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Weight Gain during Pregnancy: the characteristics of women who experience excess weight gain.

by

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(ABSTRACT)

Weight gain during pregnancy, relationships among body image, body weight standards, and attitudes toward weight gain were investigated. Weight gain recommendations, based on preconceptional weight status (PCWS) reflected current practices in prenatal care at Sentara Norfolk General Hospital, Norfolk, VA, and provided a basis on which to categorize weight gain as inadequate, appropriate, and excess. Women who experienced excess weight gain (EWG) were compared to those who experienced appropriate weight gain (AWG) or inadequate weight gain (IWG) to identify their characteristics. Of the 138 women studied, 54 experienced EWG. Weight gain recommendations for overweight women were similar to those for normal weight women, 20-25% PCW. Obese women who lost weight or gained less than 15 pounds were identified with the inadequate weight gain group. EWG and AWG groups differed only with regard to parity; more primigravidas experienced excess weight gain. Significant correlations were noted between self perceived preconceptional weight (SPCW) and actual weight status, between SPCW and body mass index (BMI),and between the 1983 Metropolitan Life Table on body

weight and BMI. Relationships between attitude toward weight gain, SPCW, PCWS, and weight gains (IWG, AWG, EWG) were examined. Significant correlations were noted between scores (Attitude Questionnaire) and SPCW. EWG during pregnancy contributes to obesity, and it is suggested that primigravidas have a greater need for individualized nutrition counseling.

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INTRODUCTION

Obesity is a major health problem in the United States. The National Institutes of Health Consensus Development Panel on the Health Implications of Obesity (1985) defined obesity as "an excess of body fat frequently resulting in significant impairment of health" (p. 1073). It has also been defined by Bray (1979) as an "increase in body weight of 20% or more above desirable weight" (p. 4). However, Simopoulos and Van Itallie (1984) report that "body weight, by itself, is not a measure of obesity. Therefore, when it is used to define obesity, weight must be related to more appropriate measures of body fat" (p. 292), such as BMI or skinfold thickness.

The hazards of obesity include the development of hypertension, (Kannel, Brand, Skinner, Dawber, and Mc Namara, 1967; Stamler, Stamler, Rhomberg, Dyer, Berkson, Reedus, and Wannamaker, 1975) hypercholesterolemia (Van Itallie, 1985), type II diabetes, coronary heart disease, cancer (Lew and Garfinkel, 1979), and complications associated with pregnancy (Abrams, 1988, Abrams and Parker, 1988; Garbaciak, Richter, Miller, and Barton, 1985). Current practices employed to address the problem of obesity include activities aimed at reducing body fat and body weight. These activities are increased physical activity, surgery, participation in weight-loss groups, and the use of "diet pills", (Vasselli, Cleary, and Van Itallie, 1984; Pi-Sunyer, 1988). Individuals predisposed to excess body fat or excess weight need to be

identified so that appropriate intervention may be offered to alleviate or eliminate the problem. Obesity has been attributed to many factors which increase the complexity of the problem. These factors are metabolic, psychological, environmental, dietary, socioeconomic, cultural, and genetic (Vasselli et al., 1984). Some environmental factors contributing to obesity in adults are the addition of solid food early in infancy, the presence of thousands of food choices in the market place, physical inactivity, and accumulation of body fat during pregnancy.

In 1981, the National Center for Health Statistics (Gillum, 1987) reported that approximately 20% of women aged 25-34 years were overweight, and the percentage increased to approximately 27% in women aged 35-44 years. What contributes to the increase in percent of overweight women from ages 25-34 to ages 35-44? Does pregnancy weight gain have any effect on the increase in the percentage of overweight women?

Pregnancy weight gain is composed of the weights of several components: fetus, placenta, amniotic fluid, breasts, uterus, blood, fluid, and fat. Relatively stable contributions are made to the gain from placenta, amniotic fluid, and uterus. However, weights of fetus, blood, and breasts may vary a few pounds between individuals. While the weight of cellular fluid is fairly constant, fluid retained later in pregnancy may contribute small or large amounts to weight gain. The same is also true for fat content.

Although early studies on weight gain during pregnancy addressed its effect on birth weight, recent works have addressed effects of excess

weight gain on women themselves. In their study, Greene, Smiciklas-Wright, Scholl, and Karp (1988) reported that during the postpartum period, approximately 25% of women do not lose the excess weight they have gained. The relationship between excessive weight gain and complications at labor and delivery has also been addressed. Results indicate an increase in the incidence of those complications when women experience EWG (Whittaker, 1983; Garbaciak et al., 1985).

A definition for EWG, per se, was not found in the literature. Since recommendations for desired weight gain during pregnancy range from 9-15 kilograms (kg) or 20-33 pounds (lbs) (Thomson and Billewicz, 1957; Naeye, 1981; Brown, 1988; Niswander and Jackson, 1974; Simpson, Lawless, and Mitchell, 1975; Orstead, Arrington, Kamath, Olson, and Kohrs, 1985; Chesley, 1944; Worthington-Roberts, 1987; National Research Council, 1970 and 1974), any weight gain above the recommendations could be considered EWG.

Several studies have investigated smoking (Picone, Allen, Schramm, and Olsen, 1982), marital status (Billewicz and Thomson, 1970), attitude toward weight gain during pregnancy (Pomerance, Johnson, Kagel, Brooks, Margolin, and Allen, 1980; Palmer, Jennings, and Massey, 1985), and their effects on pregnancy weight gain. However, except in obese women, the simultaneous effects of these factors on pregnancy weight gain and on complications during pregnancy have received little attention.

This study investigates weight gain during pregnancy in an effort to examine the effect of EWG on the incidence of gestational diabetes, preeclampsia, and primary cesarean section, and characterizes women who

experience EWG. This group of women is compared to a group of women who experienced AWG. The groups are compared with respect to parity, PCW, smoking, marital status, race, employment status, and the incidence of the aforementioned complications. If these women who experience EWG could be characterized, other women likely to experience EWG might be identified early in pregnancy and provided the prenatal nutrition counseling and support needed to reduce or eliminate that gain.

Perception of PCW, PCWS, BMI, and attitude toward weight gain during pregnancy are examined. Does the women state that she is too skinny or just right or overweight? What is the relationship between the woman's PCW and the recommendations in the 1983 Metropolitan Life Height and Weight Table? What is the relationship between PCWS and BMI? What are current attitudes toward weight gain during pregnancy?

REVIEW OF LITERATURE

Obesity

Definitions of obesity

Several definitions of obesity have been offered. Obesity has been defined in terms of body weight: 20% greater than suggested weight for height and frame (Metropolitan Life Table, 1960). Obesity was defined as a "surplus of body fat" (Bray, 1979), and Pi-Sunyer, (1988) defined it as "an excess accumulation of fat". "Obesity is an excess of body fat frequently resulting in a significant impairment of health" was the definition formulated by the National Institutes of Health Consensus Development Panel (Burton and Foster, 1985). Simopoulos and Van Itallie (1984), in a review of studies on body weight, health, and longevity, concluded that body weight and measurements of body fat must be related to each other when diagnosing the presence of obesity.

Sims, during the Fogarty International Center Conference on Obesity at the National Institutes of Health in 1977 (Bray, 1979), offered three definitions for obesity: social, statistical, and operational.

> A social definition involves clearly visible obesity, which requires no sophisticated measurements. A purely statistical definition, which is useful in population studies, sees the "obese" as persons who fall in the upper 5-20% of whatever criterion is being used, and the "superobese" as those above the upper 5%. An operational definition estimates a level of overweight based on

various criteria below which there is no improvement in mortality and morbidity (p. 20).

Summary

Obesity has been defined in terms of body weight, body fat, and perspective. Obesity is the presence of an increase in body weight and/or body fat that affects physical appearance, health, and length of life.

Diagnosis of Obesity

Methods

Several methods are used in the diagnosis of obesity. This section describes those methods and notes their characteristics.

Deuterated water, body density, total body potassium, and whole body plethysmography are complicated, time-consuming laboratory methods used to determine accumulation of fat. In clinical practice simpler approaches to measuring fat accumulation are BMI, skinfold thickness (Simopoulos and Van Itallie, 1984; Heymsfield and Williams, 1988), and comparison of an individual's height and weight measurements with those in standard tables.

Body mass index. Quetelet was the first to note the relationship between weight and height (W/H^2), and the ratio was named the Quetelet Index. Keys and his colleagues renamed it the "body mass index" (Garrow

and Webster, 1985).

Skinfold measurement. Skinfold measurements are determined at several sites: biceps, triceps, subscapular, suprailiac, thigh, and calf. The method has been described by Heymsfield and Williams (1988):

> Lift the skin and fat layer from the underlying tissue by grasping the tissue with the thumb and forefinger. Apply calipers about 1 cm distal from the thumb and forefinger, midway between the apex and base of the skinfolds. Continue to support the skinfolds with the thumb and forefinger for the duration of the measurement. After 2 to 3 seconds of caliper application, read skinfolds to nearest 0.5 mm. Measurements are then made in triplicate until readings agree within ± 1.0 mm; results are then averaged (p. 851).

Height and weight tables. Several anthropometric measurements are performed as the initial phase in assessment of obesity using height and weight tables. Height, wrist circumference, and/or elbow breadth measurements are used to determine frame size.

One technique used to measure height was described by Novascone and Smith (1989):

> Height was measured . . . with the subject wearing no shoes, standing erect, heels together, against a graduated vertical stadiometer. Subjects were advised to look straight ahead while a horizontal bar was lowered snugly onto the head (p. 965).

Wrist circumference is measured below the styloid process (Grant, Custer, and Thurlow, 1981), and elbow breadth is measured at the point of greatest distance between the two bones. The technique is described by the Metropolitan Life Insurance Company (Statistical Bulletin, 1983):

> Extend your arm and bend the forearm upwards at 90-degree angle. Keep the fingers straight and turn the inside of your wrist toward the body. If you have a caliper, use it to measure the space between the two prominent bones on either side of your elbow. Without a caliper, place thumb and index finger of your other hand on these two bones. Measure the space between your fingers against a

ruler or tape measure (p. 5).

The privacy of the situation will influence the technique used when a subject is weighed. Ideally, weight should be measured without shoes and nude or lightly clothed.

Anthropometric measurements are used in various formulae and are compared to standards presented in reference guides. Values above the standards contribute to the diagnosis of obesity.

Weight is converted to kilograms and height is converted to meters to determine BMI (Simopoulos and Van Itallie, 1984). Obesity, 20% overweight in women, is diagnosed when the BMI is greater than 25.8 (1959 Metropolitan Life Table) or 26.9 (1983 Metropolitan Life Table) (Burton and Foster, 1985). The ratio W/H1.5 is sometimes used when determining BMI for women (Van Itallie, 1985).

Detailed description of the use of skinfold measurements is beyond the scope of this review; however, it should be noted, individual measurements or a sum of measurements are age- and sex-adjusted, then compared to standards.

Height (inches) and frame (small, medium, large) are used to locate "standard weight" range in height-weight tables. When frame size is determined using wrist circumference measurement, the ratio of height (cm) to wrist circumference (cm) is calculated, and the results compared to values established for small, medium, and large frames (Grant et al., 1981). Elbow breadth measurements are compared to a table of measurements designated for medium frame. Measurements below and above the range listed for height denote small and large frames respectively

(1983 Metropolitan Height and Weight Tables).

Reference guides

Several height and weight tables are available as reference guides (Weigley, 1984); however, the most commonly used tables are those prepared by the Metropolitan Life Insurance Company (Weigley, 1984; Robinett-Weiss, Hixson, Keir, and Sieberg, 1984; Burton and Foster, 1985), and nomograms for the 1959 and 1983 Metropolitan tables have been developed to determine BMI (Burton and Foster, 1985).

Comparisons of relative weight indices in 7,424 men from around the world were conducted by Keys, Fidanza, Karvonen, Kimura, and Taylor (1972). For example, skinfold thickness (sum of triceps and scapula measurements) and body density were measured in Minnesota students and executives. The results indicated a correlation between the two methods as measurements of body fat. BMI was also examined and found to have a low correlation with height. The authors stated, "the best relative weight index is the one that shows the least correlation with body height and the highest correlation with independent measures of body fatness" (p. 331).

BMI has been classified as the "most satisfactory index of obesity based on weight and height that is available" (Simopoulos and Van Itallie, 1984, p. 337). A National Institutes of Health Consensus Panel agreed that BMI "minimizes the effect of height" (p. 1076) and noted another benefit: BMI can be used across populations.

Characteristics of selected measurements and guides

Frame size as determined by Grant et al. (1981) was based on the actual measurements of height (H) and wrist circumference (W) of 100 adult males and females at Duke University Medical Center. The results H(cm)/W(cm), were assigned to three groups - 50% medium frame, and 25% each for large and small frames - and values for each group were established. Grant et al. (1981) concluded, "the applicability of this table to the table of ideal body weight must certainly be questioned, but perhaps standardization of the method for determining frame size might reduce some of the error" (p. 448). Recent studies (Novascone and Smith, 1989; Nowak and Schulz, 1987) indicate that a 25%, 50%, 25% distribution for small, medium, and large frame sizes, respectively, is not representative of actual distribution in the population.

The values for elbow breadth, as stated in the 1983 Metropolitan Life Height and Weight Tables, are not based on actual measurements. The distribution, 25% small frame, 50% medium frame, and 25% large frame, was superimposed on the data from the National Health and Nutrition Examination Survey I (Weigley, 1984; Robinett-Weiss et al., 1984). "An accurate determination of frame size demands a measurement not influenced by adiposity" (Nowak and Schulz, 1987, p. 340).

The wrist circumference and elbow breadth methods have been compared. Nowak and Schulz (1987) compared the two methods in 80 men and women, ages 18-55. The same frame size was the designation in 69%

of the subjects. Although agreement between the two methods was lower (43%), the results from Novascone and Smith (1989) showed the "highest incidence of overall agreement was achieved when the Eb [elbow breadth] and the H:W [height:weight] methods were compared" (p. 965).

Controversy has centered on the use of height and weight tables for years. As early as 1955, Keys, in an editorial statement on obesity and heart disease, argued that

> The appraisal of obesity from height-weight tables adjusted for "frame size" or "skeletal type" offers neither theoretical nor practical advantage; . . . "ideal weight" tables also fail to get at . . . an assessment of fatness (p. 460).

The data collected from 25 insurance companies used to prepare the Metropolitan Life Tables is limited in its scope. The population did not represent a random sample and was limited to ages 25-59. It included smokers and non-smokers, and no actual measurement of frame size was performed, nor was the percentage of body fat considered. The ranges represent weights that are associated with the greatest longevity and lowest mortality. The issue of morbidity was not addressed during the formulation of the table (Weigley, 1984).

Robinett-Weiss et al. (1984) advised that "health care professionals should use height-weight tables with caution and in conjunction with other parameters to assist in nutritional status assessment" (p. 1481). Weigley (1984) agreed and suggested that "knowledge of the underlying philosophy and data base used in preparation of the tables will foster appropriate use" (p. 423).

