

California State University, San Bernardino

CSUSB ScholarWorks

Theses Digitization Project

John M. Pfau Library

2012

Examinations of body fat and physical self-concept

Hyung-Seok Cho

Follow this and additional works at: <https://scholarworks.lib.csusb.edu/etd-project>



Part of the [Health and Physical Education Commons](#)

Recommended Citation

Cho, Hyung-Seok, "Examinations of body fat and physical self-concept" (2012). *Theses Digitization Project*. 4069.

<https://scholarworks.lib.csusb.edu/etd-project/4069>

This Project is brought to you for free and open access by the John M. Pfau Library at CSUSB ScholarWorks. It has been accepted for inclusion in Theses Digitization Project by an authorized administrator of CSUSB ScholarWorks. For more information, please contact scholarworks@csusb.edu.

EXAMINATIONS OF BODY FAT AND PHYSICAL SELF-CONCEPT

A Project
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Education:
Kinesiology

by
Hyung-Seok Cho

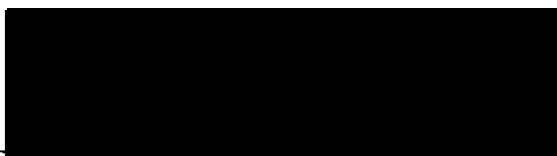
June 2012

EXAMINATIONS OF BODY FAT AND PHYSICAL SELF-CONCEPT

A Project
Presented to the
Faculty of
California State University,
San Bernardino

by
Hyung-Seok Cho
June 2012

Approved by:



Dr. Hosung So / First Reader

6/8/2012

Date



Dr. Hyun-Kyoung Oh, Second Reader

ABSTRACT

This study reviewed and focused primarily on the correlation between body fat and physical self-concept as well as the physical and psychological benefits of physical activity. The Physical Self-Description Questionnaire (PSDQ) was the instrument used to measure physical self-concept and self-esteem. The literature review paper provided not only the measurement method of body fat and physical self, but also the pros and cons of each measurement instrument. Findings from the review of literature indicated that (1) exercise generally exerts a positive influence on self-concept and self-esteem for all populations, (2) the greatest improvements in self-concept, physical fitness, and body composition are likely to occur in those populations that have the most to gain physically and psychologically from exercise participation. Included among these groups are middle-aged with disability and elderly adults who are overweight or obese; those with low levels of physical ability, self-confidence, self-concept, or self-esteem; and those who maintain a negative body image. Consequently, the review of literature illustrated that many factors are related to body fat, physical activity, self-concept, self-esteem, and physical self-

concept. In other words, these factors were considered as what could contribute to the physical and psychological benefits of physical activity. Finding from this study indicates what definitive conclusions can be made regarding the relationship among exercise and self concept, physical fitness, body composition, and physical self-concept.

ACKNOWLEDGMENTS

I would like to acknowledge my parents for supporting me both financially and emotionally while I embarked on the education process that none of us thought would ever end. I must also thank my wonderful committee, Dr. Hosung So and Dr. Hyun-Kyoung Oh for their guidance, support, and eternal patience. And finally, my heartfelt thanks go to my wife, Young Lee and Dewey who continued to stick by my side.

TABLE OF CONTENTS

ABSTRACT	iii
ACKNOWLEDGMENTS	v
LIST OF FIGURES	viii
CHAPTER ONE: INTRODUCTION	
Statement of the Problem	1
Purpose of the Project	2
Scope of the Project	2
Significance of the Project	2
Limitations of the Project	3
Definition of Terms	3
CHAPTER TWO: REVIEW OF RELATED LITERATURE	
What Body Fat Is	6
Methods for Assessing Body Fat	8
Self-Concept, Self-Esteem, and Physical Self	13
Methods of Measurement for Self-Concept	15
CHAPTER THREE: METHODOLOGY	18
CHAPTER FOUR: RESULT	20
CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS	
Conclusion	22
Recommendations	23
APPENDIX A: CONVERSION OF BODY DENSITY TO BODY FAT	24

APPENDIX B: SKINFOLD PREDICTION EQUATIONS	26
REFERENCES	28

LIST OF FIGURES

Figure 1. Hydrostatic Weighing Using Scale	10
Figure 2. Load Cells and Platform.	10
Figure 3. Dual-Energy X-ray Absorptiometry.	12

CHAPTER ONE

INTRODUCTION

Statement of the Problem

It has been reported that physical inactivity and poor diet are responsible for at least 365,000 deaths per year which is 16 percent of all deaths in United States, according to the U.S. Centers for Disease Control and Prevention (Mokdad, Marks, Stroup, & Gerberding, 2005). This is consistent with finding of the World Health Organization (Geneva, 2003). These are two of the leading causes for major noncommunicable diseases. These include type II diabetes, cardiovascular disease and certain type of cancers, in addition to contributing significantly to death, disease and disability due to other causes.

