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Development of a Mathematical Model That Will Predict the Mean Daily Dietary Intake of Pregnant Women Based upon Sociological, Psychological and Physiological Factors Assumed to be Related to the Mean Daily Dietary Iron Intake

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To the Graduate Council:

I am submitting herewith a dissertation written by Waneen Ann Liudahl entitled "Development of a Mathematical Model That Will Predict the Mean Daily Dietary Intake of Pregnant Women Based upon Sociological, Psychological and Physiological Factors Assumed to be Related to the Mean Daily Dietary Iron Intake." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Nutrition.

Daniel W. Hubbard, Major Professor

We have read this dissertation and recommend its acceptance:

Priscilla White, Jane R. Savage, Mary A. Bass

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DEVELOPMENT OF A MATHEMATICAL MODEL THAT WILL PREDICT THE MEAN DAILY DIETARY IRON INTAKE OF PREGNANT WOMEN BASED UPON SOCIOLOGICAL, PSYCHOLOGICAL AND PHYSIOLOGICAL FACTORS ASSUMED TO BE RELATED TO THE MEAN DAILY DIETARY IRON INTAKE

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ABSTRACT

The purpose of this investigation was to develop a mathematical model using linear stepwise regression analysis that would predict the dietary iron intake of pregnant women. Development of the mathematical model was based upon sociological, psychological and physiological factors assumed to be related to the dietary iron intake of pregnant women.

Fifty-seven pregnant women participated in the study. They were private outpatients of two obstetricians at the Macomb Clinic, Macomb, Illinois.

The dependent variable used in the development of the models was the seven-day mean daily dietary iron intake for each pregnant woman which was obtained during the second and/or third trimester of pregnancy. Independent variables used were eight socioeconomic factors, one personality score, two food and nutrition variables and four blood level determinations.

Linear stepwise multiple regression analysis was done using the total sample of 57 cases. Two subsamples of 53 cases and 34 cases were also analyzed by stepwise multiple regression analysis.

It was found that in using 34 cases, two variables were entered into the equation at both the 1 and 5 percent _F_ levels. The food frequency history score entered first and the hematocrit level entered second. In the 53 case run, two variables were entered at the 5 percent _F_ level; the first variable entered was the food frequency history

score, and the second variable entered was the educational level of the spouse. At the 1 percent *F* level the only variable entered was the food frequency history score. In the 57 case run, the only variable used was the food frequency history score; it was entered at the 1 percent *F* level.

When using this model as a case-finding tool in nutrition programs, the equation to use would be the one with only the food frequency history score which was developed in the 57 case run. The mathematical model would be:

Estimated Mean Daily Dietary Iron Intake = 0.00125 (food frequency history score) + 5.93705

This equation has a standard error of estimate of ±2.3 mg of iron. The mathematical model may apply to other pregnant women in a different locality, but further study would be needed to test the reliability and validity of the model under various settings.

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CHAPTER I

INTRODUCTION

There may exist in this country a life continuum of iron deficiency with or without the presence of anemia. The continuum occurs when the iron deficient infant grows to be an iron deficient preschool child, and, later, the iron deficient adolescent. Reaching adulthood, an iron deficient mother will be likely to raise an iron deficient infant, thus completing the chain of generational iron deficiency. This continuum needs to be broken at one or more of its points. In most instances, pregnant women make a number of visits to a clinic during pregnancy; this provides a good opportunity to estimate the pregnant women's iron intake and provide nutrition counseling if needed. The iron deficiency continuum may be broken if adequate nutrition counseling is given to the pregnant women needing it.

One major problem encountered in breaking the continuum of iron deficiency is deciding what method will be used for determining or estimating which pregnant women will have an inadequate dietary intake of iron. Most of the methods for determining nutrient consumption commonly in use are difficult, time consuming, expensive and often require the presence of an experienced nutritionist or dietitian.

The purpose of this study was to develop a mathematical model that will predict the iron intake of pregnant women in a private outpatient clinic in West Central Illinois by using specific sociological, psychological and physiological factors as a base. This predictive

model may be used as a case-finding tool by nutritionists to indicate those patients who need more detailed nutrition evaluation, treatment and counseling. The model may also be incorporated into planning and evaluating nutrition education programs.