Although tables have their limitations, Keys et al. (1972) noted that

> . . . for some purposes it is immaterial whether a proposed table of "standard" weights accurately portrays the average (or median) of the reference population. So long as the standard is acceptable and all sets of data on individuals are referred to it, the validity of comparison between individuals or groups will be independent of the "quality of the table" (p. 330).

The situation regarding height and weight tables was summarized by Simopoulos and Van Itallie (1984):

> An appropriate data base that relates body weight by age, sex, and possibly frame size to morbidity and mortality should be developed to permit the preparation of reference tables for defining the range of desirable weight from morbidity and mortality statistics (p. 293).

Summary

Methods used to diagnose obesity in a clinical setting include skinfold thickness measurements, BMI, and height and weight tables. The last do not include an assessment of fat accumulation; therefore, they represent the least desirable method.

BMI has been shown to correlate with skinfold thickness, and weight and height measurements can be accomplished with a reasonable degree of accuracy. BMI and degree overweight can be quickly determined using an established nomogram (Burton and Foster, 1985).

The use of height and weight tables requires determination of frame size. Although wrist circumference and/or elbow breadth measurements can be used in the calculations for frame size, the standard to which the latter result is compared was not based on data from actual measurements.

Health Implications of Obesity

The risks of developing hypertension, hypercholesterolemia, diabetes, coronary heart disease, cancer, digestive diseases, and complications during pregnancy are increased when obesity is present.

Hypertension. The relationship between blood pressure and six variables including relative weight was studied in Chicago between 1965 and 1971 (Stamler et al., 1975). Relative weight is the midpoint of desirable weight range for medium frame in the Desirable Weights for Men and Women, Metropolitan Life Insurance Company, 1959. Relative weight has been "chosen as reference weight for a given height" (Simopoulos and Van Itallie, 1984, p. 286).

A total of 13,469 black and white women and men, ages 30-64, participated. The data were subjected to partial correlation, multiple cross-classification, multiple logistic regression, and multiple linear regression analyses. All four statistical methods produced significant results for the relationship between blood pressure and weight. The conclusion drawn was as follows:

> Normotensive persons who are overweight have a greater risk of developing hypertension than non-overweight individuals, and normotensive adults originally non-overweight who become obese over the years are more prone to hypertension than those who put on a few pounds (p. 518).

Data from the Framingham Study were examined to determine "the relation of adiposity to blood pressure and development of hypertension" (Kannel et al., 1967, p. 48). The 5,127 subjects included men and

women, ages 30-62. Relative weight was determined and the subject's weight was expressed as a percent of standard. The results supported the existence of a relationship between relative body weight, blood pressure, and the development of hypertension. "The risk of 'hypertension' in previously normotensive individuals was proportional to the degree of overweight" (p. 58). Adiposity was determined by skinfold thickness since, it had been noted earlier, "relative body weight is not a good measure of fatness" (Keys, 1955, p. 459).

A behavioral risk factor survey was completed with 22,236 individuals, and final analysis on height and weight data was computed from 19,405 (Forman, Trowbridge, Gentry, Marks, and Hagelin, 1986). Uncontrolled hypertension was indicated when the respondent reported that a diagnosis had been made, treatment had been prescribed, and treatment did not appear to have lowered the blood pressure. The data was adjusted for age and education, and the results indicated that ". . . more overweight females have uncontrolled hypertension compared with women of average weight. . ." (p. 412).

Hypercholesterolemia. Van Itallie (1985) examined the data collected on serum cholesterol from National Health and Nutrition Examination Surveys I and II (NHANES I and II). The risk of hypercholesterolemia, serum cholesterol greater than 250 mg/dL, increased in Americans aged 20-75 years by 1.5 times in overweight persons as compared to non-over weight persons. The risk appeared greatest, 2.1 times, between 20 and 45.

Diabetes. The relative risk of diabetes in overweight individuals,

as compared to non-overweight individuals, was 2.9 times greater in ages 20-74, 3.8 times greater in ages 20-45, and about two times greater in ages 45-75 (Van Itallie, 1985). The risk of diabetes was also investigated by the American Cancer Society. A questionnaire that addressed family and medical history, present physical complaints, personal habits (smoking, alcohol use, and diet), and occupational exposures was completed by volunteers with 750,000 individuals. The results indicated that when individuals are 40% overweight, the incidence of diabetes is eight times higher for women and five times higher for men (Lew and Garfinkel, 1979).

The American Cancer Society Survey also investigated the incidence of coronary heart disease, cancer, and digestive diseases. For individuals 30%-40% overweight, the results indicated that the incidence of coronary heart disease was 55%; for individuals 40% overweight, occurrence rates for different diseases were as follows:

Coronary heart disease	50%
Cancer	33% men, 55% women
Digestive diseases	4 times greater for men 2.25 times greater for women

The evidence presented at a national conference on obesity showed that "obese women had a higher mortality rate from cancer of the gallbladder, biliary passages, breast (postmenopausal), uterus (including both cervix and endometrium), and ovaries" (Burton and Foster, 1985, p. 1116).

Coronary heart disease. Review of the Framingham Heart Study (Simopoulos and Van Itallie, 1984) showed that higher relative weight was associated with "incidence of coronary disease, congestive heart

failure, and coronary death in men" (p. 289). Higher relative weight in women is "associated with an increasing incidence of coronary disease, stroke, congestive heart failure, and death from coronary and cardiovascular disease" (p. 289).

Heart disease was the subject of the Manitoba Study which included 3,983 men. BMI was a "significant predictor of the 390 cases of ischemic heart disease" (Simopoulos and Van, Itallie, 1984, p. 289). The influence of cigarette smoking was not considered. The data indicated that "the association with weight gain was most apparent in men less than 40 years old" (p. 289), and it was significant "with the development of myocardial infarction, sudden death, and coronary insufficiency" (p. 289).

Complications during pregnancy. The relative risks of complications during pregnancy in a racially mixed group of overweight and obese women were examined in California (Abrams and Parker, 1988). The results indicated that risks for hypertension, pregnancy-induced hypertension, diabetes, and primary cesarean section delivery were elevated in obese women.

Data from 9,667 women in Illinois were examined for the incidence of pregnancy complications (Garbaciak et al., 1985). The results indicated that the risks were higher for hypertensive disease, diabetes mellitus, preeclampsia, and urinary tract infections. These women experienced more cord accidents, meconium, late decelerations, and shoulder dystocia. When women experienced one or more of these complications, the incidence of perinatal mortality and the incidence of delivery by

cesarean section rose.

Analysis of data from several studies showed a significant increase in perinatal mortality in overweight women (Abrams, 1988). These studies included the Collaborative Perinatal Project of the National Institute of Neurological and Communicative Disorders and Stroke (Collaborative Perinatal Study) which was conducted from 1959 to 1966; a Missouri study of 144,000 births which took place between 1978 and 1979; and a report from the National Center for Health Statistics, the National Natality Study, which was conducted from 1976 to 1980.

Summary

The health implications of obesity are broad. Conditions that are likely to develop include hypertension, hypercholesterolemia, type II diabetes, coronary heart disease, cancer, and digestive diseases. The risks of complications during pregnancy are increased both when obesity is present prior to conception and when it develops during the course of pregnancy. A reduction in the incidence of obesity could reduce morbidity and mortality from these conditions.

Causes of Obesity

Socioeconomic, cultural, dietary, environmental, and psychological factors have been implicated in the development of obesity.

Weight data from NHANES I and II were subjected to multivariate analysis. The results showed "that race and poverty are independent predictors of overweight for women" (Van Itallie, 1985, p. 984). Low-income black women are more likely to be overweight; and this assessment was supported by findings from the 1985 National Health Interview Survey of Health Promotion and Disease Prevention (Dawson, 1985).

Childhood obesity, overeating, physiological disruptions, and sedentary lifestyles were determined to be causative factors in obesity during a conference sponsored by the Office of Medical Applications of Research of the National Institutes of Health; the National Institute of Arthritis, Diabetes, and Digestive and Kidney Diseases; and the National Heart, Lung, and Blood Institute (Burton and Foster, 1985).

Pregnancy, because of the associated increase in body fat, has been suggested as a cause of obesity (Vasselli et al., 1988). The increase in the number of women in the work force and the subsequent reduction in breast feeding have contributed to the incidence of women retaining more of the weight gained during pregnancy (Greene et al., 1988).

Age, educational level, and weight perspective are contributing factors to obesity (Forman et al., 1986). The percentage of the population that was overweight increased from age 25 to age 64 in the time period 1976-1980, indicating the effect of age on weight. Additional data on mean weights of individuals based on educational level reflects the influence of this variable on obesity (Gillum, 1987).

Black women are not as likely to perceive themselves to be overweight as are white women (Dawson, 1988). Based on relative weight, the

percentage of black women who consider themselves 10-19.9% above ideal weight is 57.8% compared to 83.8% for white women, excluding Hispanics. Because of the similarities noted in weight perception within specific weight ranges and age groups in her study, the author's finding "suggests that women's perceptions of whether or not they are overweight are more strongly influenced by their weight relative to their peers than by their weight relative to an arbitrary, health-based standard" (p. 1326). Heights and weights were self reported, usually considered a less reliable source of such information.

Summary

Income, race, food selection and preparation, exercise patterns, weight gain during pregnancy, attitudes toward weight and weight gain, age, and educational level all influence whether or not a person will become obese.

Body Image

Body image is a composite developed from perceptual and attitudinal reactions to one's body. Body image perception is "body size estimation", and attitude about it refers to "body image affect and cognition" (Cash and Brown, 1988). Cash, Winstead, and Janda (1986) had earlier defined 'affect' as an evaluation of one's body and 'cognition' as the attention and importance given to one's body. The other "psy-

chological dimension" proposed was the behavioral aspect which refers to "action or activity". The body is also perceived in terms of physical appearance, fitness, and health.

Many measurement procedures have been developed throughout the years to assess body image, but they have tended to address only one of these aspects. Cash and Brown (1988) employed several different measures addressing both aspects of body image in their work with college students.

The authors concluded:

> . . . the results of the present investigation provide much stronger evidence for the validity of attitudinal measures of body image than for perceptual measures that focus on the accuracy of body size-estimation (p. 23).

Summary

Attitude and perception contribute to an individual's classification of body image. Attitude includes self-evaluation, self-attention, and self-importance, while perception includes evaluation of body size, physical appearance, fitness, and healthiness. A complex issue such as body image should be discussed using measurements that address all its aspects.

Components of Pregnancy Weight Gain

In the early 1900's, the components of weight gain during pregnancy were listed as fetus, placenta, amniotic fluid, uterus, breasts, blood,

and tissue fluid (Slemans and Fagan, 1927). The weight contributed to pregnancy gain from these elements was 6.8 kg (15 lbs).

Between 1932 and 1940, 2,502 pregnancies were studied at New York Hospital and Cornell University Medical Center (Stander and Pastore, 1940). The authors concluded that weight gain, in addition to that contributed by fetus, placenta, amniotic fluid, uterus, and breasts, was "due mainly to fluid retention in circulation and tissues" (p.936). Chesley and Chesley (1943) had examined interstitial fluid by thiocynate method in 1,388 cases and determined its weight contribution to be 2 kg (4 1/2 lbs).

A review of nineteen papers (Chesley, 1944) that presented data on weight gain during pregnancy in 11,960 cases indicated an average weight gain of 10.9 kg (24 lbs). Additional review of 958 cases indicated the average weight gain from the aforementioned elements was 7.7 kg (17 lbs). The other 3.2 kg (7 lbs) were accounted for by a gain in protein, water with electrolytes, and fat. Results of studies with rats provided additional information on protein storage: 2.7 kg (6 lbs) total: 0.9 kg (2 lbs) found within the other components, and an additional 1.8 kg (4 lbs) found outside the components. Chesley 1944) suggested that since water may have shifted from the cells, it should not be considered as a separate component (Chesley and Chesley, 1943). The contribution from fat was not discussed because of lack of data; however, the results of a study by Hytten and Leitch in 1966 attributed 2.5 kg (approximately 8 lbs) of weight gain to fat (Brown, 1988).

Hytten (1981) reported a study done with 100 healthy primigravidas

in the United Kingdom. The purpose of the study was to examine composition of weight gain in excess of the weights of fetus, placenta, amniotic fluid, uterus, breasts, and blood. Using deuterium oxide, the researchers studied the location of water and discovered that "women did not store water outside the recognized areas of growth except for perhaps two liters in the last ten weeks of pregnancy" (p. 16). Additional water, except for edema associated with the end of pregnancy, was located within other components. They concluded that the remaining weight gain was due to accumulation of fat because protein is stored with water, not alone.

Consistent values have appeared throughout the literature regarding the approximate weights of fetus, placenta, amniotic fluid, and uterus. Discrepancy exists when values are presented for the approximate weight contributed by breasts, blood, tissue and other fluids, and fat (Slemans and Fagan, 1927; Chesley, 1944; Brown, 1988; Eastman and Jackson, 1968; Hytten, 1981; Dohrmann and Lederman, 1986). The average weights reported for the components representing the consistent values are listed as follows:

Fetus	3.3 kg (7.4 lbs)
Placenta	0.6 kg (1.3 lbs)
Uterus	0.96 kg (2.1 lbs)
Amniotic Fluid	0.8 kg (1.8 lbs)

The ranges of values for the remaining components are listed as follows:

Breasts	0.4-1.4 kg (0.9-3 lbs)
Blood	1.3-1.6 kg (2.8-3.5 lbs)
Tissue and other fluids	0.9-2.5 kg (2-5.6 lbs)
Fat	3.2-4.5 kg (7-10 lbs)

Summary

The components of weight gain during pregnancy include the fetus, placenta, amniotic fluid, uterus, breasts, blood, tissue fluid, and fat. The components of pregnancy can contribute from 10.7 to 15.9 kg (23.7-35.1 lbs) to pregnancy weight gain. With the exception of the amount contributed by placenta, amniotic fluid, and uterus, the weight contributed by additional components is subject to great variance.

Physiology of Pregnancy Related to Weight Gain

Physiological events that occur during pregnancy include development of the fetus and placenta, changes in nutrient metabolism, storage of fat for future demands of pregnancy, changes in metabolic rate, and energy adjustments.

Fetal and placental development

Widdowson (1981) reviewed studies conducted from the thirties to the seventies that examined physiologic changes of pregnancy. Particular attention was directed toward protein, fat, and glucose composition of fetus and placenta. Her survey indicated that protein and fat in the fetus have been found to increase with gestational age, most rapidly in the last eight weeks. Jacobsen (1986) reported that protein in the form of free amino acids is transferred across the placenta. Free amino acid

concentrations are higher in the umbilical artery and vein, and the active transport of protein depends on blood flow. Fat for the fetus is supplied by three sources: maternal serum triglycerides, free fatty acids (Jacobsen, 1986), and maternal glucose (Widdowson, 1981). Maternal serum triglycerides increase in the third trimester with a simultaneous increase in fetal fat deposition. Free fatty acids are also transported through the placenta, but the levels rise to only one-fifth of maternal levels. Fat is synthesized from the glucose provided by the mother.

The amount of glucose needed to provide the energy requirements of the fetus (110 kcal/day), is approximately 38 grams (143 kcal/day), and half of the glucose removed from maternal circulation is used by the placenta. "Fetal glucose consumption depends largely on uterine arterial supply" (Jacobsen, 1986, p. 22).