Conversely, physical activity, such as regular exercise and competitive sports, is fundamental to a healthy life style (Lau, Cheung, & Ransdell, 2008). A healthy life style is one which balances activities promoting psychological and physical health is cited as a major factor for decreasing the risk factors for obesity as well as reinforcing positive self-concept. Accordingly, investigations of obesity and physical self-concept are

important in order to better understand the physical and psychological benefits.

Purpose of the Project

Based on previous study findings, physical activity has been promoted as a means of reinforcing self-concept and decreasing obesity rate. Therefore, the purpose of this project was to review literature about the physical and psychological benefits of physical activity and the correlation between body fat and physical self-concept.

Scope of the Project

This study was designed to provide not only the measurement method of body fat and physical self, but also the pros and cons of each measurement instrument. It also demonstrated the relationship between body fat and physical self-concept. Furthermore, it demonstrated the physical and psychological benefits of physical activity.

Significance of the Project

This study could be significant not only to encourage school administrators, health counselors, and physical education teachers who measure students' self-concept and

body fat, but also to provide information to researchers who investigate the correlation between body fat and physical self-concept and the physical and psychological benefits of physical activity. The findings of this study highlight directions for further exploration and may help guide future research.

Limitations of the Project

First, the limitation of this study was that there has been little research conducted on the correlation between body fat and physical self-concept. Second, few studies have specifically reflected on the physical and psychological benefits of physical activity.

Definition of Terms

The primary terms used in this study are conceptually defined below and contextual usage is based on the following definitions.

- A. Skinfold measurement is defined as "quantitative technique for determining a person's body fat composition by measuring the width of the subcutaneous fat with calipers at various skinfold sites on the body" (Bosaeus, 2002).

- B. Body fat is defined as "a lipid produced in the body"
The percentage of body mass that is not composed of water, muscle, bone, and vital organs (Bosaeus, 2002).
- C. Physical activity is generally defined as "a behavior consisting of bodily movement that requires energy expenditure above the normal physiological requirements" (Frankenfield, Rowe, Cooney, Smith, & Becker, 2001).
- D. Physical self-concept is defined as "the way a person thinks about their abilities in a various facets of life, including academics, athletics and social interactions" (Fox, 2000).
- E. Self-concept is defined as "the composite of ideas, feelings, and attitudes that a person has about his or her own identity, worth, and capabilities" (Tiggemann, Williamson, 2000).
- F. Self-esteem is defined as "person's overall sense of self-worth or personal value" (Horn, 2004).
- G. Self-efficacy is defined as "the belief in one's capabilities to organize and execute the courses of action required to manage prospective situations" (Tiggemann, Williamson, 2000).
- H. The Physical self-concept description questionnaire

(PSDQ) is a relative instrument that measures multidimensional, and hierarchical physical self-concept. It is a 70-item test designed to measure nine specific components of physical self-concept (Strength, Body Fat, Physical Activity, Endurance, Fitness, Sports Competence, Coordination, Health, Appearance, Flexibility), as well as having scales measuring global physical self-concept and global self-esteem (Marsh, Richards, Johnson, Roche, & Tremayne, 1994).

CHAPTER TWO

REVIEW OF RELATED LITERATURE

A healthy life style is one which balances activities promoting psychological and physical health, and is cited as a major factor for decreasing the risk factors for obesity as well as reinforcing positive self-concept. Physical activity, such as regular exercise and competitive sports, is fundamental to a healthy life style (Lau, Cheung, & Ransdell, 2008).

What Body Fat Is

Body fat is essential to health (Musaiger, Lloyd, Al-Neyadi, & Bener, 2003). It regulates body temperature, absorbs shock and stores nutrients. However, excess body fat is detrimental to health (Gallagher, Heymsfield, Heo, Jebb, Murgatroyd, & Sakamoto, 2000). Obesity, from the Latin word "obesus" (meaning fat or plump), is a condition where too much fat is stored in the body (Hekler, Gardner, & Robinson, 2010). The World Health Organization notes that more than 1 billion people worldwide can be classified as overweight or obese (Geneva, 2003). A synonym for obesity is overfatness (Going et al., 1993).

By analyzing the definition of obesity, it is apparent that the source of the epidemic is not body fat itself, but the struggle to maintain fatness levels at desirable points.

