations of less than seven to eight hours are associated with an increased BMI (Kripke et al., 2002; Taheri et al., 2002) and with obesity (Gangwisch et al., 2005; Hasler et al., 2004). Although the precise mechanism relating lowered sleep duration to weight gain/obesity remains unclear, recent research has indicated a hormonal component involving leptin and ghrelin (Prinz, 2005/2006).

Lower levels of leptin, a peptide hormone responsible for suppressing food intake and increasing energy levels (Prinz, 2005/2006), has been related to increased BMIs and sleep duration of less than eight hours (Spiegel, Tasali, Penev, & Van Cauter, 2004; Taheri et al., 2004). Conversely, higher levels of ghrelin, a peptide hormone responsible for stimulating appetite, fat production, and body growth (Prinz, 2005/2006), have been related to increased BMIs and less than eight hours of sleep (Spiegel; Taheri). Spiegel and colleagues (2004) found that young men who had their sleep curtailed had lower levels of leptin, increased ghrelin levels and increased appetite and hunger ratings. It was noted that the men in the experimental condition reported craving sweets and high starch food compared to controls. Research has indicated that those with sleep restriction or decreased sleep show a decrease in insulin response to glucose (Spiegel, Leproult, Van Cauter, 1999). This typical hormone pattern found in individuals with decreased sleep is a pattern that consistently has been associated with decreased energy expenditure and increased appetite and obesity (Prinz).

In adults, less than seven hours of sleep per night can effect normal growth and development as well as the maintenance of a healthy immune system. Both protein synthesis and growth hormones play a substantial role in physical growth, and are secreted at their highest levels during REM sleep (Parker, Rossman, & Kripke, 1980; Sassin, Parker, & Johnson, 1969), which occurs at a higher frequency at the end of the sleep cycle. Further, individuals who obtain less than six hours of sleep can have 50%

reduction in natural killer T-cells that aid the body's immune system in fighting infections (Irwin, McClintick, & Costlow, 1996). Finally, Taylor and McFatter (2003) linked sleeplessness to cardiovascular disease.

During the sleep period following a night of sleep deprivation, SWS predominates over the other stages and significantly less REM sleep takes place (Angus, Heslegrave, & Myles, 1985; Bonnet, 2000). Stage four sleep increases after unusually high amounts of exercise (Trinder, Paxton, Montgomery, & Fraser, 1985). Additionally, the greatest amounts of growth hormone are released during SWS (Sassin et al., 1969). These findings demonstrate the important role played by SWS in maintaining physical health.

The literature also suggests a relationship between sleep quality and psychological health. Poor sleep quality has been linked with poor mental health as early as pre-adolescence, with a clear relationship established between poor sleep quality and negative mood states for adults, as well (Bonnet, 1985; Gau, 2000; Gray & Watson, 2002; Lacks & Morin, 1992; Pilcher & Huffcutt, 1996). Stress and worry have been linked to poor sleep quality (McCann & Stewin, 1987), as have increased tension, decreased psychological well-being, and general lower life satisfaction (Pilcher, Ginter, & Sadowsky, 1997). Similarly, poor sleep appears to be related to Type A personality, the latter involving a chronic incessant struggle to achieve more and more in less time, which can result in health difficulties (Krantz, Arbrier, Davia, & Parker, 1988). Buboltz and colleagues (2006) found that college students who were able to fall asleep faster with fewer sleep disturbances had fewer mental and social health difficulties. In a study by Taub and Hawkins (1979), adults who reported irregular sleeping schedules demonstrated fewer tendencies toward achievement potential, intellectual efficiency, self-control, and sociability.

Research on sleep deprivation and psychological health has demonstrated that sleep deprivation of only one night is related to increased excitability and impulsiveness (Sicard et al., 2001; Vein et al., 1983). One study involving psychologically healthy college students found a relationship between sleep loss and decreased psychological health, with increased somatic complaints, obsessive-compulsive activities, higher levels of interpersonal reactivity, and higher social discomfort after only a single night of sleep loss (Zammit, 1988). Other studies have linked sleep loss to changes in mood (Blagrove & Akehurst, 2001).

Cognitive skills also are affected by poor sleep quality perhaps due to a relationship of cognitive abilities and REM sleep (Pilcher & Walters, 1997). Research has demonstrated that the last half of a full night's sleep, specifically REM sleep, may be the most important in the learning process (Smith & Lapp, 1991). When this sleep is terminated prematurely, cognitive abilities are negatively affected. Harrison and Horne (2000) and Blagrove and Akehurst (2001) found dramatic negative effects on cognitive functioning, impacting logical reasoning and decision making in adults following the loss of only one night of sleep. Adults reporting excessive sleepiness also report negative effects on working memory (short-term memory used for thinking and problem solving), psychomotor reactivity, and increased suggestibility (Blagrove & Akehurst). Other studies have shown that sleep difficulties can significantly impair academic performance, learning, visuomotor skills, and general cognitive ability (DeKonick, Lorrain, Christ, Proulx, & Coulombe, 1989; Lack, 1986; Schredl, Weber, & Heuser, 1998). Attention is susceptible to partial sleep deprivation poor cognitive functioning, as well as false recall of recently learned words and decreased visuomotor skill (Grosvenor & Lack, 1984; Karni, Tanne, Rubenstein, Askenasy, & Sagi, 1994; Webb & Agnew, 1974).

There also is a body of research linking sleep quality with clinical (abnormal) aspects of psychological health. Studies indicate a relationship between higher rates of anxiety in poor sleepers (Aikens & Mendelson, 1999; Monroe, 1967; Zammit, 1988). Carpenter (2001) also found that Attention Deficit Hyperactivity Disorder is often associated with deficits in sleep quality. Further, in a study comprised of urban police officers with posttraumatic stress symptoms, only those who reported poor sleep quality also reported somatic health problems (Mohr, Vedantham, Neylan, Metzler, Best, & Marmar, 2003).

The studies of sleep disturbances and depression have yielded contradictory results. Aikens and Mendelson (1999) found higher rates of depression were associated with deficits in sleep quality. Zammit (1988) confirmed these studies by finding increased symptoms of depression after sleep loss. However, Kraft (1984) found that short-term sleep deprivation was linked with decreased symptoms of depression. This contradiction indicates the need for further research on the psychological effects of sleep disturbances.

Personality

Theories of personality organize, explain, and predict facts about the personality, providing an explanatory-predictive basis for producing knowledge about the person (Hall & Lindzey, 1970). Studies attempting to integrate theories of personality have formalized traditional personality concepts for purposes of psychological investigation

(Cattell, 1978). Psychologists typically agree that there are three to five factors (categories of personality traits) that have meaningful similarity in various formations: openness, conscientiousness, extraversion, agreeableness, and neuroticism (Golubkov, 2002). The main personality factors are considered universal for people of different cultures and languages (McCrae & Costa, 1999).

Personality assessment. Personality concepts are assessed on two dimensions: general (normal) personality traits and psychopathological (abnormal) personality traits. Psychological instruments often used to identify normal personality traits include the Sixteen Personality Factor Inventory (16 PF), the California Psychological Inventory (CPI), and the NEO Five-Factor Personality Inventory (NEO-FFI). Abnormal personality traits, psychological disorders (e.g., mood disorders and anxiety disorders), and personality disorders (e.g., borderline personality disorder and histrionic personality disorder) are identified with instruments such as the Minnesota Multiphasic Personality Inventory-3 (MMPI-3), the Rorschach, the Thematic Apperception Test (TAT), and the Millon Clinical Multiaxial Inventory (MCMI).

Personality and obesity/health status. Research relating personality, obesity, and health often has focused on the relationship of personality and eating behaviors. Some researchers have noted a negative relationship between anxiety, a general personality trait, and restraint in eating, which can decrease levels of obesity. For example, Westenhoefer (1991) found that participants overate to lessen anxiety when dieting. This association among restraint, anxiety, and eating behavior is seen as an important consideration in dieters who experience anxiety during periods when food intake is restricted. Polivy and colleagues (1994) also found that dieters significantly increased their intake of food when anxious. Ironically, the experienced anxiety was not significantly reduced after eating. Other researchers have noted that anxiety and hostility were associated with continued eating until satiated, while sociability and low impulsivity were related to greater monitoring and control of food intake and body weight. Further, lack of persistence was associated with increased snack and alcohol consumption, while immaturity, self-gratification, aloofness, and self-consciousness were related to a greater susceptibility to hunger (Van den Bree et al., 2006).

Other studies of personality and obesity have researched different personality traits as emotional triggers to eating behaviors. Dube and colleagues (2005) found that positive emotions precipitated eating for emotional comfort (comfort food consumption) in males, whereas negative affect generated comfort food consumption in females. Additionally, although comfort consumption alleviated female negative emotions, guilt was produced. Differentiating between older and younger participants, comfort food consumption produced positive affect in the former and intense negative emotions in the later. Finally, those of both genders who consumed high sugar and fat content foods experienced lessened negative affect while low-calorie foods increased positive emotion (Dube).

Factors Affecting Obesity and Health Status

Personality Variables and Exercise Compliance

Most research on the relation of personality and compliance has focused on personality variables and treatment compliance in medical settings (Bebbington, 1995; Becker & Maiman, 1975; Demyttensere, 1997; Fawcett, 1995; Von Korff, Katon, Bush, Simon, & Walker, 1995). Some studies found that personality dimensions were linked with compliance to medication regimens (taking medications as prescribed). One such study found that Extraversion, as measured on the NEO-PI (NEO-PI; Costa & McCrae, 1992), was negatively related to antidepressant medication compliance and significantly predicted medication noncompliance. Another study of personality and medication compliance used the Inventory of Interpersonal Problems (IIP; Horowitz, Rosenberg, Baer, Ureno, & Villasenor, 1988) to assess personality dimensions and found that antidepressant medication compliance was associated with the absence of pathology (Sirey et al., 2001). Others used the Karolinska Scales of Personality and found that medication noncompliance was associated with elevated scores on the Sensation-Seeking subscale (Ekseluis, Bengtsson, & Knorring, 2000). Finally, other researchers used the Minnesota Multiphasic Personality Inventory (MMPI-2) and the NEO-PI to assess associations between medication compliance and personality. Researchers found that low scores on the Work Interference scale of the MMPI-2, low scores on the Conscientiousness scale of the NEO-PI, and high scores on the Neuroticism Scale were associated with noncompliance to a medication treatment regimen (Stein & Hackerman, 1991).

Other researchers have examined the relation between personality variables and compliance to dietary weight loss programs. Galluccio and Roberta (2003) used the NEO-PI to examine correlations between personality dimensions and compliance to a dietary weight loss regimen. This study found that the two personality variables of Openness and Conscientiousness were positively correlated with compliance to the weight loss regimen (Galluccio & Roberta). An additional study utilizing the MMPI found that individuals characterized as passive, dependent, less dominant, and lower in social status were the most compliant in attending a dietary weight loss program (Keegan, Dewey, & Lucas, 1987). Studies also have examined the impact of personality on compliance to a physical exercise regimen, with some researchers endorsing that such factors are important and should be studied in more depth (Jones et al., 1998). Overall, noncompliance to an exercise program has been associated with poorer mental health (Shapiro, Griesel, Bartel, & Jooste, 1975).

The studies on exercise compliance and mental health have examined both broad personality traits and more abnormal personality variables. Broad personality traits have been linked with overall adherence to an exercise routine. For example, Dishman and Ickes (1982) found that self-motivation and behavioral decision-making were linked with adherence to exercise programs, with these traits found to predict behavior the best when combined with biological traits such as body weight and composition. Self-motivated individuals are less sensitive to activity barriers, such as inconvenience or competing lifestyle behaviors (Dishman & Ickes). Rhodes and colleagues found that self-efficacy and social support contributed significantly to compliance (Rhodes et al., 2001), while merely perceived self-efficacy (confidence in one's ability to exercise) and self-estimates of the likelihood of adherence predicted adherence to an exercise regimen in other studies (Dishman, 1994; Dishman, Sallis, & Orenstein, 1985; Edmunds et al., 2007). Self-efficacy also predicts task adherence as well as expended effort (Litt et al., 2001; Marks, 2001). Self-perceptions of a person's overall physical competence are not linked to increased compliance to an exercise regimen, nor has one's attitude or one's awareness of the benefits of exercise (Sonstroem, 1982).

In other studies of broad personality traits and compliance, researchers often have focused on self-reported Type A personalities. Type A personalities demonstrate behaviors in which the person is aggressively attempting to achieve more and more in less time (Friedman et al., 2001). Type A personality individuals are demanding of others and themselves, while individuals with Type B personalities are more agreeable, relaxed, and less urgent than Type A (Strube, 1989). Studies have demonstrated that, although Type A personality is positively related to fitness gains, people who demonstrate Type A behavior tend to dropout early from fitness regimens. Type A individuals dropped out earlier and more frequently from formal cardiac rehabilitation exercise classes than Type B individuals (Oldridge, Donner, Buck, Jones, & Andrew, 1983). Other researchers have found that Type A individuals are infrequent participants in corporate exercise programs (Dishman et al., 1985). Related to Type A personalities, the personality trait of extroversion has been negatively related to adherence (Cox, 1984), and ego-strength is uncorrelated (Dishman & Ickes, 1982).

Studies on abnormal personality traits and compliance to an exercise regime have been few. Ward & Morgan (1984) found that attrition from an exercise regimen was related to the traits of perceived depressed mood. In a study of adult exercises, Collingwood (1983) found that exercise program attrition was positively related to participants with multiple somatic complaints that were not explained by a medical condition. Welsh and colleagues found that exercise compliance was related to low state anxiety (Welsh, Labbe, & Delaney, 1991). Other researchers also have noted that depression is negatively associated with compliance to an exercise regimen (Lobstein, Mosbacher, & Ismail, 1983). For example, Morey et al. (2003) studied sedentary adults (ages 65-90) and compliance to a home-based exercise regime and found that less depressed mood was associated with better adherence. However, Downing, Littman, Scheer and Pegg (1992) measured depression symptoms in cardiac rehabilitation patients upon initiation of an exercise regimen and found that the level of depression upon entry into the program was uncorrelated.

Researchers also have proposed that past exercise experience may be a more accurate predictor of compliance to exercise regimens. Oldridge (1982) found for men and women that the rate of participation typically drops within the initial three to six months, then plateaus and continues gradually decreasing but levels off across the next 12 to 24 months. Individuals who remained active after six months were the most likely to remain active a year later. Minor and Brown (1993) also found that the best predictors of compliance to an exercise regime over an 18 month time period was exercise at the three-month point, followed by high levels of depression, anxiety, and social support. At 18 months, the only significant predictor was the individual's previous exercise level (Minor & Brown).

Personality Variables and Sleep

Some psychological factors may play roles in sleep difficulties (Monroe, 1967; Taub, 1978; Taub, 1979; Verlander et al., 1999). Research often has focused on the relationship between sleep duration and personality. When defined at the levels of long sleep lengths or short sleep lengths, the relationship of sleep duration to personality has yielded inconclusive results, generally finding only weak correlations between the two. Domino, Blair, and Bridges (1984) observed that persons with short sleep lengths scored higher on 7 of the 18 variables on the CPI than persons with long sleep lengths. However, other researchers have criticized that the construct of sleep length was not defined by objective measures in this study, rather using ambiguous, subjective definitions based on answers to three "yes" or "no" questions (Pilcher et al., 1997). Follow-up studies concluded that sleep length is a weak predictor of mood and functioning (Pilcher; Verlander).

Other studies on personality and sleep length also have yielded conflicting results. Jenkins (2005) found a weak relationship between sleep length and the primary factor of Warmth on the 16 PF, with higher levels of Warmth indicating increased sleep length. This researcher found no relationship between sleep length and the global factors of the 16 PF. Webb and Friel (1971) found that undergraduate students who typically slept 9.5 hours or longer did not differ significantly from students who slept 5.5 hour or less on a battery of personality tests (MMPI, CPI, and Zung Measurement of Depression Scale). Another study (McCann & Stewin, 1987) found no relationship between the constructs of worry and preferred sleep length. Finally, two other studies found no significant correlations between all of the Big Five factors of personality and sleep length (Buela-Casal, Carlos, & Caballo, 1991; Hill, Diemer, & Heaton, 1997). Conversely, Blagrove and Akehurst (2001) found that young adults who were deprived of 29 to 35 hours of sleep showed deficits in mood and significantly higher scores on neuroticism on the Profile of Mood States (McNair, Loor, & Droppleman, 1971; 1992). Further, college students deprived of one night of sleep had heightened anxiety, sensitivity to external stimuli, and excitability in a study by Vein and colleagues (1983). Similarly, Sicard and colleagues (2001) found that sleep deprived military pilots demonstrated increased impulsiveness.

