

BODY FRAME MEASURES
AND PERCEPTIONS OF FRAME SIZE AND WEIGHT

by

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(ABSTRACT)

The purpose of this research was to examine five methods of determining frame size. In addition, self perception of frame size and of desired weight was compared to two height-weight table recommendations. Pearson correlation coefficients were calculated to determine relationships between measurements used as criteria for frame measures and between the five frame measures studied. Agreement of frame size identification was examined by comparing percentages of small, medium and large frame for each method. While the Pearson correlation coefficient of wrist circumference with elbow breadth was greater than 0.5 for both men and women, the correlations between frame measures using wrist circumference criteria and frame measures using elbow breadth criteria were less than 0.5. Self-perceived frame size was not significantly correlated with any of the five frame measures examined or

with weight perception variables. Comparison of weight perception with evaluation of measured weight using two height-weight tables indicated men appear to desire to be heavier and women appear to desire to be thinner than weights recommended for height and measured frame size. Results were discussed in relation to findings of other researchers. Recommendations were made concerning the frame measures examined, the relationship of frame size perception to self-evaluation of weight, and the use of height-weight tables in determining weight goals.

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Chapter 1

INTRODUCTION

Introduction

Body physique has been defined as three separate but interrelated aspects of the body: size, composition and structure (1). Describing the body in terms of volume, mass, length and surface area indicates physical magnitude or body size. The amounts of body constituents of fat, muscle, water and ash are the components of body composition while the third aspect of physique - body structure - includes the skeleton and muscle-fat distribution or arrangement of body parts. The difficulty in accurately measuring body size, composition, and structure is compounded by the interrelation among each component. Many measures of physique are a combination of two or three aspects and are applied for different purposes by researchers and practitioners in dietetics and nutrition, anatomy, biomechanics, physiology of exercise, human genetics, general medicine and anthropology (2).

For dietitians, nutritionists, and health educators measures of body physique are valuable in assessing nutritional status and in assisting clients to determine an

appropriate body weight. Anthropometric indexes, such as weight-height relationships, skinfold measurements and determinations of percent body fat are important components of these processes (3).

One guide which is frequently used by dietitians in determining appropriate body weight is a height-weight standard or height-weight table (4-7). Numerous tables are available, with the most widely used being those from the Metropolitan Life Insurance Company (5,6).

The concept of frame size was introduced as a factor in appropriate weight with the presentation of revised height-weight tables in 1942 and 1943 by the Metropolitan Life Insurance Company (8). However, guidelines for determining frame size were not presented other than to suggest that chest girth, hip width and length of trunk were body points to consider (9). In the years since the concept was presented several methods developed for determining frame size have been attributed to the general public (10). Anthropometric measurement studies have also been reported with samples of various sizes. Measurements taken during two National Health and Nutrition Examination Surveys (NHANES) have provided the largest sample and have been utilized to develop a determination of frame size from

elbow breadth measurements (11). While there is conceptual validity in frame size, the lack of available objective measures based on research of a large sample has

contributed to confounding the subjective judgments of frame size (12).

Five Frame Measures Selected

One popular method for determining frame size, the development of which has been credited to the lay public, is to measure, in inches, the circumference of one's wrist (6,10). Separate sets of values are given for men and women to determine small, medium and large frame. A second method using wrist circumference, specifies that the right wrist be measured in centimeters (13). The wrist measurement is then divided into the person's height in centimeters, measured without shoes. The resulting height:wrist circumference ratio provides an "r" value, with separate sets of values for men and women to determine small, medium and large frame.

The NHANES data on frame size determinations from elbow breadth measurements has been utilized to develop a Frameter, an instrument for measuring elbow breadth

(14,15). The Frameter instrument, marked for both males and females, provides a rapid assessment of small, medium and large frame based on elbow breadth in centimeters. Additionally, the elbow breadth measurement and height can be used in a computation to give a more accurate assessment of small, medium and large frame with sets of values defined for men and women (16). The fifth method of determining frame size was developed by the Metropolitan Life Insurance Company for height-weight tables released in 1983 (17). This frame measure uses NHANES data on elbow breadth measures to categorize frame size into small, medium and large frame separately for men and women by height ranges.

Statement of Problem

Without objective guidelines for determining frame size, perception of one's frame size may be unrealistic and misleading. Given the range of suggested weight for a particular height using the 1983 Metropolitan Life Insurance Company height-weight tables, it is possible for a person to overestimate or underestimate a calculation of suggested weight by as much as ten to twenty pounds. Misjudging frame size can contribute to unrealistic goals

of appropriate weight. There are a variety of methods available for determining frame size, some without population measurements to substantiate them. For the professional in the field assisting clients in setting realistic goals for weight, this variety of methods available for measuring frame size can be confusing. This confusion is compounded for the lay public.

Purpose of Research

The purpose of this research was to examine and evaluate five methods of determining frame size which can be found in textbooks and references used by dietitians and nutritionists. The methods chosen were compared for agreement of frame size identification in order to provide recommendations for health care practitioners. Additionally, self perception of frame size and of desired weight was compared to height-weight table recommendations to explore the relationship between perception of weight and recommendations used in health care.

Research Questions

* Are measurements of elbow breadth, wrist circumference, shoe length and shoe width indicative of

frame size?

* Are there significant correlations between the selected five methods of determining frame size?

* Are there differences between the five frame measure methods evaluated in terms of the distribution of small, medium and large frames?

* Are there significant correlations between self perceived frame size and the five methods of determining frame size?

* Is self perception of frame size significantly correlated with perception of mother's and/or father's frame size?

* Are there differences between men and women in their perceptions of weight and desired weight?

* Is there a significant correlation between perception of frame size, perception of weight and height-weight tables?

Definitions

For the purposes of this study the following definitions apply:

Frame size : Length, width and depth of skeleton (12).

Reported Height/Weight : Measurement reported by subject when asked "What is your height?, What is your weight?".

Perceived Frame Size : Frame size reported by subject following, "People are often described as small, medium or large frame to indicate their bone thickness or body size. How would you describe yourself?".

Measured Height/Weight : Subject's height and weight measured using a platform scale apparatus.

Limitations

The sample population of subjects was drawn from students enrolled in two popular elective courses at a southeastern university. Reflecting the total university population, a small number of nonwhites (10.3%) were measured within the sample. Therefore, data were analyzed only from the majority Caucasian subsample. Although the age range of measured subjects was 18 to 42 years, the majority (96.7%) were 18 to 24 years old.

Chapter 2

REVIEW OF LITERATURE

Review of Literature

There are several areas of study to consider in exploring the concept of body frame measures. The concept of frame size is strongly linked to height-weight tables, especially the Metropolitan Life Insurance Company tables. Reported studies of attempts to measure frame size are limited and, in some cases, the number of subjects is small. Another concern in determining frame size measures is the potential for prediction of body fat, lean body weight and relative weight. Finally, perceptions of body frame size and weight in terms of individual body image are a part of the exploration of body frame size measures.

Height-Weight Tables

The development of height-weight tables has been accomplished primarily by insurance companies. The first tables were indications of average weights for insurees and usually included age. It was assumed that weight would increase with age and judgements concerning desirable weights were not made. Generally, it was believed that underweight people were of greater insurance risk because they lacked reserves to draw upon during disease. However,

in 1908, the chief medical director of the Mutual Life Insurance Company of New York presented an analysis of his company's data from which he concluded overweight was more of a risk factor than underweight except for those people under the age of twenty-five (8).

As pneumonia and tuberculosis were brought under control, the popularly held belief that overweight children and young adults had a higher chance of surviving severe illness was questioned. It was recognized that overweight in the early years was predisposing to obesity in older adults. The Metropolitan Life Insurance Company challenged the use of average weights as standards and developed tables based on weights associated with longevity. These tables, for women and men, presented in 1942 and 1943, defined average weight of ages 25-30 as "ideal" since these weights were associated with longevity. These tables also introduced the concept of small, medium and large body frame as a factor in appropriate weight although no guidelines were given for determining frame size (9,18).

The Metropolitan Life Insurance Company revised its tables in 1959 based on a Build and Blood Pressure Study conducted by the Society of Actuaries. It was concluded that the lowest mortality rates were associated with below average weight and from these data, tables of "desirable" weight for women and men age 25 and over were developed

(19). Again weight ranges for small, medium and large frame were presented without providing a method of determination. Later it was said the categories were created by dividing the weight distribution for each height into thirds and labeling each third accordingly (20).

In 1983 the Metropolitan Life Insurance Company presented another revision of its height-weight tables utilizing updated information from the 1979 Build Study by the Society of Actuaries. This study indicated that the difference between average weight and the lower weights associated with lowest mortality had narrowed. However, the increased weights of the new height-weight tables still fell below average weights. The 1983 Metropolitan Life Insurance Company height-weight (Metropolitan) tables utilized anthropometric measures from the National Health and Nutrition Survey (NHANES 1971-75) to provide guidelines for determining frame size. Elbow breadth measurements from the NHANES data were grouped such that 50% of the population measured fell within the medium frame category and 25% of the population each fell within the small and large frame categories (17).

Height-Weight Table Considerations

Several analyses of data have been used to correlate weight with mortality experience in the development of the

concepts of desirable weight and height-weight tables (21,22). However, conceptual and methodological objections to the use of height-weight tables as a means of evaluating the desirability of a given weight for a given person have been raised. These objections include technical quality of the data, relationship of weight to obesity and selection of relative weight indices, sampling and design problems and confounding variables.

For the Metropolitan tables, 10% of the heights and weights from the data base of the 1979 Build Study were self-reported, rather than measured. Of those measured, all wore non-standard clothing and shoes. It can be noted that in a study of self-reported heights and weights, Schlichting et.al. found a tendency for tall and heavy people to underestimate their measurements while short and thin people overestimate their measurements (23). However, Pirie et.al. found women's self-reported weight tended to be low and that reporting of height seemed to be accurate with a slight tendency for women to report shorter heights and men taller heights (24).

Although a relationship exists between weight and adiposity, the correlation is not strong (21). Adiposity or fatness is not as easy to measure, however it is important to distinguish between overweight and overfatness. A relationship which does appear to be a

valid and practical indicator of overfatness is the Body Mass Index (BMI), weight in kilograms divided by height in meters squared (25). Skinfold Thickness, a direct measure of body fat correlates highly with BMI while height has a near zero correlation. A range of 20 to 25 weight in kilograms divided by height in meters squared is now frequently recommended as the standard of normality for body weight (25). The midpoint of the medium frame recommendations of the Metropolitan tables yields a BMI of 22.5 weight in kilograms divided by height in meters squared. Several studies have indicated that higher Body Mass Indexes are associated with lower mortality for older age groups, suggesting age should be a factor in height-weight tables.

The sampling problem in the data base of the 1979 Build Study used for the Metropolitan tables is one of representation (21). Primarily white men from the upper and middle income levels under the age of 60 years were represented. Therefore, standards reflected in the tables may not be appropriate for all Americans and generalized use with various groups of people, especially older people, is not recommended. In the analysis of the 1979 Build Study data, a design problem becomes apparent in that insurance policies were the unit of analysis rather than people. People with more than one policy were counted more

than once, as were people with breaks in policy coverage (21,22). This is important when weight is linked to mortality from this data since it was the termination of a policy which was counted. The relationship between termination of policy (cause of death) and weight was not examined.

There are several confounding variables in determining the relationship between weight and mortality to develop desirable height-weight recommendations. A major variable is that of the effect of cigarette smoking on weight, health and mortality (21). The 1979 Build Study did not consider this variable in the compilation of data. The variation in skeletal mass is a variable which appears to have been addressed by the small, medium and large frame weight ranges within the Metropolitan tables. However, the suggested method for determining frame size presented with the 1983 tables was not used to measure the people from which the weight data is derived. The weight of the skeleton is also affected by variations in bone density, variations which have been correlated to age, sex and race.

In summary, height-weight tables have been developed primarily by insurance companies based on weight associated with lowest mortality. The data bases used have not been representative of the total population nor is the relationship between excess weight and mortality clear from

the analysis. The use of frame size as a component in height-weight tables was introduced without appropriate measurement and may not be of value in determining overfatness.

Frame Measures

Frame size is a skeletal concept reflecting differences of chest breadth, hip width, bone thickness and length of trunk relative to total height when comparing persons of the same height and sex (26). Factor analyses have shown frame size to have conceptual validity, however, objective measures are needed. Ideally, measures of skeletal length, width and depth would be statistically independent of each other and unaffected by subcutaneous fat deposits at measurement sites (12).