In times of food scarcity, people with extra stored body fat have an advantage which regulates body temperature, absorbs shock and stores nutrients. During these times, people are often routinely physically active, counteracting obesity (Finkelstein, 2009). With changes in life style and access to food, many people now have unlimited quantities of food as well as sedentary lifestyles.

Fifty years ago, people expended significantly more energy than people do today (Davison & Birch, 2001). For this reason, obesity is increasing at an alarming rate in developing and developed countries. Reduced physical activity, junk food, and lack of adequate healthcare are significant factors impacting people's attempts at maintaining healthy weight (Freedland et al., 2008).

In 2000, accumulation of excess body fat was defined as a medical condition, obesity, which was associated with reduced life expectancy (Gallagher et al., 2000). It has become a major epidemic health problem, the fifth leading cause of mortality globally (James et al., 2004). Indeed, it is also a risk factor associated with type II diabetes

mellitus, hypertension, some cancers, metabolic syndrome, and coronary heart disease (Yang et al., 2009; Nguyen, Magno, Lane, Hinojosa, & Lane, 2008).

Methods for Assessing Body Fat

Human body is composed of water, protein, minerals, and fat. In order to make the most valid assessment of body fat, it must be examined the underlying theoretical models.

Hydrostatic Weighing

The two-component model of body composition divides the body into a fat component and a fat-free body component (Brozek, Grande, Anderson, & Keys, 1963; Siri, 1961). The fat-free component consists of all residual chemicals and tissues including water, muscle and bone. This two-component model has served as the foundation for the hydrodensitometry method that is under water weighing. Using the assumed proportions of water, minerals, and protein and their respective densities, equations were derived to convert the individual's total body density from hydrostatic weighing into relative body fat proportions. Two commonly used equations are the Siri's (1961) equation, $\% \text{body fat} = (4.95/\text{body density} - 4.50) * 100$, and the

Brozek, and his colleague's (1963) equation, % body fat
= $(4.57/\text{body density}-4.142)*100$.

This method determines body volume by totally submerging the body in an underwater weighing tank or pool and measuring the underwater weight of the body. To measure underwater weight, the experimenter can use either a chair attached to a hydrostatic weighing scale which is illustrated in Figure 1, or a platform attached to load cells which are illustrated in Figure 2.

For certain population subgroups, therefore, scientists have applied multicomponent models of body composition based on measured total body water and bone mineral values. With the multicomponent approach, the experimenter can avoid systematic errors in estimating body fat by replacing the reference man with population specific reference bodies that allow for the age, gender, and ethnicity of the individual. Table 1 provides population-specific formulas for converting body density to % body fat.

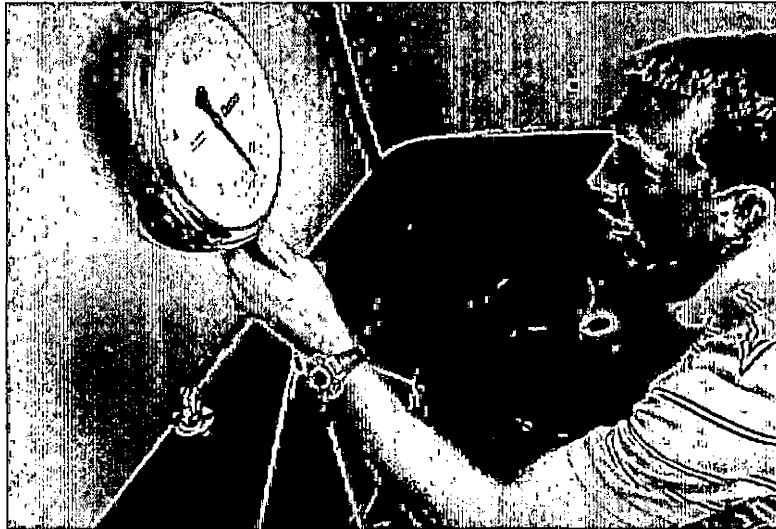


Figure 1. Hydrostatic Weighing Using Scale.

Note. Adapted from "Body composition assessment," by Journal of Exercise Physiology Online, 2001, Retrieved May 5, 2012, from <http://www.tzhealth.com/Urine%20Analyzer/plasma%20urine%20after%20equilibration%20is%20measured%20used%20estimate%20TBW%20analyzer%20measures%20lower%20body%20resistance%20between%20Urine%20Analyzer.htm>



Figure 2. Load Cells and Platform.