Fat metabolism

Fat cell metabolism in pregnancy was studied by determining lipoprotein lipase (LPL) activity from adipose tissue biopsies in women undergoing legal terminations of their pregnancies which were between 8 and 11 weeks gestation. The results were expressed per unit cell surface area, and the LPL activity increased in the femoral area but not in the abdominal area. Increase in enzyme activity was associated with decreased lipolysis. Lipolysis was increased in the abdominal region during pregnancy. These metabolic changes may result in an "accumu-

lation of triglycerides in the femoral depot producing larger fat cells" (Rebuffé Scrive, Enk, Crona, Lönnroth, Abrahamsson, Smith, and Björntorp; 1985, p. 1976).

The possibility that fat may actually be mobilized during pregnancy was supported by study results of fat gain examined in Gambian women (Lawrence, Coward, Lawrence, Cole, and Whitehead, 1987). Total body fat (TBF) was determined using the formula TBF = weight - total body water/0.73. Women were classified into two groups, supplemented and unsupplemented. Total weight gain was greater in the supplemented group. Using the factorial method developed by Hytten and Leitch during their examination of the physiology of human pregnancy, fat stores were calculated. The results indicated a loss of fat stores in unsupplemented women and fat stores of approximately 1.7 kg (3.75 lbs) in supplemented women.

Protein and energy metabolism

Conflicting conclusions from studies on the effects of reduced protein and energy intakes on birth weight were reported. Widdowson (1981) contended that since "the fetus is at the far end of the supply line" (p. 14), the mother is the one affected by the food supply whether it is increased or decreased. Studies on women in Taiwan and Guatemala who received supplements to increase protein and/or energy intakes produced no significant improvement in birth weight results. It should be noted that both groups of women were undernourished and that subsequent

studies have disclosed the effect of low prepregnant weight on birth weight (Naismith, 1980). Additionally, the author reviewed studies that researched nitrogen balance and excretion of 3-methylhistidine in pregnancy, the changes in plasma urea, and alanine aminotransferase and argininosuccinate synthetase activity in rats in an effort to determine protein and energy needs. The author concluded that since metabolism changes in pregnancy, "the requirements for energy, for protein and all other nutrients so far investigated may be no greater than those of the nonpregnant woman" (p. 30).

Papernik, Frydman, and Belaisch (1981) examined maternal caloric intake and its relationship to birth weight. A group of French women were classified as slim, normal, or obese using the 1959 Metropolitan Life Table. Nutrition habits prior to pregnancy were determined by interview, and the women were instructed to weigh food for one day and estimate weights for six days at 30, 34, and 38 weeks gestation. Women at risk to deliver large-for-date babies were counseled to consume 1800 calories and less than 200 grams carbohydrate per day. The weights were transformed into dietary constituents. Birth weights and placenta weights were monitored.

The results showed that women at risk to deliver small-for-date babies, who actually delivered small-for-date babies, consumed fewer calories and gained less weight than their counterparts who delivered normal-weight infants. Women at risk to deliver large-for-date babies consumed the same number of calories, but those women who gained less weight delivered normal-weight babies.

The authors concluded that in slim women only, calorie intake, especially during the latter third of pregnancy, affects fetal growth, and that

> . . . as one approaches adequate levels of maternal nutrition, the efficiency of conversion of food into baby mass decreases, a fact which explains why one discerns no effect of nutrition in well nourished populations (p. 78).

Since the mother provides glucose for the fetus, it was suggested that her energy requirements for this purpose would be 150-300 calories from additional food intake during the last four weeks of gestation. The researcher concluded that needs for additional food are less when sufficient stores are available within the mother and in the early stages of pregnancy (Widdowson, 1981).

Basal metabolic rate

In addition to fulfilling the energy needs of the fetus, energy requirements should "provide for the increased work load associated with movement of the mother, support increase in resting metabolic rate" (National Academy of Sciences, 1974), and provide for the synthesis of the fat stored for lactation (Widdowson, 1981).

Lawrence, Singh, Lawrence, and Whitehead (1985) measured the energy costs of different activities in two groups of African women (142 total) residing in three towns in Gambia. One group consisted of non-pregnant, non-lactating women or women in the first trimester of pregnancy. The second group included women in the second and third trimesters of pregnancy. The researchers examined the effect of added body weight in

pregnancy on energy expenditure. The energy cost of most activities was less than 3.5 kcal/min, which classified them as "light" activities. The results indicated no difference in energy costs between the two groups, with the exception of walking. An increase in body weight did not result in an increase in energy cost, and the increase in resting metabolic rate (RMR) was smaller than expected in the latter part of pregnancy.

Although Hytten and Leitch estimated that basal metabolic rate (BMR) increases in pregnancy and this increase requires additional calories, Lawrence, Lawrence, Lamb, and Whitehead (1984) concluded from their studies that only 1000 kcal during the course of pregnancy is needed to cover the minor increases in BMR. The rate dropped before it rose after 25 to 30 weeks in unsupplemented, Gambian women.

BMR and self-paced walking were measured in 16 non-smoking women; 6 non-pregnant, 6 in early pregnancy, and 4 in late pregnancy (Nagy and King, 1983). Although it has been assumed that basal metabolism increases during pregnancy, the results of this study indicated no significant differences when the BMR was expressed as kcal/kg/hr. The researchers concluded that "because of the sedentary life style of the American population and the very small increase in energy needed for weight-bearing activities during pregnancy, such an increase (energy intake) is probably not warranted for most women" (p. 376).

Total energy expenditure for pregnancy was estimated at 13,000 calories for Gambian women after RMR had been studied (Nutrition Reviews, 1985). RMR and increases in RMR after a test meal were

examined in seven Scottish women to determine if energy expenditure is altered in pregnancy (Illingworth, Jung, Howie, and Isles, 1987). Analysis of results indicated the rise to be significant in the latter stages of pregnancy, but "when RMR was expressed per kg of body weight. . . there was a constant RMR per unit of weight throughout the pregnancy" (p. 1575).

BMR changes were examined by Prentice, Whitehead, Coward, Goldberg, Davies, and Murgatroyd (1987). In a study of eight subjects, BMR status varied prior to 18 weeks but increased for all subjects after 18 weeks. Physical activity and fat deposition, using the double-labeled water method, were measured. The authors concluded that changes in activity and body composition are probably more significant than changes in BMR or thermogenesis.

Energy adjustments

Insulin response after a meal was measured; it significantly increased ($p < 0.001$) in the gestational period from 34 to 36 weeks (Prentice et al., 1987). Insulin increases in the serum have been shown to increase energy expenditure.

> In conclusion our study shows that at a time of maximal energy demand in pregnancy women reduce energy expenditure by diminishing the metabolic response to a mixed constituent meal. The increased energetic efficiency inherent in this adaption may play some part in making energy available for fetal nutrition without the need for maternal energy intake appreciably to increase (p. 1576).

Blackburn and Calloway (1976) examined food and activity diaries of

26 women, and the results indicated an expenditure of 35 kcal/kg for multigravidas and 31 kcal/kg for primigravidas, less than the current recommendation, 36 kcal/kg. Energy output during the latter half of pregnancy has been reported at between 2200 and 2300 calories, for an average of 32.5 kcal/kg.

Energy costs were measured in 11 pregnant Asian women (Saha, 1986). The results indicated that although the costs of rest and activities increased in the second and third trimesters, the increase was slight when described as kg/hr. A subsequent study with 24 Asian women was conducted to observe energy balance. The results of the 7-day study indicated an "average positive balance of about 200 kcal/day" (p. 102). The results showed great variability among individuals, and it was suggested that "energy cost is greatly influenced by body composition, such as proportions of body fat and muscle bulk" (p. 102). The researcher concluded that perhaps current recommendations for calorie intake are greater than what is actually needed and suggested that further study is needed on the subject.

Truswell, Ash, and Allen (1988) collected food and activity diaries and elicited 24-hour recalls from 49 healthy, pregnant Australian women. The time periods addressed were 10-12, 22-24, and 32-34 weeks gestation. Caloric intakes were reported as 8.84, 8.9, and 8.88 MJ, respectively. One MJ (Millijule) equals 239 kcal. The recommended dietary intake in Australia for pregnant women is 9.0 MJ (2250 calories), with the increase added during the second and third trimesters. Review of the food recalls indicated caloric intakes below the recommendations; however,

mean weight gain from 12 weeks gestation was 12.4±3.7 kg (27.3±7.1 lbs). The following conclusion was offered:

> . . . pregnant women in affluent countries are usually able to gain enough weight to support adequate fetal growth on energy intakes of around 9.00 MJ, a level very little higher than their nonpregnant energy allowance (p. 49).

The most comprehensive study to date on energy requirements during pregnancy examined body weight, body fat, energy intake, BMR, exercise metabolic rate (EMR), daily activity patterns, and daily energy expenditures in women from many countries (Durnin, 1987). The groups included low income and middle-class Scottish women, middle-class urbanites from the Netherlands, Gambian women, and rural, well-nourished women from Thailand and the Philippines.

With the exception of minor differences, methodology was consistent throughout the research centers. Weight was obtained on beam balance scales, the sum of three or four skinfold thicknesses and/or total body water was used to determine body fat content, and energy intake was based on individual inventory or precise weighing methods. Local food composition tables were used to calculate caloric content of food eaten. BMR and EMR were measured by indirect calorimetry. Detailed 24-hour activity diaries for 5 consecutive days were completed by the participants in Scotland and the Netherlands and "by a trained (local) observer" in the other three countries. "Energy expenditure was calculated from the data on the duration of the single activities combined with measurements by indirect calorimetry. . ." (p. 896).

Physical characteristics differed between the groups, but the differences were small when "expressed as a proportion of the initial body

mass" (p. 1131).

The proportions of weight gain and fat disposition were similar, the energy costs of basal metabolism were widespread, small differences of little importance were noted from the results of measuring EMR, and energy intakes rose slightly. Pregnancy outcome, as measured by birth weight, was successful.

The specific findings revealed mean weight gains that ranged from a low of 14% initial weight to a high of 20% initial weight. Initial weight usually referred to weight at 10 weeks gestation. Mean fat gain, measured from 10 weeks gestation to 4-6 weeks postpartum ranged from 1.2% to 4% body weight. The low and high values for weight gain and fat gain were observed in Gambian women and Scottish women, respectively. Energy costs ranged from 7-9 MJ/day, to 144 MJ/day, and energy intakes ranged from 7.3 to 8.9 MJ/day.

Several factors were noted that may have influenced the results. The accuracy of measuring fat deposition is questionable because changes in fat mass occur during pregnancy. BMR measurements in Thai and Philippine women were based on a different starting point, and Gambian women seem to have experienced a "quite remarkable physiological adaption" (p. 1132) to pregnancy which resulted in a very low rise in BMR for these women.

Hytten and Leitch reported the estimated energy costs of pregnancy to be 80,000 calories: 40,000 for fat deposition, 40,000 for increases in metabolic rate. These groups did not amass fat in the amount equivalent to 40,000 calories, and increases in BMR varied greatly, espec-

ially among Thai, Gambian, and Philippine women. It was postulated that energy requirements are less for women from "developed" countries and questionable for women from "developing" countries.

Energy costs of pregnancy, excluding Gambian women, were observed to be about 250 MJ (60,000 calories) when results were "standardized for body weight" (p. 1133). Group differences that occurred were attributed to differences in fat deposits. In this study, calorie diaries did not show an increase in food; therefore it was suggested that energy costs were not provided for by additional food.

It was proposed that energy requirements are less than current recommendations and that further study is needed and should not be "carried out on small numbers of subjects or on measurements made only on one or two occasions at infrequent intervals" (p. 1133).

Summary

The mother is the source of protein, fat, and glucose for fetal development. These elements are provided by exogenous and endogenous sources, i.e., food intake and physiological changes within the mother's body.

Early studies of human pregnancy estimated increased nutrient needs based on physiological changes of pregnancy. The changes included increased demand for the building blocks of fetal development, increased energy costs of activities, increased maternal metabolic rate, and maternal fat storage in preparation for lactation. More recently,

results from studies have led investigators to conclude that the energy costs of the physiological changes may be less than previously thought, that the body adapts to the pregnant condition, and that increased nutrients from exogenous sources may not be necessary.

Factors Affecting Weight Gain during Pregnancy

Smoking

The results of a study of 60 women attending an urban hospital clinic in Hartford, Connecticut, indicated that smoking did not affect food intake but was "associated with a reduced efficiency of calorie utilization for weight gain" (Picone et al., 1982, p. 1212). The caloric intake of smokers (32) was higher than that of non-smokers (28). The mean caloric intakes for each group respectively were 2119±588 and 1810±390. The weight gain of 17 smokers and 18 non-smokers was considered average: more than 24 pounds. Although the remaining 15 smokers experienced low weight gain (less than 15 pounds), they gained more weight than the low-weight-gain non-smokers.

Diet

Picone et al. (1982) studied a racially mixed, sedentary group of women, most of whom were enrolled in the WIC program, for dietary intake using the 24-hour-recall method. The caloric consumption averaged less

than the current Recommended Daily Allowance of 2300 calories, but weight gains were adequate.

The mean consumption of 41 foodstuffs and 10 beverages by French women was determined by a dietitian trained in epidemiological studies at the St. Antione Maternity Hospital in Paris (Papoz et al., 1981). Twenty-two nutrients were computed and the results were analyzed using analysis of variance, Student's t-test, Pearson's correlation coefficients, and step-wise multiple regression methods. The calories consumed increased in the first 6 months and decreased in the last 3 months for normal and thin women. Calorie consumption for fat women decreased throughout the pregnancy. The authors concluded:

> Weight gain is not significantly related to the absolute amounts of food consumed at any time during pregnancy but longitudinal analysis reveals a significant positive relationship between the increase in weight and the increase in daily caloric intake during the first six months (p. 47).

Papoz et al. (1981) suggested that "beyond a certain amount of food necessary to satisfy the fetal requirements, the caloric intake of the mother would only be of benefit to herself" (p. 52).

Food and activity diaries of 26 women from the San Francisco Bay area were collected from May 1973 through January 1974. Review of these diaries indicated an average protein intake of 82 grams per day and calorie intakes of 1801±381 during the period 29-36 weeks gestation and 2000±452 during the period 37-40 weeks. Although these intakes were less than the estimated needs for the same time periods, 2520 and 2600 calories respectively, multigravidas experienced weight gains of 15.1±3.3 kg (33±7.25 lbs) and primigravidas experienced weight gains of

14.5±4.7 kg (31.9±10.3 lbs) (Blackburn and Calloway, 1976).

Naeye (1979) examined the effects of weight gain on perinatal outcome using data from the Collaborative Perinatal Study. Women were classified by prepregnancy weight as a percent of 1959 Metropolitan Life Desired Values, and optimal values for weight gain were established. The author stated, "maternal calorie intake has a large influence on pregnancy weight gain" (p. 7) and concluded, "the results of the study indicated that the fetus may be more vulnerable to maternal dietary deficiencies and excesses than has often been assumed" (p. 8).