Several methods of determining frame size can be found which do not appear to have been substantiated by a measured population. Hui gives credit to the general public for the development of two of these methods (6,10). The first method is to encircle the wristbone with the index finger and thumb. A large frame is indicated if the fingers do not touch or overlap, a medium frame is indicated if the fingers just touch and if they overlap a small frame is indicated. The second method provides actual wrist measurements in inches for men and women which

indicate frame size. While the first method perhaps considers height in relation to finger length and is at least an individual assessment, the second method makes no distinction between heights. A third method utilizes a grid of height measured in feet and inches on the vertical and wrist measured in inches on the horizontal. Shadings for small, medium and large frame within the grid clarify the intercepts (27). While this method distinguishes between height it does not distinguish between men and women.

Grant measured 100 male and 100 female adult patients at Duke University Medical Center to develop a more reliable method for determination of frame size (13). Measurements of height without shoes and the right wrist circumference distal to the styloid process, in centimeters, were utilized. By dividing wrist circumference into height, body frame size was related to the height: wrist circumference ratio "r" calculated. Arbitrarily the population was proportioned into 25% small frame, 50% medium frame and 25% large frame. Ranges of "r" values for men and for women indicate small, medium and large frame.

A frame size model has been developed by Katch and Freedson based on conceptualization of frame size as a two dimensional scheme simultaneously considering body stature

and width (28). Body width measurements which were marginally related to stature, based on correlation analyses, were chosen to develop a scheme which considers frame size in two related but independent dimensions. The sum of biacromial and bitrochanter diameter measurements in centimeters was chosen to represent body width, with height in centimeters as the linear body measurement. A linear regression equation, the "HAT" frame size formulation, was developed to determine the least squares line of best fit between height and the sum of the two width measurements. The boundaries of small, medium and large frames were determined by drawing lines perpendicular to the regression line at minus one standard deviation and plus one standard deviation from the mean stature. Separate models for men and women were developed based on different calculated slopes of the regression line.

Elbow breadth measurements from the data sets of the first Health and Nutrition Examination Survey (HANES I) were used by Frisancho and Flegel to develop frame size categories (11). Zero order correlation coefficients of weight, elbow breadth and bitrochanteric breadth to the log transformed sum of skinfold values were calculated from the 16,494 measured individuals, aged 18 to 74, for age, sex and race. Elbow breadth, in both men and women and in both blacks and whites, exhibited the lowest correlation to

skinfold thickness. Some correlation was noted between elbow breadth and the 25-54 year old age category. Sex, age and race specific categories of small, medium and large frame were determined using elbow breadth measures below the 15th percentile, between the 15th and 85th percentiles and above the 85th percentiles respectively.

Frisancho has continued to study elbow breadth as a determinant of frame size by combining data from HANES I and HANES II (14,15). The total sample of children and adults, ages 1 to 74 years, was 44,130. He has developed several frame indexes from the data available. Frame Index One was determined using age and sex specific percentiles of elbow breadth. From these percentiles, a small frame category was established with age and sex specific percentiles of elbow breadth below the 15th, a medium frame category of those between the 15th and 85th, and a large frame category of those above the 85th percentile. Frame Index Two incorporates height by dividing the square root of height, measured in centimeters, into elbow breadth, in millimeters and multiplying by ten. Again the three frame categories were established using below the 15th, between the 15th and 85th and above the 85th sex- and age-specific percentiles. These two Frame Indexes were modified for the Frameter, an instrument developed by Frisancho to measure elbow breadth. The Frameter provides a quick assessment of

frame size using average values which do not consider age or height (29). A formula on the Frameter allows for consideration of height, but again the frame categories do not consider age (16).

The bony chest breadth has been studied by Garn as a frame size standard in nutritional assessment (30). Radiogrammetric data from participants in the Western Scotland Health Survey were used to correlate bony chest breadth with weight, height and three measures of fatness. The bony chest breadth diameter as measured on 70 millimeter photographic films was compared with weight data on each subject. Partial correlations were calculated with the bony chest breadth measure held constant to show the effect of height on weight, and with height held constant to show the effect of the bony chest breadth measure on weight. Height was also correlated to weight. The relationship between bony chest breadth and weight was stronger than the relationship between height and weight. The partial correlations between bony chest breadth and weight corrected for height were also higher than those between height and weight corrected for bony chest breadth. After establishing an appropriate weight correction factor for bony chest breadth, three frame size groupings were established.

Studies Using Frame Measures

A comparison of Grant's method of determining frame size and the guidelines for determining frame size from the 1983 Metropolitan tables which utilize elbow breadth data from NHANES I was made by Nowak and Schulz (31). Thirty-eight men and forty women were measured for height, weight and elbow breadth. The two methods produced the same frame measure for 64% of the men and 74% of the women. Grant's method determined 53% of the men and 69% of the women as small frame, 47% of the men and 29% of the women as medium frame, and none of the men and 2% of the women as large frame. Determination of frame size by the Metropolitan guidelines divided 67% of the men and 62% of the women into the small frame category, 33% of the men and 36% of the women into the medium frame category, and none of the men and 2% of the women into the large frame category. Two men could not be assigned a frame because they were taller than the maximum height provided by the tables. Of the 31% who did not have the same frame size by both methods, a small frame was observed for one method and a medium frame for the other. However, consistency was not noted in one method indicating a smaller frame.

Kathch's method of measuring frame size was used to examine accuracy of self-appraisal or perception of frame size (32). Subjects were asked to rate their frame size

and an expert rater also evaluated the 39 males and 33 females in their street clothes. The necessary measurements were taken to calculate frame size using the "HAT" frame size formula. The expert rater was in error 27.8% of the time while self-appraisals erred 41.7% when responses were compared to the "HAT" calculations. When the self-appraisal responses were separated by sex, 35.9% of the men misjudged their frame size while 48.5% of the women misjudged their frame size.

In an assessment of the 1083 Metropolitan tables, Hines and Bouchard examined the relationship between body frame and body fat (33). The authors noted that the inclusion of frame size assumes frame size provided an estimate of fat-free mass and measures of frame size had no association with body fat. To examine this assumption, 225 men and 212 women, ages 18-59, were measured for height, weight and six body breadths: shoulder, elbow, wrist, hip, knee and ankle. Body density was determined by hydrostatic weighing, percent body fat was calculated using Siri's equation, and total fat weight and fat-free mass were derived from the percent body fat calculated and body weight. Fat-free mass was correlated with the measures of frame size to examine their relationship. Substantial correlation with each of the measures was found for both men and women. Controlling for the effects of height

diminishes the relationship. however, the partial correlations were sufficient to provide differences in average fat-free mass allowing each frame measure to satisfy the initial assumption.

To consider the association of frame measures with body fat, correlations were calculated between the frame measures taken and total fat weight. Since increases in fat free mass are associated with increases in body fat, the authors also evaluate the partial correlation of frame and body fat controlling for this association. Considerable variation in association was found. Shoulder, elbow, hip and knee breadths were partially correlated with fat weight. Wrist and ankle breadths were not correlated with fat weight and therefore were the frame measures recommended for little or no association with body fat.

The authors concluded that their results confirmed findings of correlation between bony breadths and fat free mass as appropriate for frame measure determinates. However, the variation in association with total body fat among the bony breadths examined is an important factor in the choice of appropriate frame measure. From their data, the authors noted that because of the association of elbow breadth with fat, use of it as a frame measure, as suggested by the 1983 Metropolitan tables, would

underestimate frame size in lean individuals and overestimate in fat individuals.

In summary, while frame size is a valid concept, objective measurement must contend with height, width, body fat and fat-free mass. Wrist circumference has been used in several methods, sums of body weights have been included in a calculation equation, elbow breadth measurements and bony chest breadth have also been proposed as frame size determinants. Comparison of two methods for determining frame size provided agreement for less than 75% of subjects measured while self-perception of frame size provided less than 60% agreement with the objective frame measure used. And despite the large sample base for the proposed elbow breadth measure for frame size determination, there is still question concerning the possible influence of body fat on measurements taken.

Weight Perception

The desirable feminine body shape has varied throughout history and varies from culture to culture. In the last twenty years the idealized body shape for western women has become increasingly angular and lean. Garner and coworkers collected data from several sources in an attempt to document this shift in cultural standard for women (34). Height, weight and measurement data (self-reported) from 20

years of monthly Playboy magazine centerfold playmates was analyzed. Playmates' yearly mean weight was significantly less than corresponding population means. When converted to a percentage of population average weight, playmates' yearly average weight dropped from 91% of population average in 1959 to 83% in 1979. The more angular shape emerged as bust measurements decreased (-1.5 inches), waists became larger (+1.0 inches) and hips smaller (-1.5 inches) over the 20 year period.

The authors also examined height and weight data for state representatives and winners of the Miss America Pageant for the same 20-year period. Again, a decline in percent of average weight was noted. Their data analysis was based on population norms published in 1959. When these norms were compared to 1979 norms, an increase in average weight was evident in all age and height categories for women under 30 years of age, while a decrease in average weight was noted in the age categories of women over age 30. The authors suggested that this increase in average weight for women, in contrast to the desirable cultural standard of an increasingly lean body image, contributes to the pressure on women to diet and to the development of body image disturbance manifested in anorexia nervosa and bulimia.

In a study of cross-cultural differences in perception of female body shapes, three groups of women were studied: British women, Kenyan women who had lived in Britain for at least four years and Kenyan Asian women (35). Twelve sketches of female shapes, ranging from extremely anorexic to extremely obese, were shown to the 45 subjects. For each sketch a scoring sheet, listing thirteen bipolar personality constructs, was given to the subjects, along with a sheet for each subject to match herself with one of the twelve pictures. The bipolar constructs were (un)affectionate, (un)assertive, (un)confident, (un)emotional, masculine-feminine, (un)friendly, (un)happy, (un)popular, (in)secure, (un)sociable, tense-relaxed, and cold-warm. Analysis of responses indicated the Kenyan Asian women perceived the thin shapes more negatively and the fat shapes more positively than the British women. The British Kenyan women's perceptions were more similar to the perceptions of British women than to the perceptions of Kenyan Asian women. The differences between the three groups in perception of the fat figures were highly significant while there were only a few significant differences in perception of the anorectic figures. However, the British and British Kenyans rated the moderately thin borderline anorectic shapes significantly

more positively than did the Kenyan Asians, suggesting the cultural influence in acceptance of body image standards.

Acceptance of the culturally defined body shape for women can be seen in adolescent girls. Storz and Greene conducted a study among adolescent girls age 14 to 18 years to examine their satisfaction with body weight (36). Of the 203 subjects questioned, 169 desired to lose weight, yet measurements indicated 104 subjects fell within average range for body weight determined by National Center for Health Statistics height and weight growth charts. Subjects were asked to examine five outline drawings of the female figure, representing 20% underweight, 10% underweight, average weight, 10% overweight and 20% overweight. They were then asked to select the figure most like themselves and the figure they would most like, their "ideal". The underweight figure drawings were overwhelmingly selected as "ideal".

In another study of adolescent girls, the Eating Attitudes Test (EAT), a 40 item questionnaire, was administered to 151 10th grade girls (37). In addition to identifying anorexic patients, the EAT test provides information on bulimic symptoms of binge eating, vomiting after eating, and fears of weight gain. Evaluation of the items related to fear of weight gain indicated that 43.1% of the subjects were terrified of being overweight, 39.1%

were preoccupied with a desire to be thinner and 35.2% were preoccupied with the thought of having fat on their bodies.

Davies and Furnhan examined dieting and body shape concerns of a group of British school girls between the ages of 11 and 18 years (38). Subjects were asked to assess their own body weight and to answer questions relating to desire to gain or lose weight, dieting practices and exercise habits. Responses were evaluated within four age groups, 12, 14, 16 and 18 year olds. The percentage of subjects rating themselves as overweight rose from 26.1% in the 12-year-old group to 49.1% in the 18-year-old group. Ratings of just right fell from 69.8% in the 12-year-old group to 34.0% in the 18 year old group.

Self-perception of body, perception of the "ideal" body and body satisfaction were examined as part of a study of college women by Davis (39). A perceived somatotype scale of seven female figures ranging from thin (ectomorphic) to muscular (mesomorphic) to fat (endomorph) was used to assess self-perceived body build. Each subject chose the figure most resembling her own body and the figure she would most like to have. To measure satisfaction with body and body build, subjects indicated on a five point scale the degree of satisfaction felt toward 24 body characteristics. Nearly 80% of the subjects selected one of

the two thin (ectomorphic) figures as the "ideal" body. For 78% of the subjects there was a discrepancy between their perceived body and their self-perceived "ideal" body. Body satisfaction decreased as perceived body type deviated from the perceived (thin) cultural ideal.

A difference in the degree of concern about weight is found when both men and women are included in studies of body image and weight. Franzoi and Shields, in a two phase study, examined the differences between men and women in body satisfaction (40). A body satisfaction scale was administered to 257 male and 366 female college students. A principal components factor analysis for each gender resulted in three main factors. Results of the factor analysis were used to modify the instrument, creating a new body esteem scale which was administered to a second sample of 182 male and 301 female college students. The same statistical analysis was used for the second set of data. Three similar factors again resulted. For men, these factors were upper body strength, physical attractiveness, and general physical condition and for women, the factors were physical attractiveness, weight control, and general physical condition. The authors note the three aspects of men's body esteem were more highly correlated than the three aspects of women's body esteem, indicating greater differentiation for women.