Note. Adapted from "Body composition assessment," by Journal of Exercise Physiology Online, 2001, Retrieved May 5, 2012, from <http://www.tzhealth.com/Urine%20Analyzer/plasma%20urine%20after%20equilibration%20is%20measured%20used%20estimate%20TBW%20analyzer%20measures%20lower%20body%20resistance%20between%20Urine%20Analyzer.htm>

Dual-Energy X-ray Absorptiometry

In most laboratory and clinical settings, densitometry and dual-energy X-ray absorptiometry are used to obtain reference measures of body fat. Dual-energy X-ray absorptiometry is gaining recognition as a reference method for body composition research. This method yields estimates of bone mineral, fat, and lean soft-tissue mass.

Illustrated in Figure 3. is dual-energy X-ray absorptiometry equipment which is highly reliable, and there is a high degree of correlation between %body fat estimates obtained by hydrostatic weighing and by dual-energy X-ray absorptiometry (Going et al., 1993; Van Loan & Mayclin, 1992). Dual-energy X-ray absorptiometry is an appropriate alternative to hydrostatic weighing as a reference method because it is safe and rapid, requires minimal subject cooperation, and most importantly, accounts for individual variability in bone mineral content.

Although some body composition prediction equations have been developed and validated using dual-energy X-ray

absorptiometry as a reference method, additional research is needed before dual-energy X-ray absorptiometry can be firmly established as the best reference method (Kohrt, 1995; Roubenoff, Kehayas, Dawson, Hughes, & Heymsfield, 1993).

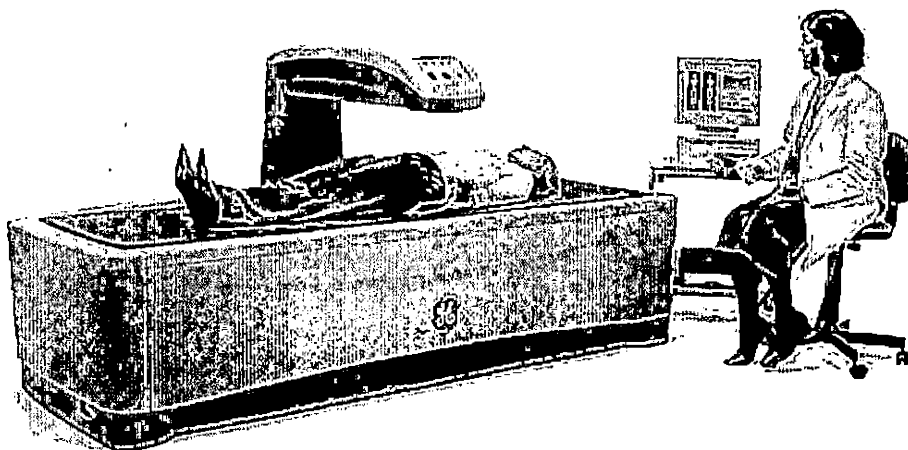


Figure 3. Dual-Energy X-ray Absorptiometry

Note. Adapted from "Body composition assessment," by Journal of Exercise Physiology Online, 2001, Retrieved May 5, 2012, from <http://www.tzhealth.com/Urine%20Analyzer/plasma%20urine%20after%20equilibration%20is%20measured%20used%20estimate%20TBW%20analyzer%20measures%20lower%20body%20resistance%20between%20Urine%20Analyzer.htm>

Skinfold Method

In a field setting, the experimenter can use more practical methods to estimate clients' body composition via the skinfold method due to time restraints, space limitation, and economical reasons. A skinfold indirectly measures the thickness of subcutaneous adipose tissue. When

the experimenter uses the skinfold method to estimate total body density in order to calculate relative body fat, certain basic relationships are assumed that (a) the distribution of fat subcutaneously and internally is similar for all individuals within each gender (Lohman, 1981), (b) due to the fact that there is a relationship between subcutaneous fat and total body fat, the sum of several skinfold measurements can be used to estimate total body fat (Lohman, 1981), (c) There is a correlation between the sum of skinfold measurements and body density (Jackson, 1984), and (d) age is an independent predictor of body density for both female and male (Jackson, 1984).

The equations to measure body composition use two or three skinfold measurements to predict body density. The body density is then converted to %body fat using the appropriate population-specific conversion formula which is indicated in Table 1. Table 2 presents commonly used population-specific and generalized skinfold prediction equations (Ng, 1997).