Studies on personality factors and sleep quality have yielded more important results than those of personality and sleep duration. The majority have used the NEO-PI and have tested various populations, including college students, junior high students, clinical populations, and healthy adults. The findings indicate that poor sleep quality is associated with negative mood states as defined by the Neuroticism scale of the NEO-PI (Bonnet, 1985; Gau, 2000; Gray & Watson, 2002; Lacks & Morin, 1992; Pilcher & Huffcutt, 1996). Whether the negative mood states create sleep difficulties, the sleep difficulties create the negative mood states, there is an interaction between the two, or a third variable affects the others remains unclear. Since sleep difficulties are one of the hallmark symptoms of depression (American Psychiatric Association, 2002), it is possible that the relationship is reciprocal: depressed mood can lead to poor sleep quality, and in return, poor sleep quality can exacerbate negative mood states.

Extraversion is another personality factor with a relationship with sleep quality, particularly subjective sleep inefficiency (Gray & Watson, 2002). Extraversion has predominately been studied in terms of "morningness vs. eveningness" or a person's time of peak activity. Morningness refers to individuals who are more alert during the early hours of the day while eveningness refers to individuals who are night owls (Guthrie, Ash, & Bendapudi, 1995). Taub, Hawkins, and Van de Castle (1978) found that individuals with "morning" circadian rhythms exhibited regular times of going to sleep and awakening while individuals with evening circadian rhythms exhibited more disturbed nocturnal sleep and chronic sleeping routine irregularities. Although other studies have supported the concept that individuals who are more extroverted are "evening types" (Blake, 1967; Larsen, 1985), more recent research has found a weak or no relationship between eveningness and extroversion (Beaulieu, 1991; Gray & Watson, 2002). Additionally, because morning types have reported higher daily positive affect, optimism, positive emotions, and greater life satisfaction than evening types, the relationship between morningness and personality appears to be more complicated than a simple relationship to Extraversion (Clark, Watson, & Leeka, 1989).

Conscientiousness, another Big Five factor, also has been linked to morningness. Researchers have found that higher scores on Conscientiousness are associated with higher academic achievement (Barrick & Mount, 1991; Gray & Watson, 2002; Organ, 1975). Sleep may be a moderator in this relationship. Also, eveningness was associated with lower scores on Conscientiousness (Gray & Watson). Finally, some studies have linked higher scores on Psychoticism of the Eysenck Personality Questionnaire (EPQ, Eysenck & Eysenck, 1975) with a more evening-oriented sleep schedule (Mitchell & Redman, 1993; Wilson, 1990). The Psychoticism scale measures an individual's aspect of personality characterized as cold, impersonal, hostile, lacking in sympathy, unfriendly, distrustful, odd, unemotional, unhelpful, lacking insight, strange, and paranoid (Eysenck & Eysenck).

Poor sleep quality has been associated with 16PF factors. Jenkins (2005) found that poor sleep quality was related to lower scores on Emotional Stability, Rule Consciousness, and Tough-Mindedness and higher scores on Vigilance, Apprehension, Tension, Abstractedness, and Anxiety. Jenkins noted that individuals with poor sleep quality are generally less emotionally stable, self-assured, and observing of rules and regulations, as well as more skeptical of others' motives, more oriented to internal processes, and possess higher trait anxiety. Further, these individuals were more anxious, reactive, and reckless, as well as less grounded and practical than those with good sleep quality.

Some studies have linked sleep quality and Type A personalities. Research has shown in young adults that Type A behavior is associated with decreased sleep duration (Hicks, Allen, Armogida, Gilliland, & Pellegrini, 1980; Hicks et al., 1979; McKelvie, 1992). Additionally, they experience more sleep disturbances, including difficulties falling asleep (Koulack & Nesca, 1992). Koulack and colleagues found that individuals who perceive their lives as stressful may also view their sleep time as such, with higher negative affect predicting higher incidences of sleep difficulties (Brissette & Cohen, 2002; Koulack, Nesca, & Stroud, 1993).

Stress may be related to Type A personality. As individuals experience stress, the body responds by increasing the functioning of the sympathetic nervous system. Similarly, studies have demonstrated that individuals with Type A personalities react to stressors with higher increases in blood pressure and pulse rate than their Type B counterparts (Krantz et al. 1988). Stress has been associated with sleep disturbances in a number of studies (Hicks & Garcia, 1987; Paulsen & Shaver, 1991; Weller & Avinir, 1993). In a study by Verlander and colleagues (1999), high intensity anxiety, hostility, and depression were associated with sleep difficulties. Thus, sleep difficulties may be associated with coping styles of the individual.

Research suggests a relationship between clinical aspects of personality and sleep quality, as well. In a study by Monroe (1967), seven of the ten clinical scales of the MMPI were significantly elevated in poor sleepers. Of these seven scales, Depression, Hypomania, Social Introversion, and Psychasthenia were most elevated. The Depression scale measures feelings of hopelessness, slowing of thought or action, and oftentimes suicidal ideations, while high scores on Hypomania reflect an energetic, expansive, and emotionally excitable individual. High scores on the Social Introversion scale indicate a preference for being alone, while tension, anxiety, and negative self-evaluations are reflected in individuals scoring high on the Psychasthenia scale (Friedman et al., 2001). Monroe (1967) also found that poor sleepers tended to be less well-adjusted.

Summary

Obesity and the associated negative effects on health status have been identified as a chronic, escalating problem for American adults. Obesity research has consistently identified genetics, poor dietary habits, and lack of physical exercise as factors that contribute to the problem. However, some scholars argue that this research has yet to identify a unified theme for understanding obesity, with underlying mechanisms that drive the behaviors that contribute to obesity and health yet to be identified (Buboltz, 2005).

Research on obesity and health demonstrates that sedentary persons weigh more than active ones, with research associating exercise with a lower BMI (Blair, Jacobs, & Powell, 1985; Folsom, 1985). Research has indicated that active adults have positive fitness measures and fewer degenerative diseases than inactive adults (Morris et al., 1980; Paffenbarger et al., 1984; Salonen et al., 1982). Additionally, the physical benefits associated with compliance to an exercise regimen include decreases in musculoskeletal conditions (Haskell et al., 1985; Siscovick et al., 1985) and increases in cardio respiratory fitness (Bortz, 1980; DeVries, 1970; USDHHS, 2001). Psychological benefits include higher levels of body satisfaction and overall psychological well-being (ACSM, 2006;

Bortz; Kesaniemi et al., 2001; Myers et al., 2000; Okonski, 2003; Taylor et al., 1985; Tucker, 1982). Existing theories and research on predictors of compliance in exercise programs and other health behaviors have suggested that the variables of stage of change, self-efficacy, and psychological well-being are particularly important (Calfas et al., 1997; Marcus et al., 1992; Marcus et al., 1998; Sarkin et al., 2001).

Researchers also have focused on the relationship of sleep to obesity and overall health status. In general, insufficient sleep duration has been associated with obesity (Gangwisch et al., 2005; Hasler et al., 2004; Kripke et al., 2002; Prinz, 2005/2006; Taheri et al., 2004) and adverse effects on normal physiological health (Parker et al., 1980; Sassin et al., 1969; Taylor & McFatter, 2003). Insufficient sleep duration has been associated with decreased psychological health (Blagrove & Akehurst, 2001; Harrison & Horne, 2000; Pilcher & Walters, 1997; Sicard et al., 2001; Vein et al., 1983; Zammit, 1988). Studies examining the relationship between obesity and sleep quality have focused on eating behaviors and have indicated an association between the two (Hicks et al., 1986). Lower psychological well-being also is associated with poor sleep quality (Bonnet, 1985; Gau, 2000; Gray & Watson, 2002; Lacks & Morin, 1992; McCann & Stewin, 1987; Pilcher et al., 1997; Pilcher & Huffcutt, 1996). Of course, the direction of causality is hard to establish.

Another factor associated with obesity and health status is personality. Often focusing on personality and eating behaviors, studies have shown that high levels of anxiety are associated with a lack of restraint in eating. Other researchers have found anxiety and hostility were associated with eating following satiation, while sociability and low impulsivity were related to greater monitoring and control of food intake and body weight. Lack of persistence was associated with increased snack and alcohol consumption, while immaturity, self-gratification, aloofness, and self-consciousness were related to a greater susceptibility to hunger (Van den Bree et al., 2006). Other researchers have found that both positive and negative emotions triggered comfort food consumption and high sugar and fat content foods alleviated negative affects while low-calorie foods increased positive emotions (Dube et al., 2005).

Other studies associating personality and compliance have focused on personality and medication compliance (Bebbington, 1995; Becker & Maiman, 1975; Demyttensere, 1997; Ekseluis et al., 2000; Fawcett, 1995; Sirey et al., 2001; Stein & Hackerman, 1991; Von Korff et al., 1995). Some have associated personality and compliance to dietary weight loss programs (Galluccio & Roberta, 2003; Keegan et al., 1987). In studies that have associated personality and compliance to physical exercise regimes, the personality variables of self-motivation, behavioral decision-making, and self-efficacy were predictors of adherence (Dishman, 1982; 1994; Dishman & Ickes, 1982; Dishman et al., 1985; Edmunds et al., 2007; Rhodes et al., 2001). Type A personality has met with inconsistent results when associated with compliance (Cox, 1984; Dishman et al., 1985; Oldridge, 1982). Stress was noted to be an obstacle to exercise adherence (Belisle & Sherbrooke, 1987; Klonoff et al., 1994). In studies of abnormal personality traits, exercise regimen attrition was positively related to perceived mood disturbance (Ward & Morgan, 1984), somatization, and anxiety (Collingwood, 1983). Clinical levels of depression produced mixed results in studies of exercise compliance (Downing et al., 1992; Lobstein et al., 1983; Morey et. al., 2003).

Research has associated personality with sleep duration and sleep quality. Sleep duration (as defined as long or short sleep lengths) was a weak predictor of mood and functioning (Buela-Casal et al., 1992; Hill et al., 1997; Jenkins, 2005; McCann & Stewin, 1987; Pilcher et al., 1997; Verlander et al., 1999; Webb & Friel, 1971), but sleep durations of greater or less than seven-eight hours per night had a positive relationship with the personality constructs of neuroticism (Blagrove & Akehurst, 2001), anxiety, and excitability (Vein et al., 1983), as well as increased impulsiveness (Sicard et al., 2001). Type A behavior was linked to decreased sleep duration (Hicks et al., 1980; Hicks et al., 1979; McKelvie, 1992). Studies relating personality dimensions and sleep quality have related poor sleep quality with lower emotional stability, rule consciousness, tough-mindedness, as well as higher vigilance, apprehension, tension, abstractedness, and anxiety (Jenkins), along with negative mood states, and negative self-evaluations (Bonnet, 1985; Friedman et al., 2001; Gau, 2000; Gray & Watson, 2002; Lacks & Morin, 1992; Pilcher & Huffcutt, 1996; Verlander et al., 1999). Poor sleep quality also was linked with Type A personalities (Brissette & Cohen, 2002; Koulack & Nesca, 1992; Koulack et al., 1993) and lower conscientious personalities (Gray & Watson, 2002). Further, hostility correlated with sleep disturbances in a one study (Verlander). Although some researchers have found that poor sleep quality is related to extroverted personalities (Gray & Watson, 2002), others have found it is associated with introverted personalities (Monroe, 1967). These varied findings suggest that the relationship between certain aspects of personality and sleep quality is complex and requires further investigation for a more refined understanding.

Hypotheses

A model was developed to test direct and indirect effects of personality constructs, compliance to exercise, and sleep quality on changes in body fat and changes in health status. This model will explain hypothesized relationships between factors that previous research has shown to be related to obesity and overall health status as well as test new hypothesized relationships. In the model, the arrows indicate the hypothesized path and the direction of influence. The absence of an arrow between variables implies that the relationship is insignificant or absent. The model directing this study consists of three groups of variables. The first group is composed of the exogenous constructs of trait anxiety and extraversion. These constructs will be assessed through scores obtained on the Anxiety and Extraversion subscales of the 16 Personality Factors (16PF). The second group is composed of endogenous variables; participants' percent compliance with an exercise regimen and sleep quality scores obtained on the Pittsburgh Sleep Quality Index (PSQI). The final group consists of changes in fat mass (FM; pre-post difference scores), changes in physical health (pre-post difference scores), and changes in mental health (pre-post difference scores). Because certain factors in the model have been related in previous research studies, specific hypotheses can be proposed and tested (see Figure 1).

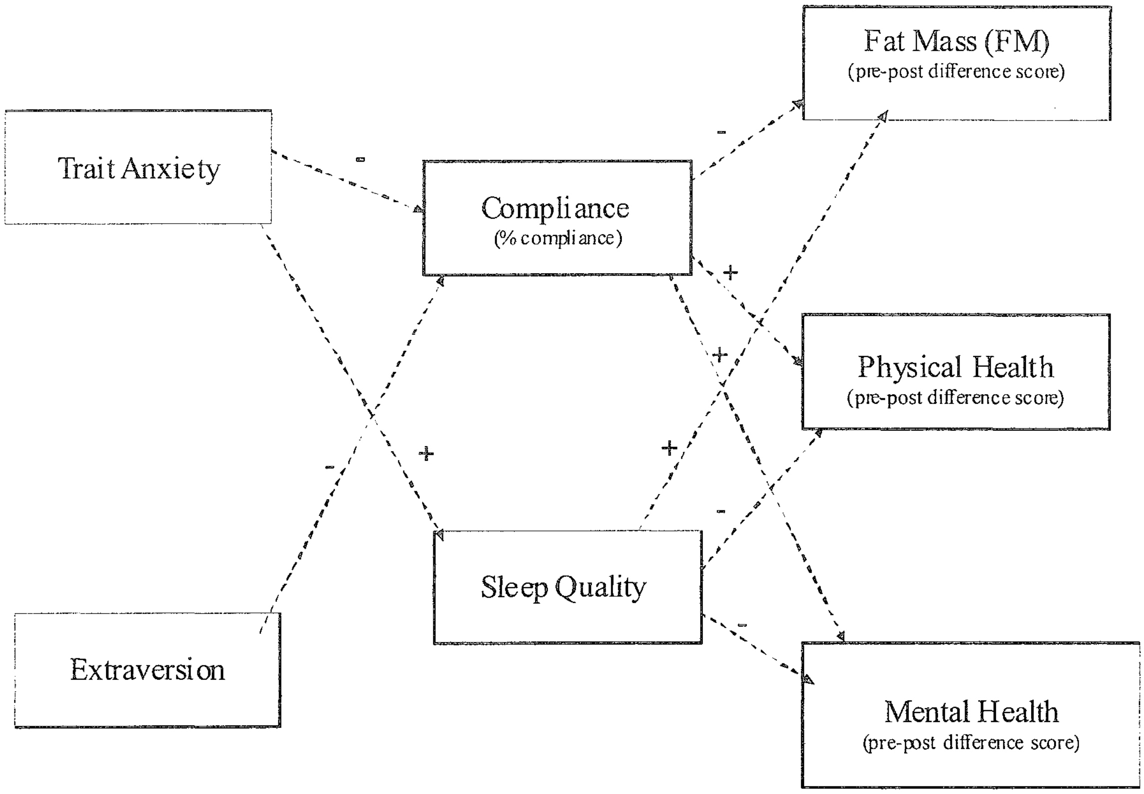

Figure 1. Personality-compliance-sleep path model of obesity and health.

Hypothesis One

Trait anxiety and extraversion will have a direct effect on compliance with an exercise regimen.

There will be a significant negative relationship between the Anxiety score and the Compliance percentage score; Anxiety = sub-scale of 16PF, with higher scores indicating more anxiety; Compliance = log of exercise attendance, with scores indicating percentage of compliance with assigned exercise attendance.

There will be a significant negative relationship between the Extraversion score and the Compliance percentage score: Extraversion = sub-scale of 16PF, with higher scores indicating more extraversion; Compliance = log of exercise attendance, with scores indicating percentage of compliance with assigned exercise attendance.

Justification for Hypothesis One. Studies indicate that attrition from an exercise regimens related to the traits of perceived mood disturbance (Ward & Morgan, 1984), somatization (Collingwood, 1983), and levels of state anxiety (Welsh et al., 1991). Extraversion also has been negatively related to adherence in studies of medical treatment plans (Cox, 1984). Related to the trait of Extraversion, studies of Type A personality and attrition have demonstrated that although Type A has been positively related to fitness gains, Type A individuals have increased rates of early dropout from fitness regimens. In one study, Oldridge and colleagues found that Type A individuals dropped out earlier and more frequently from formal cardiac rehabilitation exercise classes than Type B individuals (Oldridge, Donner, Buck, Jones, & Andrew, 1983). Other researchers have found that Type A individuals are infrequent participants in corporate exercise programs (Dishman et al., 1985).