Gray found slight differences between college men and women in a study of weight perception (41). A ten item questionnaire concerning body affect, requiring responses on a five point scale (agree-disagree), was presented to 62 male and 117 female undergraduate students, including whites, blacks, and Hispanics, with an average age of 28.5 years. Self-evaluation of height, weight, frame size and perception of under, average or overweight was also asked of the subjects. The 1959 Metropolitan Life Insurance Company height-weight tables were used to evaluate weight. Evaluation of weight by the tables determined 23.0% men and 37.8% women underweight, 31.1% men and 38.8% women normal weight, and 45.9% men and 23.3% women overweight. To contrast, 12.9% of the men and 5.1% of the women perceived themselves as underweight, 59.7% of the men and 69.2% of the women perceived themselves as normal weight, and 27.4% of the men and 25.6% of the women perceived themselves as overweight. Women were more likely to perceive themselves as overweight while men were more likely to perceive themselves as underweight. Those determined underweight were more likely to perceive themselves as weighing more, while the reverse was found in those determined overweight being more likely to perceive themselves as weighing less.

In a smaller study by Miller et.al, of college students and their weight perception, differences between men and

women were more pronounced (42). A questionnaire requesting information on weight and desired weight, satisfaction with body dimensions, and eating practices related to weight control was presented to 22 men and 46 women undergraduate students between 18 and 23 years old. Triceps skinfold thickness was also measured. Both weight and skinfold thickness were used to create an anthropometric index to categorize subjects. Based on the anthropometric index 73% of the men were normal weight, 18% slightly overweight and 9% were overweight while men's perceptions were 18% slightly underweight, 50% normal weight, 23% slightly overweight and 9% overweight. The distribution of women's weights by the anthropometric index was wider with 7% underweight, 17% slightly underweight, 37% normal weight, 22% slightly overweight and 17% overweight. Women's perception of their weight, however, was 2% underweight, 7% slightly underweight, 22% normal weight, 39% slightly overweight and 30% overweight. While the perceptions vary from Gray's study, the tendency was also observed in this study for men to perceive themselves as underweight while women perceived themselves as overweight. The contrast between men's and women's desired weight is strong. While no men desired to be underweight, 37% of the women did, 77% of the men desired to be normal weight compared to 50% of the women, and 23% of the men

desired to be slightly overweight yet only 4% of the women desired to be slightly overweight.

Men's and women's perception of desired weight influences perception of body shape most attractive to the opposite sex (43). Line drawings of nine male figures and nine female figures ranging from very thin to very heavy were presented to 248 male and 227 female undergraduate students. The subjects were asked to indicate their current figure, their ideal figure, the figure they felt would be most attractive to the opposite sex and the opposite sex figure to which they would be most attracted. Results of the data analysis indicated men's choices of current, ideal and attractive to women figures were almost identical. However, women identified a current figure larger than their ideal which was also larger than the figure they perceived to be most attractive to men. Also their choice of ideal was thinner than their choice of figure most attractive to men. The men's choice of male figure they think women would prefer was larger compared to the male figure women found most attractive, while the women's choice of female figure they think men would prefer was thinner than the female figure men found most attractive. From their data, the authors suggest men's perceptions serve to keep them satisfied with their weight while women's perceptions create dissatisfaction with their

weight and pressure to lose weight.

Men's choice of the muscular mesomorphic somatotype as "ideal" body was the finding of Tucker, in a study of 285 college males (44). A Perceived Somatotype Scale was used which required subjects to choose, among line drawings, a physique which represented themselves and a physique they considered "ideal". Analysis of perception of physique indicated 71% of the men chose body builds containing some ectomorphic (thin) traits to represent their perceived body. The median build chosen by 37% of the men was a mesoectomorphic physique, one moderately thin and muscular. The "ideal" physique chosen by 66% of the men was the mesomorphic somatotype, a highly muscular figure. A discrepancy between self-perception of body and perception of "ideal" was observed for 78% of the men.

The concern men have for being too thin was explored by Harmatz et.al. in a study of attitudes about eating and food, self-image and effect of weight in social relationships (45). The authors point out that most studies focus on the problem of body image disturbance in women. Those studies which include men generally use college age men who may not be obese but overweight due to muscle development. For this study, two questionnaires were used, the Eating Patterns Questionnaire and the Relationship Questionnaire. The first questionnaire was

administered to 146 males and 291 females who received extra credit for the various psychology classes from which subjects were recruited. The following semester the Relationship Questionnaire was administered, also for extra credit. Due to the personal nature of the questions, subjects were given a description of the general nature of this test. Self-selection was therefore assumed for the 64 males and 109 females who completed the Relationship Questionnaire. Subjects were asked their height, weight, age and sex. The "Standard Metropolitan Life Insurance Tables" were used to assign subjects to the overweight or underweight group if their weight deviated more than 10% from the mean of the reference group appropriate for their age/sex/height/weight. From this categorization 284 subjects were normal weight, 82 were overweight and 71 were underweight.

The Eating Patterns Questionnaire indicated underweight males have fewer concerns with eating habits and dieting. Significant differences were found in the underweight males responses to, "I am afraid of getting fat", "I diet to improve my appearance", "I think about calories when I exercise" and "Most people think I have a good build", when compared to the responses of the other subjects.

Striking differences were found between underweight males and the other subjects in several of their responses

on the Relationship Questionnaire. Underweight males rated themselves lower than even overweight females in their comparison of themselves to others for pretty/handsome, "good natured" and "sex appeal". Answers to the question "I would be more attractive if I were:" for underweight males were significant in their desire to be "strong" and to be less "shy" more than any other group. Underweight males were the least demanding of beauty in potential partners and saw their present partners as less assertive, less intelligent, lower in sense of humor and less sexually appealing. For both overweight females and underweight males, their responses were in greatest agreement with the statement "People to whom I am attracted often like me only as a friend" and greatest disagreement with the statement "People are often interested in me romantically".

Responses from a reader survey on body image in Psychology Today were evaluated by Cash and associates (46). Nearly 30,000 people mailed in the 97 item questionnaire which was printed in the magazine. While people who chose to return the questionnaire may care more than most about their appearance, the authors note the results are similar to those found in random samples. A quarter of the responses were from people in the 20 to 29 year age range, 21% in the age range 30 to 39 years and the remaining responses were distributed among the other age

categories (under 20, 40-49, 50-59, 60-74).

Dissatisfaction with weight was indicated by 41% of the men and 55% of the women responding. The 1983 Metropolitan Life Insurance Company height-weight tables were used to evaluate self-reported weight, although frame size was not considered. In comparing reported weight with perception of weight, underweight and normal weight men were more accurate in classifying their weight while underweight women were more likely to consider themselves normal weight and normal weight women were more likely to consider themselves overweight.

In summary, perception of weight is culturally influenced and varies in women and men. Women accept the current thin body image ideal, beginning in adolescence and judge their own body accordingly. Men's body image ideal is one of muscular substance, which in turn influences their weight and body perceptions.

Chapter 3
METHODOLOGY

Population

The sample population was drawn from college students enrolled in two freshman level courses. Both courses are required for several majors as well as being popular electives for juniors and seniors. After arrangements were made with course professors, each class was visited by the researcher and a brief explanation was given of what was required. Students then signed up for appointments, up to four students per fifteen minute segment. Students received extra credit points towards their final class grade as determined by the respective course professor. A total of 408 students, ranging in age from 18 years to 42 years, was measured.

Instruments

A questionnaire/data collection sheet was designed for this study (Appendix 1). Students were asked to provide demographic data, their height, weight and shoe size. They were also asked to describe how they saw themselves in terms of underweight, just right or overweight; and to describe their body frame and their perception of the frames of their mother and father.

Spaces were provided below the questions for recording by the researcher of measured weight, height, right wrist circumference in centimeters and inches, right elbow breadth in centimeters and right foot length and width.

Weight and height were measured using a platform beam scale with moveable kilogram weights and an adjustable centimeter height stick. Wrist circumference was measured using a Ross Laboratories plastic insert tape which provided both centimeter and inch increments. The elbow breadth was measured using a Frameter. Length and width of right foot was measured with a Brannock device for men or for women as indicated by the sex of the subject.

Procedure

A room was reserved for the hours of data collection. Signs directing students unfamiliar with the building were placed at entry doors and in stairwells. Tables and chairs were available for students to complete the questionnaire. The platform scale was not moved for the duration of the data collection period. At the beginning of the study the scale was checked for accuracy using a ten kilogram weight. Before each data collection period it was rechecked. The questionnaires were numbered from 001 to 425 and two consent forms (Appendix 2) were stapled to the back of each questionnaire.

As students arrived they were instructed to read the consent form attached to the questionnaire and to sign both copies. One copy was placed in an envelope labeled consent forms and dated for the day of collection, the other copy was for their records.

After the student answered the ten questions on the questionnaire, instructions were given to remove shoes and any heavy jackets or sweaters so measurements could be taken. Student appointments for participation in the study were set up on eight days in a three week period. Appointments were available in the morning, early and late afternoon, and early evening. The weather ranged from spring cold to very warm. The data collection period and setting were similar to what would be encountered in a field clinical situation.

For the first measurement the student sat down in a chair with a table to the right for the right elbow to be measured using the Frameter. The student was instructed to extend the right elbow and bend the forearm towards the shoulder at a 90 degree angle, turning the palm of the hand toward the body. The student's elbow was placed on the Frameter baseboard against the fixed end board, with the fixed end board to the student's left and the mobile board to the student's right. The mobile board was pressed against the right side of the student's elbow as firmly as

possible (Appendix 3) and the actual elbow breadth in centimeters was recorded to the nearest fraction of a centimeter (14-16). While still seated the student's right wrist was then measured by placing the insert tape around the smallest part of the wrist distal (towards the fingers) to the styloid process of the radius and ulna (wrist bone) (47). Inches were recorded to the nearest sixteenth inch and centimeters to the nearest fraction of a centimeter (Appendix 4).

The student then stood for measurement of the right foot. Instructions were given to place the right heel against the back of the Brannock device appropriate for the sex of the subject. The width bar was adjusted and then numerical shoe length and letter width was recorded.

The student was next asked to stand on the platform scale facing the adjustable weights. After the weights were balanced, the student stepped off and the weight was recorded in kilograms to the nearest tenth. The student then stepped back on the center of the platform scale, facing away from the adjustable weights. After instructions were given to face forward and stand up straight with heels together, height was measured by bringing the moveable arm firmly down until it touched the student's head. Height was recorded to the nearest half

centimeter. All measurements were taken and recorded by the researcher.

Upon completion of each set of data, the student's name was checked on the sign up sheets. The sign up sheets were then given to each course professor to assign extra credit points.

Criteria of Five Frame Measures Chosen

Hui describes the determination of frame size by wrist measurement as a popular layman's method (6,10). The circumference measurement, in inches, of a person's wrist determines a small, medium or large frame as follows:

	MEN	WOMEN
SMALL	< 6	< 6
MEDIUM	>/= 6 </= 7	>/= 6 </= 6 1/2
LARGE	> 7	> 6 1/2

THIS FRAME MEASURE WILL BE NOTED FMW.

Grant proposed a frame measure based on the wrist circumference measured in centimeters divided into the height measured, without shoes, in centimeters (13). The resulting "r" value determines a person's frame size as follows:

	MEN	WOMEN
SMALL	> 10.4	> 10.9
MEDIUM	10.4 - 9.6	10.9 - 9.9
LARGE	< 9.6	< 9.9

Grant arbitrarily assigned 25% of the population to small frame, 50% to medium frame and 25% to large frame.

THIS FRAME MEASURE WILL BE NOTED FMH/W.

Frisancho utilized elbow breadth measurement data from the National Health and Nutrition Examination Surveys I and II (NHANES) as a base for development of a Frameter instrument. The instrument accurately measures the distance between the medial and lateral epicondyles of the humerus -the elbow breadth, and provides a quick assessment of frame size for both men and women (14-16). The Frameter measures elbow breadth in centimeters to the nearest millimeter and designates small, medium or large frame as follows:

	MEN	WOMEN
SMALL	< 6.8	< 5.9
MEDIUM	6.8 - 7.9	5.9 - 6.8
LARGE	> 7.9	> 6.8

The Frameter designations of frame size are averages with no consideration for age or height (29). Elbow

breadth measures below the 15th percentile are identified as small frame, measures between the 15th and 85th percentiles are identified as medium frame and measures above the 85th percentile are identified as large frame.