Self-Concept, Self-Esteem, and Physical Self

In recent years, psychology researchers have found that individuals who are popular, rich, and powerful are

not necessarily happy (Sheldon, Elliot, Kim, & Kasser, 2001). Indeed, Sheldon and her colleagues found that these components ranked toward the bottom of psychological needs, while self-esteem topped the list of needs that bring happiness to people. This is certainly good news in the field of exercise psychology, as researchers have repeatedly stated that the greatest potential impact of physical activity may be seen in the participant's self-esteem (Folkins & Sims, 1981; Hughes, 1984; McAuley, 1994). Therefore, improved self-esteem could be expected as a positive change in participants' physical and overall self-concept following successful adoption and maintenance of a physical activity regimen. Physical self-concept is formulated by the individual's judgments of both general physical abilities and physical appearance. According to a multifaceted model of self-concept, individuals with elevated perceptions of their physical abilities and positive feelings regarding their physical appearance would be expected to report a strong, positive physical self-concept (Shalvenson, Hubner, & Stanton, 1976). Another research suggest that promoting the self-esteem enhancing properties of physical activity might be a viable strategy for improving activity levels in those individuals who view

self-esteem as a primary psychological need (Sheldon et al., 2001).

Methods of Measurement for Self-Concept

Self-concept and self-esteem have traditionally been defined as unidimensional constructs, and early measures designed to assess these constructs reflected this approach (Sheldon et al., 2001). In order to make the most valid assessment of physical self-concept, it is necessary to understand two measurement methods, which are the Physical Self-Perception Profile (PSPP) and the PSDQ.

Physical Self-Perception Profile (PSPP)

The PSPP (Fox & Corbin, 1989) was largely based on the notions of self-concept proposed by Shalvelson, Hubner, and Stanton (1976). The 30 item battery follows a reponse pattern similar to that successfully employed by Hartter (1985), in that two contrasting statements are presented. Respondents are asked to read each pair of statements, decide which of the two statements is most characteristic of themselves, and check a box denoting the extent to which the statement is characteristic of themselves. The instrument is divided into five subscales related to beliefs on sports competence, physical conditioning, body

appearance, physical strength and global self-worth. The Physical Self-Perception Profile has been shown to be a valid and reliable measure across a variety of populations, including middle aged adults, American college students, and overweight adults (Fox & Cobin, 1989; Fox & Dirkin, 1992; Page, Ashford, Fox, & Biddle, 1993).

Physical Self-Description Questionnaire (PSDQ)

The PSDQ (Marsh et al., 1994) is a 70 item instrument divided into nine components of physical self-concept such as physical strength, body fat, levels of physical activity in which one has engaged, endurance/fitness, sports competence, coordination, physical health, appearance, and flexibility and includes scales measuring global physical self-concept and global self-esteem.

Marsh and his colleagues have documented considerable support for the validity of the instrument in Austrian adolescents (Marsh & Redmayne, 1994), and the PSDQ appears to provide a comprehensive assessment of physical self-concept with the added feature of global measures of both physical self-concept and self-esteem (Marsh, Asci, & Tomas, 2002). Especially, in adolescence, most of students experience significant psychological and physical changes (Ninot & Bilard, 2004). During this period of development,

physical activity helps to sustain self-confidence and provide a base for construction of a stable identity. Additionally, physical activity promotes self-affirmation through physical performance, better body image and opportunities for various types of peer relationships (Brettschneider, 1999).

CHAPTER THREE

METHODOLOGY

The study was initiated by conducting research to demonstrate the physical and psychological benefits of physical activity and the correlation between body fat and physical self-concept.

Research was then collected on the various types of 16 articles from 11 journals. This information was found using the online databases, EBSCO Host and ERIC. The main keywords used were: body fat, physical activity, self-concept, self-esteem, self-efficacy, self-confidence, Physical Self-Perception Profile, Physical Self-Description Questionnaire and physical self-concept. Next, the databases were used to find scholarly journal articles. The scholarly journals used were the Journal of Clinical Psychology, the International Journal of Sport Psychology, the Journal of Sport and Exercise Psychology, the International Journal of Obesity, the Journal of Clinical Nutrition, the American Journal of Clinical Nutrition, the American Journal of Preventive Medicine, the Journal of the American Medical Association, the Journal of the American College of Surgeons, the Journal of Personality and Social

Psychology, and the European Journal of Cancer. Above journal article and online article were copied for review purposes. Other journals were also viewed, but were not considered specifically related to the topic of this project.

CHAPTER FOUR

RESULT

After completing the review of literature, this study mainly focused on the correlation between body fat and physical self-concept as well as the physical and psychological benefits of physical activity.

In one of the earliest studies of self-concept and exercise, Collingwood and Willett (1971) enrolled five obese male teenagers in a three week physical activity program in which participants engaged in daily aquatic and gymnastic activities for one hour. The results indicated that significant improvements in body weight, cardiovascular fitness, attitude toward the body and self, and self-acceptance. More recently, researchers found that African American girls who are eight to 12 years of age with high levels of self-esteem attended significantly more physical activity sessions per week than those with low self-esteem (Lemmon, Ludwig, & Howe, 2007).

