

## ABSTRACT

ZAHALKA, Joan M. The relationship of body image to percent body fat of HPER and Business majors. M.S. in Adult Fitness/Cardiac Rehabilitation, 1982, 69 pp. (N.K. Butts)

Fifty-three randomly selected male Ss, 28 HPER majors and 25 Business majors, at the University of Wisconsin-La Crosse, participated in a study to compare % body fat (BF) and body image (BI) between each major and within each major. %BF was measured by hydrostatic weighing and BI was measured by the Tennessee Self Concept Scale (TSCS) and the Body Cathexis Scale (BCS). The Ss ranged in age from 20 to 24 yrs. Independent "t" tests were performed on Ht, Wt, %BF and 5 BI variables. Results indicated no sig diff ( $p < .05$ ) between HPER majors and Business majors in any of the variables. A discriminant analysis was done on the 40 item BCS. The calculated Wilks' Lambda for items 1 through 20 was .52 and the chi-squared transformation ( $\chi^2 = 26.16$ ) was not sig ( $p < .05$ ). The calculated Wilks' Lambda for items 21 through 40 was .62 and the chi-squared transformation ( $\chi^2 = 19.35$ ) was not sig ( $p < .05$ ). A Pearson Product Moment  $r$  was employed to compare %BF to each BI variable within each major. The only sig  $r$  ( $p < .05$ ) obtained was between %BF and the physical-self/self-satisfaction BI score of the Business majors ( $r = .542$ ). It was concluded that the lack of sig diff in %BF between the 2 majors could be attributed to the health and fitness atmosphere associated with the University of Wisconsin-La Crosse campus. Furthermore, in these Ss, there was no relationship between %BF and BI.

THE RELATIONSHIP OF BODY IMAGE  
TO PERCENT BODY FAT OF  
HPER AND BUSINESS MAJORS

---

A Thesis Presented  
to  
The Graduate Faculty  
University of Wisconsin-La Crosse

---

In Partial Fulfillment  
of the Requirements for the  
Master of Science Degree

---

by  
Joan M. Zahalka  
December, 1982

UNIVERSITY OF WISCONSIN - LA CROSSE  
College of Health, Physical Education and Recreation  
La Crosse, Wisconsin 54601

Candidate: Joan M. Zahalka

We recommend acceptance of this thesis in partial fulfillment of this candidate's requirements for the Master of Science degree in Adult Fitness/Cardiac Rehabilitation. The candidate has completed her oral report.

Nancy Kay Butts 27 July 1982  
Thesis Committee Chairperson Date

Margaret F. Dorel 5/19/82  
Thesis Committee Member Date

John E. Casteti 5/19/82  
Thesis Committee Member Date

This thesis is approved for the College of Health, Physical Education and Recreation.

John C. Mitchem August 4, 1982  
Dean, College of Health, Physical Education and Recreation Date

Howard C. Rok August 5, 1982  
Dean of Graduate Studies Date

### ACKNOWLEDGEMENTS

First of all, I would like to express a sincere thanks to my chairperson, Dr. Nancy Butts, whose guidance and advice encouraged me through-out this endeavor. I would also like to thank Dr. Peg Dosch and Dr. Jack Castek for contributing valuable input.

Special thanks goes to Kathy Menard. Even though the odds were against us, we still managed to obtain 88% of our random subject population!

A warm appreciation is extended to Barbara Evans for her patience and cheerfulness as a room-mate during the final stages.

Four people have been instrumental and supportive in my long drive to attain my goals here at the University of Wisconsin-La Crosse. First, I would like to thank my Mom and Dad. With their encouragement, as in the words of my Father, "Put your nose in the air, your chin in the wind and don't look back", I was able to persist.

Secondly, thanks to my sister Kris who helped me to maintain my sanity during the week.

Finally, special thanks and love goes to my husband Rick. His understanding, patience, love and support encouraged me always through-out my graduate work. He was the backbone of this ordeal. Thanks Rick for giving me the drive!

## TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES . . . . .	vii
<b>CHAPTER</b>	
I. INTRODUCTION . . . . .	1
Purpose of the Study . . . . .	2
Need For the Study . . . . .	3
Hypothesis . . . . .	3
Assumptions . . . . .	4
Delimitations . . . . .	4
Limitations . . . . .	5
Definition of Terms . . . . .	5
II. REVIEW OF RELATED LITERATURE . . . . .	7
Introduction . . . . .	7
Body Image in Relationship to Percent Body Fat	7
Tennessee Self Concept Scale . . . . .	9
Description . . . . .	9
Reliability . . . . .	11
TSCS Test Manual . . . . .	11
Validity . . . . .	12
Conclusions . . . . .	13
Body Cathexis Scale . . . . .	15
Description . . . . .	15
Reliability . . . . .	16
Validity . . . . .	16
Conclusions . . . . .	16

CHAPTER	Page
Hydrostatic Weighing . . . . .	17
Introduction . . . . .	17
Development of the Formulas . . . . .	17
Residual Volume . . . . .	19
Summary . . . . .	20
III. METHODS . . . . .	21
Subject Selection . . . . .	21
Obtaining the Sample . . . . .	21
General Procedures . . . . .	23
Instrumentation . . . . .	24
Height and Weight . . . . .	24
Residual Volume . . . . .	25
Hydrostatic Weighing . . . . .	28
Statistical Treatment of the Data . . . . .	30
IV. RESULTS AND DISCUSSION . . . . .	31
Introduction . . . . .	31
Subjects . . . . .	32
Physical Characteristics . . . . .	32
Percent Body Fat . . . . .	34
Body Image . . . . .	35
Body Image and Percent Body Fat . . . . .	37
Discussion . . . . .	39
V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS . . . . .	42
Summary . . . . .	42
Conclusions . . . . .	43

CHAPTER	<u>Page</u>
Recommendations . . . . .	43
REFERENCES CITED . . . . .	45
APPENDICES	
A. Letter to the Dean of Business and HPER . . . . .	50
B. Letter to Business/HPER Instructors . . . . .	52
C. Letter to Business/HPER Subjects . . . . .	54
D. Water Immersion Densimetry Information . . . . .	56
E. Consent Form . . . . .	58
F. Body Cathexis Scale . . . . .	60
G. Instruction Sheet . . . . .	62
H. Residual Volume Data Sheet . . . . .	64
I. Underwater Weighing Data Sheet . . . . .	66
J. Discriminant Analysis Results of the 40 Item Body Cathexis Scale . . . . .	68

LIST OF TABLES

TABLE	<u>Page</u>
1. Means, Standard Deviations and Ranges for Physical Characteristics of HPER Majors and Business Majors . . . . .	33
2. Means, Standard Deviations and Ranges for Body Image Variables of HPER Majors and Business Majors . . . . .	36
3. Correlation Coefficients of the Body Image Variables to Percent Body Fat . . . . .	38

CHAPTER I  
INTRODUCTION

In the past several decades, the problem of obesity has grown to major proportions in the United States. According to the United States Public Health Service, 25 to 46% of the American population over 30 years of age are 20% or more above their ideal weight (U.S. Public Health Service, 1966). Obesity refers not only to excess poundage or overweightness, but also to an increased amount of body fat. Actual percent body fat can be determined through such techniques as hydrostatic weighing.

According to Zion (1965), through-out history man has been intrigued with possibility that outward characteristics of the body might reveal the inner personality of man. Secord and Jourard (1953) also stated that "an individual's attitudes toward his body are of crucial importance to any comprehensive theory of personality" (p. 343). How an individual perceives his/her percent body fat may have an effect on that individual's own body image. Body image, as defined by Schilder (1935), is a mental picture an individual has of his/her own body. Individuals with a high body fat percentage have shown disturbances in body image. For example, Brantley and Clifford (1976) reported a difference in body image between obese adolescents and non-obese

adolescents. Young and Reeve (1980) reported that individuals high in body fat and those of normal body fat differ according to body image measures.

In order to measure body image of the students in the College of Health, Physical Education and Recreation (HPER) and the students in the School of Business randomly chosen for this study, two tools of measurement were utilized: Secord and Jourard's Body Cathexis Scale (1953) and Fitts' Tennessee Self Concept Scale (1965). Percent body fat measurements were determined by hydrostatic weighing.

#### Purpose of the Study

The purpose of this study was to compare percent body fat, as measured by hydrostatic weighing, and body image, as measured by the Tennessee Self Concept Scale (TSCS) and the Body Cathexis Scale, between the students in the College of HPER and the students in the School of Business. It was also of interest to investigate the relationship between body image and percent body fat within each group of randomly selected students.