THIS FRAME MEASURE WILL BE NOTED FMF:A

Frisancho also developed a formula for frame size determination based on elbow breadth (EB) and height (H). The formula on the Frameter requires a conversion of elbow breadth in centimeters to inches (in) and is as follows (16): $\langle EB \text{ (in)} \times 12.33 \rangle + \langle H \text{ (in)} \times -0.25 \rangle + 16.32$. The resulting value determines a person's frame size as follows:

	MEN	WOMEN
SMALL	< 32.6	< 29.0
MEDIUM	32.6 - 36.2	29.1 - 32.9
LARGE	> 36.3	> 33.0

The three categories of frame size were established by percentiles of below the 15th for small frame, between the 15th and 85th for medium frame and above the 85th percentile for large frame.

THIS FRAME MEASURE WILL BE NOTED FMF:B

The Metropolitan Life Insurance Company utilized NHANES data on elbow breadth measurements to develop guidelines

for determining frame size which were released with its 1983 height-weight tables for men and women (17).

Guidelines were provided for elbow breadth in inches and height in feet and inches with one inch heels; and elbow breadth in centimeters and height in centimeters with 2.5 centimeter heels (16). The guidelines to determine small, medium and large frame with centimeter measures of elbow breadth and height with 2.5 centimeter heels are as follows:

MEN

HEIGHT	SMALL	MEDIUM	LARGE
158 - 161	< 6.4	6.4 - 7.2	> 7.2
162 - 171	< 6.7	6.7 - 7.4	> 7.4
172 - 181	< 6.9	6.9 - 7.6	> 7.6
182 - 191	< 7.1	7.1 - 7.8	> 7.8
191 - 193	< 7.4	7.4 - 8.1	> 8.1

WOMEN

HEIGHT	SMALL	MEDIUM	LARGE
148 - 151	< 5.6	5.6 - 6.4	> 6.4
152 - 161	< 5.8	5.8 - 6.5	> 6.5
162 - 171	< 5.9	5.9 - 6.6	> 6.6
172 - 181	< 6.1	6.1 - 6.8	> 6.8
182 - 183	< 6.2	6.2 - 6.9	> 6.9

The three categories were established using elbow breadth measures below the 25th percentile for small frame,

between the 25th and 75th percentile for medium frame and above the 75th percentile for large frame.

THIS FRAME MEASURE WILL BE NOTED FMM

Frame Measure Adjustments for Statistical Analysis

Elbow breadth, wrist circumference, shoe length and shoe width were assumed to be indicative of frame size. Three measures were created to be subjected to principal component extractions of roots. The first, elbow breadth in centimeters divided by height in centimeters and the second, wrist circumference in centimeters divided by height in centimeters were two of the measures created. The third measure assumed foot size as a proportion of height. The numerical shoe length from the Brannock device was multiplied by the letter shoe width which was converted to a number (Appendix 5) and this value was divided by height in centimeters.

Small, medium and large frame sizes were designated numerically as one, two or three respectively. Perceived frame size and FMW were coded and entered into the computer. The remaining four frame measures were computer calculated.

For FMF:B it was necessary to slightly adjust the values given on the Frameter to eliminate numerical gaps. For men the changes in the large frame criteria were an

adjustment of > 36.3 to >36.2 and in medium frame criteria an adjustment of ≥ 32.6 and ≤ 36.2 . For women the large frame criteria was adjusted from > 33.0 to > 32.9 and medium frame criteria was adjusted to ≥ 29.0 and ≤ 32.9 . The Frameter formula was adjusted for the data base as follows: $\langle EB \text{ (mm)} \times 12.33 - H \text{ (mm)} \times 0.25 \rangle / 25.4 + 16.32$.

Two adjustments for FMM were made. The allowance of 2.5 centimeters for shoe height was subtracted from the height values given for consistency with height measurement taken. It was also necessary to adjust the height values to eliminate the one centimeter gap between height ranges.

Variables for Weight Perception Analysis

Three variables were created to examine weight perception and height-weight tables. The first variable, Pounds Plus or Minus, was determined from the subject's response to question six. The number of pounds perceived overweight was subtracted from the number of pounds perceived underweight. This procedure gave a negative number if the perception were of underweight ($00 - 10 = -10$) or a positive number if the perception were of overweight ($10 - 00 = +10$). A "just right" answer produced a zero ($00 - 00 = 0$). When a range of pounds was given, the

midpoint, rounded up, was recorded (5-10 pounds recorded as 8 pounds).

Frisancho's height-weight tables and the Metropolitan Life Insurance Company height-weight tables (appendix 6) were used to create Weight Discrepancies F and M. A subject's height and frame size (FMF:A for Weight Discrepancy F and FMM for Weight Discrepancy M) were used to determine the weight range suggested by each table. The subject's measured weight was then compared to the determined weight range. If the measured weight was less than the lower number of the range, the number of pounds underweight was determined by subtraction, giving a negative number. If the weight was within the suggested range a zero value was assigned. If the weight was greater than the higher number of the range, the number of pounds overweight was determined by subtraction, giving a positive number. For example, the suggested weight range from Frisancho's height-weight table for a small frame woman 66 inches tall is 120 - 128 pounds. A woman weighing 115 pounds would have a Weight Discrepancy F of -5. A woman weighing 133 pounds would have a Weight Discrepancy F of +5.

Statistical Analysis

The data were analyzed using (SAS) the Statistical Analysis System (48). Data for men and women were analyzed separately. Due to the small number of blacks and Asian/Asian Americans measured, only the Caucasian subsample was used in the data analysis. A frame size variable was created from a principal components extraction of roots using three measurement variables, elbow breadth/height, wrist circumference/height and shoe length x shoe width/height. Means, ranges, frequencies, percentages and Pearson correlation coefficients were calculated from the data. In examining the Pearson correlation coefficients, those correlations of 0.50 or greater were selected for discussion. Two levels of significance were noted, probability less than 0.01 and less than 0.001.

Statistical Analysis of Research Questions

* A principal components extraction of roots was used to examine elbow breadth, wrist circumference, shoe length and shoe width measurements as indicative of frame size.

* Pearson correlation coefficients were calculated among the five frame measures.

* For each frame measure, the percentage of small, medium and large frames within the population measured was determined separately for men and for women.

* Pearson correlation coefficients, comparing the relationship of self-perceived frame size to the five frame measures and to perception of mothers' and/or fathers' frame size were calculated.

* Differences in perceptions of weight and desired weight in men and women were examined by determining percentages of the five responses to the question "How do you see yourself?" and by calculating Pearson correlation coefficients for the three variables created, Pounds Plus or Minus, Weight Discrepancy F and Weight Discrepancy M. In addition, ranges of Pounds Plus or Minus were compared to similar ranges of Weight discrepancies F and M by determining the percentage of each range.

* Pearson Correlation Coefficients were calculated between the variable Pounds Plus or Minus and perceived frame, Weight Discrepancy F and Weight Discrepancy M; and between the two weight discrepancies and measured weight, reported weight for men and for women to examine significant correlations between perception of frame size, perception of weight and height-weight tables.

Chapter 4

RESULTS

General Characteristics of Subject Population

Four hundred and eight students completed the questionnaire and were measured. Of those measured, 89.7% identified themselves as white, 6.4% identified themselves as black and 3.9% identified themselves as Asian/Asian American. Because of the small number of blacks and Asian/Asian Americans, only the data of those students who identified themselves as white were analyzed. This subsample was further divided into 144 males and 221 females for analysis. The majority (96.7%) of the subsample was between 18 and 24 years old, while the range in age was from 18 to 39 years.

For the men measured, the mean reported height, 180.68 centimeters (SD \pm 5.97), was 1.1 centimeters taller than the mean measured height of 179.58 (SD \pm 6.07) (Table 1). The mean reported weight, 76.11 kilograms (SD \pm 8.88), was 0.41 kilograms less than the mean measured weight of 76.52 (SD \pm 9.05). Mean elbow breadth and wrist circumference were 7.0 (SD \pm 0.38) and 16.8 (SD \pm 0.69) centimeters respectively. On a scale of one to five for perception of under/overweight, the mean response for men was 3.01 or just right. The range in answers was from one

TABLE 1

ANTHROPOMETRIC AND WEIGHT PERCEPTION DATA

Men N=144

	<u>Mean</u>	<u>+Standard Deviation</u>	<u>Range</u>
Measured Height (cm)	179.583	6.07	154.5 - 196.0
Reported Height (cm)	180.675	5.97	154.9 - 198.0
Measured Weight (kg)	76.519	9.05	51.6 - 106.9
Reported Weight (kg)	76.110	8.88	49.9 - 107.0
Elbow Breadth (cm)	7.023	0.38	5.9 - 8.1
Wrist Circumference (cm)	16.806	0.69	14.6 - 19.4
"See Self" (1-5)	3.014	0.78	1 - 4
Pounds Plus or Minus	-0.155	8.30	-33 - +20
Weight Discrepancy F (lb)	3.741	11.91	-21 - +55
Weight Discrepancy M (lb)	11.304	14.05	-13 - +63

Women N=221

	<u>Mean</u>	<u>+Standard Deviation</u>	<u>Range</u>
Measured Height (cm)	165.014	6.05	150.0 - 182.5
Reported Height (cm)	165.040	6.56	149.9 - 185.4
Measured Weight (kg)	59.389	8.39	42.0 - 86.7
Reported Weight (kg)	58.243	7.97	42.2 - 87.1
Elbow Breadth (cm)	6.124	0.37	5.2 - 7.5
Wrist Circumference (cm)	14.901	0.71	13.2 - 17.5
"See Self" (1-5)	3.692	0.63	2 - 5
Pounds Plus or Minus	7.751	9.40	-15 - +60
Weight Discrepancy F (lb)	0.507	10.54	-22 - +48
Weight Discrepancy M (lb)	-0.120	9.58	-24 - +46

(very underweight) to four (slightly overweight). The average reported pounds underweight or overweight was -0.2 pounds, while the range was from -33 to +20 pounds. When measured weight was compared to Frisancho's height-weight table for men, the average was +3.7 pounds overweight and the range was -21 to +55 pounds. The comparison of measured weight to the Metropolitan table for men resulted in an 11.3 pound average overweight with a range of -13 to +63 pounds.

For the women measured, the mean reported height was the same as the mean measured height of 165.0 centimeters (SD \pm 6.56, 6.05, respectively) (Table 1). The mean reported weight of 58.24 kilograms (SD \pm 7.97) for women, as for men, was less than the mean measured weight of 59.39 (SD \pm 8.39), however the difference was 1.2 kilograms. Elbow breadth and wrist circumference averages were 6.1 (SD \pm 0.37) and 14.9 (SD \pm 0.71) centimeters respectively. Womens' perceptions of underweight/overweight ranged in answers from two (slightly underweight) to five (very overweight) with an average answer of 3.7. The average reported pounds underweight or overweight was +7.8 pounds while the range was from -15 to +60 pounds. When measured weight of women was compared to Frisancho's height-weight table the range of discrepancy was from -22 to +48 pounds with an average discrepancy of 0.5 pounds overweight. The

Metropolitan table comparison to women's measured weight determined an average discrepancy of 0.1 pounds underweight, with a range of -24 to +46 pounds.

Frame Measures

Matrices of intercorrelations for men and for women among the three measures (elbow breadth/height, wrist circumference/height and shoe length x width/height) assumed to be indicative of frame size (with one s in the diagonal) were subjected to a principal components extraction of roots. In each case only one eigen value greater than one resulted. It was, therefore, concluded that only one physical characteristic underlies these three measurements, that of frame size. Linear combinations of these variables should yield more precise values relative to frame size than any one of the three input variables alone. And so, for each subject, a standardized ($\bar{x}=0$, $\bar{s}=1$) factor score (F1) was constructed by applying the vector of scoring coefficients to the standardized input variables. Table 2 gives the factor loadings and scoring coefficients for men and women. Although the scoring coefficients for men and women in Table 2 appear similar, it should be noted that when data of men and women were combined for the same analysis described, a single factor arose but with scoring coefficients somewhat different. Therefore, it was

Table 2

FACTOR ONE SCORE CONSTRUCTION

Men N=144

	<u>Factor Loadings</u>	<u>Standardized Scoring Coefficients</u>
Wrist/Height	0.845	0.502
Elbow/Height	0.793	0.471
Shoe length x Width /Height	0.584	0.347

Women N=221

	<u>Factor Loadings</u>	<u>Standardized Scoring Coefficients</u>
Wrist/Height	0.833	0.486
Elbow/Height	0.853	0.498
Shoe length x Width /Height	0.541	0.316

concluded a single frame size metric would not serve for both sexes.