Employing a more theory-based study rationale, Lau, Cheung, and Ransdell (2008) recruited 320 Chinese children who were seven to 12 years of age and assessed their self-perceptions of fat, appearance, strength, global physical

self-concept, and global self-concept. The authors tested the proposition that perceptions about body fat, appearance, and strength would impact the children's physical self-concept which would, in turn, influence their overall self-concept. While the relationship held for body fat, appearance, and strength, each had a twofold effect. First, each exerted a significant influence on physical self-concept, as hypothesized. A somewhat similar approach to theory-testing was reported by Ryan (2008), who found that perceptions of strength, flexibility, and endurance were associated with enhanced physical self-esteem in male and female college students.

The results from the review of literature show that many factors related to body fat, physical activity, self-concept, self-esteem, and physical self-concept. As a result, these factors were considered as those that could contribute to the physical and psychological benefits of physical activity.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

Conclusion

The literature review findings indicate what definitive conclusions can be made regarding the relationship among exercise and self concept, physical fitness, body composition, and physical self-concept.

First, exercise generally exerts a positive influence on self-concept and self-esteem for all populations. Indeed, as shown in the reviewed literature, a number of research studies have demonstrated the significant changes of self-concept, physical fitness, and body composition in physical activity settings.

Second, the greatest improvements in self-concept, self-concept, physical fitness, and body composition are likely to occur in those populations that have the most to gain physically and psychologically from exercise participation. Included among these groups are middle-aged with disabilities and elderly adults who are overweight or obese; those with low levels of physical ability, self-confidence, self-concept, or self-esteem; and those who maintain a negative body image.

Recommendations

This study recommends that future research is needed in the following areas: negative effect of exercise on self-concept and self-esteem, greater cross-cultural breadth, wider range of age groups, especially, early childhood range, and the Physical Self-Perception Profile and the Physical Self-Description Questionnaire for deeper examination of psychological self-concept.

Although some of these topics were brought into this study, the study lacked greater detail, and additional research must be conducted. It will be useful for future studies.

APPENDIX A
CONVERSION OF BODY DENSITY TO BODY FAT

Table 1. Conversion of Body Density to Body Fat

Population (Ethnicity)	Age	Gender	% Body Fat	FFB (g/cc)
American Indian	18-69	Female	(4.81) / Db - 4.34	1.108
African American	19-45	Male	(4.86) / Db - 4.39	1.106
	24-79	Female	(4.85) / Db - 4.34	1.106
Hispanic	20-40	Female	(4.87) / Db - 4.41	1.105
Asian	18-48	Male	(4.97) / Db - 4.52	1.099
		Female	(4.76) / Db - 4.28	1.111
	61-78	Male	(4.87) / Db - 4.41	1.105
		Female	(4.95) / Db - 4.50	1.100
White	7-12	Male	(5.30) / Db - 4.89	1.084
		Female	(5.35) / Db - 4.95	1.082
	13-16	Male	(5.07) / Db - 4.64	1.094
		Female	(5.10) / Db - 4.66	1.093
	17-19	Male	(4.99) / Db - 4.55	1.098

Note. Adapted from "Body composition assessment," by
 Journal of Exercise Physiology Online, 2001, Retrieved May
 5, 2012, from
<http://www.tzhealth.com/Urine%20Analyzer/plasma%20urine%20after%20equilibration%20is%20measured%20used%20estimate%20TBW%20analyzer%20measures%20lower%20body%20resistance%20between%20Urine%20Analyzer.htm>.

*FFB = fat free body

APPENDIX B
SKINFOLD PREDICTION EQUATIONS

Table 2. Skinfold Prediction Equations

Skinfold sites	Population subgroups	Equation
7sites (chest+abdomen+thigh+triceps+ subscapular+suprailiac+midaxilla)	Black or Hispanic Women, 18-55years	$Db(g/cc) = 1.0970 - 0.00046971(7S-SKF) + 0.00000056(7S-SKF)^2 - 0.00012828(age)$
	Black men or male athletes, 18-61 years	$Db(g/cc) = 1.1120 - 0.00043499(7S-SKF) + 0.00000055(7S-SKF)^2 - 0.00028826(age)$
4sites (abdomen+thigh+triceps+anterior suprailiac)	Female athletes, 18-29 years	$Db(g/cc) = 1.096095 - 0.0006952(4S-SKF) + 0.00000011(4S-SKF)^2 - 0.0000714(age)$
3 sites (thigh+triceps+suprailiac)	White or anorexic women, 18-55 years	$Db(g/cc) = 1.0994921 - 0.0009929(3S-SKF) + 0.00000023(3S-SKF)^2 - 0.0001392(age)$
	White men, 18-81years	$Db(g/cc) = 1.109380 - 0.0008267(3S-SKF) + 0.0000016(3S-SKF)^2 - 0.0002574(age)$
2 sites (triceps+calf)	Black or white boys, 6-17 years	$\%bodyfat = 0.735(2S-SKF) + 1.0$
	Black or white girls, 6-17years	$\%bodyfat = 0.610(2S-SKF) + 5.1$