#### Need for the Study

Because of increased interest and participation in physical activities that develop and maintain cardiorespiratory fitness and control body weight and fat, evaluation of physical fitness plays an important role in health management (Pollock, Schmidt & Jackson, 1980). Among the areas associated with physical fitness, body composition has been

considered a necessary component when assessing the average adult. Excessive fat weight and obesity are related to many health problems such as hypertension, diabetes mellitus, depression, anxiety, hyperlipidemia, etc. (Pollock et al., 1980). This exemplifies that people need to take charge of their mental and physical health needs by personal body composition awareness. It was, therefore, beneficial that a study be conducted in an attempt to ultimately make people more aware of percent body fat as a component of total fitness.

As recommended by Young and Reeve (1980), additional research is also needed to identify common body image measurements which discriminate between groups who differ on several indices of fitness, specifically percent body fat.

#### Hypothesis

The following null hypotheses were recognized in this study:

1. There is no significant difference between percent body fat of HPER majors compared to Business majors.
2. There is no significant difference between body image of HPER majors compared to Business majors.
3. There is no significant relationship between body image and percent body fat of HPER majors.
4. There is no significant relationship between body image and percent body fat of Business majors.

### Assumptions

Within the limits of the study, it was necessary to make the following assumptions:

1. The subjects fasted twelve hours prior to hydrostatic weighing.
2. The subjects were healthy the day of testing.
3. The subjects performed the residual volume and hydrostatic weighing procedures to the best of their ability.
4. The subjects were truthful in answering the TSCS and the Body Cathexis Scale.
5. Consistency was present on the part of the experimenter when administering the testing procedures.
6. Any additional air present in the subject's suit, on the body surface or in the mouth after attempting to eliminate it prior to submersion was minimal and therefore, not corrected for.
7. The TSCS and the Body Cathexis Scale adequately measured body image.

### Delimitations

A number of delimitations were recognized in the study:

1. Only University of Wisconsin-La Crosse undergraduate males were tested.
2. Only Juniors, ranging in age 20 to 24 years old were considered.
3. Only two specific groups within the University

population were recognized: the College of HPER and the School of Business.

4. Physically handicapped individuals were not considered.
5. Subjects with respiratory problems or diseases were not considered.

#### Limitations

In reference to this study, the following limitations must be considered:

1. A refusal of the randomly selected subjects to participate in any part of the study was beyond the control of the researcher.
2. Heredity factors of the subjects were not in control of the researcher.
3. The over-all physical activity and health atmosphere associated with the University of Wisconsin-La Crosse campus may positively influence the results. *good*

#### Definition of Terms

Density - the weight of an object per unit volume ( $D=M/V$ ).

Hydrostatic Weighing - the process of weighing a body underwater to determine the volume of the body.

Percent Body Fat - the percentage of total body weight that consists of adipose tissue as measured by hydrostatic weighing.

Residual Volume (RV) - the volume of air remaining in the lungs following the greatest possible maximal expiration.

Body Image - a mental picture an individual has of his/her own body as measured by the TSCS and the Body Cathexis Scale.

Body Cathexis - the degree of feeling of satisfaction or dissatisfaction with various parts or processes of the body.

CHAPTER II  
REVIEW OF RELATED LITERATURE

Introduction

The following discussion deals with the related literature concerning body image and its relationship to percent body fat; background information regarding the Tennessee Self Concept Scale (TSCS) and the Body Cathexis Scale; and, some history pertaining to hydrostatic weighing and residual volume procedures.

Body Image in Relationship to Percent Body Fat

A review of related literature revealed that not many studies have been done concerning the measurement of body image and its relationship to percent body fat. Although it has been shown that individuals with a high percent body fat show disturbances in body image.

In 1976, Brantley and Clifford conducted a study to estimate the predictive value of measures of cognitive organization, self concept and body image in correctly classifying three groups of adolescents: normal, cleft palate and obese. The subjects, ranging from age 11 to 18, were subjected to an extensive battery of psychological tests. The responses to each measure of body image underwent a factor analysis data reduction process which identified 18 body image variables. Discriminant analysis was then applied to

this subset of body image variables. Three separate but overlapping discriminant analyses were performed comparing normal, cleft and obese subjects; normal and cleft subjects; and cleft and obese subjects.

The results indicated that a linear combination of 11 of the 18 body image variables was discriminating. These measures included appearance, body satisfaction and physical health concerns. The discriminant analysis of body image measures classified normals and clefts with 72.2% accuracy and clefts and obese with 95.9% accuracy. Out of the three areas measured, cognitive organization, self concept and body image, body image seemed to be the area that differentiated obese adolescents from the other groups the most (Brantley & Clifford, 1976).

Young and Reeve (1980) performed a study to determine whether individuals with a high percent body fat can be distinguished on the basis of body image from those individuals with a low percent body fat. In order to measure body image of 65 female college students, the Body Cathexis Scale (Seward & Jourard, 1953) was used. Skinfold measurements were taken to determine percent body fat. The 20 highest and the 20 lowest subjects in terms of percent body fat were included in the analysis.

The discriminant analysis statistical procedure was used to determine if women classified as high percent body fat could be differentiated from women with a low percent body

fat on the basis of body image measures. Six body image items from the Body Cathexis Scale were entered into the discriminant analysis; weight, legs, chest, teeth, posture and body build. "The Wilks' Lambda based on all six items was 0.15. The chi-squared transformation ( $X^2=66.49$ ) was significant ( $p < .01$ ), indicating that body image significantly distinguished between the two groups" (Young & Reeve, 1980, p. 550). To determine if the body image items accurately distinguished between the groups, the 40 subjects were reclassified using the derived discriminant function. The reclassification resulted in 100% of the subjects correctly being classified as either high or low in percent body fat from the body image data.

Since six body image items were identified as discriminating between the two groups, the results demonstrated that females differing in percent body fat can be differentiated on selected body image items. The females high and low in percent body fat displayed obvious differences in satisfaction about their bodies. It was suggested by Young and Reeve (1980) that future studies be directed toward identifying a common core of body image items which would discriminate between groups of varying indices of health and fitness.

#### Tennessee Self Concept Scale

##### Description

A wide variety of instruments have been employed to measure self concept/body image (Robinson & Shaver, 1973).

Among these particular scales, the Tennessee Self Concept Scale or TSCS (Fitts, 1965) was chosen to be used for this research since it involves five areas, one of which measures the physical self or relates to body image. Two forms of the TSCS exist; a Counseling Form and a Clinical and Research Form. The Counseling Form was used since it was quicker and easier to score and provided the necessary information for the purpose of this research.

The TSCS consists of 100 self description questions based on a five-point Likert scale in which the subject had the choice of five response categories ranging from completely true (category 5) to completely false (category 1). Ninety of the 100 items, equally divided as to positive and negative questions, were grouped into a two-dimensional, 3 x 5 self concept classification. The first dimension yields three measures from the individual's internal frame of reference: identity (how the person sees himself/herself), self-satisfaction (how the person accepts himself/herself), and behavior (how he/she acts). The second dimension consisted of five measures of external frame of reference: physical self, moral-ethical self, personal self, family self and social self. Of concern to the researcher, was all three measures in the first dimension; identity, self-satisfaction and behavior and how they relate to the physical self. Together these eight measures form a self-esteem score or total score.

### Reliability

The test-retest reliability coefficient of the TSCS was reported to be .92 (Fitts, 1965). Since the norm group of 626 people was over represented by the number of college students, white subjects and persons in the 12-30 year age bracket (Fitts, 1965), the test-retest reliabilities are quite substantial for a college student sample as used in this study (Buros, 1972).

### TSCS Test Manual

The manual, written by Fitts (1965), that was concurrent with the test booklet, received some basic criticisms. Bentler, according to Buros (1972), reported two major inter-related defects in the manual. First of all, Bentler noted that the manual was virtually in complete absence of information regarding the internal structure of the scale. "No explicit definitions of the constructs which guided item choice are offered" (Wylie, 1974, p. 230). Secondly, a high degree of over interpretation of the profiles regarding the data was indicated (Buros, 1972; Wylie, 1974). In other words, no factor analysis was reported and the few independent dimensions in the subscores may lead to over interpretations not warranted on the basis of the data. Since publication of the manual, factor analysis studies have been documented which will be reported later in this chapter.

Swinn, according to Buros (1972), was disappointed in the manual for the following reasons: there was no

descriptive statistics on a normative sample, the method of selection of the samples cited was absent and the exact nature of results leading to the author's various conclusions was unclear. Swinn concluded that an enormous amount of research has been stimulated and a revised manual is needed to deal with this research.

### Validity

Most of the past criticisms concerning the TSCS fell in the area of validity. According to Gable, LaSalle and Cook (1973), content validity was well supported by the manual's description of the generation of the original item pool. Also, Gable and associates felt that the description of the development of the 3 x 5 item-scale classification lended further support to content validity.

According to Swinn (Buros, 1972) and Gable et al. (1973), a strong aspect was the TSCS's current scoring system which can be used to discriminate between normals and non-normals (e.g., psychotics, neurotics, etc.). Concurrent with this belief was the need for additional evidence pertaining to construct validity and factor analysis. Since Pitts (1965) did claim that the TSCS was a multi-dimensional approach to self concept, research was needed to verify this ascertainment.