Hypothesis Two

Trait anxiety will have a direct effect on sleep quality.

There will be a significant positive relationship between the Anxiety score and the Sleep Quality score; Anxiety = sub-scale of 16PF, with higher scores indicating more anxiety. Sleep Quality = PSQI global score, with higher scores indicating poorer sleep quality.

Justification for Hypothesis Two. Studies have associated poor sleep quality with lower emotional stability, rule consciousness, tough-mindedness, as well as higher vigilance, apprehension, tension, abstractedness, and anxiety (Jenkins, 2005). Poor sleep quality also has been associated with tension, negative mood states, and negative self-evaluations (Bonnet, 1985; Friedman et al., 2001; Gau, 2000; Gray & Watson, 2002; Lacks & Morin, 1992; Pilcher & Huffcutt, 1996; Verlander et al., 1999).

Hypothesis Three

Compliance with an exercise regimen and sleep quality will have a direct effect on changes in fat mass (FM).

There will be a significant negative relationship between Compliance percentage scores and FM difference scores; Compliance = log of exercise attendance, with scores indicating percentage of compliance with assigned exercise attendance. FM difference scores = change in body fat, with lower FM difference scores indicating positive changes in FM.

There will be a significant positive relationship between Sleep Quality scores and the FM difference scores; Sleep quality scores = PSQI global scores, with lower numbers indicating better sleep quality. FM difference scores (FM score obtained at the end of the study minus the FM score at the beginning of the study) = change in FM, with lower difference scores indicating a positive change in FM.

Justification for Hypothesis Three. Research on compliance with an exercise regimen has demonstrated that sedentary persons weigh more than actives ones, associating exercise with a lower BMI (Blair et al., 1985; Folsom, 1985; Cooper, 1976). In adults, active males and females have positive changes in fitness measures and fewer chronic degenerative diseases than inactive males and females (Morris et al., 1980; Salonen et al., 1982; Paffenbarger et al., 1984). The studies on sleep quality and obesity focus on the relationship of sleep quality and eating behaviors. Poor sleep quality is associated with increased snacking behaviors (Hicks et al., 1986) and poorer overall dietary habits (Tanaka et al., 2002). These behaviors often lead to weight gain and obesity.

Hypothesis Four

Compliance with an exercise regimen and sleep quality will have a direct effect on changes in physical health.

There will be a significant positive relationship between the Compliance percentage score and the SF-36 Physical Component Summary (PCS) difference score; Compliance = log of exercise attendance, with scores indicating percentage of compliance with assigned exercise attendance. PCS difference scores (PCS score obtained at the end of the study minus the PCS score at the beginning of the study) = change in physical health, with higher difference scores indicating improvement in physical health.

There will be a significant negative relationship between Sleep Quality scores and the SF-36 Physical Component Summary (PCS) difference score; Sleep Quality scores = Pittsburgh Sleep Quality scores, with lower numbers indicating better sleep quality. PCS difference scores (PCS score obtained at the end of the study minus the PCS score at the beginning of the study) = change in physical health, with higher difference scores indicating improvement in physical health.

Justification for Hypothesis Four. Compliance with an exercise regimen is associated with decreases in musculoskeletal conditions, such as osteoporosis (Haskell et al., 1985; Siscovick et al., 1985), and increases in bone mineral content in the cortex (Jones et al., 1977; Montoye et al., 1980; Smith et al., 1984). Exercise also causes significant improvements in joint flexibility and range of motion. Cardiorespiratory fitness and reductions in coronary artery disease risk factors also have been associated with participation in exercise regimens (Bortz, 1980, Cassel et al., 1971; De Vries, 1970; Kesanieme et al., 2001; Paffenbarger & Hale, 1975; Shapiro et al., 1969; Zukel et al., 1959; USDHHS, 2001). Additionally, seven hours of sleep per night can undermine the ability to function, having adverse effects on normal growth and development as well as the maintenance of a healthy immune system. Both protein synthesis and growth hormones play a substantial role in physical growth, and are secreted at their highest levels during REM sleep (Parker et al., 1980; Sassin et al., 1969), which occurs at a higher frequency at the end of the sleep cycle. Further, individuals who obtain less than six hours of sleep can have 50% reduction in natural killer T-cells that aid the body's immune system in fighting infections (Irwin, McClintick, & Costlow, 1996). Sleeplessness also has been linked to cardiovascular disease (Taylor & McFatter, 2003).

Hypothesis Five

Compliance with an exercise regimen and sleep quality will have a direct effect on changes in mental health.

There will be a significant positive relationship between the Compliance percentage score and the SF-36 Mental Component Summary (MCS) difference score; Compliance percentage score = log of exercise, with scores indicating percentage of compliance with assigned exercise attendance. MCS difference scores (MCS score obtained at the end of the study minus the MCS score at the beginning of the study) = change in physical health, with higher difference scores indicating improvement in mental health.

There will be a significant negative relationship between Sleep Quality scores and the SF-36 Mental Component Summary (MCS) difference score; Sleep Quality scores = PSQI global scores, with lower numbers indicating better sleep quality. MCS difference scores (MCS score obtained at the end of the study minus the MCS score at the beginning of the study) = change in mental health, with higher difference scores indicating improvement in mental health.

Justification for Hypothesis Five. The psychological benefits associated with compliance to an exercise regimen include less depression, anxiety, and stress (Taylor et al., 1985), as well as improved self-confidence and academic success (Bortz; Tucker, 1982). Exercise is associated with enhanced feelings of well-being, enhanced work, recreational and sports performances, as well as enhanced independent living in the elderly (Kesaniemi; USDHHS, 1996).

Studies also indicate that poor sleep quality is linked with negative mood states (Bonnet, 1985; Gau, 2000; Gray & Watson, 2002; Lacks & Morin, 1992; Pilcher & Huffcutt, 1996), stress and worry (McCann & Stewin, 1987), increased tension and depression, decreased psychological well-being, and general lower life satisfaction (Pilcher et al., 1997). College students with fewer sleep disturbances report fewer mental and social health difficulties (Jenkins et al., 2002). Poor sleep quality is related to less realization of achievement potential, intellectual efficiency, self-control, and sociability (Taub & Hawkins, 1979). Similarly, poor sleep is related to Type A personality, involving a chronic incessant struggle to achieve more and more in less time. This struggle can then result in health difficulties (Friedman & Rossman, 1974; Krantz et al., 1988). Associating sleep quality with clinical aspects of psychological health, studies have linked increased symptoms of depression, anxiety, and social introversion with poor sleepers (Aikens & Mendelson, 1999; Monroe, 1967). Psychopathologies such as attention deficit hyperactivity disorder and depression are often associated with deficits in sleep quality as well as higher reports of somatic health problems (Mohr, Vedantham, Neylan, Metzler, Best, & Marmar, 2003).

Hypothesis Six

Trait anxiety and extraversion will have an indirect effect through compliance with an exercise regimen on changes in FM.

Compliance will mediate the relationship of Trait Anxiety, Extraversion, and FM; as Compliance percentage scores increase, FM difference scores decrease.

Justification for Hypothesis Six. Studies indicate that attrition from an exercise regimen is related to the traits of perceived mood disturbance (Ward & Morgan, 1984), somatization (Collingwood, 1983), and levels of state anxiety (Welsh et al., 1991). Extraversion also has been negatively related to adherence in studies of medical treatment plans (Cox, 1984). Related to the trait of Extraversion, studies of Type A personality and attrition have demonstrated that although Type A has been positively related to fitness gains, Type A individuals have increased rates of early dropout from fitness regimens. (Oldridge, Donner, Buck, Jones, & Andrew, 1983). Conversely compliance with an exercise regimen has been associated with a lower BMI (Blair et al., 1985; Folsom, 1985; Cooper, 1976). In adults, active males and females have positive changes in fitness measures and fewer chronic degenerative diseases than inactive males and females (Morris et al., 1980; Salonen et al., 1982; Paffenbarger et al., 1984). Compliance with a physical exercise regimen decreases overall body fat, with sedentary persons weighing more than actives ones, associating exercise with a lower BMI (Blair et al., 1985; Folsom, 1985; Cooper, 1976). Therefore, as a participant complies with an exercise regimen, Trait Anxiety and Extraversion will have less of a negative effect on FM scores.

Hypothesis Seven

Trait anxiety and extraversion will have an indirect relationship through compliance with an exercise regimen on changes in physical health.

Compliance will mediate the relationship of Trait Anxiety, Extraversion, and Physical Health; as Compliance percentage scores increase, Physical Health difference scores increase.

Justification for Hypothesis Seven. Active adult males and females have fewer chronic degenerative diseases than inactive males and females (Morris et al., 1980; Salonen et al., 1982; Paffenbarger et al., 1984). Therefore, although trait anxiety and extraversion are correlated with poor physical health, this relationship will be mediated by compliance with an exercise regimen.

Hypothesis Eight

Trait anxiety and extraversion will have an indirect relationship through compliance with an exercise regimen on changes in mental health.

Compliance will mediate the relationship of Trait Anxiety, Extraversion, and Mental Health; as Compliance percentage scores increase, Mental Health difference scores increase.

Justification for Hypothesis Eight. Active males and females experience less depression, anxiety, and stress than sedentary counterparts (Taylor et al., 1985). Physical exercise also has been associated with improved self-confidence and better academic records in studies of young adults (Bortz, 1980; Tucker, 1982). In studies of adults of all ages, exercise has been associated with enhanced feelings of well-being, enhanced work, recreational, and sports performances, as well as enhanced independent living in the elderly (Kesaniemi et al., 2001; USDHHS, 1996). Therefore, the effects of trait anxiety and extraversion on the participants' mental health will be mediated by compliance with the exercise regimen.

Hypothesis Nine

Trait anxiety will have an indirect relationship through sleep quality on changes in FM.

Sleep Quality will mediate the relationship between Trait Anxiety and FM; as Sleep Quality scores decrease, FM difference scores decrease.

Justification for Hypothesis Nine. Poor sleep quality is associated with decreased energy expenditure, increased appetite, increased BMI, and obesity (Gangwisch et al., 2005; Hasler et al., 2004; Prinz, 2005/2006; Spiegel et al., 1999; Taheri et al., 2004). Therefore, the effects of trait anxiety on FM will be mediated by the participants' sleep quality.

Hypothesis Ten

Trait anxiety will have an indirect relationship through sleep quality on changes in physical health.

Sleep Quality will mediate the relationship between Trait Anxiety and Physical Health; as Sleep Quality scores decrease, Physical Health difference scores increase.

Justification for Hypothesis Ten. Poor sleep quality is associated with adverse effects on normal growth and development, a healthy immune system, protein synthesis, growth hormones, natural killer T-cells, and cardiovascular fitness (Irwin, McClintick, & Costlow, 1996; Parker et al., 1980; Sassin et al., 1969; Taylor & McFatter, 2003). Therefore, the effects of trait anxiety on physical health will be mediated by the participants' sleep quality.

Hypothesis Eleven

Trait anxiety will have an indirect relationship through sleep quality on changes in mental health.

Sleep Quality will mediate the relationship between Trait Anxiety and Mental Health; as Sleep Quality scores decrease, Mental Health difference scores increase.

Justification for Hypothesis Eleven. Poor sleep quality is linked with negative mood states, stress, worry, increased tension, decreased psychological well-being (Bonnet, 1985; Gau, 2000; Gray & Watson, 2002; Lacks & Morin, 1992; McCann & Stewin, 1987; Pilcher & Stewin, 1987; Pilcher et al., 1997). *Therefore, the effects of trait* anxiety on mental health will be mediated by the participants' sleep quality.

Hypothesis Twelve

Non-completers will obtain higher scores on the Extraversion score than completers; Non-completers = participants that complete initial surveys, Completers = participants that completed initial surveys, initial FM measurement, second survey, and second FM measurement. Extraversion = sub-scale of 16PF.

Justification for Hypothesis Twelve. The trait of Extraversion has been related to Type A personalities in the literature. Studies of Type A personality and attrition have demonstrated that Type A individuals have increased rates of early dropout from fitness regimens (Oldridge, Donner, Buck, Jones, & Andrew, 1983). Other researchers have found that Type A individuals are infrequent participants in corporate exercise programs (Dishman et al., 1985).

Hypothesis Thirteen

Completers will obtain lower scores on the Independence score than non-completers. Non-completers = participants that complete initial surveys, Completers = participants that complete initial surveys, initial FM measurement, second survey, and second FM measurement. Independence = sub-scale of 16PF.

Justification for Hypothesis Thirteen. High scores on the Independence factor are indicative of dominance, social boldness, fearlessness, and skepticism of others, while low scores are indicative of agreeableness, varying degrees of deference, cooperation, shyness, trust, and adherence to the status quo (Cattell et al., 1994). Therefore, completers will obtain lower scores on the Independence subscale.

Hypothesis Fourteen

The data collected will support the overall model as depicted in Figure 1.

Justification for Hypothesis Fourteen. Hypothesis One through Thirteen are supported by theory, research, and logic.

CHAPTER 2

METHOD

The purpose of this study is to develop a model to propose hypotheses that examine the direct and indirect effects of personality, sleep, and compliance to an exercise regimen on weight gain and health status. This study will use a demographic questionnaire as well as the Pittsburgh Sleep Quality Index (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) to measure sleep quality. The 16 Personality Factors Questionnaire (Cattell, Eber, & Tatsuoka, 1970) will measure personality constructs and the Workout Program Ledger of Physical Activity (HealthWorks Fitness Center, 2007) will record the compliance with the exercise regimen (percentage of recommended attendance). Finally, the Medical Outcomes Study 36-Item Short-Form Health Survey (Ware, Kosinski, & Dewey, 2000) will be used to measure overall health status, and the BOD POD S/T for FM measurements.

Participants

Participants will be approximately 100 adults ($\geq$18 years of age) who voluntarily join a wellness center in a small town in southern Arkansas. The wellness center is hospitalized-based, a member of the Medical Fitness Association, and is designed to identify, develop, and foster programs and services that futher the health and well-being of individuals. The center offered individual aerobic exercise and strength training to participants. Also, available to participants were group aerobic exercise classes, including aquatics, cycling, kickboxing, Pilates, yoga, and Tai Chi. A meditation room, computer access, and massage therapy also were available (Healthworks Fitness Center, 2007). kickboxing, Pilates, yoga, and Tai Chi. A meditation room, computer access, and massage therapy are available for participants (Healthworks Fitness Center, 2007).

All individuals ≥18 years of age who joined the wellness center during the time of data collection were invited to participate in the study. The University Human Use Committee approved the study (see Appendix A) and all participants were treated in accordance with the ethical guidelines established in the American Psychological Association's *Ethical Principles of Psychologists and Code of Conduct* (American Psychological Association, 2002). All survey information was held strictly confidential and only viewed by the researcher. A consent form explaining the nature of the study was signed by all participants prior to receiving the initial survey packet (see Appendix B). As an incentive for participation, participants were offered $50.00 in merchandise vouchers. These vouchers were purchased through a grant received by the researcher from the HealthWorks Fitness Center (see Appendix C). Data were analyzed collectively; no data were analyzed or reported individually. All collected data were securely stored and privately processed.

Instrumentation

Demographic Questionnaire

The demographic questionnaire consisted of questions eliciting standard demographic information. The standard information collected consisted of four items and inquired about the participant's a) age, b) gender, c) ethnicity, and d) marital status (see Appendix D).

Pittsburgh Sleep Quality Index Scale

The Pittsburgh Sleep Quality Index (PSQI; Buyesse et al., 1989) retrospectively measures self-reported sleep quality and disturbance over the past month (see Appendix E). The PSQI contains 19 items which include forced choice Likert-type questions. Administration time is approximately five to ten minutes.

The instrument addresses seven factors, including sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medications, and daytime dysfunction. The instrument is designed to measure sleep for the previous month, with items scored as 1 (good sleep), 2 (fair sleep), or 3 (poor sleep). The items are summed to derive a global score, with summed scores of 1 to 2 indicating good sleep, scores from 3 to 4 indicating fair sleep, and scores greater or equal to 5 indicating poor sleep.

The instrument was originally designed for use with adult clinical populations, but has been used with a variety of non-clinical populations, such as with a nursing staff (Kunert, King, & Kolkhorst, 2007), with pregnant women (Jomeen & Martin, 2007), and with college students (Carney, Edinger, Meyer, Lindman, & Istre, 2006). The PSQI has a reliability of 0.83 for the seven components (Buysee et al., 1989). Validity has been established by studies using the PSQI in different adult populations throughout the world (Buysee).