Note. Adapted from "Body composition assessment," by Journal of Exercise Physiology Online, 2001, Retrieved May 5, 2012; from <http://www.tzhealth.com/Urine%20Analyzer/plasma%20urine%20after%20equilibration%20is%20measured%20used%20estimate%20TBW%20analyzer%20measures%20lower%20body%20resistance%20between%20Urine%20Analyzer.htm>

*Db = body density, S-SKF = sum of skinfolds (mm)

REFERENCES

- Bosaeus, I. (2002). Body composition, as assessed by bioelectrical impedance spectroscopy and dual-energy X-ray absorptiometry, in a healthy pediatric population. *Acta Paediatr*, 91, 755-760.
- Brettschneider, W. (1999). Adolescents in top-level sport: Growing up with the pressures of school and training. *European Physical Education Review*, 5(2), 121-133.
- Brozek, J., Grande, F., Anderson, J.T., & Keys, A. (1963). Densiometric analysis of body composition. *Annals of the New York Academy of Sciences*, 110, 113-140.
- Collingwood, T.R., & Willett, L. (1971). The effects of physical training upon self-concept and body attitude. *Journal of Clinical Psychology*, 27, 411-412.
- Davison, K., & Birch, L. (2001). Childhood overweight: A contextual model and recommendations for future research. *Department of Human Development and Family Studies, Pennsylvania State University*, 2(3), 159-71.
- Finkelstein, E. (2009). Annual medical spending attributable to obesity. *Health Affairs*, 28(5), 822-31.
- Folkins, C.H., & Sime, W.E. (1981). Physical fitness training and mental health. *American Psychologist*, 36, 373-389.

- Fox, K.R. (2000). Self-esteem, self-perceptions and exercise. *International Journal of Sport Psychology*, 31, 228-40.
- Fox, K.R., & Corbin, C.B. (1989). The physical self-perception profile: Development and preliminary validation. *Journal of Sport and Exercise Psychology*, 11, 408-430.
- Fox, K.R., & Dirkin, G.R. (1992). Psychological predictors and outcomes of exercise in patients attending multidisciplinary obesity treatment. *International Journal of Obesity*, 16, 84.
- Frankenfield, D.C., Rowe, W.A., Cooney, R.N., Smith, J.S., & Becker, D. (2001). Limits of body mass index to detect obesity and predict body composition. *Nutrition*, 17, 26-30.
- Freedland, S.J., Wen, J., Wuerstle, M., Shah, A., Lai, D., Moalej, B., Atala, C., & Aronson, W.J. (2008). Obesity is a significant risk factor for prostate cancer at the time of biopsy. *Urology Health*, 72, 1102-1105.

- Gallagher, D., Heymsfield, S.B., Heo, M., Jebb, S.A., Murgatroyd, P.R., & Sakamoto, Y. (2000). Healthy percentage body fat ranges: An approach for developing guidelines based on body mass index. *The American Journal of Clinical Nutrition*, 72, 694-701.
- Geneva, F. (2003). World Health Organization technical reportseries: Diet, nutrition and the prevention of chronic diseases. *World Health Organization*, 916.
- Going, S.B., Massett, M.P., Hall, M.C., Bare, L.A., Root, P.A., Williams, D.P., & Lohman T.G. (1993). Detection of small changes in body composition by dual-energy x-ray absorptiometry. *American Journal of Clinical Nutrition*, 57, 845-850.
- Hartter, S. (1985). Manual for the self-perception profile for children. *University of Denver*
- Hekler, E.B., Gardner, C.D., & Robinson, T.N. (2010). Effects of a college course about food and society on students' eating behaviors. *American Journal of Preventive Medicine*, 38(5), 543-47.