A comparison of the two measures used, wrist circumference and elbow breadth, can be seen in Table 3. Neither wrist circumference nor elbow breadth was correlated significantly with height for either men or women. Height divided into each of these two measures did not affect the correlations. The inverse of wrist circumference divided by height is the basis for the frame measure FMH/W and it was not significantly correlated with height for either men or women. There was a significant correlation (men: 0.53, women: 0.64) between wrist circumference measurements and elbow breadth measurements for both men and women. Again, the correlation was not affected by the division of height into each of these measures. When wrist circumference and elbow breadth were correlated with weight, significant correlation coefficients (men: 0.71, 0.51; women: 0.75, 0.68; respectively) were found. However, the division of height into these measures greatly affected the correlation with weight and the correlations were no longer significant (men: 0.26, 0.15; women: 0.37, 0.41; respectively).

The five frame measures examined and Factor One were correlated with the measurements taken and can be seen in Table 4 for men and Table 5 for women. Height was not

TABLE 3

CORRELATIONS OF MEASURES TAKEN OR CALCULATED
WITH EACH OTHER, HEIGHT AND WEIGHT

	MEN N=144	WOMEN N=221
Wrist circumference with Height	0.486 **	0.454 **
Wrist circum/height with Height	-0.358 **	-0.337 **
Height/wrist circum with Height	0.360 **	0.344 **
Elbow breadth with Height	0.349 **	0.439 **
Elbow br/height with Height	-0.290 **	-0.185 *
Wrist circum with Elbow br	0.534 **	0.639 **
Wrist circum/height with Elbow br/height	0.512 **	0.566 **
Wrist circumference with Weight	0.710 **	0.753 **
Wrist circum/height with Weight	0.260	0.372 **
Elbow breadth with Weight	0.505 **	0.681 **
Elbow br/height with Weight	0.152 *	0.405 **

* $p < 0.01$

** $p < 0.001$

Pearson correlation coefficients rounded to 3 places

Table 4CORRELATIONS OF FRAME MEASURES AND FACTOR ONE
WITH MEASURES TAKEN OR CALCULATED

MEN

N=144 (except FMM: N=138)

	<u>FMW</u>	<u>FMH/W</u>	<u>FMF:A</u>	<u>FMF:B</u>	<u>FMM</u>	<u>F1</u>
Height	0.353 **	-0.201	0.239 *	0.054	-0.031	-0.265 *
Elbow Breadth	0.335 **	0.282 **	0.812 **	0.809 **	0.807 **	0.606 **
Elbow /Height	0.116	0.421 **	0.676 **	0.790 **	0.771 **	0.793 **
Wrist Cir- cumference	0.614 **	0.533 **	0.380 **	0.354 **	0.358 **	0.571 **
Wrist /Height	0.339 **	0.750 **	0.202	0.337 **	0.369 **	0.845 **
Shoe Length	0.432 **	0.073	0.307 **	0.183	0.189	0.112
Shoe Width	-0.043	0.172	-0.047	0.045	0.021	0.384 **
Shoe L*W /Height	0.276 **	0.300 **	0.212	0.217 *	0.173	0.584 **

* p < 0.01

** p < 0.001

Pearson correlation coefficients rounded to 3 places

Table 5CORRELATIONS OF FRAME MEASURES AND FACTOR ONE
WITH MEASURES TAKEN OR CALCULATED

WOMEN

N=221 (except FMM: N=219)

	<u>FMW</u>	<u>FMH/W</u>	<u>FMF:A</u>	<u>FMF:B</u>	<u>FMM</u>	<u>F1</u>
Height	0.369 **	-0.286 **	0.313 **	0.067	0.129	-0.154
Elbow Breadth	0.466 **	0.214 **	0.801 **	0.779 **	0.780 **	0.686 **
Elbow /Height	0.262 **	0.426 **	0.670 **	0.497 **	0.758 **	0.853 **
Wrist Cir- cumference	0.782 **	0.544 **	0.495 **	0.422 **	0.416 **	0.663 **
Wrist /Height	0.524 **	0.814 **	0.268 **	0.147	0.335 **	0.831 **
Shoe Length	0.432 **	0.073	0.307 **	0.183 *	0.189	0.159
Shoe Width	-0.003	0.091	-0.022	0.064	0.041	0.369 **
Shoe LxW /Height	0.341 **	0.120	0.259 **	0.064	0.223 **	0.542 **

* p < 0.01

** p < 0.001

Pearson correlation coefficients rounded to 3 places

significantly correlated with any of the measures for either men (highest correlation 0.35) or women (highest correlation 0.37). For the frame measures FMF:A, FMF:B and FMM which utilize elbow breadth measures, the correlation of elbow breadth with each of these frame measures for both men and women were significant (highest correlation 0.81, 0.80; respectively). When the elbow breadth /height measure was correlated to these frame measures the correlation drops slightly and was not significant (0.497) for FMF:B for women. For the frame measures FMW and FMH/W there was little correlation with elbow breadth and elbow breadth/ height. However, as one would expect the wrist circumference was significantly correlated with these two measures which utilize wrist circumference (highest correlation men: 0.61, women: 0.78). Wrist circumference was not as highly correlated with frame measures FMW and FMH/W as were the correlations of elbow breadth to FMF:A, FMF:B and FMM. Shoe length and width were not significantly correlated to any of the frame measures nor was shoe length x width/ height. Elbow breadth/height and wrist circumference/height were more highly correlated with F1 than was shoe length x width/height for both men and women.

Looking at the frame measures and Factor One derived from the measurements taken, a wide variation in

relationships between frame measures can be seen (Table 6 for Men and Table 7 for Women). FMW did not correlate significantly with any of the other frame measures (highest correlation men: 0.38, women: 0.47) nor did FMH/W for either men (highest correlation 0.38) or women (highest correlation 0.47). FMH/W was however, significantly correlated with F1 for both men (0.68) and women (0.65). There was a greater correlation of FMF:A for women than for men with the frame measures FMF:B and FMM (women: 0.77, 0.88; men: 0.65, 0.67; respectively). The correlation of frame measure FMF:B with FMM (men: 0.94, women: 0.85), both measures which utilize elbow breadth and height, was higher than the correlation of FMF:B with FMF:A (men: 0.65, women 0.77) the frame measure of elbow breadth only. The correlations of Factor One with FMH/W, FMF:B and FMM were significant for both men (highest correlation 0.68) and women (highest correlation 0.67). Factor One was also significantly correlated with FMF:A for women (0.55). However, the highest correlation of Factor One for men was between F1 and FMH/W (0.68) while for women it was between F1 and FMM (0.67).

The distribution of small and medium frames varied considerably between the five frame measures and between men and women in the sample measured (Table 8). There was less difference in the percent large frames observed in all

Table 6

CORRELATIONS OF FRAME MEASURES AND FACTOR ONE

MEN

N=144 (except FMM: N=138)

	<u>FMW</u>	<u>FMH/W</u>	<u>FMF:A</u>	<u>FMF:B</u>	<u>FMM</u>	<u>F1</u>
FMW	1.000	0.381 **	0.170	0.162	0.160	0.320 **
FMH/W	0.381 **	1.000	0.212	0.263 *	0.285 **	0.679 **
FMF:A	0.170	0.212	1.000	0.647 **	0.668 **	0.493 **
FMF:B	0.162	0.263 *	0.647 **	1.000	0.937 **	0.616 **
FMM	0.160	0.285 **	0.668 **	0.937 **	1.000	0.634 **
F1	0.320 **	0.679 **	0.493 **	0.616 **	0.634 **	1.000

* p < 0.01

** p < 0.001

Pearson correlation coefficients rounded to 3 places

Table 7

CORRELATIONS OF FRAME MEASURES AND FACTOR ONE

WOMEN

N=221 (except FMM: N=219)

	<u>FMW</u>	<u>FMH/W</u>	<u>FMF:A</u>	<u>FMF:B</u>	<u>FMM</u>	<u>F1</u>
FMW	1.000	0.471 **	0.305 **	0.294 **	0.284 **	0.491 **
FMH/W	0.471 **	1.000	0.183 *	0.307 **	0.221 *	0.645 **
FMF:A	0.305 **	0.183 *	1.000	0.767 **	0.884 **	0.550 **
FMF:B	0.294 **	0.307 **	0.767 **	1.000	0.848 **	0.615 **
FMM	0.284 **	0.221 *	0.884 **	0.848 **	1.000	0.665 **
F1	0.491 **	0.645 **	0.550 **	0.615 **	0.665 **	1.000

* p < 0.01

** p < 0.001

Pearson correlation coefficients rounded to 3 places

Table 8

PERCENT OF SAMPLE DETERMINED
SMALL OR MEDIUM OR LARGE FRAME
BY EACH FRAME MEASURE

	<u>SMALL</u>	<u>MEDIUM</u>	<u>LARGE</u>
FMW			
Men N=144	0.7	91.7	7.6
Women N=221	65.2	33.0	1.8
FMH/W			
Men N=144	77.8	21.5	0.7
Women N=221	63.8	34.8	1.4
(Proposed)*	(25.0)	(50.0)	(25.0)
FMF:A			
Men N=144	23.6	74.3	2.1
Women N=221	21.3	75.1	3.6
(Proposed)*	(15.0)	(70.0)	(15.0)
FMF:B			
Men N=144	47.2	50.7	2.1
Women N=221	29.4	66.5	4.1
(Proposed)*	(15.0)	(70.0)	(15.0)
FMM			
Men N=138	44.2	54.3	1.4
Women N=219	21.5	74.9	3.7
(Proposed)*	(25.0)	(50.0)	(25.0)

*Proposed percent of population for given frame size
indicated by theory of frame measure determined

five measures. When wrist alone was used to determine frame size, 91.7% of the men measured were medium frame while 65.2% of the women were small frame. For men, frame size determined by dividing wrist circumference into height changed the distribution of small frame observed for FMW from 0.7% to 77.8% for FMH/W, medium frame from 91.7% to 21.5%, and large frame from 7.6% to 0.7%. For women, FMH/W changed the distribution observed for FMW very little. When the frame measures which utilize elbow breadth were examined, the distribution of small and medium frame for women was reversed. However, the percentages of small and medium frame were more similar for the three frame measures FMF:A, FMF:B and FMM for women than were observed for men. For women the difference in distribution of small and medium frame was greater between FMF:B and FMM, both of which use elbow breadth and height, than between FMF:A which uses elbow breadth only and FMM. For men, the distribution of small and medium frames observed in FMH/W was reversed in FMF:A. However, the distribution of small and medium frame shifts when FMF:B and FMM measures were used. For men, the distribution of small and medium frames was more similar between FMF:B and FMM than between FMF:A and FMM, as was observed for women.

Perception of Frame Size

In examining the correlations of subject perception of frame size with the frame measures evaluated, little correlation was seen for either men or women (Table 9). The highest correlations were with FMW for both men (0.392) and women (0.446), neither of which can be considered significant. Subject perception of frame size was also not significantly correlated with either perception of mother's frame or father's frame (Table 10). It can be noted that women's perception of their frame size had a higher correlation with their perception of their mothers' frame size, while men's perception of their frame size had a higher correlation with their perception of their fathers' frame size.

Perception of Weight

The question, "How do you see yourself?", followed by five choices - very underweight, slightly underweight, just right, slightly overweight or very overweight - was asked to examine subjects' perception of their weight. Men's responses ranged from very underweight to slightly overweight while women's responses ranged from slightly underweight to very overweight (Table 11). More men perceived themselves as underweight than did women. While 41.5% of the men perceived themselves as just right, this

Table 9CORRELATIONS OF PERCEIVED FRAME SIZE
WITH FRAME MEASURES AND FACTOR ONE

		<u>PERCEIVED FRAME</u>	
FMW			
Men	N=143	0.392	**
Women	N=221	0.446	**
FMH/W			
Men	N=143	0.268	*
Women	N=221	0.193	*
FMF:A			
Men	N=143	0.342	**
Women	N=221	0.303	**
FMF:B			
Men	N=143	0.271	*
Women	N=221	0.254	**
FMM			
Men	N=137	0.278	*
Women	N 219	0.251	**
F1			
Men	N=143	0.392	**
Women	N=221	0.338	**

* p < 0.01

** p < 0.001

Pearson correlation coefficients rounded to 3 places

Table 10

CORRELATIONS OF PERCEPTION
OF MOTHER'S AND FATHER'S FRAME
WITH PERCEIVED FRAME

PERCEIVED FRAME	<u>PERCEPTION OF MOTHER'S FRAME</u>	<u>PERCEPTION OF FATHER'S FRAME</u>
Men N=142	0.239 *	0.393 **
Women N=220	0.406 **	0.342 **

* $p < 0.01$

** $p < 0.001$

Pearson correlation coefficients rounded to 3 places

Table 11

RESPONSES OF MEN AND WOMEN
TO QUESTION "HOW DO YOU SEE YOURSELF?"