It was hypothesized that the mean daily dietary iron intake of pregnant women could be estimated based upon selected sociological, psychological and physiological factors. The objectives of the study were to determine if the following were predictors of the mean daily dietary iron intake of pregnant women:

1. Age
2. Height
3. Weight Prior to Pregnancy
4. Educational Level of Subject
5. Educational Level of Spouse
6. Gross Yearly Income to Nearest $1,000
7. Number of Pregnancies
8. Number Living in the Household
9. Noncomprehensive Nutrition Knowledge Score
10. Food Frequency History Score
11. Total California Personality Inventory Standard Score
12. Hemoglobin
13. Hematocrit
14. Mean Cell Hemoglobin Concentration
15. Mean Cell Volume

CHAPTER II

REVIEW OF LITERATURE

Iron deficiency anemia is the most widely occurring nutritional deficiency in the United States. Nutritional anemia is most likely to develop during periods of rapid growth, such as infancy and adolescence, and during the childbearing years in women (1).

Anemia due to iron deficiency is presently recognized as the most common type of nutritional anemia. Iron deficiency anemia is due to a long-term deficient iron intake which results in the depletion of iron stores in the body. There is not complete agreement on the significance of anemia in terms of health. Anemia can contribute to the incidence and seriousness of other health hazards, such as infections. Iron deficiency has adverse consequences on learning ability, the morphology of subcellular structure and the functions of various heme proteins. In iron depletion without anemia, a decrease of iron-containing-enzymes has been found in some tissues. Pathological or clinical symptoms as a result of these enzyme deficiencies have not been demonstrated (2).

Anemia is usually defined as a reduction in red cell mass, or total body hemoglobin. Some measure of body oxygen metabolism should be used to complement the current laboratory definition of anemia since the main function of the red cells is to deliver and release adequate quantities of oxygen to the tissue. Many variables must be considered in determining what level of hemoglobin is appropriate for an individual. Some of the variables include: age, level of activity, sex, altitude, physiological

state and the position of the individual's oxygen-hemoglobin dissociation curve (3).

According to Hytten (4), individual variation in hemoglobin is much greater in pregnant women than in normal nonpregnant women. A few women show no decrease in hemoglobin concentration during pregnancy, or even a slight rise, and others may show a considerable decrease. For a few women age appears to have little or no effect and parity a doubtful effect on hemoglobin concentration. A decrease in hemoglobin concentration has been observed in older mothers. Multiparity has a greater effect than primiparity on hemoglobin concentration.

Starting about the third month of pregnancy, the hemoglobin concentration, the red cell count and the packed cell volume all decrease and rise again slightly towards term. The size of the red cell and its hemoglobin content are not altered during a normal pregnancy. Hemoglobin concentration in pregnancy is not a reliable guide to the presence or absence of iron deficiency anemia unless total blood volume is known. The mean cell hemoglobin concentration and, possibly, the mean cell volume, appear to be the only reasonably accessible laboratory criteria for assessing iron deficiency anemia during pregnancy.

According to Wintrobe (5), anemia may be severe, and yet, may be associated with few or no symptoms. A mild grade of anemia may be found with prominent symptoms. Development of symptoms in association with anemia depends upon:

> (1) the causative disorder; (2) the rapidity with which anemia has developed; (3) the degree of reduction in the oxygen carrying power of the blood, as well as the extent of changes in total blood volume; and (4) the preexisting status of the cardiovascular system.

Berry and Nash (6) asked 360 housewives attending a clinic for tuberculosis patients if they had certain symptoms characteristic of anemia. They were asked if they felt fit, average or below par and if they suffered from breathlessness, poor appetite, always felt tired, had swelling of ankles or needed a laxative once a week or more. Of the 360 housewives in the study, 49 felt below par, 172 felt average and 127 felt fit. The group that felt below par had a mean hemoglobin level of 13.5 g/100 ml, the group that felt average had a mean hemoglobin level of 13.3 g/100 ml and the group that felt fit had a mean hemoglobin level of 12.3 g/100 ml. No difference in mean hemoglobin level was found between those that did and did not complain of these symptoms.

Opinions vary concerning the question whether intervention measures should be taken in the case of iron depletion not yet associated with the symptoms of anemia. During the Ross Conference, Schulman, Howell, Pearson, Diamond and others (2) reminded the group that "our concern should be with the problem of iron deficiency and its nutritional implications rather than with anemia."