Sixteen Personality Factors Questionnaire

The Sixteen Personality Factors Questionnaire (16PF) defines basic, underlying personality without regard to application or environment (Yang, Choe, Baity, Lee, & Cho, 2005). The 16PF is a 185 item, self-administered inventory developed for individuals 16 years-of-age and older, and is presented at the fifth-grade reading level. The pencil and paper version takes approximately 40 to 50 minutes to complete.

The 16 PF is hierarchical and is composed of 16 Primary Factor scales and five Global Factor scales. All factor scales are bipolar in nature with high and low scores. The 16 primary factor scales are: Warmth, Reasoning, Emotional Stability, Dominance, Liveliness, Rule Consciousness, Social Boldness, Sensitivity, Vigilance, Abstactedness, Privateness, Apprehensiveness, Openness to Change, Self-Reliance, Perfectionism, and Tension. From these 16 factors, the five global factors are obtained: Extraversion, Anxiety, Tough-Mindedness, Independence, and Self-Control. These five factors broadly describe personality. For example, the highest scores on the Extraversion Global Factor are indicative of a personality that is people-oriented, gregarious, and values time with others, while the lowest scores indicate discomfort with self-disclosure, a preference for working alone, and less seeking of social activities with others.

The highest scores on the Anxiety Global Factor indicate worry, self-doubt, feeling driven or frustrated, while low scores indicate emotional stability, trust, and self-assurance. The Tough-Mindedness factor indicates logic, objectivity, concrete thinking at the highest level and imaginative ideas and thoughts, openness to feelings, people, and new ideas at the lowest level. High scores on the Independence factor are indicative of dominance, social boldness, fearlessness, and skepticism of others, while low scores are indicative of agreeableness, varying degrees of deference, cooperation, shyness, trust, and adherence to the status quo. Finally, high scores on the Self-Control factor indicate cautiousness, restraint, self-discipline, goal-oriented, practicality, and focus, while low scores indicate spontaneity, carefreeness or impulsiveness, non-conformity, inattention to rules and regulations, flexibility, and playfulness (Cattell et al., 1994).

The newest edition of the 16PF has revised item content while maintaining the 16 factors. Gender and racially biased language was removed from the newest edition and normative data were updated. Administrative indices were added to assess response bias. The Impression management Index, which replaced the "Faking Good" and "Faking Bad" scales of the last edition, is comprised of items that are not a part of the sixteen factor scales. Acquiescence and Infrequency scales also were added to help assess the validity of profiles (Cattell et al., 1994).

Overall, the 16PF has been shown to be both a reliable and valid instrument. Test-retest reliability was calculated for two-week and two-month intervals (Cattell et al., 1994). The reliability coefficients for the primary factors ranged from .69 to .87, with a mean of .80. Higher test-retest coefficients were found for the global factors, which ranged from .84 to .91, with a mean of .87. The two-month interval sample consisted of similar demographics. The primary factors were found to have internal consistency reliability coefficients ranging from .56 to .79, with a mean of .70. The global factors for this sample ranged from .70 to .82, with a mean of .78. To assess for internal consistency Chronbach alpha coefficients were calculated on the general population norm sample of 2,500 adults. Values ranged from .64 to .85, with an average of .74 (Cattell).

Convergent validity for the 16PF was assessed both through factor analyses and by correlating the scales with other psychometrically valid tests. Factor analyses indicate that the 16PF measures sixteen distinct personality factors. (Cattell et al., 1994).

The Workout Program Ledger of Physical Activity

The Workout Program Ledger of Physical Activity (see Appendix F) assesses physical activity, including attendance, type of exercise, type of machine (if used), weights, sets, repetitions, and duration of exercise. The ledger is routinely used at the wellness center as a record of client attendance and activities conducted at the center (HealthWorks Fitness Center, 2007).

The Medical Outcomes Study 36-Item Short-Form Health Survey

The Medical Outcomes Study Short-Form Health Survey (SF-36) is a measure of overall health status (Ware & Sherbourne, 1992). The SF-36 was originally designed as a generic measure of physical and mental health for use in health policy evaluations, clinical practice, and general population questionnaires. Since then, the instrument has been used to assess specific diseases and the benefits of various treatments (Turner-Bowker, Bartley, & Ware, 2002; McHorney, Ware, Lu, & Sherbourne, 1994; Ware et al., 1995).The SF-36 is designed for individuals 14-years-of-age or older, is self-administered, and completion time is five to ten minutes.

The SF-36 contains eight scales that are composed of two to ten items each and two summary measures that amass scales (Ware et al., 2000). A total of 35 items are used to score the eight scales. The 36th item is a self-report of health transition which indicates the average changes in health status during the year prior to administration of the survey. SF-36 scales include the Physical Functioning (PF), Role-Physical (RP), Bodily Pain

(BP), General Health (GH), Vitality (VT), Social Functioning (SF), Role-Emotional (RE), and Mental Health (MH) scales.

The PF scale measures the degree of limitations in performing physical activities. The lowest scores indicate the respondent is very limited in performing all physical activities, such as self-hygiene, while the highest scores indicate the respondent performs all types of physical activities without limitations due to physical health. The RP scale assesses the degree of limitations in usual role activities due to physical health problems. The lowest scores indicate problems with work or other daily activities as a result of physical health, while the highest scores indicate no problems with work or daily activities.

The BP scale measures the incidence of pain and level of limitations due to pain. The lowest scores indicate very severe and extremely limiting pain, while the highest scores indicate no pain or limitations due to pain. The GH scale is a self-assessment of personal health. The lowest scores indicate the respondent evaluates personal health as poor and believes it is likely to worsen. The highest scores indicate the respondent evaluates personal health as excellent.

The VT scales measure the respondent's level of energy versus fatigue. The lowest scores indicate the individual feels tired and worn out all of the time, while the highest scores indicate that the individual feels energetic all of the time. The SF scale measures the degree of limitations in social activities due to physical or emotional problems. Lowest scores indicate extreme and frequent interference with normal social activities, while the highest scores indicate that the individual performs normal social activities without interference due to physical or emotional problems.

The RE scale assesses the degree of limitations in usual role activities due to emotional problems. The lowest scores indicate problems with work or other daily activities. The highest scores indicate no problems with work or other daily activities. The MH scale measures level of psychological distress or well-being. The lowest scores indicate feelings of nervousness and depression all of the time, while the highest scores indicate the respondent feels peaceful, happy, and calm all of the time.

The lowest scores on the PCS measure indicate limitations in self-care, physical, social, and role activities, severe bodily pain, frequent tiredness, and health rated as "poor." The highest scores indicate no physical limitations, disabilities, or decrements in well-being, high energy level, and health rated as "excellent." The lowest scores on the MCS indicate frequent psychological distress, social and role disability due to emotional problems, and health rated as "poor." The highest scores indicate frequent positive affect, absence of psychological distress, limitations in usual social and role activities due to emotional problems, and health rated as "excellent."

The Physical Component Summary (PCS) measure is obtained using scores from the PF, RP, BP, and GH scales, whereas the Mental Component Summary (MCS) measure is obtained using scores from the VT, SF, RE, and MH scales (Ware et al., 2000). The physical component correlates most highly with PF, RP, and BP scales and contributes most to the PCS score. Similarly, the MH, RE, and SF scales correlate most highly with the mental component and contribute most to the MCS score. Scales loading highest on the physical component are most responsive to treatments impacting physical morbidity; while scales loading highest on the mental component are most responsive to treatments influencing mental health (Ware & Gandek, 1994).

The reliability of the eight scales and two summary measures was estimated using both internal consistency and test-retest methods. Statistics from reliability studies have yielded estimates of approximately 0.70 for the eight scales (Tsai, Bayliss, & Ware, 1997), with most exceeding 0.80 (McHorney et al., 1994). Internal consistency reliability estimates for physical and mental summary scores were 0.90 or higher (Ware, Kosinski, & Keller, 1994).

Studies have yielded evidence of content, concurrent, criterion, construct, and predictive validities (Garratt, Ruta, Abdalla, Buckingham, & Russell, 1993; Jenkinson, Coulter, & Wright, 1993; McHorney et al., 1994; Wagner et al., 1995; Ware, Snow, Kosinski, & Gandek, 1993; Ware et al., 1995). The content validity of the SF-36 has been compared to that of other generic health surveys indicating that the SF-36 includes eight of the most frequently measured health concepts. As a generic measure of physical and mental health, symptoms and difficulties that are specific to a particular condition are not included in the SF-36 (Ware et al., 1993; Ware, 1995). The validity of each of the eight scales and the two summary measures differ markedly. Specifically, the MH, RE, and SF scales and the MCS summary measure are the most valid of the SF-36 scales as mental health measures. This pattern of results has been replicated in both cross-cultural and longitudinal tests. The PF, RP, and BP scales and the PCS summary are the most valid SF-36 scales for measuring physical health (Kravitz et al., 1992; McHorney et al., 1993; Ware et al., 1993; Ware et al., 1994; Ware, Keller, Gandek, Brazier, & Sullivan, 1995).

Version 2.0 of the SF-36 (SF-36v2) was introduced in 1996 to correct deficiencies identified in the original (Ware et al., 2000). This version provided an improved layout for questions and answers in the self-administered forms that made questions easier to read and complete. Wording was shortened and simplified to increase familiarity and decrease ambiguity in the wording. Five-level response choices replaced dichotomous response choices for seven items in the two role functioning scales. To simplify questions, five-level response categories replaced the six-level response categories in the MH and VT scales (Ware et al.).

BOD POD S/T

The BOD POD S/T is a method of measuring body composition that estimates body volume by air through the technique of air displacement plethysmography (ADP). The BOD POD S/T uses a closed chamber plethysmograph that measures body volume by changes in pressure in the chamber (Dempster & Aitkens, 1995; Going, 1996; Lohman et al., 1997). The participant enters the air chamber in which the volume of air displaced is determined by computerized measurements obtained in approximately two minutes. Although the participant breathes normally, lung volume is determined in an automated manner. Once the body density has been determined by ADP, percent body fat or fat mass (FM) is calculated (% fat = 495/BD - 450). This calculation is electronically conducted by the BOD POD S/T and is derived from the two-component model for body composition (Brozek, Grade, & Anderson, 1963; Siri, 1956).

As a relatively new technique in the estimation of percent body fat, the ADP method has been tested for reliability with other instruments of densitometry. In a study by Levenhagen and colleagues, ADP was compared to four other methods of plethysmography. These methods included hydrostatic weighing (HW), which also measures body density, bioelectrical impedance (BIA), which determines electrical resistance and total body water to estimate fat-free mass, and dual-energy x-ray absorptiometry (DXA), which measures bone, fat, and fat-free soft tissue masses. Percent body fat measurements obtained by the four methods were highly correlated across a wide range of body fat levels in healthy adults ($r > .90$; Levenhagen, Borel, Welch, & Piasecki, 1998).

A second study by McCrory and colleagues evaluated the BOD POD S/T in comparison to HW techniques of measuring body composition (McCrory, Gomez, & Bernauer, 1995). The researchers examined the results of the BOD POD S/T and an HW technique with 68 adult participants (26 F, 42 M) varying widely in age (range 20 to 56 years of age), ethnicity, and obesity. Same-day test-retest reliability was assessed in a sub sample of 16 participants (9 F, 7 M) and validity was assessed in all participants ($N = 68$). The test-retest coefficients of variation (CV) for % FAT measured by the BOD POD S/T and HW were not significantly different, 1.7% +/- 1.1% and 2.3% +/- 1.9% for BOD POD S/T and HW, respectively, indicating excellent reliability for both methods. Validity of percent fat measured by the BOD POD S/T also was excellent. The mean difference in % FAT (BOD POD S/T-HW) was -0.3 +/- 0.2 (SEM), with a 95% confidence interval of -0.6 to 0 % FAT. These findings indicated that the BOD POD S/T is a highly reliable and valid method for determining % FAT in adult humans in comparison to HW. The researchers concluded that the BOD POD S/T method had several advantages over HW in that it is quick; relatively simple to operate; and may be able to accommodate special populations such as the obese, elderly, and disabled (McCrory et al.).

Developed, manufactured, and marketed by Life Measurement, Inc., more than 500 BOD POD ST instruments currently are used worldwide in 39 different countries.

The instrument is used in research, clinical, athletic, military, and health fitness settings. Researched topics using the instrument include metabolic disease, nutrition, and athletic performance (Das et al., 2007; Ekelund et al., 2006; Weyers et al., 2002; Whigham, Watras, & Schoeller, 2007). As a technique for body composition and metabolic analysis, the BOD POD ST is used clinically in weight management programs, obesity assessment, and physical assessment. The instrument also is used by professional, collegiate, Olympic, and high school programs to monitor and track the effectiveness of training programs and to develop individual and sport body composition ranges. The US army, US Air Force, and the US Military Academy use the BOD POD ST to provide feedback necessary to help achieve and maintain appropriate fitness levels (Life Measurement, Inc., 2007).

Procedure

A wellness center in a small southern town was the site for the data collection. The wellness center has a hospital affiliation and membership in the Medical Fitness Association. Membership in the facility allows individuals the opportunity to participate in a variety of exercise programs. Some of these programs include individual aerobic exercise, strength training, aquatics, cycling, kickboxing, Pilates, yoga, and Tai Chi. Members also have access to a meditation room, computers, and massage therapy (Healthworks Fitness Center, 2007).

At the initiation of the study, the researcher met with all involved center staff. Instructions were given for data collection, survey completion, and order of data collection. The staff also was informed of the need for confidentiality related to the study. When an individual voluntarily visited the wellness center to inquire about membership, the sales director routinely met with the individual and discussed the offered services. If the individual decided to join the facility, required membership paperwork was signed by the individual and the sales director. The individual then was assigned a randomly selected five digit number for identification. After completion of the membership paperwork, the sales director offered all eighteen-year-old or older individual members an opportunity to participate in the current study.

The participants read and signed the consent form that explained the purpose of the study. This form noted that participation was voluntary, that all information would remain confidential, and information would be disseminated only as group data. As an incentive for participation, participants were offered $50.00 in merchandise vouchers. The vouchers were given in $25.00 amounts at two points in the study: after completion of the first set of surveys (Demographics Questionnaire, PSIQ, 16PF, and SF-36) and the initial FM measurement, and after completion of the second survey (SF-36) and FM measurement. Each participant met with a licensed exercise physiologist who assigned an exercise regimen that best fit the participant's fitness needs and expressed requests (e.g., aerobics, strength training, and yoga), with a recommendation for a minimum of three work out sessions per week. This assigned regimen was recorded by the physiologist on the Work-out Program Ledger; a form of exercise documentation routinely used by the wellness center. Participants were instructed to record exercise participation on the ledger after each exercise session and were instructed on the use of computer keying as an additional record of attendance. A FM measurement was taken at this time and the participant's FM was recorded on a FM form. The participant then completed the study's surveys: Demographics Questionnaire; PSIQ, 16PF, and SF-36 and received $25.00 in merchandise vouchers.

To insure confidentiality, the survey and FM form were numbered and placed in a locked filing cabinet separate from other members' records. Only the researcher had access to the filing cabinet that contained the surveys. At this time the exercise physiologist instructed each participant to document dates of exercise attendance, providing instruction on entering the five digit membership number into a computer before exercising.

The membership director established a spread sheet of the participant's activities to include dates of completion of the initial surveys and FM measurement. This spreadsheet was forwarded to the researcher. There was no identifying information on the spreadsheet other than the participant's membership number. The researcher continually assessed the spreadsheet, notifying the membership director after three months from the time the participant initially completing the surveys and FM measurement. The membership director then contacted the participant and instructed the participant to complete the second survey (SF-36) and the second FM measurement (BOD POD S/T). After the participant completed the second survey and FM measurement, the participant received the final $25.00 in merchandise vouchers. This activity was recorded on the spreadsheet by the membership director, who forwarded the updated spreadsheet to the researcher on a weekly basis. Data analysis commenced after a sufficient number of data were collected by the researcher.

Data Analysis

A path model was hypothesized that formulated links among constructs based on theory, research, and logic. In path models, there are two types of variables: endogenous and exogenous (Klem, 1995). Exogenous variables have no direct links toward them from other variables in the model. Additionally, the exogenous variables are not explained by the other variables in the model. In contrast, an endogenous variable can have several links coming toward it in the model and is explained by one or more of the other variables. Endogenous variables can be both dependent and independent variables (Klem; Schumacker & Lomax, 2004). The personality variables of trait anxiety and extroversion were the exogenous variables of the model. Compliance with an exercise regimen, sleep quality, changes in fat mass, changes in physical health status, and changes in mental health status were the endogenous variables of the model. Additionally, compliance with an exercise regimen and sleep quality as well as dependent and independent variables, while changes in FM, changes in physical health status, and changes in mental health status served as the dependent variables only.