Rentz and White (1967) factored data from 138 college students and concluded that only two independent factors of self concept, self-esteem and conflict integration, accounted for the total test variance. Thus five major measures of

self concept; physical self, moral-ethical self, social self, personal self and family self, were aspects of only two independent dimensions.

Vacchiano and Strauss (1968) factored item level data for 260 college students. The emergence of 20 factors suggested that the TSCS was indeed a complex measure of the self and that the item interrelationships suggested dimensions that adequately reflected the five external frame of reference measures. It was then summarized that the five proposed measures of the self, when considered together, lend some support to validation of the TSCS.

Gable et al. (1973) followed this research with a study administered to 125 college freshmen. They concluded that the two dimensional (external and internal) 3 x 5 item scale classification used in the TSCS may only be one dimension representing the five external self concept measures and supported by the three internal self concept measures (identity, self-satisfaction and behavior). This evidence thus tended to partially support the external self concept measures and Gable et al. (1973) recommended further studies be done concerning construct validity of the TSCS.

### Conclusions

The capability of research to measure self concept/body image variables is a problem that exists with self concept/body image assessment. Naturally the question about any self concept/body image measuring device that arises is, does the

scale actually measure what it is supposed to? Thus the measurement problem in self concept/body image research was critical. Crites, according to Buros (1972), stated that the TSCS "does not allow the examinee to use his own words to describe himself and consequently some would argue that it is not truly phenomenological" (p. 369) and thus does not adequately measure self concept/body image. At this point, the researcher would like to point out that this type of test could be very time consuming for the subject and could also present some problems concerning scoring.

The TSCS definitely had some positive advantages indicated in the literature. According to Fitts (1965), the TSCS was simple for the subject, widely applicable and also well standardized. Fitts (1972) also pointed out that ten years of extensive research was devoted to the development of the TSCS. Since the TSCS is one of the most frequently used self concept instruments, it serves as a common thread for tying together research findings (Fitts, 1965). Robinson and Shaver (1973) pointed out that since this scale is widely used, it seems appropriate to challenge it more than others.

The researcher chose this particular tool for a number of reasons. First of all, the TSCS only requires approximately 20 minutes to take which was important since the researcher did not wish to take up too much of the subject's time. The scoring procedure of the scale was relatively easy. According to Robinson and Shaver (1973), the TSCS "has most

of the positive attributes we would look for in a scale and an active author" (p. 69). More importantly, the scale considered five external frame of reference measures, one of which involved the physical self. This was of particular interest to the researcher since measuring body image was imperative to the study.

#### Body Cathexis Scale

##### Description

The Body Cathexis Scale, developed by Secord and Jourard (1953), was the tool used to measure one aspect of self concept; satisfaction with aspects of the body. Secord and Jourard (1953) defined body cathexis as the "degree of feeling satisfaction or dissatisfaction with various parts or processes of the body" (p. 343). According to Wylie (1974), this scale was more concerned with a limited aspect of self-regard, namely body image. Thus this scale is broad and prominate enough to subjects that it would be expected to correlate with over-all self-regard.

The test consisted of 40 physical body parts and functions in which the subjects rate their satisfaction with each on a five point Likert scale. The five ratings ranged from a positive rating of 1 (have strong positive feelings) to a negative rating of 5 (have strong negative feelings). To determine the mean score, the item ratings were added together and divided by 40.

### Reliability

Secord and Jourard (1953) reported a split-half reliability coefficient for a 46 item Body Cathexis, for 45 males and 43 females, of  $r=.78$  for college males and  $r=.83$  for females. Johnson (1956) reported a split-half reliability for males of  $r=.72$ , with a mean age of 20.2. Weinburg (1960) reported a reliability for the 40 item Body Cathexis Scale of  $r=.84$  for college males and  $r=.75$  for college females.

### Validity

According to Robinson and Shaver (1973) and Wylie (1974), no item analysis and little validity work have been performed on the Body Cathexis Scale. A number of studies (Secord & Jourard, 1953; Johnson, 1956; Weinburg, 1960; Rosen & Ross, 1968) have shown that satisfaction with body image and feelings about body image are related to feelings about the self. Wylie (1974) suggested that although the reliability of the Body Cathexis Scale was fairly good, and some theoretically predicted correlations with a number of other variables were present, convergent and discriminant validity needs further investigation.

### Conclusions

Since body image is an important element of self concept, measurement techniques are needed in the area of self-regard and body image. Even though the Body Cathexis Scale has offered a take-off point for measuring body image, further development and refinement of this scale seems worthwhile

(Burns, 1979; Wylie, 1974).

## Hydrostatic Weighing

### Introduction

Hydrostatic weighing was chosen as the best method for estimating body volume when assessing individual percent body fat. This method gives the subject a better perception of his or her "ideal" body weight which refers to a minimal amount of fat on the body (Astrand & Rodahl, 1977; Behnke & Wilmore, 1974).

### Development of the Formulas

In examining the history of hydrostatic weighing, some basic underlying principles and equation derivations were followed to develop the workable formulas used in this research. To determine the density of any object, the relationship of weight to volume ( $D=W/V$ ) dates back to Archimedes (Behnke, 1961; Keys & Brozek, 1953). The Archimedes principle states that "a body immersed in a fluid is acted on by a buoyancy force, which is evidenced by a loss of weight equal to the weight of the dispersed fluid" (Behnke & Wilmore, 1974, p. 22). Once the density of the body is known, the proportion of fat in the body can be calculated by using an equation that converts density to body fat (Rathbun & Pace, 1945; Keys & Brozek, 1953; Brozek, Anderson, Grande & Keys, 1963). These equations differ in that each deal with slightly different density values for lean and fat tissue (Behnke & Wilmore, 1974).

To determine the density of the subject, mass ( $M_A$ ) was measured by weighing the subject in air while volume of the body was obtained from the mass of water displaced by the body in the hydrostatic weighing tank. The difference between  $M_A$  and the weight of the completely submerged body ( $M_W$ ) was the mass of the displaced water ( $M_A - M_W$ ). A correction for density of the water, which corresponds to the water temperature at the time of underwater weighing, must be taken into account (Goldman & Buskirk, 1961; Behnke & Wilmore, 1974):

$$\text{Volume} = \frac{(M_A - M_W)}{D_W} \quad (1)$$

This equation then became (Goldman & Buskirk, 1961, p. 79):

$$\text{Body Density} = \frac{M_A}{\frac{M_A - M_W}{D_W}} \quad (2)$$

Two other volumes needed to be subtracted from the gross body volume to yield body density: 1) the volume of air left in the lungs or residual volume (RV); and, 2) the gas in the gastro-intestinal (GI) tract. Residual volume measurement consists of an oxygen dilution technique described by Wilmore (1969). To account for gas in the GI tract, it was proposed that a correction of 100 ml or 0.1 L (BTPS) be subtracted in the equation (Buskirk, 1961). With these two corrections taken into account, the final equation became:

$$D_B = \frac{M_A}{(M_A - M_W) - RV - 0.1 L.} \quad (3)$$

as reported by Behnke and Wilmore (1974), Buskirk (1961), Goldman & Buskirk (1961) and Sinning (1975).

Once body density is known, the percentage of body fat can be determined. The equation used in this research for converting density to percent body-fat was developed by Brozek et al. (1961, p. 131):

$$\% \text{ Body Fat} = \frac{4.570}{D_B} - 4.142 \times 100 \quad (4)$$

#### Residual Volume

Residual volume (RV) is an important measurement that demands the highest degree of accuracy possible. The recommended method described by Wilmore (1969) was a modified nitrogen wash-out procedure originally developed by Darling, Courmand and Richards (1940).

Validity of Wilmore's technique was established by comparing it with the technique by Darling et al. (1940). Twenty subjects were tested twice by each of these methods. ". . . the intercorrelation coefficient of  $r=.958$  indicated that the degree of common variance of the individual mean values for the two methods were extremely high ( $r^2=0.958$ )" (Wilmore, 1969, p. 98).

The reliability of the method chosen was shown through a test-retest correlation to be  $r=0.993$  with a standard error of  $\pm 28$  ml for a sample of 195 males and  $r=0.987$  with

a standard error of 130 ml for a sample of 102 females (Wilmore, 1969).

#### Summary

It is apparent from the present review of related literature that there is a lack of research relating body image to percent body fat in a given population of people. The two studies conducted in this area have reported that individuals with a high percentage of fat can be distinguished from individuals with a low percentage of fat based on body image measurements.

The TSCS was found to be very reliable for college age students. Because of the TSCS's 3 x 5 item-scale classification, a body image score could be determined separately. Even though reliability of the Body Cathexis Scale was fairly good, convergent and discriminant validity needs further investigation. This scale offered a beginning for the measurement of body image but still needs additional development and refinement.