An immediate problem in nutrition counseling is how the knowledge gained from studies can be incorporated into maternity services. One of the persons having the greatest professional contact with a pregnant woman is the nurse. A joint nurse-physician curriculum work group from Harvard Medical School (7) proposed that an important part of a nurse's function in maternity care would be to provide instruction and guidance in nutrition for pregnant women. This program visualized the dietitian as part of the maternal health team providing clinical consulting

service to both the nurse and physician. Direct services would be provided to patients whose food and nutrition problems presented special difficulties. The redistribution of the patient services would enable the dietitian to teach the positive aspects of nutrition. At present, dietitians only infrequently have the opportunity to work with private patients.

Another major problem encountered by nutritionists counseling pregnant women is determining which women are in need of nutrition counseling. One possible way this may be done would be by the development of a predictive equation using multiple regression analysis which would include those factors affecting a specific nutrient intake of an individual.

Predictive equations containing factors influencing plasma ascorbic acid levels of pregnant women were developed by Mason and Rivers (8, 9). The predictive equations were developed using multiple regression analysis. Seventeen variables were used in studying the factors which influenced the plasma ascorbic acid levels of pregnant women. Independent variables selected were eight socioeconomic factors, four personality dimensions, three food and nutrition variables and the initial hematocrit levels. Half of the subjects were randomly chosen to receive instructions on selecting ascorbic acid containing foods while the others received no instructions. The most significant variable in predicting plasma ascorbic acid level was the nutrition knowledge test. The equation which yielded the largest multiple correlation coefficient ($\underline{R}$ value) was the equation incorporating all of the independent variables. Mason and Rivers (8, 9)

were able to predict from the equation that the subjects with comparatively high mean plasma ascorbic acid values during the latter half of pregnancy were:

1. Older.
2. Scored high on fruit preference survey and the Gordon Profile responsibility and ascendancy dimensions.
3. Scored high on the nutrition knowledge test.
4. Received dietary instruction.
5. Earned income over $4,000.
6. Scored poorly on emotional dimension of Gordon Profile and vegetable preference survey.

Development of a Mathematical Model for Predicting Dietary Iron Intake of Pregnant Women

The most widespread nutritional deficiency state recognized in the United States today is iron deficiency. Since pregnant women have the highest incidence of iron deficiency, it would be of value to develop a mathematical model that would predict the dietary iron intake of pregnant women. An equation is a mathematical model that explains the relationship between variables (10). The following factors must be considered in developing a model that will predict the dietary iron intake of pregnant women:

1. Previous dietary studies of pregnant women.
2. A valid and reliable method of determining dietary intake.
3. Isolation of socioeconomic, physiological and psychological variables.

Dietary Studies of Pregnant Women

Seeler and Fox (11) found that calcium, iron and vitamin A were the least adequately supplied nutrients in foods consumed by 50 percent of their group of pregnant and nonpregnant adolescent girls. Supplementation improved the nutrient intakes, except for calcium.

Thompson, Morse and Morrow (12) obtained at least seven-day food recall records, biweekly from the twentieth week of pregnancy to parturition. Food recall records were obtained from 55 subjects. The subjects were divided into three age groups: group 1, 15-17 years of age, group 2, 18-24 years of age and group 3, 25-32 years of age.

None of the subjects had iron intakes greater than the 1968 Recommended Daily Allowance of 18 mg. Forty-five percent of the subjects in group 1 and 3 had levels below two-thirds of the 1968 Recommended Daily Allowance as compared with 21.7 percent in group 2.

Darby (13) obtained food records from patients who had their prenatal care at Vanderbilt University Hospital. The food records were obtained for a week, once during each trimester. Ninety-four percent of the subjects kept seven-day food records and the remainder kept four, five or six-day food records.

The mean daily dietary intake of iron during the first trimester was 13 mg, 14 mg the second trimester and 13 mg during the third trimester. The mean caloric intake decreased by approximately 200 kilocalories between the second and third trimester.

Season of the year influenced the dietary intake of some of the nutrients. The mean daily dietary intake of protein, calcium, phosphorous, iron, B vitamins and kilocalories were higher during the fall and winter.