	<u>MEN</u>	<u>WOMEN</u>
	N=142	N=221
	%	%
RESPONSE		
VERY UNDERWEIGHT (1)	0.7%	0.0%
SLIGHTLY UNDERWEIGHT (2)	27.5%	4.5%
JUST RIGHT (3)	41.5%	26.2%
SLIGHTLY OVERWEIGHT (4)	30.3%	64.7%
VERY OVERWEIGHT (5)	0.0%	4.5%
	**	**

** total may not equal 100% due to rounding

was true for only 26.2% of the women. This contrast was even greater in the percentage of men perceiving themselves as slightly overweight (30.3%) compared to the percentage of women (64.7%) perceiving themselves as such.

Men's and women's perception of their weight ("See Self") was significantly correlated to the "Pounds Plus or Minus" they reported; however the correlation was greater for men (0.919) than for women (0.769) (Table 12). The correlation of weight perception ("See Self") with the calculated Weight Discrepancies F and M for women was significant (0.58, 0.56, respectively), while it was not significant for men (0.33, 0.40, respectively).

When the reported "Pounds Plus or Minus" was compared to the calculated Weight Discrepancies F and M for men, some major differences can be seen (Table 13). Of the men responding, 28.5% perceived themselves as underweight. When the measured weights of men were compared to the Frisancho height-weight table, 21.5% weighed less than suggested for their height and frame size while only 7.2% weighed less than suggested for their height and weight when measured weights were compared to the Metropolitan tables. While 41.5% of the men perceived themselves to be "just right", the two height-weight tables contrast considerably. Evaluation using Frisancho's table determined 40.6% of the men "just right" but only 21.7% were "just right" when

Table 12

CORRELATIONS OF "SEE SELF"
WITH POUNDS PLUS OR MINUS, WEIGHT DISCREPANCY F
AND WEIGHT DISCREPANCY M

	<u>"SEE SELF"</u>	<u>"SEE SELF"</u>
	MEN	WOMEN
POUNDS PLUS OR MINUS	0.919 N=142	0.769 N=221
WEIGHT DISCREPANCY F	0.330 N=141	0.584 N=217
WEIGHT DISCREPANCY M	0.403 N=136	0.558 N=217

p < 0.0001

Pearson correlation coefficients rounded to 3 places

Table 13COMPARISON OF POUNDS PLUS OR MINUS
TO WEIGHT DISCREPANCIES F AND M

			MEN					
<u>POUNDS PLUS OR MINUS</u>			<u>WEIGHT* DISCREPANCY F</u>			<u>WEIGHT* DISCREPANCY M</u>		
N=142			N=143			N=138		
%			%			%		
			-21 to -16	1.2%				
-33 to - 5	28.5%		-14 to - 1	20.3%	-13 to - 1	7.2%		
00	41.5%		00	40.6%	00	21.7%		
+ 3 to + 5	6.4%		+ 1 to + 5	13.6%	+ 1 to + 5	12.3%		
+ 6 to +10	18.3%		+ 6 to +10	9.1%	+ 6 to +10	18.1%		
+13 to +20	05.6%		+12 to +24	7.7%	+11 to +24	26.8%		
	**		+26 to +55	7.7%	+25 to +63	13.8%		**
				**				

* in pounds

** total may not equal 100% due to rounding

evaluated by the Metropolitan table. The contrast was greater in the percentages of men evaluated as weighing more than recommended for their height and frame by the two tables. Again, the 38.1% of men evaluated as overweight using Frisancho's table was similar to the 30.3% of men who perceived themselves as being overweight. However, evaluation using the Metropolitan height-weight table categorized 71.0% of the men as over the recommended weight for height and frame size.

The comparison of women's reported "Pounds Plus or Minus" and the calculated Weight Discrepancies F and M reflected greater difference between women's responses and the two height-weight tables than between the two height-weight recommendations (Table 14). Only 4.1% of the women reported themselves as underweight. Yet evaluation of women's measured weight using Frisancho's height-weight table suggested 34.6% of the women were underweight for their height and frame size and the Metropolitan table suggested 35.5% as such. Only 26.2% of the women perceived themselves as "just right", but 38.2% of the weights measured for women fell within the ranges suggested by Frisancho's table for their height and frame size and 45.6% fell within the Metropolitan suggested ranges. While 69.8% of the women reported 2 to 60 pounds of perceived extra weight, only 27.2% of the women's weights evaluated using

Table 14

COMPARISON OF POUNDS PLUS OR MINUS
TO WEIGHT DISCREPANCIES F AND M

			WOMEN					
<u>POUNDS PLUS OR MINUS</u>			<u>WEIGHT * DISCREPANCY F</u>			<u>WEIGHT * DISCREPANCY M</u>		
N=221 %			N=217 %			N=217 %		
			-22 to -16	4.6%	-24 to -16	3.7%		
-15 to - 4	4.1%		-15 to - 1	30.0%	-15 to - 1	31.8%		
00	26.2%		00	38.2%	00	45.6%		
+ 2 to + 5	15.0%		+ 1 to + 5	9.2%	+ 1 to + 5	5.5%		
+ 6 to +10								
	**			**		**		

* in pounds

** total may not equal 100% due to rounding

Frisancho's table were above suggested ranges, and 19.0% were above ranges for height and frame size suggested by the Metropolitan table.

The "Pounds Plus or Minus" reported by men and by women did not correlate significantly with their perception of frame size (0.27, 0.29, respectively) (Table 15). For men their reported "Pounds Plus or Minus" also did not correlate significantly with Weight Discrepancy F or M (0.39, 0.46, respectively) calculated from the respective height-weight tables. However, for women there was a significant correlation between the "Pounds Plus or Minus" reported and the weight discrepancies (0.81, 0.78, respectively) based on the two height-weight tables examined. When the Weight Discrepancies F and M were correlated with measured weight and reported weight of both men and women there was very little difference in the correlations, all of which were significant (lowest correlation men: 0.78, women: 0.79) (Table 16).

Table 15

CORRELATIONS OF POUNDS PLUS OR MINUS
WITH PERCEIVED FRAME, WEIGHT DISCREPANCY F
AND WEIGHT DISCREPANCY M

	<u>POUNDS + OR -</u>	<u>POUNDS + OR -</u>
	MEN	WOMEN
PERCIVED FRAME	0.267 * N=141	0.289 * N=221
WEIGHT DISCREPANCY F	0.391 ** N=141	0.812 ** N=217
WEIGHT DISCREPANCY M	0.463 ** N=136	0.799 ** N=217

* $p < 0.01$

** $p < 0.001$

Pearson correlation coefficients rounded to 3 places

Table 16

CORRELATIONS OF WEIGHT DISCREPANCIES F AND M
WITH MEASURED WEIGHT AND REPORTED WEIGHT

	<u>WEIGHT DISCREPANCY F</u>	<u>WEIGHT DISCREPANCY M</u>
Men	N=143	N=138
MEASURED WEIGHT	0.818	0.883
REPORTED WEIGHT	0.775	0.843
Women	N=217	N=217
MEASURED WEIGHT	0.865	0.825
REPORTED WEIGHT	0.831	0.792

$p < 0.0001$

Pearson correlation coefficients rounded to 3 places

Chapter 5

DISCUSSION AND RECOMMENDATIONS

General Characteristics

The general characteristics of the population measured were in agreement with several previous studies. The comparison of mean measured height and weight with mean reported height and weight provided results similar to those of Pirie et.al. (24). The men's mean reported height was taller by 1.1 centimeters than mean measured height while women's mean reported and measured heights were the same, indicating greater accuracy. Additionally, there was a greater difference between women's mean reported and measured weight (1.2 kg) than between men's (0.4 kg).

Average responses to the question, "How do you see yourself?" can be seen as similar to the observations of Fallon and Rozin (43). Men tended to see themselves as "just right" (3.01) while women were more likely to see themselves as "slightly overweight" (3.69). This tendency is further supported by the average "Pounds Plus or Minus", a figure representing perceived over or underweight. For men the average was -0.16 pounds while for women the average was +7.75 pounds.

Measurements Taken

From the principal components extraction of roots, analysis of the measures assumed to be indicative of frame (elbow breadth/height, wrist circumference/height and shoe length x width/height) indicated all were measures of frame. Elbow breadth/height and wrist circumference/height appear to be better indicators, with higher standardized scoring coefficients than shoe length x width/ height. Due to the exploratory nature of this examination of the relationship between foot length and width to frame, the Brannock device was used for measurement. It is possible this relationship would be stronger if a more accurate unisex length/ width grid measuring device could be created for further research.

Frame Measures

The relationship between frame measures, as indicated by Pearson correlation coefficients is variable for both men and women. There appeared to be little relationship between the two frame measures using wrist circumference (FMW and FMH/W) and the three using elbow breadth (FMF:A, FMF:B and FMM). However, these correlations were of the frame sizes determined from wrist and elbow measurement criteria. The correlations observed between wrist circumference and elbow breadth measurements for both men

and women were significant. Himes and Bouchard measured wrist breadth rather than wrist circumference, and their recommendation, based on their findings, was wrist breadth instead of elbow breadth as an indication of frame size less influenced by body fat (33). It is possible the criteria for determination of frame size by wrist circumference could be adjusted to parallel the criteria for frame size determined by elbow breadth. Additionally, it would be necessary to examine wrist circumference to determine any body fat influences on measurement. In the present study the correlation of wrist circumference with weight was higher than the correlation of elbow breadth with weight for both men and women. However, all four correlations were significant. None of the correlations was significant when height was divided into each measurement.

Height appeared to be of greater influence in frame measure determinations for men than for women when the frame measures using elbow breadth are examined. For men the correlations of FMF:A (elbow breadth only) with FMF:B and FMM (elbow breadth and height considered) were 0.647 and 0.668 respectively. However, for women the correlations of FMF:A with FMF:B and FMM were higher, 0.767 and 0.884 respectively.

The percentages of small, medium and large frames observed in the population measured varied by each method. In proposing his method of frame determination, Grant projected 25% of the population as small frame, 50% of the population as medium frame and 25% of the population as large frame (13). The percentages of small, medium and large frames observed in this population were quite different from Grant's projections, as were the percentages observed by Nowak and Schulz (31). This was also true when the projections of the Metropolitan height-weight table frame determination were compared to the percentages observed in both this population and the population measured by Nowak and Schulz. It is interesting to note the percentages of small, medium and large frames observed by FMF:A, FMF:B and FMM for women were all very similar, again suggesting less influence of height in frame determination for women. For men, the difference between the percentages of observed frame sizes determined by FMF:A (elbow breadth only) compared to those of FMF:B and FMM (elbow breadth and height considered) suggests height influence in determination of frame size for men.

Perception of Frame Size

Self-perception of frame size was not significantly correlated to any of the five frame measures examined.

While Katch et.al. did not use correlations in evaluating their data, they did determine 41.7% of their responses were inaccurate when compared to the "HAT" frame calculation (32). Since self-perception of frame size was not significantly correlated to the five frame measures examined, it is likely perception of parents' frame size would not be significantly correlated to parents' measured frame size. However, it would be interesting to correlate measured frame size of parents to measured frame size of adult children to examine the relationship.

Perception of Weight

The responses of subjects in this study to the question, "How do you see yourself", were similar to observations in several other studies. A greater percentage of men (28.2%) in this study perceived themselves as underweight than did women (4.5%). In Gray's study, 12.9% of the men and 5.1% of the women perceived themselves as underweight while Miller reported 18% of the men and 9% of the women studied perceived themselves as underweight (41,42). Perception of "just right" in the present study was the response of 41.5% of the men compared to 26.2% of the women. While Gray's study reported this response from 59.7% of the men and 69.2% of the women, Miller reported "just right" responses from 50% of the men

and 22% of the women. In the present study, only 30.3% of the men saw themselves as slightly overweight while 69.2% of the women saw themselves as slightly or very overweight. Again, Gray's report of this perception was 27.4% for men and 25.6% for women while Miller's study indicated 32% of the men and 69% of the women perceived themselves as overweight. Gray's sample included blacks and Hispanics, which may have contributed to fewer differences based on cultural definitions of weight. Also, the average age of subjects in Gray's study was 28.5 years, several years older than Miller's sample (18 to 23 years old) and the present sample (96.7% between 18 and 24 years old).

Evaluation of measured weight for subjects in this study was also similar to results reported by Gray and Miller for those determined underweight. While 4.1% of the women perceived themselves between 4 and 15 pounds underweight, evaluation using the 1983 Metropolitan height-weight tables determined 35.5% of the women to be between 1 and 24 pounds underweight. The reverse was true for men. Again, using the Metropolitan tables, only 7.2% of the men were evaluated as 1 to 13 pounds underweight yet 28.5% perceived themselves as 5 to 33 pounds underweight. Gray used self-reported heights, weights and frame sizes to evaluate subjects' weight by the 1959 Metropolitan tables and determined 23.0% of the male and 37.9% of the female

subjects underweight. Miller used an anthropometric index based on self-reported weight and measured skinfold to determine that none of the male subjects and 24% of the female subjects were underweight.