Psychological stress

King (1948) addressed the effect of psychological stress on weight gain in pregnancy when he examined the weight gains of 226 moderate to high-income women. The results indicated that "simple obesity" is a primary cause for the gain. When this condition is present, "the woman gets fat because she eats more than she needs for her particular metabolism and activity;. . . the origin of obesity is psychological" (p. 302). The aspects of psychological stress affecting the pregnant women presented included fear for her life and her child's health, and concern about her ability to care for the child, manage the financial burden, and adjust to the change in her lifestyle. Additional influences suggested were the effects of a changing body on the woman and the father's attitude towards this change.

Psychological stress was measured "using a social readjustment

rating scale that was abbreviated from the Holmes-Rohe life events questionnaire" (Picone et al., p. 1207). Although stress did not affect food intake, the women with higher stress scores gained less weight. Hormones responsible for metabolic processes are increased during stress and the authors suggested that their presence may be the cause of reduced efficiency in the use of dietary energy.

Attitude toward weight gain

The patient's and the doctor's attitudes toward weight gain are significant factors. Palmer et al. (1985) developed and tested a Likert-format questionnaire to examine women's attitudes toward weight gain during pregnancy. Twenty-nine women responded to the questionnaire. Results were subjected to chi square analysis, and a relationship between attitudes and weight gain was shown. A positive attitude was associated with a larger weight gain, and a negative attitude was associated with a smaller weight gain. The women were also questioned about the doctor's recommendation for weight gain, and "there was a significant relationship between attitude score and doctor's recommendation" (p. 948).

Attitudes toward weight gain in pregnancy with emphasis on the role of doctor's reaction to weight gain were examined by questionnaire in 195 women from California. Ninety-nine women attended a clinic, and 96 women received their care from a group of private physicians (Pomerance et al., 1980). Weight gains were not reported, and definitions for "too

much" and "too little" were not provided. However, 88% of the women responded that their physicians would be upset with too much weight gain, and 39% responded that their physicians would be upset with too little weight gain.

Nutrition counseling

The benefits of nutrition counseling were noted as early as 1927, when studies were reported on the advantages of "prenatal care. . .; the prospective mother should receive specific advice regarding her diet" (Slemans and Fagan, 1927, p. 159) because many of the complications of pregnancy are the results of changes in metabolism.

Nutrition counseling has been shown to have an effect on weight gain during pregnancy. Orstead et al. (1985) provided nutrition counseling to 200 women at Mercy Hospital Medical Center in Chicago, Illinois. One group of predominantly black, low-income women attended only a nutrition class. A similar group attended the nutrition class and had contact with a dietitian, at which time they were presented additional information. This information included food choice and weight gain charts, snack food alternatives, and handouts that addressed food-oriented complications of pregnancy. This group of women watched a nutrition film, and food recalls and food diaries were completed. The data from the two groups were collected separately (1977 to 1979 and 1979 to 1981). Frequency distributions indicated weight gain to be more appropriate, 7.1-14.0 kg (15.6-30.8 lbs), in the group provided additional

nutrition information than in the "class-only" group; 71.9% and 23.6%, respectively. Fewer women experienced weight gain in excess of 14 kg (30 lbs) when they participated in the intensive nutrition counseling (10.5% vs 12.5%).

Worthington-Roberts (1987) reviewed recent studies that addressed nutritional aspects of pregnancy: energy requirements, protein, vitamins and minerals, alcohol, and caffeine. The author states:

> Data support a clear relationship between maternal nutritional status and successful reproduction. Nutrition education during the prenatal period is therefore justified. . . (p. 8).

The importance of nutrition counseling was acknowledged by Simpson et al. (1975):

> Physicians who supervise prenatal care must have a good basic knowledge of the pregnant women's nutritional requirements. This implies skill in evaluating the dietary history and nutritional status in early pregnancy and the knowledge of measures required for the correction of malnutrition and undernutrition. The assistance of an expert nutritionist may be required (p. 486).

It is important for the pregnant women to understand the benefits of good nutrition, and that goal cannot always be accomplished by the physician alone because "unfortunately, the physician's knowledge of nutrition, in general, is deficient. . ." (Simpson et al., 1975, p. 484). The nutritionist (dietitian) is well trained in the field of nutrition, whereas the physician's experience with nutrition education ". . . in most medical schools is absent or cursory" (p. 484).

Prepregnant weight

Different conclusions regarding the effect of prepregnant weight on weight gain during pregnancy appear in the literature. The results from a study of weight gains during pregnancy of American women, between 1932 and 1940 (Stander and Pastore, 1940), indicated that weight gain increases as prepregnant weight increases. The average prepregnant weight of the population studied was 58.3 kg (128 lbs).

Eastman and Jackson (1968) examined weight gains in 6,675 white women and 5,236 black women who delivered at Johns Hopkins Hospital between January 1954 and December 1961. The results of the study indicated similar mean weight gains in each prepregnant weight group for both races, and the researchers concluded that "prepregnancy weight exerts no effect whatsoever on weight gain except in women weighing 160 pounds or more" (p. 1009).

The Collaborative Perinatal Study was the source of data for 8,609 white women and 7,242 black women examined by Niswander and Jackson (1969). The results supported the earlier findings of Eastman and Jackson (1968), and a similar conclusion was offered: "the data suggest, therefore that for a great number of mothers of both races, their weight gain is relatively independent of their prepregnancy weight" (p. 489).

Rosso (1985) classified women according to prepregnant weight (PPW) and examined weight gains during pregnancy. The Society of Actuaries (1959) body height-weight table was the reference source for the classification of underweight, normal weight, and overweight. The classi-

fications were defined as follows:

Underweight	PPW, 89% or less of standard
Normal weight	PPW, 90-110% of standard
Overweight	PPW, 111% or more of standard

Mean pregnancy weight gains for each group were 11.7±8.3 kg (25.7±18.3 lbs), 10.4±6.3 kg (22.9±13.9 lbs), and 7.3±6.6 kg (16±14.5), respectively. The results indicated that prepregnancy weight in fact does affect weight gain during pregnancy.

Prepregnant body mass

Abrams and Laros (1986) examined weight gains of women who were allowed to "eat to appetite" and who had received nutrition counseling for adequate, unrestricted diet and recommendations for a total weight gain of at least 24 pounds. Prepregnant body mass was established using the Quetelet Index, weight (kg) divided by height (cm) squared. Groups were stratified using the 1959 Metropolitan Life Tables. The mean weight gain was 15.2 kg (33.44 lbs). Multiple regression analysis indicated a "statistically significant linear relationship between prepregnant body mass and birth weight" (p. 505) in women who weighed less than 135% standard weight.

Miscellaneous

Other factors that may have an effect on weight gain during pregnancy are age, parity, and knowledge of desired weight gain during preg-

nancy. Billewicz and Thomson (1970) examined weight changes between pregnancies to determine if women weigh more as a result of parity. The results of mean weight changes adjusted for age and secular trends between para 0-1, para 0-2, and para 0-3 were 1.0, 1.5, and 1.9 kg respectively. Weight changes upwards have been shown to be affected by economic prosperity, changing food habits, mechanization, marriage, and age. The conclusion drawn from the results was that "there is no evidence that age or parity have much effect on the amount of weight gained during pregnancy" (p. 97).

In their study of attitude toward weight gain during pregnancy, Palmer et al. (1985) included a question to determine the subject's knowledge of appropriate weight gain was in the range of 9-11.8 kg (20-26 lbs). The relationship between knowledge and weight gain was significant using chi square analysis.

The majority (52%) of the respondents to a questionnaire". . . designed to establish attitudes toward weight gain in pregnancy" (Pomerance et al, 1980, p. 290) indicated the desired weight gain during pregnancy to be between 21 and 30 pounds. Comparisons between knowledge and weight gain were not done and weight gain information was not provided.

Summary

Weight gain during pregnancy is influenced by the interaction of physical, emotional, and mental factors. It is affected by smoking,

age, diet, prepregnant weight and body mass, psychological stress, attitudes toward weight gain, knowledge, and nutrition counseling. Effects of the interactions may be positive and/or negative depending on individual circumstances.

Weight Gain during Pregnancy

Chesley (1944) reviewed many papers that presented data on weight gain during pregnancy. The range of weight gain for 11,960 women was 6-17 kg (13.3-37.4 lbs), with an average of 10.9 kg or 24 lbs. When the results did not include a standard deviation, one was determined based on the results from the studies which included some statistical assessment of variability. When the "derived" standard deviation was applied to all the results, the average weight gain was 10.9±4.9 kg (24±10.8 lbs).

Thomson and Billewicz (1957) studied the weight gain of 4,214 primigravidas. The results indicated a weight gain range from 12.5 to 13.4 kg (27.5-29.5 lbs). Weight gain was reported based on observations made during the period from 13 to 36 weeks gestation, and weight gains in the periods prior to 13 weeks and following 36 weeks were estimated to total 2.9 kg (6.4 lbs).

Results of weight gain during pregnancy (Eastman and Jackson, 1968) indicated that the average weight gains, excluding weight loss cases, for white and black women were 10.4 kg (22.1 lbs) and 9 kg (20.8 lbs), respectively. The weight loss incidence was primarily among obese

women.

Weight gain in 700 clinic patients was studied at Jamaica Hospital in New York (Abitbol, 1969). The average weight gain was 10±4.5 kg (22±10 lbs). At a time when suggested weight gain was 17 pounds, approximately 460 women gained greater than 17 pounds: 85 gained greater than 30 pounds.

The Collaborative Perinatal Study was the source of data for study of weight gain by Niswander and Jackson (1974). The results indicated mean weight gains of 9.8±4.5 kg (21.7±10 lbs) in white women and 9.7±5.2 kg (21.5±11.6 lbs) in black women.

Between 1946 and 1966, the weight gains of 24,335 white and 2,133 black women married to servicemen were examined at Brooke General Hospital in Houston, Texas (Simpson et al., 1975). The mean weight gain among white women was approximately 8.6 kg (19 lbs) and among black women was almost 9.6 kg (almost 21 lbs). The study examined prepregnant weight, weight gain, and birth weight. The weight gain results indicated a range of from 2.27 kg (-5 lbs) to 22.7 kg (50 lbs). The authors stated:

> . . .American authors agree that for a woman of standard weight before pregnancy a gain of 20-25 pounds is associated with the most favorable outcome and will permit a return to prepregnancy weight (p. 484).

Summary

Major reports on weight gain during pregnancy have been presented from the 1940's to the 1970's. Weight gain restriction was "current

practice" for most of that time, and average gains were 8.6-13.4 kg (19-30 lbs). Results included weight loss cases, and inconsistent findings with regard to parity and race were prevalent.

Consequences of Excess Weight Gain

Complications during pregnancy, labor, and delivery

From 1949 to 1954, the rate of weight gain between 20 and 30 weeks gestation was studied in primigravidas (Thomson and Billewicz, 1957). No weight gain restrictions were practiced during this time period. The results indicated that the "incidence of preeclampsia rises as the rate of weight gain increases" (p. 246). Women who experienced weight gains of 3.6-5.4 kg (8-12 lbs) for the 10-week study period and slightly less weight gain thereafter "had preeclampsia, prematurity, and perinatal mortality rates only about half the average" (p. 246).

Stander and Pastore (1940) examined weight changes and the incidence of toxemia in 2,935 pregnancies from 1932 to 1940 at New York Hospital and Cornell University Medical College. The total change in weight for normal pregnancies (1,227 primigravidas and 1,097 multigravidas) was 24.1%. The 35 cases of preeclampsia studied had a weight change of 25.15%.

Garbaciak et al. (1985) compared the incidence of antenatal and intrapartum complications in two groups of women: prepregnant weight below 120% and prepregnant weight above 120% "ideal" body weight. The

data were subjected to chi square analysis. Significant differences were shown for several complications including preeclampsia, diabetes mellitus, and delivery by cesarean section. The incidence of complications for obese women, above 120% ideal body weight, was increased.

The incidence of complications during pregnancy and labor and delivery was reported by Abrams and Parker (1988). The complications of diabetes, hypertension, pregnancy-induced hypertension, and delivery by primary cesarean section were significantly increased in the very overweight population. Moderately overweight women were also at higher risk than average for diabetes, pregnancy-induced hypertension, and primary cesarean section, but the results were not statistically significant. The study examined data from 4,112 deliveries of a racially mixed population.

Outcomes during labor and delivery were compiled from a review of medical charts at the Army Community Hospital, Monterey Peninsula, California (Whittaker, 1983). Two hundred seventy-two of the 447 women who delivered during 1981 were "within 10 percent of ideal weight prior to becoming pregnant" (p. 869). The complications observed were assisted delivery, lacerations of the perineum, induction of labor, postpartum hemorrhage, prolonged labor, premature rupture of membranes, preeclampsia, and cesarean section. The author states that

> The risk of having any of the above complications was 54% in the high weight gain group and 33% in the lower weight gain group (probability of being statistically significant greater than 99.5%) (p. 869).

Sixty-eight percent of the women gained 30 pounds or more. The

incidence of significant complications in this group was presented as follows:

Complication	Number (%)
Assisted delivery	34 (18)
Lacerations of perineum	54 (29)
Induction of labor	15 (8)

Assisted delivery was defined as delivery requiring the use of vacuum extraction or forceps. Only third-or fourth-degree lacerations of the perineum were considered complications, and induction of labor indicated the use of pitocin.

A review of complicated deliveries that occurred during 1980 in the United States included data on the type of delivery. The results from 3,762,000 deliveries included 11,000 deliveries complicated by edema or excess weight gain without hypertension. Although 31.8% of those deliveries were by cesarean section, the "figure does not meet standards of reliability" (Taffel and Placek, 1983, p. 857).

Postpartum complications

An average weight gain of 13.96 kg (30.7 lbs) was reported by Stander and Pastore (1940) after examination of weight gains in 2,502 normal pregnancies. The weight gains were calculated from the sixth to the fortieth week; then weight loss was observed for six weeks during the postpartum period. Since the multigravidas (1,097) had weighed more at the beginning than the primigravidas (1,227), "no difference in weight changes was noted" (p. 929) between the two groups. The results

indicated that the women, especially primigravidas, weighed more than they had at onset of pregnancy. The average prepregnant weight for primigravidas was 57.3 kg (126 lbs), and average 6 weeks postpartum weight for this group was 59.7 kg (130.8 lbs). The authors concluded that, "as a rule, it can be said that the primipara does not return to her usual weight" (p. 930).

Weight and weight loss at the 6 weeks postpartum visit were examined to determine "permanent weight gain" (Abitbol, 1969). The average weight loss was 8.1±2.2 kg (18±5 lbs); therefore, the author concluded the permanent gain to be 1.8±1.3 kg (4±3 lbs).

Billewicz and Thomson (1970) analyzed records of 5,830 married Scottish women. Women who experienced high weight gains between parities, as measured from the twentieth-week gestation in one pregnancy to twentieth-week gestation in a subsequent pregnancy, "had more hypertensive complications during pregnancy. Hypertension was defined as a diastolic blood pressure of 90 mm Hg or more, recorded at least two separate days during pregnancy" (p. 102).