The hydrostatic weighing procedure, in combination with the modified nitrogen wash-out procedure for measuring residual volume, was chosen as an accurate means of determining percent body fat.

## CHAPTER III

### METHODS

#### Subject Selection

Thirty students each were randomly chosen from the junior classes of the College of Health, Physical Education and Recreation (HPER) and from the School of Business at the University of Wisconsin-La Crosse (N=60). All subjects were males between the ages of 20 to 24. Junior level students were selected since most students are committed to their majors by this stage of their college work. Of the 60 subjects randomly selected, 25 Business majors and 28 HPER majors agreed to participate in the study. Physically handicapped students and any student not meeting the above criteria were eliminated from the study and a new random subject was selected.

#### Obtaining the Sample

The original random sample of subjects from each of the two groups were identified through a computer enrollment print-out available from the computer center located on the University of Wisconsin-La Crosse campus. The researcher assigned a number to each enrolled student in Business, placed the numbers in a hat and drew out one number at a time, replacing the number after each drawing, until 30 numbers were drawn. The same method was done for the HPER

students. Once the random sample of the names, addresses and telephone numbers of the 60 students were chosen, the researcher found it imperative to devise the best possible method for successful participation of each randomly selected student.

The first step was to seek the support of the Dean of HPER and the Dean of Business and ultimately, the instructors that were academically involved with the students. A letter of explanation regarding the research was sent to both Deans (see Appendix A). Next, letters were sent to all junior level HPER and Business instructors informing them of the study and the need for their support toward the students chosen for the study (see Appendix B).

An introductory letter was then sent to each randomly selected student that explained the study and emphasized the need for each and every student's participation (see Appendix C). Five days later, the researcher then telephoned each student and attempted to successfully persuade the student to commit himself to the study and sign up for a testing time. If the student's telephone number was unavailable, the researcher then visited that student at his home.

Since the subjects were needed to participate in two different thesis studies, the testing time for this study was made at the first appointment time of the other study. This enabled the researcher to distribute to each subject, a water immersion densiometry information sheet (see Appendix

D) that summarized the preliminary underwater weighing procedures. Seven out of the 60 randomly chosen subjects refused to participate in the study. Two students refused because of lack of interest in the study. Since the last portion of the testing was at the end of the semester, two students refused due to a busy time schedule and the remaining three students cancelled their appointment time.

#### General Procedures

Participation in the study required one visit to the Human Performance Laboratory at the University of Wisconsin-La Crosse for one hour. Upon arrival, each subject read and signed a consent form designed to include both separate thesis studies (see Appendix E).

The subject proceeded to complete two body image assessment devices; the Tennessee Self Concept Scale (TSCS) (Fitts, 1965) and the Body Cathexis Scale (Secord and Jourard, 1953). The published TSCS and the manual are available from Counselor Recordings and Tests, Box 6184 - Acklen Station, Nashville, Tennessee 37212. Because of its commercial nature, only sample items of the TSCS can be reproduced in this paper. Of specific importance were the scores that represented the physical dimension, since these best represented body image. The test, comprised of 100 items, was answered on the following Likert-type scale: completely false (1); mostly false (2); partly false and partly true (3); mostly true (4) and; completely true (5). Sample items include:

1. I have a healthy body. (Physical)
25. I am satisfied with my moral behavior. (Moral)
38. I have a lot of self-control. (Personal)
57. I am a member of a happy family. (Family)
79. I am as sociable as I want to be. (Social)

An example of the Body Cathexis Scale is given in Appendix F. This 40 item body image measurement tool was also based on a Likert-type scale. The Body Cathexis Scale can be reprinted with permission from the American Psychological Association, Copyright 1953.

An instruction sheet accompanied the two assessment tools emphasizing that the subject's identity would remain anonymous (see Appendix G). The subject placed an assigned number and his academic major or majors on his answer sheet instead of his name. The identity of the subject was of interest to the researcher only when the individual and total group results were sent out to the subjects. Both answer sheets, upon completion of the assessment devices, were placed in a sealed envelope.

#### Instrumentation

##### Height and Weight

Body weight was recorded to the nearest .25 pounds on a calibrated Health-O-Meter Scale (Continental Scale Corp., Chicago, Ill.). The subject was weighed barefoot and in a pair of shorts or a swimsuit prior to hydrostatic weighing. Weight in pounds was converted to kilograms. Height was

recorded to the nearest .25".

#### Residual Volume

The method of measuring residual volume (RV) in this study was a modification of the oxygen dilution technique described by Wilmore (1969). To avoid serious error of estimation, the amount of dead space of the total system must be reduced in order to allow a much faster clearance of nitrogen from the system prior to the test (Wilmore, 1969). The modifications in the technique utilized in the Human Performance Laboratory at the University of Wisconsin-La Crosse were developed by Jensen (1979).

All RV tests were conducted with the subject seated in front of the head of the Collins Nitrogen Analyzer (model number 21232), which continuously analyzed the subject's inspired and expired air. The subject was inclined slightly forward since this position closely resembled that of hydrostatic weighing (Wilmore, 1969). While the procedures of the test were thoroughly explained to the subject, the total system was flushed with oxygen three times to clear out the nitrogen and to check the system for possible leakage. A noseclip was then secured firmly over the subject's nose and the subject's mouth comfortably positioned around the rubber mouthpiece.

With the mouthpiece in position, the subject was to take three to four normal respirations with the breathing valve open to room air. On the last breath, the subject was

instructed to inhale deeply and then exhale as fully as possible indicating the point when maximal expiration has been attained by tapping the researcher's arm. At this point, the researcher immediately switched the two-way valve to connect the subject to the pure oxygen in the spirometer circuit while recording on the data sheet (see Appendix H) the final fractional reading of the nitrogen content at the endpoint of the expiration ( $AN_2$ ). The subject was then instructed to take a breath in, approximately two-thirds of his vital capacity, and the fraction of nitrogen measured during inspiration ( $IN_2$ ) was recorded. The subject continued to rebreathe the oxygen within the bag, approximately five to eight breaths, at a rate of one respiration every three seconds, until an equilibrium content of nitrogen ( $EN_2$ ) was reached. The  $EN_2$  represents the decimal fraction of nitrogen. By observing the continuously decreasing visual oscillation in the nitrogen percentage of the inspired and expired air, this equilibrium was fairly and precisely estimated and recorded. At this point, the subject was instructed to again take a deep breath in followed by a maximal expiration. Once again the subject signalled the end of maximal expiration by tapping the researcher's arm and the final expired fraction of nitrogen ( $FN_2$ ) was recorded while the breathing valve was turned back to room air. After approximately three minutes of normal breathing, the subject repeated the entire procedure.

Two trials were used to avoid additional error (Katch &

Katch, 1980; Wilmore, 1969). The lowest RV value obtained was used. If a difference greater than .05 liters between the two trials was present, a third trial was conducted. If the third value fell between the two trials, then it was used for the calculations.

The following equation was the working formula used for calculating RV (Wilmore, 1969, p. 98):

$$RV = \frac{VO_2 (EN_2 - IN_2)}{(AN_2 - FN_2)} - DS \times BTPS \text{ Factor} \quad (5)$$

where:

RV = Residual volume

$VO_2$  = Initial fixed volume of oxygen in system

$EN_2$  = Decimal fraction of nitrogen at the point of equilibrium

$IN_2$  = Decimal fraction of impurity nitrogen initially in  $VO_2$

$AN_2$  = Decimal fraction of alveolar nitrogen initially present when breathing room air

$FN_2$  = Decimal fraction of alveolar nitrogen at termination of the test

DS = Dead space in connecting tubes between subject and apparatus

BTPS factor was determined from a table for the correction of gas volume from STPD to BTPS at a given barometric pressure in mm Hg (Clinical Spirometry, p. 17). The highest value of the two trials within .05 l of each other was used in the calculation of body density.

### Hydrostatic Weighing

The measurement of body density provides a useful method for estimating body fat percentage. Since density was defined as "the weight of an object per unit volume" (Sinning, 1975, p. 363), determining percent body fat requires measuring body weight with a scale of adequate sensitivity and measuring body volume determined by underwater weighing described by Katch, Michael and Horvath (1967).

An underwater weighing procedure sheet (see Appendix D) was given to each subject prior to testing to inform them that it was necessary to fast twelve hours before the actual weighing. After the RV testing and the subject's dry weight and height were measured and recorded (see Appendix I), the subject was then instructed to shower. During this time, the researcher recorded the temperature of the water in order to determine water density and the weight of the weighing apparatus in kilograms. The subject then climbed into the 4'x 4'x 4' immersion tank and sat on a light-weight polyethylene chair suspended from a 15 kg autopsy scale (Chattillion & Sons, New York, N.Y.) graduated in 25 gm increments and fastened to the ceiling. The subject was instructed to remove any air bubbles from the skin and from within the swimsuit.