Correlations for each of the relationships that define the full path model were calculated and examined separately to determine significance of each relationship. As recommended by Grimm and Yarnold (1995), this process allowed the examiner to identify significant relationships to be analyzed with regression procedures in the model, ensuring that the absolute level of prediction was as least as good with multiple predictors as with any one of the predictors alone. In Hypothesis One through Eleven, the following relationships were examined with correlational analysis: anxiety and compliance; extraversion and compliance; anxiety and sleep; compliance and change in fat mass; sleep and change in fat mass; compliance and sleep; sleep and change in physical health; compliance and sleep; and sleep and change in mental health. Hypotheses Twelve and Thirteen were analyzed using a multivariate analysis of variance (MANOVA) to identify group personality differences. This analysis identified completers and non-completers as the predictor variables and anxiety and independence as the criterion variables. Hypothesis Fourteen reviews the effects of all correlations and how well the data fit the model. An alpha level of .05 was used in all analyses to determine significance.

Hypothesis One

The relationship between trait anxiety and compliance was assessed using scores on the Trait Anxiety Global Factor subscale of the 16PF and compliance percentages as variables. The Trait Anxiety Global Factor scores were attained from scores on the Emotional Stability, Vigilance, Apprehension, and Tension primary factors of the 16PF. The compliance percentages were obtained by calculating the percentage of exercise participation achieved by participants in a three month period (% compliance = 36/#; 36 = recommended number of workouts; # = number of achieved workouts).

The relationship between extraversion and compliance also was assessed using scores on the Extraversion Global Factor subscale of the 16FP and compliance percentages as variables. The Extraversion Global Factor was comprised from scores on the Warmth, Liveliness, Social Boldness, Privateness, and the Self-Reliance primary factors of the 16PF. The compliance percentages were obtained by calculating the percentage of exercise participation achieved by participants in a three month period (% compliance = 36/#; 36 = recommended number of workouts; # = number of achieved workouts).

Hypothesis Two

The relationship between trait anxiety and sleep quality was assessed using scores on the Trait Anxiety Global Factor subscale of the 16PF and scores on the PSQI. The Trait Anxiety Global Factor included scores obtained from the Emotional Stability, Vigilance, Apprehension, and Tension primary factors of the 16PF. A sleep quality global score was obtained by totaling scores from seven factors, including sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medications, and daytime dysfunction.

Hypothesis Three

The relationship between compliance with an exercise regimen and change in FM was assessed using compliance percentage scores and pre-post fat mass difference scores. Compliance percentages were obtained by calculating the percentage of exercise participation achieved by participants in a three month time period (% compliance = 36/#; 36 = recommended number of workouts; # = number of achieved workouts). Pre-post difference scores of body composition were obtained by the BOD POD S/T denoted FM difference scores.

The relationship between sleep quality and changes in FM was assessed using scores on the PSQI and pre-post FM difference scores. Sleep quality was evaluated by a global score comprised of seven factors, including sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medications, and daytime dysfunction. The FM difference scores were obtained by pre-post body composition measurements calculated by the BOD POD S/T.

Hypothesis Four

The relationship between compliance with an exercise regimen and changes in physical health was assessed utilizing compliance percentage scores and scores on the SF-36. Compliance percentages were obtained by calculating the percentage of exercise participation achieved by participants in a three month time period (% compliance = 36/#; 36 = recommended number of workouts; # = number of achieved workouts). SF-36

Physical Component Summary (PCS) pre-post difference scores were obtained using scores from the Physical Functioning, Role Physical, Bodily Pain, and General Health subscales.

The relationship between sleep quality and changes in physical health was assessed using scores on the PSQI and the SF-36. Sleep quality was evaluated by a global score comprised of seven factors, including sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medications, and daytime dysfunction. Change in physical health was determined through scores from the Physical Functioning, Role Physical, Bodily Pain, and General Health subscales.

Hypothesis Five

The relationship between compliance with an exercise regimen and change in mental health was assessed using compliance percentage scores and scores on the SF-36. Compliance percentages were obtained by calculating the percentage of exercise participation achieved by participants in a three month time period (% compliance = 36/#; 36 = recommended number of workouts; # = number of achieved workouts). SF-36 Mental Component Summary (MCS) pre-post difference scores were obtained using scores from the Vitality, Social Functioning, Role-Emotional, and Mental Health subscales. Scores on the PSQI and SF-36 were used to assess the relationship between sleep quality and change in mental health. Sleep quality was evaluated by a global score comprised of seven factors, including sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medications, and daytime dysfunction. Change in mental health was evaluated by SF-36 Mental Component Summary (MCS) pre-post difference scores, including scores from the Vitality, Social Functioning, Role-Emotional, and Mental Health subscales of the SF-36.

Hypothesis Six

Correlations were calculated separately to identify relationships among the variables of compliance with an exercise regimen, anxiety, extraversion, and change in FM. Compliance percentage scores were obtained by calculating the percentage of exercise participation achieved by participants in a three month time period (% compliance = 36/#; 36 = recommended number of workouts; # = number of achieved workouts). Anxiety and extraversion were assessed by scores on the Trait Anxiety and Extraversion Global Factor subscales of the 16PF, respectively. FM difference scores were obtained by pre-post body composition measurements made by the BOD POD S/T.

Hypothesis Seven

Correlations were calculated separately to identify relationships among the variables of compliance, anxiety, extraversion, and change in physical health. Compliance percentages were obtained by calculating the percentage of exercise participation achieved by participants in a three month time period (% compliance = 36/#; 36 = recommended number of workouts; # = number of achieved workouts). Anxiety and extraversion were assessed by scores on the Trait Anxiety and Extraversion Global Factor subscales of the 16PF, respectively. FM difference scores were obtained by pre-post body composition measurements made by the BOD POD S/T.

Hypothesis Eight

Correlations were calculated separately to identify relationships among the variables of compliance, anxiety, extraversion, and change in mental health. Scores on the Trait Anxiety and Extraversion Global Factor subscales of the 16PF were used to assess anxiety and extraversion, respectively. SF-36 Mental Component Summary (MCS) pre-post difference scores were used to assess change in mental health. The MCS difference scores were obtained using scores from the Social Functioning, Role-Emotional, Mental Health, and Vitality subscales. C*ompliance* percentages were obtained by calculating the percentage of exercise participation achieved by participants in a three month time period (% compliance = 36/#; 36 = recommended number of workouts; # = number of achieved workouts).

Hypothesis Nine

Correlations were calculated separately to identify relationships among the variables of sleep quality, anxiety and change in FM. Scores on the Trait Anxiety Global Factor subscales of the 16PF were used to assess anxiety. Sleep quality was evaluated by a global score comprised of seven factors of the PSQI, including sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medications, and daytime dysfunction. Pre-post difference scores of body composition obtained by the BOD POD S/T denoted FM difference scores.

Hypothesis Ten

Correlations were calculated separately to identify relationships among the variables of sleep quality, anxiety and change in physical health. Sleep quality was assessed using scores on the seven factors of the PSQI while Trait Anxiety subscales of the 16PF were used to assess anxiety. SF-36 Physical Component Summary (PCS) pre-post difference scores quantified change in physical health and were obtained using scores from the Physical Functioning, Role Physical, Bodily Pain, and General Health subscales.

Hypothesis Eleven

Correlations were calculated separately to identify relationships among the variables of sleep quality, anxiety, and change in mental health. Sleep quality was assessed using scores on the seven factors of the PSQI while Trait Anxiety subscales of the 16PF were used to assess anxiety. SF-36 Mental Component Summary (MCS) pre-post difference scores quantified change in mental health and were obtained using scores from the Social Functioning, Role-Emotional, Mental Health, and Vitality subscales.

Hypothesis Twelve through Thirteen

A Multiple Analysis of Variance (MANOVA) was conducted to determine significant differences between completers and non-completers on the Extraversion and Independence Global Factor Scales of the 16PF. Completion status served as the independent variable and the two global factor scales served as the dependent variables. Completers were identified as participants that completed the Demographic survey, the 16 PF, the PSQI, the SF-36, and the FM assessment (BOD POD S/T) at the initiation of the study and again at three months. Non-completers were identified as participants that completed the initial surveys and FM measurement but left the program before the completion of the three month exercise regimen.

Hypothesis Fourteen

The proposed path model was reviewed, assessing the inter-correlations among all variables. The correlations yielding significant results were then entered into a multiple regression equation. Anxiety and extraversion scores served as the predictor variables and compliance percentage served as the criterion variable.

CHAPTER 3

RESULTS

The purpose of this chapter is to present the results of the study. First, sample characteristics are presented. Standard deviations, means, and reliability estimates for the scales used in the current study are then examined. Next, correlations between variables are provided and regression results are explained. Finally, the results of the study are presented by hypothesis, with findings from exploratory analyses displayed.

Participants

Participants consisted of adult volunteers who joined a local wellness center after initiation of the study. From an initial sample of 501 individuals, data from 106 participants were retained for analysis. The remainder of the 501 individuals either failed to complete the initial surveys and/or fat mass (FM) measurement or discontinued exercising at the wellness center. Of the 106 participants, 80 participants completed all surveys and FM measurements, both at the beginning of the study and at the end of the study. The remaining 26 participants completed all initial surveys and FM measurements but discontinued membership at the wellness center prior to the end of the three month exercise program. Thirty males and 76 females ranging in age from 18 to 72 participated in the current study. The mean age was 42.6 years with a standard deviation of 13.3. In terms of ethnicity, females accounted for 71.7% of the overall sample, consisting of 80

Caucasian Americans (75.5%), 22 African Americans (20.8%), 1 Asian American (.9%), 1 Hispanic/Latino (.9%), and 2 that did not indicate ethnicity (1.9%). Of the overall sample, Thirty males and 76 females ranging in age from 18 to 72 participated in the current study.

Descriptive Statistics and Reliabilities

Table 1 presents a summary of participants' obtained means, standard deviations, and reliability coefficients of the PSQI, 16PF, and SF-36v2 scores. This study's mean and standard deviation of the PSIQ global score were 7.36 and 4.75, respectively. Although traditional norms are unavailable, Buysse and colleagues (1989) noted mean and standard deviations scores in various populations. These studies include means and standard deviations of the global score for good sleeper controls ($M = 2.67$, $SD = 1.70$), major depression ($M = 11.09$, $SD = 4.31$), disorders of initiating and maintaining sleep ($M = 10.38$, $SD = 4.57$), and disorders of excessive daytime somnolence ($M = 6.53$, $SD = 2.98$). An examination of mean scores of the current study and mean scores reported by Buysee indicate that the participants in the current study reported a higher level of sleep disturbances than those reported in other general populations. Internal consistency of the PSQI was .77 for the global score, which is composed of all seven component of sleep quality assessed by this instrument. Reliability estimates from the initial validation study were similar, with estimates of .83 for these components (Buysee et al., 1989)

The current study's means and standard deviations for the 16PF global factors ranged from 7.25 to 11.03 and 4.45 to 6.57, respectively. These scores were slightly lower than those obtained by Cattell in the initial validation studies, which ranged from

11.33 to 12.89 and 5.04 to 5.20, respectively (Cattell et al., 1994). Reliability coefficients for the 16PF in this study ranged from .64 to .68.

Table 1.

Means, Standard Deviations, and Internal Consistency of the Variables

Variables	*M*	*SD*	*α*
PSQI			
Global	7.36	4.75	.77
Sleep Quality	1.22	.89	-
Sleep Latency	1.26	1.16	-
Sleep Duration	.93	.87	-
Habitual Sleep Efficiency	.67	1.07	-
Sleep Disturbance	1.45	.72	-
Use of Sleep Medications	.87	1.24	-
Daytime Dysfunction	.95	1.05	-
16 PF			
Extraversion	10.45	6.57	.65
Anxiety	10.69	5.37	.67
Tough Mindedness	7.25	4.53	.68
Independence	11.03	4.45	.64
Self Control	7.25	4.53	.64

Table 1 (continued).

Table 1 (continued).

Variables	*M*	*SD*	*α*
SF-36v2			
Global	7.34	4.75	.87
Physical Functioning	25.66	4.65	.85
Role Physical	15.92	4.31	.89
Bodily Pain	6.44	1.47	.89
General Health	17.97	5.00	.88
Vitality	12.52	4.63	.84
Social Functioning	8.22	2.07	.80
Role-Emotional	12.17	3.33	.83
Mental Health	19.61	3.84	.81
Physical Component Summary	16.50	3.86	.88
Mental Component Summary	11.04	3.00	.82

Note. SF means, standard deviations, and reliability are the average of pre- and post-test measures.

Means of the SF-36v2 for the present study were consistent with means for the standardization sample, which ranged from 8.70 to 26.09 for the eight component scores (Ware et al., 2000). The current study's means ranged from 6.44 to 25.66 and standard deviations ranged from 1.47 to 5.00. Internal consistencies in the current study ranged from .81 to .89 and were within acceptable ranges and consistent with previous findings of approximately 0.70 for the eight scales (Tsai, Bayliss &Ware, 1997), with most exceeding 0.80 (McHorney et al., 1994). Tests were conducted to assess skewness and kurtosis of difference scores of physical health, mental health, and fat mass. The skewness and kurtosis of the SF-36 Physical Component Summary (PCS) difference scores were -2.26 (*SE* = .27) and 9.09 (*SE* = .53), respectively. These scores indicated a lack of symmetry in the data set. A perusal of frequencies (in which 26.3% had negative numbers) demonstrated that the minimum score of -39 was an outlier; the next one was -15. This score of -39 appeared twice. The two outliers were removed to lessen skewness and kurtosis. After removing the outlier, the skewness and kurtosis were at acceptable levels: -.13 (*SE* = .27) and .71 (*SE* = .54), respectively. The skewness and kurtosis of the Mental Component Summary (MCS) difference scores were in the acceptable range: .21 (*SE* = .27) and 2.46 (*SE* = .54). Tests conducted to assess the skewness and kurtosis of the fat mass (FM) difference yielded a skew of -.74 (*SE* = .27) and a kurtosis score of 2.12 (*SE* = .53). Kurtosis was found to be high, but acceptable, with 75% of the scores negative and the positive scores yielding a smaller range of scores.

Correlations between Variables

A model was proposed to examine the direct and indirect effects of personality aspects, percent compliance, and sleep on changes in health status and percent body fat. Correlations were calculated for each of the hypothesized relationships and all intercorrelations that would define the full path model. These intercorrelations are presented in Table 2. This procedure is the APA recommended initial step for presenting multiple regression data (Nicol & Pexman, 1999).

The intercorrelations among the variables revealed six significant correlations: Trait Anxiety and Compliance ($r = .22, p < .03$); Extraversion and Compliance ($r = .32, p < .00$); Extraversion and Mental Component Summary difference ($r = .28, p < .01$); Global Sleep Quality and FM difference ($r = -.30, p < .01$); FM difference and Physical Component Summary difference ($r = .40, p <.00$); Physical Component Summary difference and Mental Component Summary difference ($r = .50, p < .00$). Approximately 80% of the correlations were not significant.

Table 2.

Correlation Matrix for All Variables

Variable	1	2	3	4	5	6	7
1. AX	__	-.89	.22*	.07	.04	-.07	.02
2. EX		__	.32*	-.15	.07	.12	.28*
3. % C			__	-.10	.06	-.07	-.04
4. SQ				__	-.30*	.05	-.10
5. FM diff					__	.40**	.13
6. PCS diff						__	.50**
7. MCS diff							__

Note. AX = Anxiety score, EX = Extraversion score, % C = Compliance percentage, SQ = Sleep Quality score, FM diff = Fat Mass difference score, PH diff = Physical Health difference score, MH = Mental Health difference score

* $p < .05$ two-tailed, **$p < .001$ two-tailed

Results for Hypotheses

Hypothesis One

The first hypothesis stated that trait anxiety and extraversion would have a direct effect on compliance with an exercise regimen; a significant negative correlation was predicted between anxiety and compliance percentage scores and between extraversion and compliance percentage scores. Analyses of the relationship between Anxiety Global Factor scores (higher scores indicating higher levels of anxiety) and compliance percentage scores and of the relationship between Extraversion Global Factor scores (higher scores indicating higher levels of extraversion) and compliance percentage scores were conducted. Results showed a significant positive correlation between scores on the Anxiety Global Factor of the 16PF and compliance percentage scores ($r = .22, p < .03$) and between Extraversion Global Factor scores of the 16PF and compliance percentage scores ($r = .32, p < .00$). Since the obtained results were in the opposite direction of the predicted results, the hypothesis was not confirmed.