Energy expenditure and dietary and activity patterns were measured during pregnancy and at 8-12 weeks postpartum in 26 women. An association between the amount of weight gained during pregnancy and postpartum weight greater than prepregnant weight was reported (Blackburn and Calloway, 1976). The researchers pointed out that "this association may be spurious in that the women may have failed to remember to stipulate the prepregnant weight accurately" (p. 36).

Naeye (1979) reviewed 44,565 cases from the Collaborative Perinatal

Study and collected data on perinatal mortality. The results indicated that the rate of perinatal mortality was increased in uncomplicated pregnancies when the women gained in excess of 14.5 kg (32 lbs) independent of weight-for-height.

Greene et al. (1988) examined postpartum weight change in 7,116 United States women who were multigravidas. The data source, the Collaborative Perinatal Study, included information gathered in 1960, during a time when "restriction of prenatal weight gain was generally advised" (p. 706). The racially mixed group was 45% white, 50.5% black, and 4.5% Puerto Rican or other. The variance in maternal weight change was 24%. Some weight gain can be attributed to the element of time; however, the results of data analysis indicated that 21.1% of the variance was explained by weight gain during pregnancy.

Fifty-three percent gained greater than 9 kg (20 lbs), and 31.7% gained more than 11.3 kg (25 lbs). These women were 2.6-4.6 kg (5.7-10.2 lbs) heavier at the start of the next pregnancy. The women who gained greater than 18 kg (40 lbs) were 8 kg (17.7) lbs) heavier. One in 10 women who gained excess weight retained 6.8 kg (15 lbs) or more. The researchers concluded that a "gain of over 20 lbs [9.1 kg] is positively related to the amount of weight retained postpartum" (p. 704). The results may be applied to a non-breast-feeding group of similar ethnic mix "because of the large sample size, geographic diversity, rigorous data collection techniques, and consistent results" (p. 706).

Summary

Excess weight gain during pregnancy has been shown to affect fetus and gravida. The presence of diabetes, preeclampsia, prematurity, and/or complicated delivery compromises the fetus. Perinatal mortality rates rise usually as a result of the other complications precipitated by excess weight gain.

Women experience an increased risk for delivery by cesarean section and other problems during labor and delivery. When they are unable to lose the weight gained, it becomes a health hazard.

Considerations for Weight Gain Recommendations

Recommendations for desired weight gain during pregnancy have varied with the goals of prenatal care. Weight gain recommendations were low when the goals were to prevent preeclampsia and to restrict fetal growth to avoid delivery by cesarean section. Weight gain restrictions were discontinued when the adverse effects of low birth weight became apparent. Unrestricted weight gain has resulted in an increase in complications during pregnancy, labor, and delivery, and in the postpartum period.

Dohrmann and Lederman (1986) reviewed weight gain practices and suggested several factors to be considered when determining appropriate weight gain: prepregnant weight, age, and successful pregnancy outcome. Pregnancy outcome can be measured by birth weight, the incidence of

complications during labor and delivery, and the presence of postpartum obesity.

Weight gain recommendations based on prepregnant weight have been suggested (Naeye, 1979; Gueri, Jutsum, and Sorhaindo, 1982; Rosso, 1985). Weight gains of 12.3-13.6 kg, 9.5 kg, and 7 kg (27-30 lbs, 21 lbs, and 15 lbs) for underweight, normal, and overweight women respectively, were given by Naeye (1979).

Because women of different heights and weights will deliver different-sized babies and gain different increments of weight, Gueri et al. (1982) concluded, "it is more logical therefore to consider the weight increase as a percentage of the prepregnant weight" (p. 41). For women at ideal prepregnant weight, they suggest that a woman gain 20% of her prepregnant weight. The conclusions were based on data from a retrospective study of women on the island of Dominica.

Rosso (1985) studied the weight gains of 262 women at the Sloane Hospital for Women, Columbia Presbyterian Medical Center, New York City. The population was predominantly black (51%) and Hispanic (41.23%). The results indicated that weight gain is influenced by prepregnant weight in underweight and normal weight women but not in obese women. Prepregnant weight classifications were determined using the 1959 Society of Actuaries Table. He examined birth weights and interpreted the results to indicate that "maximum fetal growth occurred only in the women who had attained a 'critical' body mass equivalent to 120% of their non-pregnant 'standard weight'" (p. 647). Consequently, a weight gain of 20% of prepregnant weight was suggested for women at standard

weight. A weight gain of 20% of standard weight in addition to the amount of weight below standard was the recommendation for underweight women, and for overweight women the recommendation was "to increase their initial weight proportionally less than normal and underweight women" (p. 648). For obese women (greater than 130% of standard weight), weight gain recommendation was 7 kg (15.4 lbs). A chart to monitor weight was derived from actual measurements of the subjects and was applied to women in Santiago, Chile. The results from both populations were similar, improving the validity of the chart. A nomogram used to determine percent of standard weight was developed to use in conjunction with the chart.

Brown (1988) suggested a weight gain of 15 kg (33 lbs) for women at 100% of standard weight, but she stated that "given existing data, it is clear that prenatal weight gain recommendations should be identified separately for women of different prepregnancy weight status" (p. 189).

Naeye (1981) examined the data from the Collaborative Perinatal Study. Values for optimal weight gain were determined for each woman and expressed as percents. Prepregnancy weight was classified as a percent of values in the 1959 Metropolitan Life Table. "The study shows that a mother's optimal weight gain in pregnancy depends on her body build" (p. 7).

Abrams (1988) reviewed several studies done between 1954 and 1980 on weight gain during pregnancy in overweight women. Although the definition of overweight differed among the study groups, the author concluded that the results indicated that "bigger women have bigger babies

. . . tend to gain less weight than thinner women, and may even lose weight" (p. 203). The author states that there is "not yet a clear consensus on how much weight obese women should gain" and expresses concern that if no dietary care is available, "establishing a lower standard of weight gain may leave overweight pregnant women at higher risk of inadequate dietary intake, ketonuria, and potentially poor pregnancy outcomes" (p. 203).

Obese women and teenagers require special considerations when weight gain recommendations are formulated. Weight gain prescription is of secondary importance in women greater than 135% ideal body weight; instead attention should be concentrated on fetal growth, dietary quality, and exercise patterns to assure nutritional adequacy (Abrams and Laros, 1986). Maternal growth needs, food preferences, and activity patterns should be assessed when calculating recommendations for teenagers.

The search for "optimal" weight gain recommendations needs to address "the effects of prepregnancy weight status, diet quality and quantity, and the composition of weight gained on birth weight" (Brown, 1988, p. 189). In addition, the relationships between the benefits to the infants and the risks to the mother must be considered, and "an understanding of who is at risk for gaining weight excessively during pregnancy is needed" (p. 189).

Brown (1988) examined the data from term deliveries that occurred between 1980 and 1984 in a predominantly white Kansas population. The results indicated that the healthiest babies were those that weighed

greater than 3500 grams at birth. The effects of smoking were not considered. The weight gains in the different groups of women necessary to achieve this birth weight goal were greater than 45 lbs, 34 lbs, 21 lbs, 9 lbs, and 4 lbs for underweight, normal weight, overweight, obese, and very obese women respectively. Birth weight goal may differ for black women since even healthy black infants tend to weigh less at birth than white infants (Naeye, 1981).

Summary

Successful pregnancy outcome is the goal of prenatal care. Weight gain recommendations should provide for a gain that will accomplish the following: birth weight compatible with low morbidity and mortality; reduced incidence of complications during pregnancy, labor, and delivery; and loss of weight soon after delivery.

Recommendations for weight gain during pregnancy range from 7 to 15 kg (15-33 lbs). Weight gain recommendations should be individualized, and prepregnant weight is a primary consideration when the projected gain is calculated; the recommendation should decrease as prepregnant weight increases.

THE PRESENT STUDY

The purpose of this study was to investigate the characteristics of women who experienced EWG during pregnancy. Previous studies about weight gain during pregnancy have primarily been concerned with birth weight. Fewer restrictions were placed on weight gain when the relationship between inadequate weight gain and low birth weight infants was established (Simpson et al., 1975; Naeye, 1979; Luke et al., 1981; Abrams and Laros, 1986; Beilly and Kurland, 1945). Little attention was directed toward the effect of excess weight gain during pregnancy on women's health. Recent studies, however, have shown that some women who gain excess weight experience complications during labor and delivery, and some women are unable to lose the weight during the postpartum period (Whittaker, 1985; Garbaciak et al., 1985; Greene et al., 1988). Clearly, it is important to characterize women who experience EWG so that they may be identified early in pregnancy and provided with personal nutrition counseling and support to achieve AWG.

Some possible causes of EWG during pregnancy are lack of concern regarding AWG, a perception of PCW that differs from weight status as determined from a height-weight table, PCW in excess of standard weight, and lack of guidance regarding AWG. Palmer et al. (1985) examined the attitudes of women toward weight gain during pregnancy and the relationship between women's attitudes and actual weight gains. The focus of their study was low weight gain, and the results indicated that a negative attitude toward weight gain was associated with low weight

gain. The results also indicated that women with higher scores, i.e., positive attitudes, gained more than 13.6 kg (30 pounds).

In the present study, methods to identify these women who experienced EWG were investigated. To determine attitude toward weight gain during pregnancy, women were administered the Attitude Questionnaire developed and tested by Palmer et al. (1985). The reliability coefficient for the questionnaire is 0.67 by Spearman Brown Prophecy formula.

In addition to attitude characteristics, this study also assessed individual, perceptual, and physical characteristics in order to provide the investigator with a broad perspective for developing a plan to assist pregnant women achieve AWG. The method is easy, quick, and based on accepted standards for physical assessment. Recommendations are then provided based on individual needs. The method is also applicable to women at any PCW.

The individual characteristics examined were smoking habits, marital status, employment status, race, parity, and age. To determine body weight perception, women were asked the question, "Did you consider yourself too skinny, just right, or overweight, before you got pregnant?" ("this time", was included when questioning multigravidas). Physical characteristics included height, PCW, and frame size. PCWS and BMI were determined.

Assessments and recommendations for black women based on Metropolitan Life Tables may be inappropriate because collection of data used to formulate the tables from this population was limited. Perception of

body weight has been reported to be influenced by many factors, and the use of one question may be inadequate. Further study may be needed to determine the validity and reliability of the question.

Statement of purpose

The main purpose of the study was to characterize women who experience EWG during pregnancy. This group was compared to a group of women who experienced AWG during pregnancy on the basis of preconceptional weight status (PCWS), parity, and the incidence of gestational diabetes, preeclampsia, and/or primary cesarean section.

Additional goals were to examine whether relationships exist between Self-perceived preconceptional weight (SPCW) and PCWS; between SPCW and body mass index (BMI); between PCWS and BMI; between SPCW, PCWS, and attitude toward weight gain during pregnancy; and between weight gain classification and attitude.

Hypotheses

1. Compared to women with AWG during pregnancy, women with EWG during pregnancy will have been overweight at conception.
2. Compared to women with AWG during pregnancy, women with EWG during pregnancy will be primigravidas.
3. Compared to women with AWG during pregnancy, women with EWG during pregnancy will experience one or more of the following

complications: preeclampsia, gestational diabetes, primary cesarean section.

4. A significant relationship exists between SPCW and PCWS.
5. A significant relationship exists between SPCW and BMI.
6. A significant relationship exists between PCWS and BMI.
7. Scores on attitude questionnaires will be significantly related to weight gain.
8. Scores on attitude questionnaires will be significantly related to SPCW and PCWS.

METHODS

Subjects

The subjects for this study were women over the age of 18 who received prenatal care and/or delivered at term in Sentara Norfolk General Hospital, Norfolk, Virginia, during 1988 and 1989. The women had contact with the perinatal dietitian during prenatal care, and their pregnancies were without the complications of pregestational diabetes, multiple gestation, pregestational chronic hypertension, or hydramnios, due to the potential effects of these conditions on weight gain.

For the purpose of this study, 77 women responded to questionnaires about attitudes toward weight gain during pregnancy (Palmer et al., 1985), and anthropometric data were collected to determine PCWS. Medical records for 215 women were also reviewed and 188 records were used to determine weight at last prenatal visit, race, marital status, employment status, and occurrence of gestational diabetes, preeclampsia, and/or delivery by primary cesarean section. Complete data were available for 138 women.

Instruments

1. Modified 1983 Metropolitan Life Height and Weight Table (Appendix A)

The 1983 Metropolitan Life Height and Weight Table for women was

modified to list weights according to height in inches without shoes. This table was used to determine PCWS.

2. Demographic Survey and Anthropometric Data (Appendix B)

Women attending the Obstetric Clinic, Ambulatory Care Center, Sentara Norfolk General Hospital, Norfolk, Virginia, are routinely interviewed and counseled by the perinatal dietitian. The demographic survey and anthropometric measurements are usually completed at the initial visit. The form is used to record future activities between the women and the dietitian.

3. Attitude Questionnaire (Appendix C)

The Attitude Questionnaire is an 18-statement Likert-format questionnaire developed and tested to assess women's attitudes toward weight gain during pregnancy (Palmer et al., 1985). It was devised to determine the effect of attitude on weight gain during pregnancy. The Likert format includes five choices of response: strongly disagree, disagree, neither disagree nor agree, agree, or strongly agree. Scoring involves assignment of numbers, one to five respectively, to the response choices. In the study by Palmer et al. (1985), a low score indicated an attitude "favoring slimness" and was associated with low weight gain. For the purpose of this study, scores were expected to indicate degree of weight gain: low score, low weight gain; high score, high weight

gain.

Procedures

1. Completion of demographic survey

Date of birth, parity (primigravida or multigravida), and estimated date of confinement as determined by ultrasound (Ser. No. 00011, Model 46-211412P20, General Electric, Rancho Cordova, CA) were obtained from prenatal records. Usually PCW history was unavailable; therefore, the woman was asked to state her weight prior to the current pregnancy. The woman was asked if she smoked, anthropometric measurements were taken, and all information was recorded (Appendix B).

2. Determination of anthropometric data

The woman's height without shoes was measured on a Health-O-Meter Scale (No. A207296, Continental Scale Corp., Chicago, IL), with the woman facing away from the scale. The woman was encouraged to stand upright and the horizontal bar was placed firmly on her head. Measurements falling between quarter-inch gradations were recorded as the higher quarter-inch value. The measurements were converted to centimeters (Appendix D) and recorded. Wrist circumference was measured below the styloid process with a tape (Cat. No. 30942, American Hospital Supply, McGaw Park, IL) drawn firmly around the wrist. The measurement

was taken in centimeters and recorded. The height (cm) was divided by the wrist circumference (cm) and frame size was determined (Appendix E). These data were used to obtain PCWS and BMI. Desired non-pregnant weight for height and frame was determined from the modified table (Appendix A), and PCWS was determined and coded (Appendix F). Women were also classified according to BMI (Appendix G).

3. Determination of woman's perception of preconceptional weight

The woman was asked the question, "Did you consider yourself too skinny, just right, or overweight, before you got pregnant (this time)?" Her response was coded (Appendix F) and recorded.