The procedure of underwater weighing was explained to the subject and a noseclip was placed on his nose. Just

before submerging beneath the surface of the water, the subject was instructed to forcefully expire as much air as possible from his lungs. As the subject's head was slowly drawn toward his knees and gradually submerged, he continued to expell as much air as possible from the lungs and mouth. While the subject was completely immersed, the researcher steadied the weight-scale oscillations manually and recorded the underwater weight to the nearest 25 gm. The researcher then tapped on the tank signalling the subject to surface (see Appendix I).

To reduce the possibility of incorrectly interpolating the actual reading, ten trials were recommended by Behnke and Wilmore (1974) and Katch (1968). Behnke and Wilmore's (1974) method for determining the final reading was used. This involved three criterion: (a) take the highest obtained weight if observed more than twice; (b) take second highest weight if observed more than once and if first criterion is not obtained; and (c) take third highest weight if neither first not second criterion are attained.

The following equation was the working formula used for calculating body density (Behnke & Wilmore, 1974):

$$D_B = \frac{M_A}{\frac{(M_A - M_W)}{D_W} - RV - 0.1 \text{ liter}} \quad (6)$$

where:

$D_B$  = Density of the body

$M_A$  = Mass of the body in air (kg)

$M_W$  = Mass of the body in water (kg)

$D_W$  = Density of water at the time of weighing

RV = Residual volume

0.1 liter = Correction factor for intestinal gas volume

Once the  $D_B$  was calculated, the percent body fat was determined by the following working formula (Brozek, Grande, Anderson & Keys, 1963):

$$\% \text{ Fat} = \frac{4.570}{D_B} - 4.142 \times 100 \quad (7)$$

#### Statistical Treatment of Data

Means, standard deviations and ranges were determined for height, weight, percent body fat and all body image variables in the HPER group and in the Business group. A Student's independent "t" test was used to statistically compare the actual percent body fat and body image variables between HPER majors and Business majors. A discriminant analysis (Wilks Lambda stepwise procedure) (Klecka, 1975) was used specifically on the 40 item Body Cathexis Scale to identify body image items which discriminate between the two groups. The Pearson Product Moment correlation was employed to determine the correlation between percent body fat and the body image variables in each group of subjects.

CHAPTER IV  
RESULTS AND DISCUSSION

Introduction

The purpose of this study was to compare percent body fat and body image between students in the College of Health, Physical Education and Recreation (HPER) and students in the School of Business. Percent body fat was measured by hydrostatic weighing and body image was measured by the Tennessee Self Concept Scale (TSCS) and the Body Cathexis Scale. The study was conducted at the University of Wisconsin-La Crosse using male subjects only. The relationship between body image and percent body fat within each group was also investigated.

To compare body image and percent body fat between the two groups, Student's independent "t" tests were calculated. Four out of five body image variables came from the TSCS and included: total score from all 100 questions; and three internal frame of reference scores under the physical-self category (an identity score, a self-satisfaction score and a behavior score). As indicated in the research (Vacchiano & Strauss, 1968; Gable et al., 1973), factor analysis supported this 3 x 5 classification of the 100 questions in the TSCS. The fifth body image variable was the mean score from the 40 item Body Cathexis Scale. The .05 level of significance

was used to accept or reject the null hypotheses. The critical t ratio required for rejection at the .05 level was 2.01.

In addition to this procedure, a discriminant analysis (Wilks' Lambda stepwise procedure) from the Statistical Package for the Social Sciences (Klecka, 1975), was used on the 40 item Body Cathexis Scale to determine if any items significantly distinguished between the two groups.

The Pearson Product Moment correlation was employed to determine if significant correlations existed between percent body fat and the five body image variables of each specific group. A correlation of .38 was necessary for the correlation to be significant at the .05 level of confidence.

#### Subjects

The subject population consisted of 60 randomly selected male students, 30 from the College of HPER and 30 from the School of Business at the University of Wisconsin-La Crosse. Of the 60 total students, 53 volunteered to participate in the study (HPER, N=28, Business, N=25). The subjects ranged in age from 20 to 24 years ( $\bar{x}$  = 20.75). The randomized selection of subjects participating in this study signifies a fair representation of the college male population of HPER and Business majors.

#### Physical Characteristics

Means, standard deviations and ranges for percent body fat, height and weight are reported in Table 1 for each group

Table 1. Means, standard deviations and ranges for physical characteristics of HPER majors (N=28) and Business majors (N=25).

Characteristic	HPER	Business
Height (cm)	177.3 <sup>a</sup>	178.4
	3.71 <sup>b</sup>	2.53
	180.0-190.5 <sup>c</sup>	167.6-193.0
Weight (kg)	76.8	76.9
	9.64	10.77
	54.4-90.9	60.9-107.3
Percent Body Fat	11.6	13.2
	5.30	4.07
	4.1-26.7	7.1-22.2

a = Mean

b = Standard Deviation

c = Range

of random subjects. There was no significant difference ( $p < .05$ ) in weight or height between HPER majors and Business majors.

#### Percent Body Fat

The Student's "t" test supported the null hypothesis of no significant ( $p < .05$ ) difference between percent body fat of HPER majors compared to Business majors. This may be due to the over-all physical activity, fitness and health atmosphere associated with the University of Wisconsin-La Crosse campus. Business majors would thus have the same exposure to fitness and health opportunities as do HPER majors. For example, the health fairs on the La Crosse campus mall, city fun runs and the intramural sports programs are open to all majors. It would be worthwhile to see if this result is unique to the La Crosse students or if percent body fat would differ between HPER majors and Business majors on other campuses.

At the present time, there is no valid criteria for ideal percent body fat directly related to health standards (Pollock et al., 1980). According to Pollock and his associates, the average 18 to 20 year old male has a body fat measurement of 15% with a standard deviation of 5%. One standard deviation above the average (20%) is considered too fat. Most researchers define the ideal standard upper limit for percent body fat to be 16 to 19 for men (Behnke & Wilmore, 1974; Pollock, Hickman, Kendrick, Jackson, Linnerud & Dawson,

1976; Pollock et al., 1980). In this study, both groups had a mean percent body fat below the 15% (HPER,  $\bar{x}$  = 11.6; Business,  $\bar{x}$  = 13.2). Since the percent body fat of both majors is below the ideal standard upper limit, this may lend support to the idea that both groups are receiving fitness-conscience exposure. Perhaps the University of Wisconsin-La Crosse campus has a unique atmosphere associated with it that promotes a health-conscience attitude among the majority of the students. It would be interesting to see if the same group of students on other campuses have low percent body fats.

#### Body Image

The means, standard deviations and ranges of the body image variables (four from the TSCS and one from the Body Cathexis Scale), for the HPER subjects and the Business subjects are reported in Table 2. Independent "t" calculation resulted in no significant ( $p < .05$ ) difference in any of these five body image variables between HPER majors and Business majors.

To further investigate this hypothesis, a discriminant analysis statistical procedure (Klecka, 1975) was used on the 40 item Body Cathexis Scale to determine if HPER majors could be differentiated from Business majors on the basis of the Body Cathexis items. Since one HPER subject did not answer the Body Cathexis Scale, the total number of subjects for this statistical analysis was 52. Body image items 1 through

Table 2. Means, standard deviations and ranges for body image variables of HPER majors and Business majors.

Variables	HPER	Business
TSCS	(N=28)	(N=25)
Physical-self and Identity Score	25.4 <sup>a</sup> 2.08 <sup>b</sup> 20-30 <sup>c</sup>	25.0 1.76 22-29
Physical-self and Behavior Score	24.8 2.20 21-30	23.7 2.62 19-29
Physical-self and Self-satisfaction Score	21.3 3.09 15-29	20.8 3.71 13-27
Total Score	353.8 22.45 313-400	342.2 26.79 288-393
Body Cathexis Scale	(N=27)	(N=25)
Mean Score	2.4 .58 1.58-3.63	2.6 .60 1.66-4.05

a = Mean

b = Standard Deviation

c = Range

20 were entered into the discriminant analysis first. The Wilks' Lambda based on these 20 items was .52. The chi-squared transformation ( $\chi^2 = 26.16$ ) was not significant ( $p < .05$ ). Body image items 21 through 40 were also entered into the discriminant analysis. The Wilks' Lambda based on these items was .62. The larger the Wilks' Lambda, the less discriminating power present. The chi-squared transformation ( $\chi^2 = 19.35$ ) was not significant. This result signifies that the subjects could not be identified according to the two different groups on the basis of scores on the Body Cathexis Scale. The means and standard deviations for each group are reported for the 40 Body Cathexis items in Appendix J. Although four Body Cathexis items showed significance at the .05 level, they were not able to differentiate between groups as a result of the more refined discriminant analysis procedures. The Wilks' Lambda and univariate F ratios for these items are reported in Appendix J. Even though four F ratios are significant, this does not mean that the two groups differ.