Hypothesis Two

The second hypothesis stated that there would be a direct effect of anxiety on sleep quality; a significant positive correlation was predicted between anxiety scores and sleep quality scores. Analysis of the relationship between Anxiety Global Factor scores (higher scores indicating higher levels of anxiety) and the Sleep Quality Global scores (higher scores indicating poorer sleep quality) was conducted. Results showed no correlation or relationship between the Anxiety Global Factor of the 16PF and the Global Sleep Quality Factor of the PSQI ($r = .07, p <.49$). The hypothesis was not confirmed.

Hypothesis Three

The third hypothesis stated that compliance with an exercise regimen and sleep quality would have a direct effect on change in FM; a significant negative correlation was predicted between compliance percentage scores and FM difference scores and a significant positive correlation was predicted between sleep quality and FM difference scores. Analyses of the relationship between compliance percentage scores and the FM difference scores (lower scores indicating greater loss of FM) and of the relationship between PSQI Global Sleep Quality Global factor scores (lower scores indicating better sleep quality) and FM difference scores were undertaken. Results showed no correlation or relationship between compliance percentage scores and FM difference scores ($r = .06, p < .62$). A negative correlation was found between sleep quality scores and FM difference scores ($r = -.30, p < .01$). Since the obtained results were in the opposite direction of the predicted results, the hypothesis was not confirmed.

Hypothesis Four

The fourth hypothesis stated that compliance with an exercise regimen and sleep quality would have a direct effect on change in physical health; a significant positive correlation was predicted between compliance percentage scores and change in physical health scores and a significant negative correlation was predicted between sleep quality scores and change in physical health scores. Analyses of the relationship between compliance percentage scores and SF-36v2 PCS difference scores (higher scores indicating positive changes in physical health) and of the relationship between PSQI Global Sleep Quality Factor scores (lower scores indicating better sleep quality) and SF-36v2 PCS difference scores were examined. Results showed no correlation or relationship between compliance percentage scores and SF-36v2 PCS difference scores ($r = -.07, p < .53$) or between PSQI Global Sleep Quality Factor scores and SF-36v2 PCS difference scores ($r = .05; p < .67$). The hypothesis was not confirmed.

Hypothesis Five

The fifth hypothesis stated that compliance with an exercise regimen and sleep quality were predicted to have a direct effect on changes in mental health; a significant positive correlation was predicted between compliance percentage scores and change in mental health scores and a significant negative correlation was predicted between sleep quality scores and change in mental health scores. Analyses of the relationship between compliance percentage scores and SF-36v2 MCS differences scores (higher scores indicating positive changes in mental health) and of the relationship between PSQI Global Sleep Quality factor scores (lower scores indicating better sleep quality) and SF-36v2 MCS difference scores were conducted. Results indicated no significant correlation between compliance percentage scores and SF-36v2 MCS difference scores ($r = -.04, p < .74$) or between Sleep Quality Global scores and the SF-36v2 MCS difference scores ($r = -.10, p < .37$). This hypothesis was not confirmed.

Hypothesis Six

The sixth hypothesis stated that compliance would mediate the relationship of trait anxiety, extraversion, and change in FM; as compliance percentage scores increase, FM difference scores decrease (lower scores indicating greater loss of FM). The relationship between compliance percentage scores and FM difference scores was tested to assess for significance (Hypothesis Three). Since this analysis found no significance

($r = .06, p < .62$), no further tests of mediation could be conducted. This hypothesis was not confirmed.

Hypothesis Seven

The seventh hypothesis stated that compliance would mediate the relationship of trait anxiety, extraversion, and change in physical health; as compliance percentage scores increase, PCS difference scores increase. The relationship between compliance percentage scores (higher percentage scores indicating more compliance) and PCS difference scores (higher scores indicating more positive changes) was tested to assess for significance (Hypothesis Four). Since this analysis found no significance ($r = .07, p < .62$), no further tests of mediation could be conducted. This hypothesis was not confirmed.

Hypothesis Eight

The eighth hypothesis predicted that compliance would mediate the relationship of trait anxiety, extraversion, and change in mental health; as compliance percentage scores increase, MCS difference scores increase. The relationship between compliance percentage scores and MCS difference scores was tested to assess for a significant relationship (Hypothesis Five). Since this analysis found no significance ($r = -.04, p < .74$), no further tests of mediation could be conducted. This hypothesis was not confirmed.

Hypothesis Nine

The ninth hypothesis stated that sleep quality would mediate the relationship of trait anxiety and change in FM; as sleep quality scores decrease, FM difference scores decrease. The relationship between Sleep Quality Global Factor scores (lower scores indicating better quality of sleep) and FM difference scores (lower scores indicating more positive changes in FM) was tested to assess for a significant relationship (Hypothesis Three). Results indicated a significant negative correlation ($r = -.30, p < .01$). Although the significant correlation was negative and the researcher predicted a positive correlation (Hypothesis Three), a statistical significance was found between the two variables; Sleep Quality Global Factor scores and FM difference scores. Therefore, the next step in the analysis of mediation was conducted.

The relationship between trait anxiety scores and FM difference scores was tested to assess for significance. Test results indicated no statistical significant relationship between the two variables ($r = .04, p < .74$). Because there was no significance established, no further tests of mediation could be conducted. This hypothesis was not confirmed.

Hypothesis Ten

The tenth hypothesis stated that sleep quality would mediate the relationship of trait anxiety and change in physical health; as the PSQI Global Factor scores decrease, PCS difference scores increase. The relationship between PSQI Global Factor scores and SF-36v2 PCS difference scores was tested to assess for a significant relationship (Hypothesis Four). Since this analysis found no significance ($r = .05, p < .13$), no further tests of mediation could be conducted. This hypothesis was not confirmed.

Hypothesis Eleven

The eleventh hypothesis stated that sleep quality would mediate the relationship between trait anxiety and change in mental health; as sleep quality scores decrease, MCS difference scores increase. The relationship between PSQI Global Factor scores and

(Hypothesis 5). Since this analysis found no significance ($r = -.10$, $p < .74$), no further tests of mediation could be conducted. This hypothesis was not confirmed.

Hypothesis Twelve

The twelfth hypothesis stated that non-completers would obtain higher scores than the completers on the Extraversion Global Factor subscales. A multivariate analysis of variance (MANOVA) was conducted to determine these relationships. The results of the overall F test of the MANOVA indicated no significant differences between the two groups (non-completers and completers) and the five subscales that comprise the Extraversion Global Factor of the 16PF, $F(5, 106) = .00$, $p < .96$. The hypothesis was not confirmed.

Hypothesis Thirteen

The thirteenth hypothesis stated that completers would obtain lower scores than the non-completers on the Introversion Global Factor subscales of the 16PF. A multivariate analysis of variance (MANOVA) was conducted to determine these relationships. The results of the overall F test of the MANOVA indicated no significant differences between the two groups (non-completers and completers) and the four subscales that comprise the Independence Global Factor of the 16PF, $F(5, 106) = .00$, $p < .96$. The hypothesis was not confirmed.

Hypothesis Fourteen

The fourteenth hypothesis stated that the data collected would support the overall model as depicted in Figure 1. Path analysis is a regression model that requires significant relationship between all variables. If there is not significance between the variables, the model must be changed. In the current study, hypothesis one demonstrated variables, the model must be changed. In the current study, hypothesis one demonstrated a significant relationship between trait anxiety and compliance ($r = .22, p < .03$) and between extraversion and compliance ($r = .32, p < .00$). These obtained results were in the opposite direction of the predicted results. Further, a significant relationship was shown between sleep quality and change in FM ($r = -.30, p < .01$). These obtained results also were in the opposite direction of the predicted results. No other significant relationships were found between variables. Therefore, the model could not be tested.

Failing to confirm the hypotheses, an examination was conducted of the predictive abilities of statistically significant relationships discovered in the correlational analysis. A multiple regression analysis was used to ascertain the independent and cumulative predictive power of anxiety and extraversion on compliance. In this equation, anxiety scores and extraversion scores were the predictor variables and compliance percentage scores served as the criterion variable. Initially, a solution was performed in which both independent variables were simultaneously entered. In this analysis, the overall multiple regression equation was significant, $F(2,103) = 9.73, p < .00$, *adj.* $R^2 = .14$, which is summarized in Table 3. Based on the size of the standardized beta weights, extraversion was the single best predictor of compliance, $B = .34, t = 3.71, p < .00$, followed by anxiety, $B = .24, t = 2.69, p < .01$, with the combination of both variables accounting for 14% of the variance in compliance.

Table 3.

Multiple Regression of Compliance to an Exercise Regimen on Extraversion and Anxiety

Independent Variables	Standardized Beta	R^2 Change	Cumulative R^2
Extraversion (EX)	.34	.10	.02
Anxiety (AX)	.24	.06	.14

Table 3 also includes the results from a step-wise regression in which extraversion was entered first and anxiety was entered second. Under the cumulative R^2 column, the value .09 in the first row is for EX alone and .14 in the second row is for EX plus AX together. The F values are associated with the cumulative R^2s. These results demonstrate that EX predicted 9.1% of the variance in compliance to an exercise regimen and EX and AX together contributed 14%.

CHAPTER 4

DISCUSSION

The focus of the current study was to develop a model to examine direct and indirect effects of personality variables, percent compliance, and sleep on changes in health status and percent body fat. Trait anxiety and extraversion were the exogenous variables of the model. The endogenous variables were compliance with an exercise regimen, sleep quality, changes in fat mass (FM), and changes in health status. Additionally, compliance with an exercise regimen and sleep quality both served as dependent and independent variables, while changes in FM and changes in health status served as the dependent variables. The study also examined differences between completers and non-completers of the study on the personality variables of extraversion and independence. Further, an analysis was conducted on variables found significant in the correlational analysis to determine predictive abilities of extraversion and anxiety scores on compliance percentages. Explanatory analyses also were conducted.

The discussion of the current study begins with a general overview of the research. The 14 formal hypotheses are then discussed individually with interpretations of the results of the related exploratory analyses. The results of the regression analysis are discussed. A general review of the results follows, highlighting the significant findings, implications, and limitations of the study are appraised. Suggestions for future research are explored.

Overview

The purpose of this study was to develop a model to examine direct and indirect effects of personality variables, percent compliance, and sleep on changes in percent body fat and changes in health status. Initially, intercorrelations between variables were calculated and reviewed to determine the relationships that would define the model. Although there were three significant correlations noted, these correlations were inversely related to relationships hypothesized and therefore, none of the proposed hypotheses were confirmed. Significant correlations found among variables in the hypotheses provide the following information: 1) participants who rated themselves as extroverts with higher levels of anxiety complied more with an exercise program regimen over a three month time period, 2) participants who reported good sleep demonstrated an increase in FM (FM change) at end of exercise program regimen, 3) participants who rated themselves as extroverts also reported positive changes in mental health at end of exercise program regimen, 4) participants who demonstrated greater positive changes in FM also reported greater positive changes in physical health, and 5) participants who demonstrated greater positive changes in physical health also reported greater positive changes in mental health. Possible confounds are discussed and evaluated through exploratory analyses.

The current study showed no significant differences between completers and non-completers on the personality variables of extraversion and independence. Further, extraversion and anxiety were identified as effective predictors of compliance to an exercise regimen, with extraversion providing the most predictive ability.

Conclusions

Discussion of the results for each hypothesis will be presented separately to clarify the relationships and provide impetus for further study. Hypotheses One through Five hypothesized direct effects of variables and Hypotheses Six through Eleven hypothesized indirect effects. Hypotheses Twelve and Thirteen examined differences between completers and non-completers on specific personality variables, and Hypothesis Fourteen tested the overall model. An analysis of the predictive abilities of personality variables on compliance was reported.

Interpretation of Hypothesis One

Hypothesis one examined the relationships of trait anxiety, extraversion, and compliance with an exercise regimen. It was predicted that higher compliance was related to lower levels of trait anxiety and extraversion. Results indicated that higher compliance percentage scores were related to higher scores on Trait Anxiety and Extraversion subscales of the 16PF. These findings indicated that participants who rated themselves as extroverts complied more with an exercise program regimen over a three month time period. Additionally, individuals with higher levels of anxiety complied more with the exercise program.

Few studies have researched the relationship of personality variables to compliance with an exercise program. Studies often focus on the relationship between personality and compliance in medical settings or to dietary weight loss programs. Broad personality traits, such as behavioral decision-making and self-motivation, also have been extensively studied. Research on compliance and personality variables traits, such as anxiety and extraversion as measured on the 16PF, has linked introversion (Cox, 1984) and low state anxiety (Welsh et al., 1991) to exercise compliance. Others have found relationships between Type A behavior and attrition from fitness regimens (Oldridge et al., 1983), as well as infrequent participation in corporate exercise programs (Dishman et al., 1985). These studies provided support for the current hypothesis that extraversion and anxiety would be associated with decreased adherence to an exercise regimen.

One possible explanation for the current findings entails the characteristics of the sample and the inventory used in the study. The education level of participants was not assessed in the study, and therefore, the study's participants may have misunderstood the questions posed on the personality inventory. The personality inventory was a self-report measure and, as such, subject to the bias of all self-report instruments; retrospective, subjective information supplied by the participants.

The gender of the sample also could have influenced scores on the anxiety measure. Females represented 71.7% of the current study's sample and may have reported anxiety traits more readily than men. These gender differences are supported by other studies that found higher rates of reported anxiety in the female population (Dennerstein, Astbury, & Morse, 1993). The preponderance of female anxiety emerges early in life, with retrospective data indicating that by age six, females are already twice as likely to report anxiety symptoms (Lewinsohn, Gotlib, Lewinsohn, Seeley, & Allen, 1998).

Alternatively, there may be a more straightforward explanation for the present results. Quite simply, the researcher's hypothesis could have been inaccurate. The hypothesis testing therefore, may have supplied new information on the existing, limited research on personality and compliance to exercise programs. At the very least the current findings could prompt future research endeavors on this.

Interpretation of Hypothesis Two

This hypothesis examined the relationship of anxiety and sleep quality. It predicted that higher levels of anxiety would be related to poorer sleep quality. Other researchers found similar results. For example, Jenkins (2005) noted that poor sleep quality was associated with several personality variables, including anxiety and tension. Others found that individuals who perceive life as stressful also may view sleep as stressful, with higher negative affect predicting higher incidences of sleep difficulties (Brissette & Cohen, 2002; Koulack et al., 1993). The results of the current study, however, did not support the hypothesis; results indicated no relationship between anxiety and sleep. The discrepancy between the current findings and previous research findings warrants further exploration of the relationship between sleep quality and anxiety.

A possible explanation for the lack of a relationship between sleep quality and anxiety entails the multiple definitions of sleep quality; sleep quality has been defined in a multitude of ways in the literature. Some of these definitions include sleep disturbances, sleep difficulties, sleep duration, and subjective sleep inefficiency. The current hypothesis defined sleep quality by the PSQI Global Sleep Quality score. This global score is comprised of seven components defining sleep quality; sleep latency, sleep duration, habitual sleep efficiency, sleep quality, sleep disturbance, use of sleep medications, and daytime dysfunction. An examination of the relationship between each of these components and anxiety revealed a relationship between sleep latency and anxiety.

Sleep latency refers to the transition time from wakefulness to sleep. Previous studies also have linked difficulties transitioning to sleep (increased sleep latency) to increased anxiety. Calhoun (2007) found that women experiencing high levels of anxiety also experienced increased sleep latency. This result also was noted by Germain and colleagues who used the PSQI and found that higher levels of anxiety in PTSD patients were associated with longer sleep latency and shorter sleep duration (Germain, Hall, Shear, Nofzinger, & Buysse, 2006). Therefore, although global sleep quality was not correlated with anxiety in the present study, previous research and exploratory analyses with the current study indicate that increased anxiety is related to increased sleep latency. These findings indicate that certain components of sleep quality are related to anxiety while others may have no relationship with anxiety.

Interpretation of Hypothesis Three

This hypothesis predicted that participants who exercised more frequently during a three month exercise regimen would have a higher percentage of fat loss than those who exercised less frequently. Results showed no relationship between numbers of times participants exercised and changes in FM.

The predicted relationship between exercise and increased fat loss was based on previous research demonstrating that compliance with an exercise regimen was associated with lower measurements of BMI (Blair et al., 1985; Folsom, 1985) and positive changes in fitness measures (Morris et al., 1980; Paffenbarger et al., 1984; Salonen et al., 1982). This surprising finding in part may be explained by the unregulated exercise regimen of clients in the current study and an exercise program of only three months being too brief.