4. Determination of desired pregnancy weight gain

A desired weight gain during pregnancy of 20% PCW (Gueri et al., 1982) was calculated, and the information on desired weight at delivery was recorded and provided to each woman. A range of desired weight gain based on 20% of the range recommended for height and frame was calculated, and a range of desired weight at delivery was provided to underweight women and women who had no knowledge of PCW. Obese women, PCW greater than 190 lbs, were advised to gain 15-20 lbs (Gueri et al., 1982; Naeye, 1981; Worthington-Roberts, 1987). Women whose weight already exceeded the desired weight at delivery were advised by the dietitian to gain between one-half and one pound per week. Some

underweight women were referred to a Maternal Child Health Nutritionist, and teenagers were counseled by the dietitian. Recommendations for teenagers were based on age, PCW, and growth needs.

5. Administration of Attitude Questionnaire

During initial contact with the perinatal dietitian, usually at the first visit with the physician, 77 women were each asked to read the introductory section on the questionnaire (Appendix C). The study was described to them as "dealing with women's attitudes toward weight gain during pregnancy and with weight gains during pregnancy". If they consented to participate in the study, they were asked to complete the questionnaire. A written explanation of the study was presented to them (Appendix H). The completed questionnaire was number-coded to insure confidentiality, letter-coded to identify SPCW, and symbolized to identify PCWS (Appendix F). Questionnaires were scored for 60 women; complete demographic data were available for 48 women.

6. Sample selection and post-delivery data collection

Approximately 600 pregnant women had contact with the perinatal dietitian between July 1987 and July 1988. Demographic survey records on file in the dietitian's office were reviewed. Medical records of 462 women were considered for further review when the women had knowledge of PCW prior to recently concluded pregnancy and they were 18 years of age

or older. Records of women with pregestational diabetes, pregestational chronic hypertension, multiple gestation, or a diagnosis of hydramnios were not included in the study because of the potential confounding effects of these conditions on weight gain. The medical records were reviewed for weight at last prenatal visit, race, marital status, employment status, and occurrence of certain complications: gestational diabetes, preeclampsia, and/or delivery by primary cesarean section.

A diagnosis of gestational diabetes was based on results from a three-hour Oral Glucose Tolerance Test (ten ounces Dextol, Baxter Scientific Products, McGaw Park, IL 60085; analyzed by Astra Systems, Beckman Instrument Corp., Brea, CA). Two or more values above 105, 190, 165, and 145, for fasting, one-hour, two-hour, and three-hour serum glucose respectively, confirmed the diagnosis. The occurrence of preeclampsia was diagnosed and recorded by a physician. When method of delivery was not recorded, the Labor and Delivery Log, Sentara Norfolk General Hospital, Norfolk, Virginia, was reviewed.

When delivery occurred between 38 and 42 weeks gestation, as determined by prenatal ultrasound, gestational weight gains were calculated (Appendix I). Preconceptional weight was subtracted from weight at last prenatal visit, provided the visit was within two weeks of delivery. Weight gain was based on PCW, (Appendix J) and three groups were identified according to their weight gains: IWG, AWG, EWG, (Appendix K).

Demographic survey records were reviewed to determine weight gain during pregnancy for the questionnaire respondents. Weight gain groups

were also identified as IWG, AWG, and EWG.

7. Statistical treatment

The data on PCWS from AWG and EWG groups were subjected to chi square analysis. The data on parity from the AWG group and EWG group were analyzed using Fisher's Exact test. The data from each weight gain classification for each complication were analyzed using analysis of variance. Correlations between SPCW, PCWS, and BMI were calculated using Spearman's rank correlation coefficient (Siegle, 1956). Continuous data were analyzed by one-way analysis of variance (Winer, 1971). Data from weight gain study group and questionnaire respondents were analyzed using student's t-test. Pearson's correlation coefficients were used to analyze descriptive data and to establish relationships between questionnaire scores and each of the following: PCWS, SPCW, weight gain.

RESULTS

Sample Characteristics

The women in this study were predominantly black (72.6%) and single (100%). Mean age was 24.5±4.7 years, 27.3% were primigravidas, 22.9% were employed, and 20.4% smoked. Mean PCW was 142.8±33.7 lbs, mean height was 63.9±2.5 inches, and mean BMI was 24.6±5.5. PCWS, BMI, and SPCW are presented in Table 1.

Group Identification

When demographic survey records on file in the dietitian's office were reviewed to determine study subjects, criteria for the study were satisfied in 462 cases and 215 medical records were available for review. One hundred eighty-eight records were identified as appropriate for the weight gain section of this study. Information was complete for 138 women. Recommendations for weight gain were based on PCW (Appendix K). Total weight gain was obtained by subtracting PCW from the weight at last prenatal visit (Appendix I). Weight gain during pregnancy was used to establish

(1) IWG, weight gain less than recommendation;
(2) AWG, weight gain consistent with recommendation;
(3) EWG, weight gain greater than recommendation.

Fifty six, 28, and 54 women were identified as IWG, AWG, EWG respectively. Seventy-seven women selected at random completed the ques-

Table 1. Preconceptional Weight Status (PCWS), Body Mass Index (BMI), and Self-perceived Preconceptional Weight (SPCW)

	N (%)
PCWS*	
Less than	68 (24.7)
Equal to	98 (35.6)
Greater than	109 (39.6)
Total	275
BMI**	
Underweight (22.4 or less)	112 (42.7)
Standard weight (22.5 - 26.3)	80 (30.5)
Overweight (26.9 or more)	70 (26.8)
Total	***262
SPCW#	
Too skinny	41 (14.9)
Just right	120 (43.6)
Overweight	114 (41.5)
Total	275

*Relationship of preconceptional weight (PCW) to the Modified 1983 Metropolitan Life Table.
**Adopted from Burton and Foster, 1985, p. 1119.
***Data from BMI were absent in 13 cases.
#Self-perception of PCW.

tionnaire. Information on SPCW and PCWS was available for 60 women and total weight gain was available for 20 women. Weight gain classifications, IWG, AWG, EWG, were used to establish study groups.

Group Data

Preconceptional weight status

Chi square analysis produced no significant differences in PCWS between AWG and EWG groups (Table 2). The percentage of the AWG group classified as overweight at conception was 46.4%. The percentage of the EWG group with the same classification was 29%.

Parity

Statistically significant results between AWG and EWG groups were found with regard to parity (Table 3). Fisher's Exact test results indicated primigravidas experienced more weight gain than multigravidas.

Incidence of complications

Analysis of variance produced no significant differences in incidence of specific complications between AWG and EWG groups. The incidence of primary cesarean section, gestational diabetes, and preeclampsia, in this population, was relatively small (Table 4). The

Table 2. Preconceptional Weight Status and Weight Gain

Group	N	Less Than*	Equal To*	Greater Than*
Appropriate Weight Gain	28	7(25%)	8(29%)	13(46%)
Excess Weight Gain	54	15(28%)	23(43%)	16(30%)

*Relationship of preconceptional weight to the Modified 1983 Metropolitan Life Table

chi square, $p < 0.28$

Table 3. Parity and Weight Gain

Group	N	Primigravida	Multigravida
Appropriate Weight Gain	28	4 (16%)	24 (42.1%)
Excess Weight Gain	54	21 (84%)	33 (57.9%)

Fisher's Exact Test, $p < 0.02$

Table 4. Types and Incidence of Complications (N=138)

Complication	Total	IWG*	AWG**	EWG***
None	105	43	20	42
Primary cesarean section (PCS)	23	9	5	9
Preeclampsia (PE)	1	0	1	0
Gestational diabetes (GD)	5	4	0	1
PE and GD	1	0	0	1
PE and PCS	2	0	1	1
GD and PCS	1	0	1	0
Total	33	13	8	12

*Inadequate weight gain
**Appropriate weight gain
***Excess weight gain

Legend: Values assigned to each complication.

0 = none	2 = PE	4 = PE and GD
1 = PCS	3 = GD	5 = PE and PCS
		6 = GD and PCS

complications were then grouped together by occurrence rate (0,1,2) and examined. No significant differences for all three weight gain groups were noted. Total complications for IWG, AWG, and EWG groups were 13, 8, and 12 respectively (Table 5).

Self-perceived preconceptional weight, preconceptional weight status, and body mass index

Spearman's rank correlation coefficients produced significant relationships between SPCW and PCWS; SPCW and BMI; PCWS and BMI (Table 6). The strongest significant relationship was between PCWS and BMI, and the weakest significant relationship was between SPCW and PCWS.

Demographic information

Student's t-tests for race, PCWS, employment status, marital status, smoking, PCW, and height showed no statistically significant differences between the group studied for weight gain only and the group who responded to the questionnaire (Tables 7 & 8). A statistical difference appeared with regard to age; however, mean age (yrs) was 22.9 for the questionnaire respondents and 24.8 for the women in the group studied for weight gain.

Table 5. Incidence of Complications (N=138)

Group	N	Mean	p
Appropriate Weight Gain	28	0.35	NS
Excess Weight Gain	54	0.25	NS
Inadequate Weight Gain	56	0.23	NS

Legend: Values assigned to complications.

0 = none
1 = Primary cesarean section (PCS), Preeclampsia (PE)
Gestational diabetes (GD)
2 = PE and GD, PE and PCS, GD and PCS

Duncan's Multiple Range Test, $p < 0.56$

Table 6. Correlation coefficients between SPCW* and PCWS**, SPCW* and BMI***, and PCWS** and BMI***

	Mean	S. D.
SPCW*	1.26	0.70
PCWS**	1.14	0.78
BMI***	24.59	5.47

*SPCW - Self-perceived preconceptional weight
**PCWS - Preconceptional weight status
***BMI - Body mass index

SPCW/PCWS, $r = 0.70$, $p < 0.0001$
SPCW/BMI, $r = 0.75$, $p < 0.0001$
PCWS/BMI, $r = 0.92$, $p < 0.0001$

Table 7. Comparisons between Weight Gain Study Group(WGSG) and Questionnaire Respondents (QR)

	N	Mean	S. D.
Smoking			
WGSG	138	0.18	0.39
QR	60	0.21	0.41
Employment Status			
WGSG	138	0.27	0.44
QR	60	0.13	0.34
PCWS			
WGSG	138	1.32	0.68
QR	60	1.08	0.69
Race			
WGSG	138	1.19	0.44
QR	60	1.29	0.46
Marital Status			
All single			

Legend: Values assigned to variables

Smoking	Employment Status	PCWS	Race
0 = No	0 = No	0 = less than	0 = other
1 = Yes	1 = Yes	1 = equal to	1 = black
		2 = greater than	2 = white

Note: Data from WGSG were obtained from medical records and demographic surveys.

No significant differences were observed between groups.

Table 8. Comparisons between Age, Preconceptional Weight (PCW), and Height, Weight Gain Study Group(WGSG) and Questionnaire Respondents (QR)

Age(yrs)	N	Mean	S. D.
WGSG	138	24.61	4.67
QR	55*	22.95	4.00
PCW(lbs)			
WGSG	138	144.47	36.03
QR	48**	142.02	33.53
Height(in)			
WGSG	138	63.87	2.24
QR	56	64.20	3.02

*Birthdate missing
**PCW unknown

Age
T - 2.29, $p < 0.02$

Note: Data from WGSG were obtained from medical records and demographic surveys.

Weight gains

Weight "gains" ranged from -9 kg (-20 lbs) to 33.6 kg (74 lbs) in the group studied for weight gain only. Mean weight gain was 14.4 kg (31.6 lbs). Mean group weight gains were IWG, 8.8± 5.5 kg (19.4±12 lbs); AWG, 14±3.6 kg (31±8 lbs), and EWG, 20±4.9 kg (44.5±10.8 lbs). The lowest and highest weight gains for each group were -9 kg (-20 lbs), 7.8 kg (17.1 lbs), 10.8 kg (23.75 lbs) and 21.6 kg (47.5 lbs), 20 kg (44 lbs), and 33.6 kg (74 lbs) respectively.

Weight gains for questionnaire respondents were examined only in relationship to questionnaire scores.

Attitude Questionnaire Data

Scores

Questionnaires were scored for 60 women. Scores were grouped by PCWS (Appendix L) and SPCW (Appendix M). Questionnaire responses were examined (Appendix N). Possible range of scores was 18-90: the low score was 29, high score was 65. The mean score for entire group was 51.1±7 and the range was 48.9±9-53.7±5. Mean scores were 49.8, 50.9, 51.6 for PCWS "less than", "equal to", and "greater than", respectively. Mean scores for SPCW were 48.3, 50.6, 53.9 for SPCW "too skinny", "just right", and "overweight", respectively.

Weight gain and Attitude Questionnaire scores

Weight gains for 20 women out of 48 who responded to questionnaire were calculated and classified as inadequate, appropriate, or excess. Scores for all three groups combined ranged from 34 to 63. Mean sores are presented in Table 9.

Preconceptional weight status, self-perceived preconceptional weight, and Attitude Questionnaire scores

A statistically significant relationship between SPCW and questionnaire scores was indicated by Pearson's correlation coefficients. No significant difference was noted between PCWS and questionnaire scores (Table 10).

Table 9. Mean Attitude Questionnaire Scores (N=20)

Group	N	Mean Score	p
Appropriate weight gain	7	52.7	NS
Excess weight gain	6	52.3	NS
Inadequate weight gain	7	50.3	NS

Duncan's Multiple Range Test, $p < 0.72$

Table 10. Pearson Correlation Coefficients: PCWS* and Attitude Questionnaire Scores; SPCW** and Attitude Questionnaire Scores

	r	p
PCWS	0.07	0.59
SPCW	0.27	0.03

*Preconceptional weight status
**Self-perceived preconceptional weight

DISCUSSION

Pregnancy weight gain is composed of products of conception, physiological changes, accumulation of fat, and occasionally, fluid retention. The products of conception contribute approximately 5.7 kg (12.5 lbs), and physiological changes can contribute 2.6±5.5 kg (5.7±12 lbs) to weight gain (Slemans and Fagan, 1927; Chesley, 1944; Eastman and Jackson, 1968; Hytten, 1981; Brown, 1988). It has been estimated that fat deposits contribute approximately 2.5 kg or 8 lbs (Brown, 1988). Therefore, it seems reasonable to suggest that weight gain in excess of 16.3 kg (38.2 lbs) is due to additional fat.

The purpose of this study was to examine weight gain during pregnancy with emphasis on EWG. Women who experienced EWG were compared to women who experienced AWG and IWG with regard to PCW, parity, and incidence of gestational diabetes, preeclampsia, primary cesarean section, or any combination of these conditions.

Categories based on PCW were underweight, standard weight, and overweight. For the purpose of this study, women who weighed 190 lbs or more were categorized as obese (Appendix J). Pregnancy weight gain classifications were inadequate, appropriate, and excess (Appendix K). Weight gain classifications were determined based on PCW categories (Naeye, 1979; Gueri et al., 1982; Rosso, 1985).

Preconceptional weight status

It was hypothesized that women who experienced EWG would have been overweight at conception. No group differences were noted between AWG and EWG women.

Stander and Pastore (1940) reported a linear relationship between PCW and weight gain in American women, and Eastman and Jackson (1968) reported that PCW had no effect on weight gain in white and black women studied at Johns Hopkins Hospital until PCW exceeded 160 lbs, and then amount of gain decreased as PCW increased. No relationship was noted by Niswander and Jackson (1974) when they examined data from the Collaborative Perinatal Study.