For the present study, the percentage of "just right" responses compared to the percentage determined within recommended weights of the Metropolitan tables were opposite for men and women. For men, 41.5% perceived themselves as "just right". Yet, evaluation using the Metropolitan tables determined only 21.7% within weight recommended for height. For women, 26.2% perceived themselves as "just right" while 45.6% were evaluated as being within the recommended weight ranges.

Both Gray's and Miller's results are a contrast to the observations of "just right" or normal weight in this study. Gray evaluated smaller percentages of men (31.1%) and women (38.8%) as normal weight than the percentages of men and women who perceived themselves as normal weight, 59.7% and 69.2% respectively. The higher percentage of women who perceived themselves as normal weight in Gray's study may be an influence of the cultural mix of the sample and the increased age. Miller evaluated a larger percentage of men (73%) as normal weight than the percentage (50%) who perceived themselves as normal weight. The inclusion of skinfold measures in Miller's method of

weight evaluation may have allowed muscularly heavy men to be considered normal weight. Thirty-seven percent of the women in Miller's sample were evaluated as normal weight while 22% perceived themselves as normal weight, results similar to those observed in the present study.

The differences between men and women in their perception of overweight and the evaluation of weight using the Metropolitan tables were quite dramatic in this study. Only 30.3% of the men perceived themselves as 3 to 20 pounds overweight, yet comparing their weights to the recommendations for height and frame size from the Metropolitan tables, 71% of the men were determined to be 1 to 63 pounds overweight. For men, the percentages of perceived and evaluated 10 pounds or less overweight were similar, 24.7% and 30.4% respectively. However, only 5.6% of the men perceived themselves as 11 to 20 pounds overweight, while 40.6% were evaluated, using the tables, as 11 to 63 pounds overweight. It would appear the Metropolitan height-weight table recommendations do not reflect the perceived body image of these men.

For women, perception and evaluation of overweight was opposite what was observed for men. The percentage of women perceiving themselves to be 2 to 60 pounds overweight was 69.8% while only 19% were evaluated as 1 to 46 pounds overweight using the Metropolitan tables. While 50.3

perceived themselves 2 to 10 pounds overweight, only 8.8% were evaluated 1 to 10 pounds overweight. To be thinner than is recommended by the Metropolitan height-weight tables appears to be the desire of these women. The percentage of women who perceived themselves to be 12 to 60 pounds overweight and those evaluated as 11 to 46 pounds overweight are more similar, 19.5% and 10.2% respectively.

While Gray and Miller did not report such dramatic differences between men and women in perception and evaluation of overweight, their results were similar. Gray reported that 27.4% of the men and 25.6% of the women perceived themselves as overweight while evaluation of self-reported weights determined 45.9% of the men and 23.3% of the women as overweight. Using his anthropometric index, Miller evaluated 30.4% of the men slightly overweight and 40.6% as overweight while the men's perceptions were 24.7% and 5.6% respectively. For women, evaluation using the anthropometric index indicated 8.8% slightly overweight and 10.2% overweight; yet, 40.3% perceived themselves as slightly overweight and 19.5% perceived themselves as overweight. These results and the results of the present study suggest that men appear to be more realistic in evaluating slight overweight and very unrealistic in evaluating very overweight while the reverse is true for women.

The height-weight table proposed by Frisancho appears to be very similar to the 1983 Metropolitan table. For women, fewer differences were noted between the percentages observed for the ranges established to compare the weight discrepancies derived from the two tables. However, for men, there was considerable difference between the percentages observed for the ranges. Frame Index One (FMF:A) is the frame measure recommended for use with the height-weight table printed on the Frameter (16). In this study the correlation between FMF:A and FMF:B was not as high as the correlation between FMF:B and FMM (frame measure used by the Metropolitan height-weight table). It is possible, for men, that there would be less difference in the percentages observed for the ranges established to compare the two weight discrepancies if the two frame measures using height (FMF:B and FMM) had been used to determine frame size for the two height-weight tables.

Perceived frame size does not appear to influence perception of weight for either men or women as indicated by the lack of significant correlation with the "Pounds Plus or Minus" variable created in this study. For men, "Pounds Plus or Minus" also does not correlate significantly with the weight discrepancy variables created to examine Frisancho's height-weight table and the 1983 Metropolitan height-weight table. This lack of correlation

may indicate that men rely less on height-weight tables in self-evaluation of weight or that the weight tables do not reflect the perceived body image of men.

For women, "Pounds Plus or Minus" is significantly correlated to the two weight discrepancy variables. It would appear that women may rely on height-weight tables in evaluating their weight. In the present study weights within the recommended range for height and frame size were considered "just right". For the Metropolitan tables the recommended ranges vary by approximately 12-14 pounds. The large percentage of women perceiving themselves as 2 to 10 pounds overweight suggests that women desire their weight to be at the lower end of suggested weight ranges, if not below.

Recommendations

The purpose of this study was to examine five frame measures, to compare agreement in identification of frame size in order to provide recommendations for health care practitioners. While the measurements used as a basis for the frame measures, wrist circumference and elbow breadth, were significantly correlated, the frame measures incorporating these measurements were not. The two frame measures which used wrist circumference were definitely not interchangeable for men but could be for women. For the

three frame measures which used elbow breadth, frame size was not categorized similarly to those frame measures which used wrist circumference. Therefore, frame measures using wrist circumference and frame measures using elbow breadth do not appear to be interchangeable. For women, frame measurement by elbow breadth only did not appear to be greatly changed when height was considered. However, for men the potential for height to change the frame measure determined by elbow breadth only is greater. For this reason, it would be advisable to use the elbow breadth frame measures which include height in the determination of frame size.

Self-perception of frame size and of desired weight was examined and compared to height-weight recommendations to explore the relationships. The correlations of perception of frame size with the five frame measures examined and with the perceived pounds over or underweight were not significant for either men or women. It would appear that knowledge of frame size is not a major consideration in self-evaluation of weight.

For men, the perceived pounds over or underweight did not correlate with the two weight discrepancies determined from height-weight tables. When the percentages of men's perceptions of underweight, just right or overweight were compared to percentages of men's weights evaluated as

underweight, just right or overweight there were considerable differences. Height-weight tables do not appear to reflect weights which men of the age studied consider acceptable. Given the popularity of weight lifting and physical fitness and the apparent ideal body image men have as one of muscular substance, it is possible many of the men evaluated as overweight were heavy due to muscle development rather than fat. Therefore, it would be advisable for determination of percent body fat to be included in weight evaluations of men.

For women, the perceived pounds over or underweight correlated significantly with the two weight discrepancies determined from height-weight tables. When the percentages of women's perceptions of underweight, just right or overweight were compared to percentages of women's weights evaluated as underweight, just right or overweight there were considerable differences. Again, height-weight tables do not appear to reflect weights which women of the age studied consider acceptable. However, where men appeared to be accepting of greater weight, women appear to be desirous of less weight. The acceptance of a thin body image as ideal by women appears to be indicated by the data of this study. Again, it would be advisable for determination of percent body fat to be included in weight

evaluations of women to assist in developing realistic weight goals.

Further Study

There are several recommendations which can be made for further research based on this study. These recommendations include measurement of percent body fat, determination of exercise habits, and evaluation of subjects by an observer.

In an effort to distinguish between overweight and overfatness, a recommendation would be to include a measurement of percent body fat in future studies. This study was designed to collect data measurements as if in a clinic situation. Frame measures were chosen which required little or no calculation. Therefore, measures of percent body fat which meet these criteria would be desirable. Additionally, subjects' knowledge and acceptance of the concept of percent body fat could be explored in questionnaire format.

The influence of regular exercise on subjects' perception of their body and on measurements taken would be a second recommendation for exploration in further research. It is possible that regular exercise influences perception of accepted and desired weight. An observation of apparent larger wrists for weight lifters was made as

data was collected. Therefore, in addition to it being desirable to determine a frame measure least affected by body fat, it is also desirable to determine one which does not change considerably with development of muscle.

The acceptance of a desired or culturally defined body image includes comparison of perceived self to others and/or comparison of perceived self to ideal self. Therefore, the final recommendation for further study would be to include strategies for identifying potential discrepancies between acceptable weight standards for self as compared to acceptable weight standards for others. Techniques could be developed, such as visual aids to examine variations in weight perceptions.

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APPENDIX 1
QUESTIONNAIRE/DATA COLLECTION FORM

NO. _____

DATA SHEET FOR FRAME SIZE MEASURES

PLEASE ANSWER THE FOLLOWING QUESTIONS BY CIRCLING ONE OF THE RESPONSES GIVEN (questions 1, 2, 6, 7, 8, 9) OR BY FILLING IN THE BLANK(S) PROVIDED (questions 3, 4, 5, 6a or 6b, 10).

1. MALE FEMALE
 2. WHITE BLACK HISPANIC ASIAN & ASIAN AMERICAN AMERICAN INDIAN
 3. AGE IN YEARS _____ BIRTH MONTH _____ BIRTH YEAR _____
 4. WHAT IS YOUR HEIGHT? _____ (without shoes)
 5. WHAT IS YOUR WEIGHT? _____ (with light clothes, no shoes)
 6. HOW DO YOU SEE YOURSELF?

VERY UNDERWEIGHT	SLIGHTLY UNDERWEIGHT	JUST RIGHT	SLIGHTLY OVERWEIGHT	VERY OVERWEIGHT
---------------------	-------------------------	------------	------------------------	--------------------

 - a) IF YOU SEE YOURSELF UNDERWEIGHT:
HOW MANY POUNDS UNDERWEIGHT? _____
 - b) IF YOU SEE YOURSELF OVERWEIGHT:
HOW MANY POUNDS OVERWEIGHT? _____
- PEOPLE ARE OFTEN DESCRIBED AS SMALL, MEDIUM OR LARGE FRAME TO INDICATE THEIR BONE THICKNESS OR BODY SIZE.
7. HOW WOULD YOU DESCRIBE YOURSELF? SMALL FRAME MEDIUM FRAME LARGE FRAME
 8. HOW WOULD YOU DESCRIBE YOUR MOTHER? SMALL FRAME MEDIUM FRAME LARGE FRAME
 9. HOW WOULD YOU DESCRIBE YOUR FATHER? SMALL FRAME MEDIUM FRAME LARGE FRAME
 10. WHAT SIZE SHOE DO YOU WEAR? _____ (please give length & width)

PLEASE DO NOT WRITE IN THE SPACES BELOW. THE FOLLOWING MEASUREMENTS OF YOU WILL BE TAKEN AND THIS INFORMATION WILL BE RECORDED BY DEB MERRITT.

WEIGHT (KG) _____

HEIGHT (CM) _____

WRIST (RIGHT) (CM) _____

(IN) _____

ELBOW (RIGHT) (CM) _____

FOOT SIZE (M F)

LENGTH _____

WIDTH _____

APPENDIX 2
CONSENT FORM

CONSENT FORM

This project is being conducted to survey frame sizes in a university population. Your responses will provide the information needed for the study, and your participation would be greatly appreciated. The only thing you will be asked to do is to complete the attached questionnaire and to have five measurements taken - height, weight, foot size, wrist, and elbow breadth. Your participation is completely voluntary, and no names or other means of identification will be used on the form. Code numbers are for use exclusively in data handling. If you have any questions about the study, you may contact Dr. Patricia Hodges, 961-5778, or Dr. Chuck Waring, 961-5283. Once you have signed the two copies of the consent form, please tear them from the questionnaire. Keep one copy and put the other in the envelope marked CONSENT FORMS.

Thank you for your participation!