This study was designed to be non-invasive: participants chose the type of exercise in which they would participate. Research has shown that different types of exercise target fat more than other types of exercise. The exercise regimen most recommended for fat loss includes regular resistance training, interval cardio (alternating brief periods of very high intensity with periods of low intensity), and endurance-based cardio (Weiss, 2006). Because the type and frequency of the participants' exercise was not regimented, the participants may have chosen exercises that did not target fat loss. Further, although the participants registered attendance (digital recording), there are no assurances that they actually engaged in exercise when attending. A ledger routinely used by the wellness center was assigned to each participant when beginning the program, but results indicated only three participants completed the ledger of activities. The wellness center has a multitude of activities that include massage therapy and meditation that does not target fat loss. Compliance was defined simply by the number of times the participant entered the individual identification number in the computer when first arriving at the wellness center. An objective method of defining, regulating, and recording the type and amount of exercise in the current study could have altered the outcomes.

Diet is another factor that may have confounded the results of this hypothesis. Research has demonstrated that to accomplish fat loss in any exercise regimen, the individual is required to expend more energy than consumed; exercise will not decrease FM if the individual's diet is comprised of more calories than are lost during exercise (Weiss, 2006). The current study did not monitor or assess diet and therefore, the participants' diets may have contained more calories than the participants were expending through participation in the exercise regimen. This may have impacted the amount of FM loss at the post-test measurements.

The frequency of participation is an additional possible explanation for the absence of a relationship between compliance and changes in FM. The American College of Sports Medicine noted that if appropriate types of exercise are performed at the proper intensity, duration, and frequency, individuals can benefit from significant improvements in physical fitness (ACSM, 2006). The ACSM and most health professionals recommend a minimum of thirty minutes of exercise, three times weekly to achieve consistent weight and FM loss. The average compliance percentage for the participants in the current study was 22%; an average of less than one time per week. This observed low percentage of exercise participation could explain the lack of significant differences found between pre- and post-test BMI measurements.

The hypothesis also predicted that participants with better sleep quality would have a greater FM loss than participants with poorer sleep quality. This prediction was derived from research findings on sleep and obesity. These findings indicate that insufficient sleep duration has been associated with obesity (Gangwisch et al., 2005; Hasler et al., 2004; Kripke et al., 2002; Prinz, 2005/2006; Taheri et al., 2004). Results of the current study were contradictory to these results, finding that poorer sleep was related to a greater percentage of fat loss in the three month time frame tested. This was an unexpected inverse relationship between poor sleep quality and greater FM loss and deserving of further consideration.

One limitation that may have influenced the results of this hypothesis was the use of a self-report sleep questionnaire. As a self-report measure, the sleep questionnaire was subject to biased, subjective reports from participants, and thus, may have yielded inaccurate reports from participants. Also, there may have been other contributing factors outside the study that could have affected scores. For example, one participant recorded on the sleep questionnaire that she had recently begun a swing-shift job. Another participant reported a new baby in the home. These are environmental variables that could have influenced sleep quality scores.

An exploratory analysis was conducted on participants' FM measurements taken at the initiation of the study and sleep to further clarify the surprising results. The analyses indicated that better sleep quality was associated with lower initial FM measurements. Therefore, the participants who began the study with lower initial FM measurements and good sleep could have experienced the aforementioned circumstances, or others outside the study this may have affected scores.

Interpretation of Hypothesis Four

Compliance with an exercise regimen was predicted to have a relationship with physical health. Specifically, participants who exercised more frequently would demonstrate more improvements in physical health than those who exercised less frequently. Additionally, sleep quality was predicted to have a relationship with physical health, with participants with better sleep quality also reporting more improvements in physical health. The results indicated no correlations among compliance and improvements in physical health or between sleep quality and improvements in physical health.

A possible explanation for the lack of significance found between exercise and physical health involve the absence of a regulated exercise program in the current study (as addressed in Hypothesis Three). Not only is exercise clearly associated with FM in the literature, exercise also is clearly related to physical health. There are factors, however, that can confound the relationship between exercise and physical health. As important as are the general health benefits of regular exercise, the short-term effects on the body can be deleterious to an individual's physical health. These are certainly the opposite of the desired results for someone entering into an exercise program. Individuals often engage in exercise to improve physical health. However, in the everyday normal course of events, exertion can result in pain and injury (e.g., sprains, torn ligaments). This possible confound was not addressed in the current study; there was no objective measure of negative effects the participants may have experienced through the exercise process. Injuries or fatigue from beginning a new exercise program certainly could have affected the participants' rating of improvements of physical health at the conclusion of the three month study. Ratings of improvements also could have been affected by more severe physical ailments that participants could have experienced prior to and during the three month exercise program. Musculoskeletal conditions, chronic back pain, digestive disease, metabolic complications, and pulmonary complications are physical ailments that may require a more extended time period of exercising to demonstrate improvement.

Additionally, Hypothesis Four predicted that participants with better sleep quality would also demonstrate improvements in physical health. Results showed no relationship between the two. The lack of significance was counter to previous studies of sleep and physical health. As with studies on sleep quality and FM, multiple studies have addressed the relationship between sleep and physical health. Less than seven hours of sleep per night can effect normal growth and development, the maintenance of a healthy immune system, protein synthesis, and growth hormonal production (Irwin et al., 1996; Parker et al., 1980; Sassin et al., 1969), as well as being linked to cardiovascular disease (Taylor & McFatter, 2003). The surprising absence of a relationship dictates further exploration of these variables.

Defined and assessed as global sleep quality, sleep quality demonstrated no relationship with changes in physical functioning. However, an analysis of the relationship between the seven components of sleep quality (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, medication use, and daytime dysfunction) and changes in physical health revealed that subjective sleep quality was related to improvements in physical health. Participants who reported better subjective sleep quality also reported better physical health.

Subjective sleep quality is defined by one item on the PSQI. This item asks for a personal assessment of overall sleep quality. High scores on this component of sleep have been associated with various physical ailments in other research studies. For example, Yuichinique and colleagues (2002) found a relationship between subjective sleep quality, Restless Leg Syndrome, and Periodic Limb Movement Disorder.

Interpretation of Hypothesis Five

This hypothesis predicted a relationship between compliance with the exercise regimen and improved mental health, specifically hypothesizing that increased frequency of exercise is related to improvements in mental health. The current study, however, found no significant relationship between the two variables. Contradictory to this finding, previous research has noted psychological benefits associated with compliance to an exercise regimen: less depression, anxiety, and stress (Taylor et al., 1985), improved self-confidence, better academic records (Bortz, 1980; Tucker, 1982), enhanced feelings of well-being, (USDHHS, 1996), and psychological health in general (ACSM, 2006).

A possible contribution to the lack of a relationship between exercise and changes in mental health was the short duration of the exercise program. Exercise program length was identified as one of three moderator variables in two of six meta-analytical studies that found significant relationships between exercise and anxiety reduction (Petruzzello, 1995; Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991). The researchers noted that the length of the exercise training program should be at least 10 weeks but preferably greater than 15 weeks. The exercise regimen in the current study was conducted for 12 weeks, meeting the minimum recommended requirement, but not the preferred 15 weeks. A second moderator variable in the study by Petruzzello was the requirement that the exercise is "aerobic" (e.g., cycling, swimming, running). The current study had no means of identifying specific exercises of participants, and therefore participants may not have met this criterion for significant mental health changes. The third criterion reported by Petruzzello was that participants must demonstrate initially lower levels of fitness or higher levels of anxiety. Although current participants met the criterion for lower levels of fitness (mean FM of 36), the mean anxiety score was considered similar to the general population. What is indicated by previous research is that the recommended criterion was not met in the current study for exercise to have a relationship with changes in mental health as found in other studies of mental health and exercise. This could explain the lack of significance found between exercise and changes in mental health in the current study.

Another possible explanation for the lack of association between exercise and changes in mental health is the possibility of mental stress associated with participating in an exercise regimen. Intense exercising has been related to detrimental changes in mental health. Raglin (1990) found that rigorous exercise can build dependency for the physical activity and can result in mood disturbances and worsening health. These results were consistently found in studies of athletic training exercises. In the current study, some participants could have experienced these changes in mental health, affecting the outcomes of the study. However, the lack of documentation of the precise type and intensity of the exercise activities of the participants does not support investigative efforts for testing this hypothesis.

The current study also proposed a significant relationship between sleep quality and improved mental health: participants with better sleep quality were predicted to demonstrate improvements in mental health at the conclusion of the three month study. The hypothesis was formulated from research linking poor sleep quality and negative mood states, (Bonnet, 1985; Gau, 2000; Gray & Watson, 2002; Lacks & Morin, 1992), anxiety (Aikens & Mendelson, 1999; Monroe, 1967; Zammit, 1988), symptoms of attention deficit hyperactivity disorder (Carpenter, 2001), somatic health problems (Mohr, Vedantham, Neylan, Metzler, Best, & Marmar, 2003), heightened anxiety, excitability, impulsivity, and increased sensitivity to external stimuli (Sicard, 2001; Vein, 1983). Results from other studies, however, have noted a relationship between short-term sleep deprivation and decreased symptoms of depression (Kraft, 1984) and have concluded that sleep length is a weak predictor of mood and functioning (Pilcher; Verlander). The current study found no associations between sleep quality and improvements in mental health. However, as with previous hypotheses, an exploratory analysis of the association between sleep quality and pre- and post-test mental health found significant results. This analysis revealed that sleep quality scores were negatively correlated with scores of mental health; participants who reported better sleep quality also reported better mental health both at the initiation of the study and at the conclusion. These findings are consistent with the preponderance of the sleep research results associating sleep quality and mental health.

Interpretation of Hypothesis Six

The sixth hypothesis stated that compliance would mediate the relationship of trait anxiety, extraversion, and change in FM; as compliance percentage scores increase, FM difference scores decrease (lower scores indicating greater loss of FM). The relationship between compliance percentage scores and FM difference scores was tested to assess for significance (Hypothesis Three). Since this analysis found no significance ($r = .06$, $p < .62$), no further tests of mediation could be conducted. This hypothesis was not confirmed.

Interpretation of Hypothesis Seven

The seventh hypothesis stated that compliance would mediate the relationship of trait anxiety, extraversion, and change in physical health; as compliance percentage scores increase, PCS difference scores increase. The relationship between compliance percentage scores (higher percentage scores indicating more compliance) and PCS difference scores (higher scores indicating more positive changes) was tested to assess for significance (Hypothesis Four). Since this analysis found no significance

($r = .07, p < .62$), no further tests of mediation could be conducted. This hypothesis was not confirmed.

Interpretation of Hypothesis Eight

The eighth hypothesis predicted that compliance would mediate the relationship of trait anxiety, extraversion, and change in mental health; as compliance percentage scores increase, MCS difference scores increase. The relationship between compliance percentage scores and MCS difference scores was tested to assess for a significant relationship (Hypothesis Five). Since this analysis found no significance ($r = -.04, p < .74$), no further tests of mediation could be conducted. This hypothesis was not confirmed.

Interpretation of Hypothesis Nine

The ninth hypothesis stated that sleep quality would mediate the relationship of trait anxiety and change in FM; as sleep quality scores decrease, FM difference scores decrease. The relationship between Sleep Quality Global Factor scores (lower scores indicating better quality of sleep) and FM difference scores (lower scores indicating more positive changes in FM) was tested to assess for a significant relationship (Hypothesis Three). Results indicated a significant negative correlation ($r = -.30, p < .01$). Although the significant correlation was negative and the researcher predicted a positive correlation (Hypothesis Three), a statistical significance was found between the two variables; Sleep Quality Global Factor scores and FM difference scores. Therefore, the next step in the analysis of mediation was conducted.

The relationship between trait anxiety scores and FM difference scores was tested to assess for significance. Test results indicated no statistical significant relationship between the two variables ($r = .04, p < .74$). Because there was no significance established, no further tests of mediation could be conducted. This hypothesis was not confirmed.

Interpretation of Hypothesis Ten

The tenth hypothesis stated that sleep quality would mediate the relationship of trait anxiety and change in physical health; as the PSQI Global Factor scores decrease, PCS difference scores increase. The relationship between PSQI Global Factor scores and SF-36v2 PCS difference scores was tested to assess for a significant relationship (Hypothesis Four). Since this analysis found no significance ($r = .05, p < .13$), no further tests of mediation could be conducted. This hypothesis was not confirmed.

Interpretation of Hypothesis Eleven

The eleventh hypothesis stated that sleep quality would mediate the relationship between trait anxiety and change in mental health; as sleep quality scores decrease, MCS difference scores increase. The relationship between PSQI Global Factor scores and SF-36v2 MCS difference scores was tested to assess for a significant relationship (Hypothesis 5). Since this analysis found no significance ($r = -.10, p < .74$), no further tests of mediation could be conducted. This hypothesis was not confirmed.

Interpretation of Hypothesis Twelve

Hypotheses twelve examined differences between completers and non-completers of the study on the personality variable of extraversion; non-completers were hypothesized to obtain higher scores on the Extraversion Global Factor of the 16PF than completers. Results indicated there were no personality differences between participants who completed the three month exercise program and those who dropped out. The hypothesis was not confirmed.

Interpretation of Hypothesis Thirteen

Hypotheses thirteen examined differences between completers and non-completers of the study on the personality variable of independence; completers were hypothesized to obtain lower scores on the Independence Global Factor Subscale of the 16PF than completers. Results indicated there were no personality differences between participants who completed the three month exercise program and those who dropped out. The hypothesis was not confirmed.

Interpretation of Hypothesis Fourteen

This hypothesis predicted that data collected would support an overall path model that would adequately explain the paths between variables. Path analysis is a regression model that requires significant relationships between all variables (Grimm and Yarnold, 1995). Therefore, correlations for each of the relationships that define the full path model were calculated and examined separately to determine significance of each relationship. Results indicated that the hypothesized relationships in hypotheses one through twelve Because hypotheses one through eleven were not confirmed, indicating no significant relationships as hypothesized, additional tests of mediation could not be conducted and this hypothesis was not confirmed.

Overall, hypotheses one through fourteen yielded surprising results. Participants reporting higher levels of anxiety rated complied more with an exercise program regimen. Further, participants who rated themselves as extroverts also complied more with an exercise program regimen. Participants reporting higher levels of anxiety demonstrated positive changes in FM at end of exercise program regimen, and participants reporting poor sleep also demonstrated positive FM changes. There were no other significant results found for the hypothesized relationships among personality variables, compliance to an exercise regimen, sleep, and changes in FM, physical health and mental health. Several possible confounds were proposed, the most significant associated with the short length of the exercise program (12 weeks), insufficient times participants reported exercising (mean of less than one time per week), and unregulated exercise programs. The use of a global measurement of sleep quality also was noted as a possible confound in some analyses. The possible confounds led to exploratory analyses using pre- and post-test measurements independently and seven different components of sleep quality.

Exploratory analyses revealed interesting results. The results were that participants who reported higher levels of anxiety also reported more difficulties falling asleep (sleep latency). Further, better overall sleep quality was associated with lower initial FM measurements and better mental health at the beginning and at the end of the three month exercise regimen. Next, lower FM and better physical health was associated with compliance to an exercise regimen. Finally, better subjective sleep quality was associated with positive changes in physical health.

The current findings also indicate that extraversion is an effective predictor of compliance with an exercise regimen. Anxiety is the second most effective predictor of compliance of all other variables in the research study. These results were contradictive of the study's hypotheses, but research on personality variables and compliance to exercise regimens is limited in the literature. Most research has studied personality and compliance to medical regimens (Bebbington, 1995; Becker & Maiman, 1975; Demyttensere, 1997; Fawcett, 1995; Von Korff et al., 1995) or dietary programs (Galluccio & Roberta, 2003; Keegan et al., 1987). Of the studies on personality and exercise compliance, researchers have associated attrition from exercise programs with poorer mental health (Shapiro et al., 1975), poor self-motivation, poor behavioral decision-making (Dishman & Ickes, 1982), poor self-efficacy and social support (Rhodes et al., 2001), Type A personalities (Cox, 1984), and state anxiety (Welsh et al., 1991). Other researchers have offered evidence of inverse relationships between depression and compliance to an exercise regimen (Lobstein et al., 1983).

Implications

The relationship of factors associated with obesity, compliance to an exercise regimen, physical health, and mental health are multifaceted and complex. An understanding of these relationships is vital to combating the ever-growing obesity epidemic. One way our society has attempted to reduce the prevalence of obesity is through participation in exercise programs. However, the high attrition rates for exercise programs suggest a need for an understanding of the psychological variables that affect an individual's compliance to these programs.