#### Body Image and Percent Body Fat

A Pearson Product Moment correlation was used to determine the correlation between percent body fat and each of the five body image variables for the HPER majors and for the Business majors. The correlation coefficients are presented in Table 3. The only significant correlation ( $p < .05$ ) shown was between percent body fat and the physical-self/self-

Table 3. Correlation coefficients of the body image variables to percent body fat.

Variables	Percent Body Fat	
	HPER (N=28)	Bus (N=25)
	r	r
TSCS		
Physical-self and Identity Score	0.367	0.308
Physical-self and Self-satisfaction Score	0.240	0.542*
Physical-self and Behavior Score	0.357	0.117
Total Score	0.066	0.204
Body Cathexis Scale**		
Mean Score	0.173	0.150

\* Significant at .05 level ( $r=38$ )

\*\*For the Body Cathexis Scale, HPER: N=27

satisfaction score of the Business majors. The lower the percent body fat, the greater the Business student's personal view of his body image in terms of self-satisfaction. This result could be due to chance, since no other correlations were shown particularly in the same score of the HPER majors. By performing similiar studies on random subjects from other majors, one significant correlation may have resulted due to chance as exemplified here.

#### Discussion

Of the two similiar studies cited in the review of related literature, neither one compared a normal group to another normal group. Both studies were able to differentiate, utilizing discriminant analysis, between obese persons or persons with a high percent body fat and those with a low percent body fat. In the study performed by Brantley and Clifford (1976), a comparison was done between normal, cleft palate and obese adolescent males and females; normal and cleft adolescents; and cleft and obese adolescents, to determine the predictive value of body image variables in correctly classifying the three groups. The discriminant analysis of the body image measures differentiated between normals and clefts with 72.7% accuracy. For clefts and obese, the percentage was 95.9%. It was concluded that body image measures clearly differentiate between obese adolescents and all other groups.

In the study conducted by Young and Reeve (1980), two

groups of college-age females were identified out of 65 students on the basis of percent body fat: one group was the 20 females with the highest percent body fat ( $\bar{x} = 31.2$ ) and the other group was the 20 females with the lowest percent body fat ( $\bar{x} = 19.2$ ). Body image was measured by the Body Cathexis Scale. The discriminant analysis of the Body Cathexis Scale differentiated between the high percent body fat group and the low percent body fat group with 95% accuracy. It was concluded that certain body image factors could discriminate between college females high and low in percent body fat.

According to these two studies, those groups that differ greatly in percent body fat can be distinguished from each other on the basis of body fat and in the case of Young and Reeve's study (1980), also on the basis of body image. Perhaps in this study there would have been a significant difference in body image variables if percent body fat measures would also have shown a significant difference. For example, when considering the subject group as a whole, by comparing the 20 highest males in percent body fat to the 20 lowest males in percent body fat may have shown differences in body image. But yet, one needs to consider the percent body fat range and the sex of the subjects chosen for the study. The range of percent body fat for the subjects in Young and Reeve's study was 13-43%. The subjects involved in this study had a range in percent body fat from 4.1 to 26.7%.

Since the range in this study was smaller, this may be the reason why no significance was found. Young and Reeve (1980) also chose female subjects to participate in their study. The relationship found between body image and percent body fat may only exist in a female subject population and not in a male subject population as chosen in this study.

In conclusion, it is worthwhile to consider the possibility of subject somatotype or physique influencing the results of the study. Perhaps a comparison between body image and somatotype would have shown a significant difference since somatotype is readily visible by the subject. Percent body fat is a more uncommon fitness parameter to the average individual and is not as easily perceived as is one's own physique apparent in a simple reflection from a mirror.

## CHAPTER V

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

#### Summary

The purpose of this study was to compare percent body fat and five body image variables between randomly selected Health, Physical Education and Recreation (HPER) majors (N=28) and Business majors (N=25), 20 to 24 years of age, at the University of Wisconsin-La Crosse. The relationship between percent body fat and each of five body image variables within each group was also investigated.

Percent body fat was measured through hydrostatic weighing. The body image assessments tools consisted of the Tennessee Self Concept Scale (TSCS) and the Body Cathexis Scale. Four body image scores were chosen from the TSCS and one body image score (mean) was chosen from the Body Cathexis Scale.

There was no significant difference in height, weight, percent body fat and body image between HPER majors and Business majors. Only one body image variable, the physical-self/self-satisfaction score from the TSCS, correlated with percent body fat in the Business group ( $r = .54$ ). The HPER group showed no correlation between percent body fat and body image.

### Conclusions

From the present study, the following conclusions were formulated. There was no significant difference between the two majors in percent body fat or in body image. Because there was no significant difference in percent body fat between the two groups, this may have been the reason for no significant difference in body image.

Mean percent body fat of the randomly selected HPER and Business majors was below the average 15% for 18 to 22 year olds (Pollock et al., 1980). This could possibly be due to the health and ~~fitness~~ atmosphere associated with the University of Wisconsin-La Crosse campus. Perhaps the University of Wisconsin-La Crosse campus has a unique quality that is worth investigating at other University of Wisconsin campuses.

### Recommendations

Based upon the knowledge obtained in this study, certain recommendations can be made. A duplication of Young and Reeve's study (1980) using college males instead of college females could easily have been done to see if body image factors could discriminate between the 20 males with the highest percent body fat and the 20 males with the lowest percent body fat. Different scales to measure body image besides the TSCS and the Body Cathexis Scale could also be used. A follow-up comparison study on this campus between the majors in the College of HPER and also between the majors

in the School of Business may be interesting. Additional University of Wisconsin-La Crosse majors could also be added as well as female populations. A study such as this one, measuring body fat as a fitness parameter, could be conducted at additional University of Wisconsin campuses using a random selection of subjects from the total student population.

#### REFERENCES CITED

- Astrand, P. & Rodahl, K. Textbook of work physiology (2nd ed.). New York: Mc Graw-Hill, 1977.
- Behnke, A.R. Comment on the determination of whole body density and a resume of body composition data. In J. Brozek & A. Henschel (Eds.), Techniques for measuring body composition. Washington D.C.: National Academy of Sciences; National Research Council, 1961.
- Behnke, A.R. & Wilmore, J.H. Evaluation and regulation of body build and composition. Englewood Cliffs, New Jersey: Prentice-Hall, 1974.
- Brantley, H.T. & Clifford, E. Cognitive self-concept and body image measures of normal, cleft palate and obese adolescents. Cleft Palate Journal, 1976, 13, 419-420.
- Brozek, J., Grande, F., Anderson, J.T. & Keys, A. Densitometric analysis of body composition: Revision of some quantitative assumptions. Annals of the New York Academy of Sciences, 1963, 110, 113-140.
- Burns, R.B. The self concept: Theory measurement development and behavior. New York: Longman Inc., 1979.
- Buskirk, E.R. Underwater weighing and body density: A review of procedures. In J. Brozek & A. Henschel (Eds.), Techniques for measuring body composition. Washington D.C.: National Academy of Sciences; National Research Council, 1961.
- Clinical spirometry. Braintree, MA: Warren E. Collins, Inc.
- Darling, R.C., Cournard, J.S. & Richards, D.W. Studies on the intrapulmonary mixture of gases: III. An open circuit method for measuring residual air. Journal of Clinical Investigation, 1940, 19, 609-618.
- Fitts, W.H. Manual for Tennessee Self Concept Scale. Nashville, Tennessee: Counselor Recording and Tests, 1965.
- Fitts, W.H. The self concept and behavior: Overview and supplement (Monograph 7). Nashville, Tennessee: Counselor Recordings and Tests, 1972.

- Gable, R., LaSalle, A. & Cook, K. Dimensionality of self perception: Tennessee Self Concept Scale. Perceptual and Motor Skills, 1973, 36, 551-560.
- Girandola, R.N., Wiswell, R.A., Mohler, J.G., Romero, G.T. & Barnes, W.S. Effects of water immersion on lung volume: Implications for body composition analysis. Journal of Applied Physiology, 1977, 43, 276-279.
- Goldman, R.F. & Buskirk, E.R. Body volume measurement by underwater weighing: Description of a method. In J. Brozek & A. Henschel (Eds.), Techniques for measuring body composition. Washington D.C.; National Academy of Sciences; National Research Council, 1961.
- Graig, A.B. & Ware, D.E. Effect of immersion in water on vital capacity and residual lung volume. Journal of Applied Physiology, 1967, 23, 423-425.
- Jensen, D.G. Determination of body density in prepubescent males, age 7-11. Masters thesis, University of Wisconsin-La Crosse, May 1979.
- Johnson, L.C. Body cathexis as a factor in somatic complaints. Journal of Consulting Psychology, 1956, 20, 145-149.
- Katch, F.I. Apparent body density and variability during underwater weighing. Research Quarterly, 1968, 39, 993-999.
- Katch, F.I. & Katch, V.L. Measurement and prediction errors in body composition assessment and the search for the perfect prediction equation. Research Quarterly for Exercise and Sport, 1980, 51, 249-260.
- Katch, F.I., Michael, E. & Horvath, S. Estimation of body volume by underwater weighing: Description of a simple method. Journal of Applied Physiology, 1967, 23, 811-813.
- Keys, A. & Brozek, J. Body fat in adult man. Physiological Reviews, 1953, 33, 245-317.
- Klecka, R. Discriminant analysis. In H. Nie, C. Hull, G. Jenkins, K. Steinbrenner & H. Bent (Eds.), Statistical package for the social sciences (2nd ed.). New York: Mc Graw-Hill, 1975.