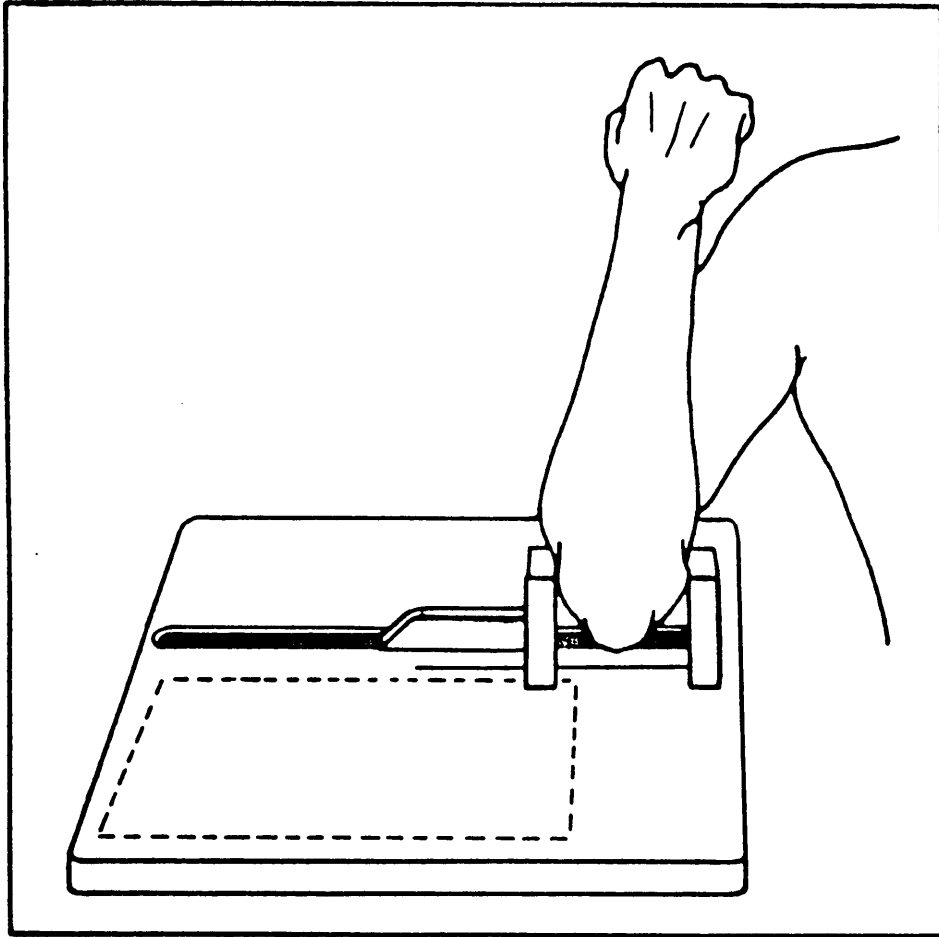
I have read the above information, and I agree to participate in the project.

Signature

Date

APPENDIX 3

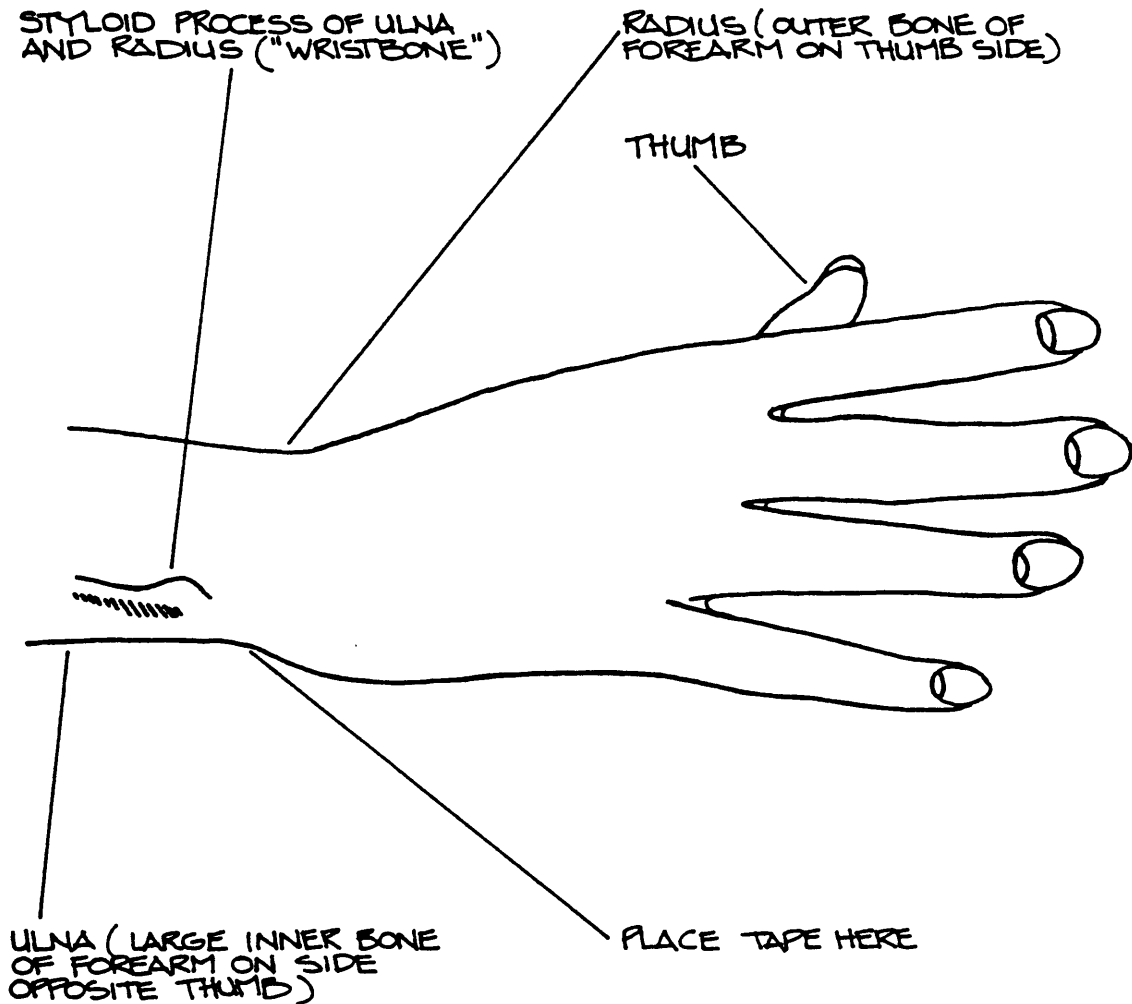
FRAMETER



Instructions for Using the Frameter, Weight and Fat Guide,
pg. 2. Ann Arbor, Michigan: Health Products, 1986.

APPENDIX 4
WRIST MEASUREMENT

DETERMINATION OF WRIST CIRCUMFERENCE



GRANT, A. AND DEHOOG, S.: NUTRITIONAL ASSESSMENT AND SUPPORT, 3RD ED., PG. 6. SEATTLE, WASHINGTON: GRANT AND DEHOOG, BOX 25057, NORTHGATE STATION, 1985.

APPENDIX 5
CONVERSION OF SHOE WIDTHS

NUMERICAL CONVERSION OF
LETTER SHOE WIDTH *

LETTER SHOE WIDTH		NUMBER ASSIGNED
MEN	WOMEN	
3A	4A	1.0
AA	3A	2.0
A	AA	3.0
B	A	4.0
NARROW		2.5
C	B	5.0
D	C	6.0
MEDIUM		5.5
E	D	7.0
EE	E	8.0
3E	EE	9.0

* from the Brannock device

phone call May, 1987
Tom Barnes
Red Wing Shoe Company
Red Wing, Minnesota
(612) 388-8211

APPENDIX 6
HEIGHT-WEIGHT TABLES

FRAMESIZE DETERMINATION - MEASURING ELBOW BREADTH

FRISANCHO'S FRAMETER BOARD

MEN

SMALL - LESS THAN 6.8 CENTIMETERS
(< 6.8 cm)

MEDIUM - GREATER THAN OR EQUAL TO 6.8
BUT LESS OR EQUAL TO 7.9 CENTIMETERS
(≥ 6.8 TO ≤ 7.9 cm)

LARGE - GREATER THAN 7.9 CENTIMETERS
(> 7.9 cm)

FRISANCHO'S HEIGHT AND WEIGHT TABLES FOR MEN
FROM THE FRAMETER

HEIGHT (INCHES) WITHOUT SHOES	# WEIGHT (POUNDS)		
	SMALL FRAME	MEDIUM FRAME	LARGE FRAME
59	119-127	132-142	
60	120-128	133-143	
61	119-128	134-144	142-152
62	126-136	137-148	145-155
63	124-137	135-149	145-160
64	130-140	138-152	150-164
65	134-145	142-155	160-171
66	134-146	146-158	160-171
67	138-150	149-162	164-173
68	141-152	151-165	165-177
69	147-156	152-166	164-178
70	146-159	157-172	169-185
71	149-161	160-174	170-190
72	147-161	162-178	171-190
73	152-167	166-181	181-195
74	153-168*	170-186	182-198
75	158-174*	176-190	182-206*
76	162-178*	170-192	181-210*

* PREDICTED VALUES

WEIGHTS WITH INDOOR CLOTHING WEIGHING 0.20 TO 0.60 POUNDS

FRAMESIZE DETERMINATION - MEASURING ELBOW BREADTH

FRISANCHO'S FRAMETER BOARD

WOMEN

- SMALL - LESS THAN 5.9 CENTIMETERS
(< 5.9 cm)
- MEDIUM - GREATER THAN OR EQUAL TO 5.9
BUT LESS OR EQUAL TO 6.8 CENTIMETERS
(≥ 5.9 TO ≤ 6.8 cm)
- LARGE - GREATER THAN 6.8 CENTIMETERS
(> 6.8 cm)

FRISANCHO'S HEIGHT AND WEIGHT TABLES FOR WOMEN
FROM THE FRAMETER

HEIGHT (INCHES) WITHOUT SHOES	# WEIGHT (POUNDS)		
	SMALL FRAME	MEDIUM FRAME	SMALL FRAME
56	100-113	107-114	
57	101-114	111-126	150-158
58	106-115	115-127	151-158
59	106-115	115-130	152-158
60	109-118	119-133	150-158
61	109-119	118-130	146-158
62	112-122	120-132	143-158
63	114-123	122-135	145-159
64	116-125	124-136	142-159
65	120-128	126-136	144-159
66	120-128	128-139	142-159
67	123-129	131-141	144-159
68	127-132	134-147	144-159
69	130-134	139-149	140-159
70	131-135*	139-150	144-160

* PREDICTED VALUES

WEIGHTS WITH INDOOR CLOTHING WEIGHING 0.20 TO 0.60 POUNDS

FRAMESIZE DETERMINATION - MEASURING ELBOW BREADTH

METROPOLITAN LIFE INSURANCE COMPANY

MEN

HEIGHT WITHOUT SHOES (cm)	SMALL LESS THAN (cm)	MEDIUM BETWEEN (cm)	LARGE GREATER THAN (cm)
155.5-158.5	6.4	6.4-7.2	7.2
159.5-168.5	6.7	6.7-7.4	7.4
169.5-178.5	6.9	6.9-7.6	7.6
179.5-188.5	7.1	7.1-7.8	7.8
189.5-190.5	7.4	7.4-8.1	8.1
(in)	(in)	(in)	(in)
61-62	2.5	2.5-2.875	2.875
63-66	2.625	2.625-2.875	2.875
67-70	2.75	2.75-3.0	3.0
71-74	2.75	2.75-3.125	3.125
75	2.875	2.875-3.25	3.25

1983 METROPOLITAN HEIGHT AND WEIGHT TABLE FOR MEN

HEIGHT (INCHES) WITHOUT SHOES	* WEIGHT (POUNDS)		
	SMALL FRAME	MEDIUM FRAME	LARGE FRAME
61	123-129	126-136	133-145
62	125-131	128-138	135-148
63	127-133	130-140	137-151
64	129-135	132-143	139-155
65	131-137	134-146	141-159
66	133-140	137-149	144-163
67	135-143	140-152	147-167
68	137-146	143-155	150-171
69	139-149	146-158	153-175
70	141-152	149-151	156-179
71	144-155	152-165	159-183
72	147-159	155-169	163-187
73	150-163	159-173	167-192
74	153-167	162-177	171-197
75	157-171	168-182	176-202

*WEIGHTS WITHOUT CLOTHING

FRAMESIZE DETERMINATION - MEASURING ELBOW BREADTH

METROPOLITAN LIFE INSURANCE COMPANY

WOMEN

HEIGHT WITHOUT SHOES (cm)	SMALL LESS THAN (cm)	MEDIUM BETWEEN (cm)	LARGE GREATER THAN (cm)
145.5-148.5	5.6	5.6-6.4	6.4
149.5-158.5	5.8	5.8-6.5	6.5
159.5-168.5	5.9	5.9-6.6	6.6
169.5-178.5	6.1	6.1-6.8	6.8
176.5-180.5	6.2	6.2-6.9	6.9
(in)	(in)	(in)	(in)
57-58	2.25	2.25-2.5	2.5
59-62	2.25	2.25-2.5	2.5
63-66	2.375	2.375-2.625	2.625
67-70	2.375	2.375-2.625	2.625
71	2.5	2.5-2.75	2.75

1983 METROPOLITAN HEIGHT AND WEIGHT TABLE FOR WOMEN

HEIGHT (INCHES) WITHOUT SHOES	* WEIGHT (POUNDS)		
	SMALL FRAME	MEDIUM FRAME	LARGE FRAME
57	99-108	106-118	115-128
58	100-110	108-120	117-131
59	101-112	110-123	119-134
60	103-115	112-126	122-137
61	105-118	115-129	125-140
62	108-121	118-132	128-144
63	111-124	121-135	131-148
64	114-127	124-138	134-152
65	117-130	127-141	137-156
66	120-133	130-144	140-160
67	123-136	133-147	143-164
68	126-139	136-150	146-167
69	129-142	139-153	149-170
70	132-145	142-156	152-173

*WEIGHTS WITHOUT CLOTHING

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