Mean PCW for AWG and EWG groups were 66±16.8 kg (146±37 lbs) and 65±14 kg (144±31 lbs). PCW ranges in each group were large: AWG, 44-99 kg (97-218 lbs); EWG, 45-114 kg (100-252 lbs). It is interesting to note that 46% of AWG group and 29% EWG were overweight at conception.

One explanation for the lack of difference between groups was the manner in which the groups were established. Overweight and obese women under 190 lbs were grouped together, and PCW ranged from 63.6 to 88.6 kg (140-195 lbs). When these women gained less than 20% PCW, weight gain was considered inadequate. Results of several studies indicated that obese and very obese women, greater than 120% PCW and 135% PCW, gained less during pregnancy than lower weight women, yet experienced successful pregnancy outcomes (Naeye, 1979; Rosso, 1985; Worthington-Roberts, 1988; Abrams, 1988).

Parity

Significant differences were noted between primigravidas and multigravidas in AWG and EWG groups. More primigravidas experienced EWG although mean weight gain, 17 kg (34 lbs), was only 1.8 kg (4 lbs) higher. Primigravidas represented 34.5% of weight gain study sample and 84% of EWG group. Differences between gravidas may occur because of several factors: energy expenditure, energy intake, activity patterns, and physiological changes. Blackburn and Calloway (1976) reported lower energy expenditures (31 kcal/kg) for primigravidas based on results from food and activity diaries. A review of activity patterns indicated that primigravidas were more sedentary.

Mean PCW for multigravidas was 66 kg (146 lbs) and for primigravidas was 63 kg (139 lb). Mean BMI was 25 for multigravidas and 23 for primigravidas. Although these differences were small, women who weigh more often gain less weight and eat fewer calories (Papoz et al., 1981). Naeye (1979) noted that calorie intakes affect weight gain; therefore if multigravidas consume fewer calories, it would be expected that weight gains would be lower.

It has been reported that primigravidas do not return to PCW (Stander and Pastore, 1940) and that weights increase between pregnancies (Billewicz and Thomson, 1970). Multigravidas have already experienced the physiological changes of pregnancy, so the impact of this factor may be less than it is for primigravidas, especially with

regard to fat accumulation.

Complications during pregnancy, labor, and delivery

It was hypothesized that the incidence of gestational diabetes, pre-eclampsia, and primary cesarean section would be increased in the EWG group. The number of complications were inadequate for statistical analysis of each one separately; therefore, analysis was done on total complications for each group. No significant results were observed.

Several researchers have conducted studies that produced significant results when weight, weight gain, and complications were examined. The study populations examined by Garbiciak et al. (1985) and Abrams and Parker (1988) were limited to women 120% standard weight or greater, in some cases much greater. The groups in the present study included all weight categories.

This sample population represents a small portion of deliveries at Sentara Norfolk General Hospital, Norfolk, Virginia, and complications may have been more prevalent in the remainder of the population. However, study results from a large population did not produce significant differences for cesarean section deliveries performed as a result of excess weight gain (Taffel and Placek, 1983). Hypertension was not present in the study sample.

Self-perceived preconceptional weight, preconceptional weight status, and body mass index

Significant relationships were shown between SPCW and PCWS, SPCW and BMI, and PCWS and BMI. The study group was predominantly black, and black women are more often overweight than white women (Gillum, 1987). Dawson (1988) reported that fewer black women perceive themselves as overweight and "that women's perceptions of whether or not they are overweight are more strongly influenced by their weight relative to their peers than by weight relative to an arbitrary health-based standard" (p. 1328).

Although values in Metropolitan Life Tables, one of the standards, were based on relatively small data collection from black populations (Weigley, 1984; Burton and Foster, 1985; and Robinett-Weiss et al., 1984), the results of this study indicated the tables to be an appropriate tool to use in the assessment of weight and determination of weight status. Wrist circumference measurement was the preferred choice to determine frame size because, unlike elbow measurements, the results are compared to a standard formulated from actual measurements (Grant et al., 1981). Nowak and Schulz (1987) suggested that "an accurate determination of frame size demands a measurement not influenced by adiposity" (p. 340).

The results of this study indicated that, in fact, black women's perception of body weight approximates those standards. Perception of body weight is the aspect of body image related to body size (Cash and

Brown, 1988). One reason for an apparent change in black women's assessment of body weight may be explained by a change in attitude. This aspect of body image addresses affect and cognition. A contributing factor to attitude change may be the increased media presence of white women of larger stature and black women of smaller stature. Body image is influenced by physical fitness, appearance, and health, issues of major importance in this society. The emphasis placed on these aspects may be another explanation for the relationship found in this study.

A stronger relationship was found between SPCW and BMI. Mean BMI for women who perceived themselves as overweight was 29.4. BMI values above 26.9 indicate the presence of obesity (Burton and Foster, 1985), and BMI is considered the best predictor of obesity (Keys et al., 1972, Simopoulos and Van Itallie, 1985). The relationship between self-perceived body weight and BMI supports the hypothesis that women who perceive themselves as overweight are accurate in their assessment.

The strongest correlation ($r = +.90$) was noted between PCWS and BMI. The opinion that height and weight tables are questionable sources for weight assessment because they include no assessment of fat has been supported by several researchers (Keys, 1955; Weigley, 1984; and Robinett Weiss et al., 1984). However, BMI was reported as the "most satisfactory index" of obesity (Simopoulos and Van Itallie, 1984). A relationship may exist between PCWS and BMI because each is formulated from the same variables, height and weight.

Weight gains and Attitude Questionnaire scores

No statistically significant differences were noted in scores between groups of women with weight gains classified as inadequate, appropriate or excess. One explanation for this result may be the small size of the total sample (20), and the even smaller size of each group. Scores from 29 women were examined by Palmer et al, (1985); however, weight gains were considered individually and were not classified as inadequate, appropriate, or excess. Most of the women considered approriate weight gain to be 20-26 lbs; however, 20 out of 29 women gained 28 lbs or more.

Preconceptional weight status, self-perceived preconceptional weight, and scores

The range of scores was broad, 29-65: possible range 18-90. The hypothesis that a significant relationship exists between attitude toward weight gain during pregnancy and PCWS was not supported; however mean scores grouped by PCWS indicated that scores increased as weight status increased. Lowest score was associated with PCWS, less than; highest score was associated with PCWS, greater than. Previous studies on attitude toward weight gain did not examine this relationship nor did the studies include definitions for inadequate, appropriate, or excess weight gain (Palmer et al., 1985; Pomerance et al., 1980).

It was hypothesized that a relationship exists between SPCW and

attitude toward weight gain. Mean scores were lowest for women who considered themselves too skinny, and highest for women who considered themselves overweight. This finding supported the hypothesis.

CONCLUSIONS

The purpose of this study was to examine EWG during pregnancy and to characterize women who experience EWG in order to identify women who would benefit from more intensive nutrition counseling.

Women who experienced EWG were compared to women who experienced AWG. No significant differences were noted between groups with regard to PCWS; however, PCW classifications in this study were too narrow in one aspect and too broad in another. Preconceptional weight was considered "equal to" only when it fell within the ranges of the 1983 Metropolitan Life Table. Most investigators suggest that weights from 10% below to 10% above the ranges should be considered within the range. The "greater than" PCW category included women at weights anywhere from one pound to 80 pounds overweight. More stringent guidelines for PCW categories are needed when EWG during pregnancy is researched because successful pregnancy outcomes may be experienced over a large range of weight gain, including weight loss. Smaller weight gains in larger women, that result in successful outcomes, should not be considered inadequate.

In addition, weight gain recommendations for overweight women need to be formulated on the basis of PCW. It is suggested that recommendations are needed for women at 111-120%, 121-130%, and greater than 131% of standard weight. Current recommendations for weight gain for these women is the same as that for normal weight women, 20% PCW. When new recommendations are formulated, weight gain groups would be more

representative of actual results than the groups in this study, and comparisons between groups may elicit different results, some of them significant.

One characteristic of women who experienced EWG identified in this study was parity. Significant results indicated that primigravidas gained more weight; therefore, during prenatal care emphasis should be directed at providing intensive nutrition counseling for this population.

Fortunately, the incidence of complications was small and no significant differences between groups were noted. Future research efforts directed at complications and the characteristics of women who experience them may produce different results than the methodology employed in the present study.

Self-perceived preconceptional weight was determined by asking the question, "Did you consider yourself too skinny, just right, or overweight, before you got pregnant (this time)?" Significant relationships existed between SPCW and PCWS, and it is suggested that although body image is a complex subject, the use of this question may be appropriate for determining perception of body weight, one aspect of body image. Further research with appropriately identified PCW groups is needed before the relationship between them is accepted, and the question becomes a tool by which women likely to experience EWG may be identified. Although it is suggested the relationships examined in this study should be re-examined with appropriately identified PCW groups, the relationship exhibited between SPCW and BMI in this study also

suggests the use of the question would be appropriate to identify underweight, standard weight, and overweight women.

The strong relationship that existed between PCWS and BMI was of particular interest because results from earlier reports indicated that PCWS, as established in this study, is considered questionable. The accuracy of this method is in doubt because no assessment of fat, a primary indicator of obesity, was done when the height and weight tables were formulated. Additional study directed at individual weight status groups is needed to support the relationship observed in this study.

Questionnaires were administered to examine attitudes toward weight gain during pregnancy and scores were compared to PCWS, SPCW, weight gains. A significant relationship was noted between scores and SPCW only. Since higher scores were associated with "overweight" women, it may be expected that these women would be more likely to experience EWG.

Previous study results (Palmer et al. 1985) indicated that weight gain is influenced by attitude toward weight gain and that higher scores were associated with higher weight gains. Although significant results were not produced in this study, the same trend was observed; therefore, the use of the Attitude Questionnaire may be suitable to identify women who will probably experience EWG.

The questionnaire respondents and weight gain study groups were compared, and there were no statistically significant differences in marital status, parity, PCW, height, race, employment status, smoking, or PCWS; therefore, it is suggested that questionnaire scores would have

been comparable for the weight gain study group.

SUMMARY

Obesity is a major health problem in the United States, and many health professionals agree that EWG during pregnancy is a contributing factor. Prenatal care providers need methods to identify women likely to experience EWG.

Recent findings support the hypothesis that weight gain during pregnancy is influenced by PCW; weight gain decreased as PCW increased. Heavier women experienced successful pregnancy outcomes with lower weight gains. It is suggested that weight gain recommendations should be formulated based on this knowledge. As the percentage of overweight increases, weight gain recommendations should decrease.

In this study, primigravidas gained more weight than multigravidas indicating that nutrition counseling may be especially important for a similar population.

Significant relationships were noted between SPCW and BMI, SPCW and PCWS, and PCWS and BMI. The evidence indicated that a woman's perception of body weight is similar to her weight status and degree of obesity. The strong relationship between PCWS and BMI suggests that the Metropolitan Life Height and Weight Table for women used in conjunction with the wrist circumference method to determine frame size provides an accurate assessment of weight and obesity. A significant relationship between attitude toward weight gain during pregnancy and SPCW was noted in this study.

All of these assessments may provide the nutrition counselor with

better direction for developing a nutrition plan for all pregnant women, especially those more likely to experience EWG.

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APPENDIX A: MODIFIED 1983 METROPOLITAN LIFE HEIGHT AND WEIGHT TABLE (Ling, Pratt, Taper, and Philput, 1989)

Height Inches	Small Frame	Medium Frame	Large Frame
57	102-111	109-121	118-131
58	103-113	111-123	120-134
59	104-115	113-126	122-137
60	106-118	115-129	125-140
61	108-121	118-132	128-143
62	111-124	121-135	131-147
63	114-127	124-138	134-151
64	117-130	127-141	137-155
65	120-133	130-144	140-159
66	123-136	133-147	143-163
67	126-139	136-150	146-167
68	129-142	139-153	149-170
69	132-145	142-156	152-173
70	135-148	145-159	155-176
71	138-151	148-162	158-179

APPENDIX B: DEMOGRAPHIC SURVEY AND ANTHROPOMETRIC DATA

1. NAME_____
2. SSN#_____
3. DATE OF BIRTH_____
4. DATE OF INITIAL CONTACT_____
5. GESTATIONAL AGE AT IC_____
6. SOCIO-ECONOMIC_____
7. WIC_____
8. WT/FRAME/MET_____
9. OB HISTORY_____
10. NUMBER OF PATIENTS VISITS_____
11. NUMBER OF TIMES COUNSELING GIVEN_____
12. REASONS FOR COUNSELING_____
13. MISCELLANEOUS_____
14. DATE OF DELIVERY_____

****

COMMENTS

GLUCOLA_____GESTATIONAL AGE_____

_____

_____

_____

_____

HT_____

WC_____PCW_____

APPENDIX C: Attitude Questionnaire (Palmer, Jennings, Massey, 1985)

Many women are concerned about weight gain during their pregnancies. These statements deal with feelings and concerns that you might have about your weight gain during pregnancy. All answers are confidential. Please read each statement. Opposite each statement circle the letter(s) which best express your feelings.

SA=Strongly Agree
A=Agree
N=Neither Agree Nor Disagree
D=Disagree
SD=Strongly Disagree

1.	I worry that I may get fat during this pregnancy.	SD	D	N	A	SA
2.	I would like to gain between 21 and 30 pounds during this pregnancy.	SD	D	N	A	SA
3.	I am trying to keep my weight down so I don't look so pregnant.	SD	D	N	A	SA
4.	I would like to gain between 11 and 20 pounds this pregnancy.	SD	D	N	A	SA
5.	As long as I'm eating a well-balanced diet, I don't care how much I gain during this pregnancy.	SD	D	N	A	SA
6.	I think a pregnant woman is beautiful.	SD	D	N	A	SA
7.	I'm proud of looking pregnant.	SD	D	N	A	SA
8.	I like being able to gain weight for a change.	SD	D	N	A	SA
9.	I am embarrassed at how big I have gotten this pregnancy.	SD	D	N	A	SA
10.	I would gain 40 pounds if it meant my baby would be healthier.	SD	D	N	A	SA
11.	I like wearing maternity clothes.	SD	D	N	A	SA
12.	The weight I gain during my pregnancy makes me feel unattractive.	SD	D	N	A	SA
13.	I'm embarrassed whenever the nurse weighs me.	SD	D	N	A	SA
14.	It bothers me that I can't wear what is in style while I'm pregnant.	SD	D	N	A	SA
15.	I feel that women have to be especially careful about getting fat during pregnancy.	SD	D	N	A	SA
16.	If I gain too much weight one month, I will try to keep from gaining the next month.	SD	D	N	A	SA
17.	Just before I go to the doctor, I try not to eat.	SD	D	N	A	SA
18.	I would gain 35 pounds if it meant my baby would be healthier.	SD	D	N	A	SA

APPENDIX D. CONVERSION TABLE: INCHES TO CENTIMETERS
(Ling et al., 1989)

Inches-Centimeters	Inches-Centimeters	Inches-Centimeters
59 - 147.5	62.75 - 156.87	66.5 - 166.25
59.25 - 148.12	63 - 157.5	66.75 - 166.87
59.5 - 148.75	63.25 - 158.12	67 - 167.5
59.75 - 149.37	63.5 - 158.75	67.25 - 168.12
60 - 150	63.75 - 159.37	67.5 - 168.75
60.25 - 150.62	64 - 160	67.75 - 169.37
60.5 - 151.25	64.25 - 160.62	68 - 170
60.75 - 151.87	64.5 - 161.25	68.25 - 170.62
61 - 152.5	64.75 - 161.87	68.5 - 171.25
61.25 - 153.12	65 - 162.5	68.75 - 171.87
61.5 - 153.75	65.25 - 163.12	69 - 172.5
61.75 - 154.37	65.5 - 163.75	69.25 - 173.12
62 - 155	65.75 - 164.37	69.5 - 173.75
62.25 - 155.62	66 - 165	69.75 - 174.37
62.5 - 156.25	66.25 - 165.62	70 - 175

APPENDIX E. FRAME SIZE DETERMINATION (Grant et al., 1981).