- Pollock, M.L., Hickman, T., Kendrick, Z., Jackson, A., Linnerud, A.C. & Dawson, G. Prediction of body density in young and middle-aged men. Journal of Applied Physiology, 1976, 40, 300-304.
- Pollock, M.L., Schmidt, D. & Jackson, A.S. Measurement of cardiorespiratory fitness and body composition in the clinical setting. Comprehensive Therapy, 1980, 6, 12-27.
- Pollock, M.L., Wilmore, J.H. & Fox, S. Health and fitness through physical activity. New York: John Wiley & Sons, 1978.
- Rathbun, E.N. & Pace, N. Studies on body composition: I. The determination of total body fat by means of the body specific gravity. Journal of Biological Chemistry, 1945, 158, 667-676.
- Rentz, R.R. & White, W.F. Factors of self perception in the Tennessee Self Concept Scale. Perceptual and Motor Skills, 1967, 24, 118.
- Robinson, J.P. & Shaver, P.R. Measures of social psychological attitudes. Ann Arbor, Michigan: Institute for Social Research, 1973.
- Rosen, G.M. & Ross, A.C. Relationship of body image to self concept. Journal of Consulting and Clinical Psychology, 1968, 32, 100.
- Schilder, P. The image and appearance of the human body. New York: International University Press, 1935.
- Secord, P.E. & Jourard, S.M. The appraisal of body-cathexis: Body-cathexis and self. Journal of Consulting Psychology, 1953, 17, 343-347.
- Sinning, W.E. Body composition assessment. In P. Wilson (Ed.), Adult fitness and cardiac rehabilitation. Baltimore: University Park Press, 1975.
- U.S. Public Health Service. Obesity and health. Washington D.C.: U.S. Government Printing Office, 1966.
- Vacchiano, R.B. & Strauss, P.S. The construct validity of the Tennessee Self Concept Scale. Journal of Clinical Psychology, 1968, 24, 323-326.
- Weinberg, J. A further investigation of body-cathexis and the self. Journal of Consulting Psychology, 1960, 24, 277.

- Wilmore, J.H. A simplified method for determination of residual lung volume. Journal of Applied Physiology, 1969, 27, 96-100.
- Wylie, R.C. The self concept. London: University of Nebraska Press, 1974.
- Young, M. & Reeve, T.G. Discriminant analysis of personality and body image factors of females differing in percent body fat. Perceptual and Motor Skills, 1980, 50, 547-552.
- Zion, L.C. Body concept as it relates to self-concept. Research Quarterly, 1965, 36, 490-495.

APPENDIX A

Letter to the Dean of Business and Health, Physical Education  
and Recreation

Date \_\_\_\_\_

Dear Dean \_\_\_\_\_

This letter is written to inform you of a study to take place in the Adult Fitness/Cardiac Rehabilitation Masters Program. Students from the College of Health, Physical Education and Recreation and from the School of Business will be randomly selected to be subjects in the experiment. The study will involve maximal oxygen uptake testing as well as hydrostatic weighing.

The purpose of the study will be to investigate the ability of Junior male Business and HPER majors to correctly or incorrectly assess their physical fitness levels and to measure their percent body fat. The students will be given the tests free of charge and the results will be available to them upon request.

Fitness is important in determining production and efficiency in the job market, therefore, we feel it is important for students to assess fitness needs before they leave the college setting.

We hope you will support our research venture and help to encourage the instructors in your department to promote the study in their classes. The instructors will be receiving a letter of explanation within a few days.

Thank you for your time and understanding.

Sincerely,

Kathryn A. Menard  
Joan M. Zahalka

Adult Fitness/Cardiac  
Rehabilitation Graduate  
Students

APPENDIX B

Letter to Business/Health, Physical Education and Recreation  
Instructors

Date \_\_\_\_\_

Dear \_\_\_\_\_

This letter is written to inform you of a study to take place in the Adult Fitness/Cardiac Rehabilitation Masters Program. The research involves the use of Junior level students of the School of Business and the College of Health, Physical Education and Recreation (HPER).

The purpose of the study will be to determine how well Business and HPER majors are able to assess their own level of physical fitness and to measure body composition. The students will be randomly selected to participate in the study which will enable the researchers to infer the results of the study to the entire male Junior Business and HPER populations.

The importance of the random sample is imperative, therefore, we ask that you support our study and encourage students enrolled in your class to participate in the study if they are chosen as a subject.

Thank you for your time and consideration.

Sincerely,

Kathryn A. Menard  
Joan M. Zahalka

Adult Fitness/Cardiac  
Rehabilitation Graduate  
Students

APPENDIX C

Letter to Business and Health, Physical Education and  
Recreation Subjects

Date \_\_\_\_\_

Dear \_\_\_\_\_

**WE NEED YOU!** Since the opportunities of Health, Physical Education and Recreation have expanded to include many fitness parameters, it is beneficial to gain insight and additional experience in the fitness area. / The trends in today's business world are increasingly recognizing the importance of fitness and it's relationship to employee production and efficiency. Because of this increasing emphasis on fitness, a graduate study is being conducted to assess current fitness levels of Junior HPER/Business majors.

We are happy to inform you that YOU have been chosen, at random, to participate in this important research. What this study involves is two brief testing situations in the Human Performance Laboratory at Mitchell Hall, consisting of an assessment of percent body fat and cardiovascular capacity.

By participating in this study, you have the opportunity to discover your own level of fitness. Under normal circumstances, the cost for the tests are extremely high but for the purpose of this special research, the cost is FREE. Also, the individual results of each test will be strictly confidential.

Because you were randomly chosen, we would greatly appreciate a small amount of your time to partake in this study. Please, **WE NEED YOU AND ONLY YOU!**

We look forward to meeting you and will contact you in the near future. Thank you in advance for your time and consideration regarding this study.

Sincerely,

Kathy Menard  
Joan Zahalka

Adult Fitness/Cardiac  
Rehabilitation Grad-  
uate Students

**APPENDIX D**

## Water Immersion Densitometry Information

Name \_\_\_\_\_

Your test time is scheduled for \_\_\_\_\_

The evaluation will be conducted at the Human Performance Laboratory in Mitchell Hall.

The underwater weighing evaluation is designed to assess one's body composition. More specifically, the purpose is to calculate one's percentage of body fat. This procedure has been substantiated as being very accurate and reliable. Due to the nature of the assessment, special preparation is required by you. Listed below are the responsibilities you have to meet to make your assessment the best possible.

1. Do not eat anything for twelve hours prior to appointment.
2. Please bring a light swimsuit, preferably nylon or thin cotton and a towel.
3. Before reporting to the immersion tank, empty your bladder and bowels, if necessary.
4. Do not exercise on the same day of the test prior to being tested.
5. If unable to attend scheduled time, please contact Joan Zahalka at 785-2605 or leave a message at the Human Performance Lab 785-8685.

Thank you for your cooperation. See you soon.

APPENDIX E

## Consent Form

I, \_\_\_\_\_ understand that I have been randomly selected from all Health, Physical Education and Recreation/Business majors to participate in two graduate studies involving the measurement of perceived and actual fitness levels; and, the measurement of body composition and body image. I will be asked to sign-up for two meeting times in the Human Performance Laboratory.

During the first appointment, I will be asked to perform two tasks: 1) a maximal oxygen uptake test, and 2) fill out a short questionnaire. This appointment will last approximately 45 minutes. I will be asked to run to exhaustion on a treadmill which will be increased in grade and speed at various time intervals. During the run, expired air will be collected and heart rate will be monitored continuously via an EKG. Certain risks are involved when taking a maximal exercise test such as; fatigue, nausea, shortness of breath, muscle soreness and in rare cases, cardiac arrest. Emergency equipment is readily available and every effort has been made to ensure my safety. *fatigue*

During the second appointment, I will be asked to complete a body image assessment scale. The individual results of this scale will remain completely anonymous. Body composition or percent body fat will be determined by my being fully submerged in an underwater weighing tank. My residual volume, height and weight will also be determined. The entire assessment will take approximately 1 hour. There exists some risk with hydrostatic weighing such as accident or infection. However, rubber mats have been placed on the floor and the underwater weighing tank has been adequately cleaned to ensure my safety.