The current findings indicated that extraverted and anxious individuals may comply more with an exercise regimen. Further, poor sleep quality was associated with individuals who lost more FM in a three month exercise program than those with better sleep quality. A review of all significant relationships among variables in the hypotheses and results of exploratory analyses yielded additional important and interesting information.

Sleep quality is defined in a multitude of ways in sleep studies, with different types of sleep disturbances associated with different variables. The current study found that individuals who reported increased anxiety also reported increased sleep latency. These results were comparable to those in other studies of sleep latency (Calhoun, 2007; Germain et al., 2006). When sleep quality was defined by the participants' subjective assessment, participants who reported better subjective sleep quality also reported positive changes in physical health at the end of the study. These results have been found in previous sleep research (Yuichnique et al., 2002).

Further, although the results indicated that participants who experienced poorer sleep quality lost more FM than participants reporting better sleep quality, additional analyses indicated that participants who reported good sleep quality at initiation of exercise regimen demonstrated lower FM measures than participants with poor sleep quality. This association with less obesity and better sleep quality is demonstrated in previous research associating sleep deprivation and an increased body weight (Gangwisch et al., 2005; Hasler, 2004), indicating a possible hormonal component (Prinz, 2005; 2006). Therefore, the findings that poor sleep quality was associated with more FM loss may be indicative of outside influences on participants' sleep that affected the difference scores.

Additional results of sleep measures indicated that participants who reported better sleep quality also reported better physical and mental health and lower FM measurements at the initiation of the study. These associations between good sleep quality and physical/mental health are supported by the literature associating poor sleep quality to negative effects on healthy immune system (Parker et al., 1998; Irwin et al.,

1996) and to negative mood states and decreased psychological well-being (Gau, 2000; Gray & Watson, 2002; Pilcher et al., 1997).

When hypothesized variables were examined in connection to difference scores (changes in FM and health) in the current study, no relationships were established. The abbreviated time of the exercise program (12 weeks), the lack of a regulated exercise regimen to ensure specific, FM targeted exercises, diet, and lack of assurance that participants did indeed exercise when at the wellness center all may have contributed to the lack of significance found in results. It is hoped that this research study may prompt wellness centers and other exercise programs to consider these obstacles when attempting to decrease attrition rates and thus, decrease obesity rates. One suggestion would be to implement techniques that would allow precise monitoring of members' exercise activities. This monitoring would allow fitness employees to educate and support members experiencing difficulties with fat loss. This education could involve establishing a regimented exercise plan, diet consultation, and support with minimal attendance rates.

By understanding the personality variables of individuals who continue to exercise, fitness professionals can identify individuals at risk for dropping out of exercise programs and implement methods to increase an individual's persistence with an exercise plan. Of all the variables in the current study, the personality traits of extraversion and anxiety were found to have the most influence on adherence. These findings also are theoretically significant. Future research is warranted on the exploration of the individual differences that increase compliance among extraverted and anxious exercises.

The current study illustrated that individuals who demonstrated better fitness and physical health exercised more regularly than other participants, although they had the least to gain from the exercise regimen. This indicates a reason to assess for the motivation of exercises to decrease attrition rates from exercise regimens.

Limitations

Several limitations may have influenced the results of this study. One limitation was the relative homogeneity of the sample. Participants in this study included predominately Caucasian adults (75.5%) in a small southern town. The participants were primarily female (71.7%) and 58.5% were married. Given the nature of the sample, caution should be used when generalizing the results.

Limitations also were related to the instruments used in the study. Self-report measures were used to assess personality, sleep, and health status. Consequently, information collected from participants was retrospective and subjective. All participates may not have answered truthfully and others may have randomly responded. Nevertheless, surveys were reviewed and efforts were made to eliminate those that were clearly unsuitable for analyses (e.g., failing to complete items, responding identically to all items).

Another limitation may entail the time of year of the research project. The study was begun in the first months of the year, the time when wellness centers have the most new members. New Years' resolutions are made at this time and enrollment is at its peak. The motivation for exercise and expectations of oneself may be different at this time of the year than any other time of the year. This may have contributed to the large amount of attrition from the study.

Future Research Suggestions

The current study addressed many factors related to obesity, health status, and compliance to an exercise regimen. However, there are many variables that if researched, may add to our understanding of factors that affect compliance to an exercise regimen. Individual differences in amount and type of exercise behavior are always factors in evaluating fitness and levels of activity. Exercise varies greatly in frequency and intensity between individuals, as well as for the same individual on different days. The term "exercise," therefore, is difficult to define for study purposes. By defining exercise, however, the type of exercise would be regulated so that participants can be provided a more uniform experience. This study was designed to be non-invasive; however, there is value in objectively defining and monitoring exercise to obtain specific measurements. This regulation of exercise also could provide a closely monitored exercise program to prevent overexertion or injury that may have confounded the results of the current study. In addition, the current study presumed that no additional exercise intervened between the times the participants exercised at the wellness center. In order to rule out participants engaging in additional exercise, the question of engaging in these additional activities should be addressed in future studies on exercise and changes in FM and health.

Also revealed in the current study is the need to differentiate between types of sleep disturbances when conducting research involving measures of sleep quality. The current study found contradictory relationships between sleep quality and variables in the study when sleep quality was defined globally and when defined by one of many subcomponents. Previous research on sleep quality often assesses the different types of sleep quality, but results are often written as global sleep quality. These results can be difficult to interpret and could lead to misinformation on results of sleep quality studies.

Individuals often engage in exercise to attain a sense of psychological and physical well-being. However, overexertion can result in negative physical and mental consequences. For example, physical consequences such as sprains and torn ligaments can affect an individual's capacity to exercise. Further, mood, motivational state, and level of daily functioning may also be negatively affected. Future research on exercise compliance should address these issues to increase the understanding of determinants of attrition from exercise programs.

A total of 501 members of the wellness center initially agreed to participate in the study and signed the initial consent form. Of these, 106 (21%) completed all the initial surveys and FM measurement. Of these, only 80 (75%) continued the study and reported varying percentages of compliance with the exercise regimen. The remaining 26 participants who began the study discontinued membership at the wellness center. This study did not address the reasons given for the attrition from the study or attrition from the wellness center. This information could be valuable in determining motivation for exercise and increase understanding of attrition from exercise regimens.

As a final suggestion for improving such study's outcomes, researchers might investigate participants' previous exercise experience. Studies have demonstrated that an individual's previous exercise experience may affect attrition from an exercise program. These researchers have supported the correlation between past exercise experience and compliance to exercise regimens, finding that the only significant predictor of exercise compliance was the individual's previous exercise level (Minor & Brown, 1993; Oldridge, 1982). Previous exercise was not addressed in the current study. To do so in future studies of exercise and compliance could add to the understanding of motivation for exercise and increase the understanding of attrition from exercise programs.

The present study served to illustrate that the multivariate relationships between personality variables, sleep, exercise, obesity, and health status are complicated and complex relationships. The results provide valuable information on the interplay of these variables and hold important implications for wellness centers, psychologists, and future researchers. It is crucial that research continues to address all the many dimensions of obesity and variables associated with obesity to assist individuals with living a healthier lifestyle.

APPENDIX A

HUMAN USE COMMITTEE APPROVAL FORM

MEMORANDUM

TO: Ms. Cynthia Dupuis, Dr. Buboltz, Dr. Soper and Dr. Walczyk

FROM: Barbara Talbot, University Research

SUBJECT: HUMAN USE COMMITTEE REVIEW

DATE: January 17, 2008

In order to facilitate your project, an EXPEDITED REVIEW has been done for your proposed study entitled:

"An Examination of Factors Affecting Obesity and
Overall Health Status in Exercising Adults: A Path Analysis"

HUC-550

The proposed study's revised procedures were found to provide reasonable and adequate safeguards against possible risks involving human subjects. The information to be collected may be personal in nature or implication. Therefore, diligent care needs to be taken to protect the privacy of the participants and to assure that the data are kept confidential. Informed consent is a critical part of the research process. The subjects must be informed that their participation is voluntary. It is important that consent materials be presented in a language understandable to every participant. If you have participants in your study whose first language is not English, be sure that informed consent materials are adequately explained or translated. Since your reviewed project appears to do no damage to the participants, the Human Use Committee grants approval of the involvement of human subjects as outlined.

Projects should be renewed annually. ***This approval was finalized on January 8, 2008 and this project will need to receive a continuation review by the IRB if the project, including data analysis, continues beyond January 8, 2009.*** Any discrepancies in procedure or changes that have been made including approved changes should be noted in the review application. Projects involving NIH funds require annual education training to be documented. For more information regarding this, contact the Office of University Research.

You are requested to maintain written records of your procedures, data collected, and subjects involved. These records will need to be available upon request during the conduct of the study and retained by the university for three years after the conclusion of the study. If changes occur in recruiting of subjects, informed consent process or in your research protocol, or if unanticipated problems should arise it is the Researchers responsibility to notify the Office of Research or IRB in writing. The project should be discontinued until modifications can be reviewed and approved. If you have any questions, please contact Dr. Mary Livingston at 257-4315.

APPENDIX B

CONSENT FORM

The following is a brief summary of the project in which you are asked to participate. Please read this information before signing the statement below.

TITLE OF PROJECT: AN EXAMINATION OF FACTORS AFFECTING OBESITY AND OVERALL HEALTH STATUS IN EXERCISING ADULTS: A PATH ANALYSIS

PURPOSE OF STUDY/PROJECT: Dissertation: To examine the factors of personality, sleep, and compliance on obesity and overall health status

PROCEDURE: At the initiation of the study, participants will read and sign the consent form that will explain the purpose of the study. This form will also note that participation is voluntary, that all information will remain confidential, and information will be disseminated only as group data. The survey packet then will be given to consenting participants to be completed at the wellness center. All packets will include the same questionnaires, but the order of the surveys will be varied. The packets will include the Human Subjects Consent Form, the Demographics Sheet, the 16PF, the Sleep Quality Index, the Pittsburgh Sleep Quality Index, and the SF-36. Participants will then be given a measure of Fat Mass (BOD/POD). The Fat Mass measure is routinely given by the fitness center staff, by a certified exercise physiologist, as part of the center's standard intake procedures. The wellness center will then assign an individual fitness regime to be completed daily (this is also standard procedure for the health center). I will not participate in the standard intake procedures. After completion of the surveys, each participant will be awarded $25.00 in vouchers to be used at the fitness center as an incentive for participation in the study. For three months, participants will complete a log of exercise participation. This is standard procedure for the fitness center and will be recorded on the center's activity log. At the end of three months of participation in the exercise regime, participants again will be given the survey packet which will include all previously administered surveys excluding the demographics sheet and personality inventory (16PF). A final Fat Mass measurement (BOD/POD) will be taken at this time as well as analysis of the percentage of compliance to the individually prescribed fitness regime. Again, the Fat Mass measurement is standard procedure for the fitness center and this researcher will not participate in this procedure. Upon completion of the final surveys and Fat Mass measurement, each participant again will be given $25.00 in vouchers from the health center. Data will then be analyzed to determine the relationship among the variables.

INSTRUMENTS: Demographic Questionnaire, the 16PF, the Pittsburgh Sleep Quality Index, a Fat Mass Measurement (BOD/POD ST), and the SF-36

RISKS/ALTERNATIVE TREATMENTS: None

BENEFITS/COMPENSATION: $25.00 in vouchers to be used at HealthWorks Fitness Center upon completion of the initial surveys and an additional $25.00 in vouchers to be used at HealthWorks Fitness Center upon completion of the surveys (excluding 16PF and Demographics Questionnaire) after three months.

I, ____________________, attest with my signature that I have read and understood the following description of the study, "_________________________", and its purposes and methods. I understand that my participation in this research is strictly voluntary and my participation or refusal to participate in this study will

not affect my relationship with Louisiana Tech University or my grades in any way. **Further, I understand that I may withdraw at any time or refuse to answer any questions without penalty. Upon completion of the study, I understand that the results will be freely available to me upon request. I understand that the results of my survey will be confidential, accessible only to the principal investigators, myself, or a legally appointed representative. I have not been requested to waive nor do I waive any of my rights related to participating in this study.**

________________________________ _____________

Signature of Participant or Guardian **Date**

CONTACT INFORMATION: The principal experimenter listed below may be reached to answer questions about the research, subjects' rights, or related matters.

Cynthia W. Dupuis

(870)862-1713

cwd007@latech.edu

Dr. Walt Buboltz

Louisiana Tech University

(318)257-4039

Dr. Barlow Soper

Louisiana Tech University

(318)257-2874

Dr. Jeff Walczyk

Louisiana Tech University

(318)257-3004

Members of the Human Use Committee of Louisiana Tech University may also be contacted if a problem cannot be discussed with the experimenters:

Dr. Les Guice (257-4647)

Dr. Mary M. Livingston (257-2292)

Stephanie Herrmann (257-5075)

APPENDIX C

GRANT AWARD LETTER

HEALTHWORKS
Fitness Center
a service of SHARE Foundation

Memorandum

To: Cynthia W. Dupuis, MS, LPE

From: HealthWorks Fitness Center

Date: 10/22/07

Re: Host site for PhD research project

This is to confirm that HealthWorks Fitness Center has agreed to host you and your study beginning January 2008 for a period not to exceed 12 months. We will grant you $10,000.00 to be used for materials and participant incentives. All HFC standard intake and matriculation procedures will apply to these study participants.

Please let us know if there are any additional questions.

Mike Dupuis, VP/Exec Dir.

304 North Madison • El Dorado, AR 71730 • Office - (870) 862-5442 • Fax - (870) 862-9922

APPENDIX D

DEMOGRAPHIC QUESTIONNAIRE

Please provide the following information by filling in the blank or circling the appropriate answer.

A. Age in years ________

B. Gender M F

C. With which ethnic group do you **most** identify?

1. African American 2. Asian American 3. Caucasian American

4. Hispanic/Latino 5. Native American 6. Other

D. Marital status

1. Single 2. Married 3. Divorced

4. Remarried 5. Widowed

APPENDIX E

PITTSBURGH SLEEP QUALITY INDEX

The following questions relate to your usual sleep habits during the past month ***only***. Your answers should indicate the most accurate reply for the ***majority*** of days and nights in the past month.

Please answer all the questions.

1. During the past month, when have you usually gone to bed at night?

____

2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night? ____

3. During the past month, when have you usually gotten up in the morning?

____

4. During the past month, how many hours of *actual sleep* did you get at night? (This may be different than the number of hours you spend in bed.)

____

For each of the remaining questions, check the one best response. Please answer *all* questions.

5. During the past month, how often have you had trouble sleeping because you…

(a) Cannot get to sleep within 30 minutes

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(b) Wake up in the middle of the night or early morning

Not during the	Less than	Once or	Three or more

past month ___	once a week ___	twice a week ___	times a week ___

(c) Have to get up to use the bathroom

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(d) Cannot breathe comfortably

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(e) Cough or snore loudly

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(f) Feel too cold

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(g) Feel too hot

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(h) Had bad dreams

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(i) Have pain

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(j) Other reasons for sleep difficulties, please describe______________________________

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

6. During the past month, how would you rate your sleep quality overall?

Very good ____

Fairly good ____

Fairly bad ____

Very bad ____

7. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

No problem at all ____

Only a very slight problem ____

Somewhat of a problem ____

A very big problem ____

10. Please answer the three following questions for your sleep last night.

1. What time did you go so sleep last night? ________

2. What time did you wake up today? __________

3. How many hours of sleep did you get last night? ________

APPENDIX F

THE WORKOUT PROGRAM LEDGER

OF PHYSICAL ACTIVITY

HEALTHWORKS FITNESS CENTER

Last Name: **First Name:** **Date:**

Weight Workout:
- 2 days per week (ie. Mon/Fri).
- Warm-up on bike or treadmill 5-10 min.

Cardio Work:
- 20-30 minutes, 3 days per week any days, just not two days in a row.

	Date																		
Seat #	*Exercise*	**W**	**S/R**	**W**	**S/R**	**W**	**S/R**	**W**	**S/R**	**W**	**S/R**	**W**	**S/R**	**W**	**S/R**	**W**	**S/R**	**W**	**S/R**
	Chest Press																		
	Seated Row																		
	Shoulder Press																		
	Leg Press																		
	Leg Curl																		
	Calf Raise																		
	Bicep Curl																		
	Tricep Extension																		
	Ab Crunch																		
	Oblique Crunch																		
		Dur	**-**	**Dur**	**-**	**Dur**	**-**	**Dur**	**-**	**Dur**	**-**	**Dur**	**-**	**Dur**	**-**	**Dur**	**-**	**Dur**	**-**
	Cardio																		

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