Value (HT/WC)*	Designation
More than 10.9	Small
Between 10.9 and 9.9	Medium
Less than 9.9	Large

*HT/WC is height in centimeters divided by wrist circumference in centimeters

APPENDIX F. CODES FOR SELF-PERCEIVED PRECONCEPTIONAL WEIGHT (SPCW)* AND SYMBOLS FOR PRECONCEPTIONAL WEIGHT STATUS (PCWS)**

SPCW*	Code	PCWS**	Symbol
"Too skinny"	T	Less than	-
"Just right"	J	Equal to	=
"Overweight"	F	Greater than	O

*SPCW is the individual's perception of preconceptional weight (PCW) as determined by the response when questioned, "Did you consider yourself too skinny, just right, or overweight, before you got pregnant (this time)?"

**PCWS is the relationship of PCW to the values in the Modified 1983 Metropolitan Life Table.

APPENDIX G. BODY MASS INDEX (BMI) CLASSIFICATIONS*
(Ling et al., 1989)

BMI**	Classification
22.4 or less	Underweight
22.5-26.8	Weight Goal (standard weight)
26.9 or more	20% overweight

*Adapted from Burton and Foster, 1985, p. 1119.

**BMI - is the ratio of weight in kilograms to height in meters squared.

APPENDIX H: DESCRIPTION OF STUDY GIVEN TO SUBJECTS

Attitudes Toward Weight Gain During Pregnancy and Pregnancy Weight Gain

Women often gain more weight than desired during pregnancy and are unable to return to the weight they maintained prior to pregnancy. This study is being conducted to learn about women's attitudes toward weight gain during pregnancy and about weight gain during pregnancy.

It is hoped the information provided on the attached questionnaire will help identify women likely to gain excess weight during pregnancy. Your name has been randomly selected from the women who receive prenatal care at the Ambulatory Care Center, Sentara Norfolk General Hospital.

Directions for responding to the questionnaire are provided at the top of the questionnaire. Please complete the questionnaire if you wish to participate in this study. You may decline to respond to the questionnaire if you do not wish to participate in the study. However, your responses will be of valuable help to me.

You will be assigned a code number and the questionnaire will be labeled with your number. The results from this study will be used for statistical purposes only; your name will never be used. These steps are taken to protect your confidentiality.

The summary results of the study will be provided to you at your request. If you have any questions, please call me (Carol C. Ling) at (804) 628-4036 or Dr. Charlotte Pratt at (703) 231-5549.

Thank you for your help.

Sincerely,

Carol C. Ling R.D.

Carol C. Ling, R.D.

APPENDIX I: PRECONCEPTIONAL WEIGHT (PCW), WEIGHT GAIN RECOMMENDATIONS, WEIGHT GAINS, GROUP DESIGNATION*

Subject	PCW	20% PCW	25% PCW	WT Gain	Group
1	110	22	27.5	27	I
2	106	21.2	26.5	74	E
3	110	22	27.5	50	G
4	105	21	26.25	29.25	A
5	120	24	30	41.5	E
6	96	19.2	24	28.75	I
7	103	20.6	25.75	38.75	A
8	105	21	26.25	37.5	A
9	127	25.4	31.75	44	E
10	114	22.8	28.5	19.75	I
11	113	22.6	28.25	20.25	I
12	115	23	28.75	26.75	I
13	97	19.4	24.25	38	A
14	106	21.2	26.5	47	E
15	120	24	30	25	I
16	114	22.8	28.5	27.25	I
17	98	19.6	24.5	27	I
18	99	19.8	24.75	27.75	A
19	115	23	28.75	30.5	I
20	130	26	32.5	40	E
21	98	19.6	24.5	43.25	A
22	110	22	27.5	18.5	I
23	112	22.4	28	29	I
24	110	22	27.5	43.5	E
25	100	20	25	41.25	E
26	104	20.8	26	34.25	I
27	98	19.6	24.5	25.25	I
28	122	24.6	30.5	49	E
29	110	22	27.5	28.5	I
30	131	26.2	32.75	54.5	E
31	99	19.8	24.75	25	I
32	101	20.2	25.25	18.75	I
33	121	24.2	30.25	44.25	E
34	120	24	30	32.5	E
35	105	21	26.25	25.5	I
36	100	20	25	27.75	I
37	145	29	36.25	46	E
38	112	22.4	28	44.5	E
39	130	26	32.5	68	E
40	110	22	27.5	37.5	A

*I, inadequate; A, appropriate; E, excess.

APPENDIX I: (Con't)

Subject	PCW	20% PCW	25% PCW	WT Gain	Group
41	103	20.6	25.75	47.5	I
42	110	22	27.5	33.25	I
43	195	39	48.75	53.5	E
44	190	38	47.5	13	I
45	195	39	48.75	4.25	I
46	189	37.8	47.25	11.5	I
47	195	39	48.75	27	E
48	200	40	50	36.5	E
49	218	43.6	54.5	19	A
50	165	33	41.25	33	E
51	210	42	52.5	18	A
52	215	43	53.75	17.25	A
53	207	41.4	51.75	49	E
54	252	50.4	63	23.75	E
55	264	52.8	66	-3.5	I
56	188	37.6	47	65	E
57	208	41.6	52	6	I
58	189	37.8	47.25	17.5	A
59	196	39.2	49	-20	I
60	195	39	48.75	33.75	E
61	184	36.8	46	11.5	I
62	180	36	45	34.5	E
63	203	40.6	50.75	-17.5	I
64	188	37.6	47	18	A
65	180	36	45	37	E
66	165	33	41.25	11	I
67	262	52.4	65.5	-5	I
68	177	35.4	44.25	33.5	E
69	148	29.6	37	41	E
70	231	46.2	57.75	-9.5	I
71	126	25.2	31.5	33.5	E
72	170	34	42.5	29.25	I
73	150	30	37.5	25.25	I
74	126	25.2	31.5	29.5	A
75	125	25	31.25	38	E
76	140	28	35	22.25	I
77	130	26	32.5	38.5	E
78	123	24.6	30.75	45.5	E
79	130	26	32.5	26	A
80	125	25	31.25	21.75	I
81	135	27	33.75	25.25	I
82	145	29	36.25	30	A
83	110	22	27.5	30.5	E
84	130	26	32.5	27	A
85	121	24.2	30.25	21.75	I
86	125	25	31.25	30	A
87	132	26.4	33	39.5	E

APPENDIX I: (Con't)

Subject	PCW	20% PCW	25% PCW	WT Gain	Group
88	136	27.2	34	28	A
89	150	30	37.5	21.25	I
90	128	25.6	32	50.5	E
91	161	32.2	40.25	24.75	I
92	165	33	41.25	17	I
93	142	28.4	35.5	47	E
94	152	30.4	38	43.5	E
95	135	27	33.75	24.25	I
96	167	33.4	41.75	33	I
97	125	25	31.25	34	E
98	130	26	32.5	12.5	I
99	137	27.4	34.25	25.75	I
100	150	30	37.5	41.75	E
101	135	27	33.75	25	I
102	135	27	33.75	37.5	E
103	158	31.6	39.5	51.75	E
104	181	36.2	45.2	43	A
105	130	26	32.5	63.75	E
106	140	28	35	17.5	I
107	150	30	37.5	22.25	I
108	140	28	35	34	A
109	150	30	37.5	57	E
110	150	30	37.5	31.75	A
111	166	33.2	41.5	25	I
112	133	26.6	33.25	19.75	I
113	135	27	33.75	26.25	I
114	175	35	43.75	6	I
115	140	28	35	29.25	A
116	136	27.2	34	37	E
117	123	24.6	30.75	31.5	E
118	122	24.4	30.5	19	I
119	135	27	33.75	35	E
120	161	32.2	40.25	37.75	A
121	138	27.6	34.5	50.25	E
122	140	28	35	56	E
123	130	26	32.5	42	E
124	130	26	32.5	40.25	E
125	170	34	42.5	51.75	E
126	165	33	41.25	39	A
127	160	32	40	48.25	E
128	162	32	40.5	32.25	I
129	119	23.8	29.75	15.5	I
130	170	34	42.5	36.25	A
131	130	26	32.5	31.5	A
132	166	33.2	41.5	63.5	E
133	135	27	33.75	29.5	A
134	163	32.6	40.75	7.25	I
135	138	27.6	34.5	42.5	E

APPENDIX I: (Con't)

Subject	PCW	20% PCW	25% PCW	WT Gain	Group
136	195	39	48.75	44	A
137	132	26.4	33	65.5	E
138	136	27.2	34	22	I

APPENDIX J: PRECONCEPTIONAL WEIGHT CATEGORIES

Underweight - preconceptional weight less than the lower value listed for height and frame in Modified 1983 Metropolitan Life Table (Appendix A).

Standard Weight - weight within the range of values listed for height and frame (Appendix A).

Overweight - weight above the higher value listed for height and frame (Appendix A). A subset of overweight women, usually those greater than 200 lbs, were considered obese.

APPENDIX K: PREGNANCY WEIGHT GAIN CLASSIFICATIONS, DEFINITIONS, AND RECOMMENDATIONS BASED ON PRECONCEPTIONAL WEIGHT CATEGORIES

Inadequate weight gain

Underweight women - less than desired weight gain which is derived from 20% preconceptional weight (PCW) added to the difference between PCW and the lower value listed for height and frame (Appendix A).

Standard weight and overweight women - less than 20% PCW.

Obese women - less than 15 lbs.

Appropriate weight gain

Underweight women - equal to desired weight gain which is derived from 20% PCW added to the difference between PCW and the lower value listed for height and frame (Appendix A).

Standard weight and overweight women - 20%-25% PCW.

Obese women - 15-20 lbs.

Excess weight gain

Underweight women - more than desired weight gain which is derived from 20% PCW added to the difference between PCW and the lower value listed for height and frame (Appendix A).

Standard weight and overweight women - more than 25% PCW.

Obese women - more than 20 lbs.

APPENDIX L: ATTITUDE QUESTIONNAIRE SCORES GROUPED BY PRECONCEPTIONAL WEIGHT STATUS (PCWS)*

PCWS Less than	PCWS Equal to	PCWS Greater than
52	52	54
53	54	52
44	59	61
55	63	49
49	47	48
46	53	50
	48	60
Total 299	48	56
Mean 49.8	48	35
	47	53
	45	51
	53	38
	52	50
	61	61
	51	34
	45	49
	65	59
	51	54
	53	56
	48	57
	47	57
	57	47
	52	58
	54	42
	42	61
	51	44
	29	57
	Total 1375	Total 1393
	Mean 50.9	Mean 51.6

*Relationship of preconceptional weight to the Modified 1983 Metropolitan Life Table.

APPENDIX M: ATTITUDE QUESTIONNAIRE SCORES GROUPED BY SELF-PERCEIVED PRECONCEPTIONAL WEIGHT (SPCW)*

SPCW Too skinny	SPCW Just right	SPCW Overweight
52	54	52
53	52	61
44	54	49
45	50	48
61	59	56
47	63	53
49	47	51
52	60	50
54	35	61
29	48	56
46	55	57
48	53	47
	48	58
Total 580	38	42
Mean 48.3	34	57
	48	61
	59	57
	47	
	54	Total 855
	53	Mean 53.9
	57	
	52	
	51	
	45	
	65	
	51	
	53	
	44	
	42	
	51	
	48	
	Total 1570	
	Mean 50.6	

*Response to question, "Did you consider yourself Too skinny, just right, or overweight before you got pregnant?"

APPENDIX N: QUESTIONNAIRE RESPONSES: DISTRIBUTION AND PERCENTAGE (N%)

Question Number	NR*	SD**	D***	NAD#	A##	SA###
1	1(1.7)	7(11.7)	18(30)	7(11.7)	16(26.7)	11(18.3)
2	9(15)	16(26.7)	8(13.3)	16(26.7)	0	11(18.3)
3	0	22(36.7)	19(31.7)	11(18.3)	4(6.7)	4(6.7)
4	0	10(16.7)	16(26.7)	7(11.7)	19(31.7)	8(13.3)
5	0	10(16.7)	16(26.7)	8(13.3)	15(25)	11(18.3)
6	0	3(5)	5(8.3)	22(36.7)	19(31.7)	11(18.3)
7	0	5(8.3)	4(6.7)	13(21.7)	25(41.7)	13(21.7)
8	0	16(26.7)	16(26.7)	14(23.3)	4(6.7)	10(16.7)
9	0	25(41.7)	13(21.7)	9(15)	7(11.7)	6(10)
10	4(6.7)	4(6.7)	5(8.3)	9(15)	16(26.7)	22(36.7)
11	1(1.7)	10(16.7)	11(18.3)	24(40)	13(21.7)	1(1.7)
12	1(1.7)	12(20)	18(30)	11(18.3)	10(16.7)	8(13.3)
13	0	20(33.3)	28(46.7)	6(10)	6(10)	0
14	0	15(25)	19(31.7)	7(11.7)	11(18.3)	8(13.3)
15	0	5(8.3)	18(30)	8(13.3)	24(40)	5(8.3)
16	0	17(28.3)	20(33.3)	11(18.3)	11(18.3)	1(1.7)
17	2(3.3)	20(33.3)	26(43.3)	5(8.3)	7(11.7)	0
18	0	3(5)	3(5)	10(16.7)	20(33.3)	24(40)

* No Response
** Strongly Disagree
*** Disagree
\# Neither Agree nor Disagree
Agree
Strongly Agree

Vita

Carol Carlson Ling was born in New York City on March 31, 1937. She received a Bachelor of Science degree in Foods and Nutrition from the University of Delaware, Newark, Delaware, in 1959. Following graduation, she worked in Therapeutic and Administrative Dietetic positions and became a member of the American Dietetic Association. She left the work force from 1968 to 1979 to raise four children. She returned to the work force as a perinatal dietitian for the Ambulatory Care Center, Sentara Norfolk General Hospital, Norfolk, Virginia. Her position became part of the services provided by The Eastern Virginia Medical Authority (now Medical College of Hampton Roads) in 1982. In the fall of 1983, she enrolled in the off-campus program for a Master's degree in Human Nutrition and foods from the Department of Human Nutrition and Foods at Virginia Polytechnic Institute and State University. She graduated in 1990.