At the completion of the studies, I understand I will be given the results of my tests. I further understand that the information which is obtained concerning the test will be treated as privileged and confidential and will not be revealed to any non-affiliated person without my consent.

To my knowledge, there are no physical reasons why I cannot participate in the tests described above. Any questions I may have regarding procedures may be directed to the researcher periodically through-out the study. I understand that I may withdraw from the study at any time.

Signed \_\_\_\_\_ Date \_\_\_\_\_

Witness \_\_\_\_\_

**APPENDIX F**

## Body Cathexis Scale

Listed below are a number of things characteristic of yourself or related to you. Consider each item listed and encircle the number of each item which best represents your feelings according to the following scale:

1. Have strong positive feelings.
2. Have moderate positive feelings.
3. Have no feeling one way or the other.
4. Have moderate negative feelings.
5. Have strong negative feelings.

1.	hair . . . . .	1	2	3	4	5
2.	facial complexion . . . . .	1	2	3	4	5
3.	appetite . . . . .	1	2	3	4	5
4.	hands . . . . .	1	2	3	4	5
5.	distribution of hair (over body)	1	2	3	4	5
6.	nose . . . . .	1	2	3	4	5
7.	physical stamina . . . . .	1	2	3	4	5
8.	elimination . . . . .	1	2	3	4	5
9.	muscular strength . . . . .	1	2	3	4	5
10.	waist . . . . .	1	2	3	4	5
11.	energy level . . . . .	1	2	3	4	5
12.	back . . . . .	1	2	3	4	5
13.	ears . . . . .	1	2	3	4	5
14.	chin . . . . .	1	2	3	4	5
15.	age . . . . .	1	2	3	4	5
16.	body build . . . . .	1	2	3	4	5
17.	profile . . . . .	1	2	3	4	5
18.	height . . . . .	1	2	3	4	5
19.	keenness of senses . . . . .	1	2	3	4	5
20.	tolerance for pain . . . . .	1	2	3	4	5
21.	width of shoulders . . . . .	1	2	3	4	5
22.	arms . . . . .	1	2	3	4	5
23.	chest . . . . .	1	2	3	4	5
24.	appearance of eyes . . . . .	1	2	3	4	5
25.	digestion . . . . .	1	2	3	4	5
26.	hips . . . . .	1	2	3	4	5
27.	resistance to illness . . . . .	1	2	3	4	5
28.	legs . . . . .	1	2	3	4	5
29.	appearance of teeth . . . . .	1	2	3	4	5
30.	sex drive . . . . .	1	2	3	4	5
31.	feet . . . . .	1	2	3	4	5
32.	sleep . . . . .	1	2	3	4	5
33.	voice . . . . .	1	2	3	4	5
34.	health . . . . .	1	2	3	4	5
35.	sex activities . . . . .	1	2	3	4	5
36.	knees . . . . .	1	2	3	4	5
37.	posture . . . . .	1	2	3	4	5
38.	face . . . . .	1	2	3	4	5
39.	weight . . . . .	1	2	3	4	5
40.	sex organs . . . . .	1	2	3	4	5

**APPENDIX G**

### Instruction Sheet

The following questionnaires are designed to estimate self-concept and/or body image. Please put your assigned number and your academic major or majors on the Tennessee Self Concept Scale answer sheet and also on the Body Cathexis Scale answer sheet.

Your identity will remain anonymous. Individual results of this testing situation will be treated as confidential and will NOT be revealed to any non-affiliated person.

Once you are finished with the questionnaires, place them in the envelope and seal it. Each questionnaire has an individual set of instructions.

THANK YOU FOR YOUR VALUABLE TIME!!

APPENDIX H

## Residual Volume Data Sheet

Name: \_\_\_\_\_ Age: \_\_\_\_\_

	<u>Trial 1</u>	<u>Trial 2</u>
Initial Volume of O <sub>2</sub> (VO <sub>2</sub> ):	_____	_____
%N <sub>2</sub> (Impurity) (IN <sub>2</sub> ):	_____	_____
%N <sub>2</sub> (Alveolar) (AN <sub>2</sub> ):	_____	_____
%N <sub>2</sub> (Equilibrium) Range:	_____	_____
%N <sub>2</sub> (Equilibrium) (EN <sub>2</sub> ):	_____	_____
%N <sub>2</sub> (Final) (FN <sub>2</sub> ):	_____	_____
Dead Space (DS):	_____	_____

$$\text{Residual Volume} = \frac{\text{VO}_2 (\text{EN}_2 - \text{IN}_2)}{(\text{AN}_2 - \text{FN}_2)} - \text{DS} \times \text{BTPS Factor}$$

= \_\_\_\_\_ liters

APPENDIX I

## Underwater Weighing Data Sheet

Name: \_\_\_\_\_ Date of Birth: \_\_\_\_\_

Date: \_\_\_\_\_ Weight: \_\_\_\_\_ Height: \_\_\_\_\_

Immersion Tank Temperature \_\_\_\_\_ C.

Density of Water ( $D_W$ ) 0. \_\_\_\_\_

Residual Volume (RV) \_\_\_\_\_ L.

Mass in Air ( $M_A$ ) \_\_\_\_\_ kg. Trial #1 \_\_\_\_\_Mass in Water ( $M_X$ ) \_\_\_\_\_ kg. 2 \_\_\_\_\_Mass of Weighing Apparatus ( $M_Y$ ) \_\_\_\_\_ kg. 3 \_\_\_\_\_  
(in water)Mass of Water ( $M_W$ ) =  $M_X - M_Y$  = \_\_\_\_\_ kg. 4 \_\_\_\_\_Air in Gastro-Intestinal Tract 100 ml./0.1 L. 5 \_\_\_\_\_Body Density ( $D_B$ ) =  $\frac{M_A}{M_A - M_W - RV - 0.1 L.}$  = \_\_\_\_\_ 6 \_\_\_\_\_

\_\_\_\_\_ 7 \_\_\_\_\_

 $D_W$  \_\_\_\_\_ 8 \_\_\_\_\_% Fat =  $\frac{4.570}{D_B} - 4.142 \times 100 =$  \_\_\_\_\_ % 9 \_\_\_\_\_

\_\_\_\_\_ 10 \_\_\_\_\_

APPENDIX J

Discriminant Analysis Results of the  
40 Item Body Cathexis Scale

Item	Mean	SD	Wilks' Lambda	F Ratio
1a	2.19	1.00		
b	2.76	1.16		
2a	2.40	1.08		
b	2.60	.96		
3a	2.00	1.14	.90	5.81*
b	2.76	1.13		
4a	2.19	.92	.90	5.83*
b	2.80	.91		
5a	2.52	.98		
b	2.76	.97		
6a	2.41	.75	.88	6.60*
b	3.00	.91		
7a	2.22	1.22		
b	2.56	1.16		
8a	2.70	.82		
b	2.80	.71		
9a	2.59	1.22		
b	2.32	.99		
10a	3.00	1.00		
b	2.72	1.24		
11a	2.18	1.08		
b	2.76	1.13		
12a	2.67	.88		
b	2.88	1.09		
13a	2.63	.79		
b	2.84	.85		
14a	2.41	.93		
b	2.36	1.04		
15a	2.37	1.01		
b	2.56	.92		
16a	2.56	.97		
b	2.48	1.00		
17a	2.44	.89		
b	2.64	.86		
18a	2.48	1.16		
b	2.64	1.19		
19a	2.15	1.06		
b	2.24	1.01		
20a	2.11	.93		
b	2.44	1.04		
21a	2.33	1.00		
b	2.52	1.12		
22a	2.59	1.01		
b	2.52	.87		

Item	Mean	SD	Wilks' Lambda	F Ratio
23a	2.48	1.01		
b	2.64	.95		
24a	2.37	.88		
b	2.24	.97		
25a	2.67	.92		
b	2.76	.72		
26a	2.56	.80	.92	4.18*
b	3.00	.76		
27a	2.30	1.03		
b	2.52	1.26		
28a	2.14	1.06		
b	2.36	1.11		
29a	2.22	1.05		
b	2.60	1.00		
30a	2.26	1.02		
b	2.32	1.11		
31a	2.59	.69		
b	2.76	.72		
32a	2.41	.88		
b	2.36	1.03		
33a	2.52	.85		
b	2.56	1.00		
34a	1.89	1.15		
b	2.20	1.15		
35a	2.41	1.05		
b	2.40	.96		
36a	2.56	.75		
b	2.76	.97		
37a	2.48	.94		
b	2.84	1.07		
38a	2.37	.88		
b	2.48	.71		
39a	2.51	.93		
b	2.64	1.19		
40a	2.37	.93		
b	2.36	.95		

a: denotes HPER majors (N=27); b: denotes Business majors (N=25)

\* Significant at the .05 level