- Horn, T.S. (2004). Developmental perspectives on self-perceptions in children and adolescents. In M. R. Weiss (Ed.), *Developmental Sport and Exercise Psychology: A Lifespan Perspective*, 101-143. Morgantown, WV: Fitness Information Technology.
- Hughes, J.R. (1984). Psychological effects of habitual aerobic exercise. *Preventive Medicine*, 13, 66-78.
- Jackson, A.S. (1984). Research design and analysis of data procedures for predicting body density. *Medicine and Science in Sport and Exercise*, 16, 616-620.
- James, W., Jackson, L.R., Mhurchu, C., Kalamara, E., Shayeghi, M., Rigby, N., Nishida, C., & Rodgers, A. (2004). Overweight and obesity: In comparative quantification of health risks. *World Health Organization*, 497-596.
- Kohrt, W. (1995). Body composition by DXA: Tried and true? *Medicine and Science in Sport and Exercise*, 27, 1349-1353.
- Lau, P.W.C., Cheung, M.W.L., & Ransdell, L.B. (2008). A structural equation model of the relationship between body perception and self-esteem: Global physical self-concept as the mediator. *Psychology of Sport and Exercise*, 9, 493-509.

- Lemmon, C.R., Ludwig, D.A., Howe, C.A., Ferguson-Smith, A., & Barbeau, P. (2007). Correlates of adherence to a physical activity program in young African-American. *Obesity, 15*, 695-703.
- Lohman, T.G. (1981). Skinfold and body density and their relation to body fatness: A review. *Human Biology, 53*, 181-225.
- Marsh, H.W., Asci, F.H., & Tomas, I.M. (2002). Multitrait-multimethod analyses of two physical self-concept instruments: A cross cultural perspective. *Journal of Sport and Exercise psychology, 24*, 99-119.
- Marsh, H.W., & Redmayne, R.S. (1994). A multidimensional physical self concept and its relations to multiple components of physical fitness. *Journal of Sport and Exercise Psychology, 16*, 43-55.
- Marsh, H.W. & Richards, G.E., Johnson, S., Roche, L., & Tremayne, P. (1994). Physical self-description questionnaire: Psychometric properties and a multitrait-multimethod analysis of relations to existing instruments. *Journal of Sport and Exercise Psychology, 16*, 270-305.

- McAuley, E. (1994). Physical activity and psychosocial outcomes. *Physical Activity, Fitness, and Health*, 551-568.
- Mokdad, A.H., Marks, J.S., Stroup, D.F., & Gerberding, J.L. (2004). Actual causes of death in the United States. *The Journal of the American Medical Association*, 10, 1238-45.
- Musaiger, A.O., Lloyd, O.L., Al-Neyadi, S.M., & Bener, A.B. (2003). Lifestyle factors associated with obesity among male university students in the United Arab Emirates. *Nutrition and Food Science*, 33(4), 145-147.
- Ng, N. (1997). Comprehensive body composition soft ware. *Human Kinetics*
- Nguyen, N., Magno, C., Lane, K., Hinojosa, M., & Lane, J. (2008). Association of hypertension, diabetes, dyslipidemia, and metabolic syndrome with obesity. *Journal of the American College of Surgeons*, 207, 928-934.
- Ninot, G., & Bilard, J. (2004). Age and gender effects on global self-esteem and physical self-perception in adolescents. *European Physical Education Review*, 10, 53-69.

- Page, A., Ashford, B., Fox, K.R. & Biddle, S.J.H. (1993). Evidence of cross-cultural validity of the Physical Self-Perception Profile. *Personality and Individual Differences*, 14, 585, 590.
- Roubenoff, R., Kehayias, J.J., Dawson, B., & Heymsfield, S.B. (1993). Use of dual-energy x-ray absorptiometry in body composition studies. *American Journal of Clinical Nutrition*, 58, 589-591.
- Ryan, M.P. (2008). The antidepressant effects of physical activity: Mediating self-esteem and self-efficacy mechanisms. *Psychology and Health*, 23, 279-307.
- Shavelson, R.J., Hubner, J.J., & Stanton, G.C. (1976). Validation of construct interpretations. *Review of Educational Research*, 46, 407-441.
- Sheldon, K.M., Elliot, A.J., Kim, Y., & Kasser, T. (2001). What's satisfying about satisfying event? Comparing ten candidate psychological needs. *Journal of Personality and Social Psychology*, 80, 325-339.
- Siri, W.E. (1961). Body composition from fluid space and density. *National Academic Science*, 4(2), 223-224.

- Tiggemann, M., & Williamson, S. (2000). The effects of exercise on body satisfaction and self-esteem as a function of gender and age. *Sex Roles: A Journal of Research, 43*, 119-127.
- Van Loan, M.D., & Mayclin, P.L. (1992). Body composition assessment: Dual-energy x-ray absorptiometry compared to reference methods. *European Journal of Clinical Nutrition, 46*, 125-130.
- Yang, P., Zhou, Y., Chen, B., Wan, H., Jia, G., Bai, H., & Wu X. (2009). Overweight, obesity and gastric cancer risk. *European Journal of Cancer, 45*(16), 2867-2873.