The utilization of calcium, phosphorous, magnesium, iron and protein by 10 pregnant women consuming self-chosen diets with or without vitamin and mineral supplements was determined by Ashe (14). The 10 pregnant women had a mean daily iron intake of 44.9 mg including an iron supplement taken by 8 pregnant women. An analysis of variance indicated a significant difference in iron intake between pregnant women consuming self-chosen diets with vitamin and mineral supplements compared to those without supplements. Two of the subjects did not meet the 1968 Recommended Dietary Allowance of 18 mg of iron per day. All of the other subjects consumed a sufficient amount of iron to meet the 1968 Recommended Dietary Allowance.

King, Cohenour, Doris, Calloway and Jacobson (15) conducted a study of pregnant teenage girls during a one-year period in two San Francisco hospitals with outpatient clinics. The adolescent girls were divided into three study groups:

Group 1—Contained 18 pregnant adolescents. Dietary and social histories were obtained during the third trimester of pregnancy. Two sets of three-day food intake records were obtained.

Group 2—Data was obtained from the medical records of 34 pregnant adolescents.

Group 3—Five healthy, never-pregnant girls recorded their food intake for 2-3 days.

Forty-four percent of the girls took vitamin and iron supplements daily. The never-pregnant girls consumed significantly less kilocalories, protein, carbohydrate, calcium, phosphorous, potassium and thiamin than

pregnant girls. The most improved nutrient intakes from food during pregnancy were phosphorous, calcium, iron and ascorbic acid. The mean daily dietary iron intake for Group 1 was 10 mg, whereas Group 3 (never-pregnant girls) had a mean daily dietary iron intake of 8 mg. Some of the subjects not taking a vitamin or mineral supplement consumed as low as 4-6 mg of iron daily.

Jeans, Smith and Stearns (16) conducted a dietary habit study of low income pregnant women in Iowa. The 404 subjects were patients of the Obstetric Department at the University of Iowa Hospitals in Iowa City. Very few of the subjects in the study consulted a physician until their third trimester of pregnancy.

The pregnant subjects were divided into the following groups:

Group 1—Fifty-two wives of university students who had a low income. They served as a control group and obtained dietary instruction early in pregnancy.

Group 2—Sixty-six wives of farm laborers.

Group 3—Two hundred twenty-eight wives of town laborers.

Group 4—Thirty wives of unemployed laborers.

Group 5—Twenty-eight unmarried women.

The majority of the women in the study had poor dietary habits dating back to childhood. Superimposed on the women's original dietary habits were the husband's and children's likes and dislikes. The women considered their own likes and dislikes last when preparing food for the family.

Bread and potatoes were the common caloric mainstays in the pregnant women's diet. It was not uncommon for a pregnant woman to eat six slices of bread and two helpings of potatoes daily. Macaroni was eaten occasionally. The mean daily caloric intakes of all groups of pregnant women in the study were adequate according to the 1948 Recommended Dietary Allowance of 2,400 kilocalories. Twenty-nine of the 404 pregnant women consumed less than 1800 kilocalories. The mean daily dietary intake of protein was below the 1948 Recommended Dietary Allowance of 85 g for all groups. Seventy-six women consumed less than 50 g of protein daily.

Forty-four to 51 percent of the daily dietary iron intake of the low income women was obtained from cereals and potatoes, 22-28 percent from animal protein foods and 15-27 percent from enriched breads. By contrast, the diets of the pregnant women who had dietary counseling (Group 1) demonstrated greater nutrition knowledge and more careful menu planning than those who did not have dietary counseling.

The mean daily dietary iron intake of 600 pregnant and lactating women in the Ten State Nutrition Survey (17) was below the 18 mg standard for iron. The method used to record food intake was the 24-hour recall. Due to the small number of lactating women in the study, the pregnant and lactating women were included in one group.

The Ten State Nutrition Survey (17) was not representative of an entire population within a county or state. Districts with the lowest average income in each of the ten states were selected. Families in the survey were divided into two groups. The "low-income-ratio states," in which more than half of the families were living at a "below poverty"

level and the "high-income-ratio states," in which more than half of the families were classified as living "above poverty level."

The pregnant and lactating women in the "low-income-ratio states" that were White, Black or Spanish American had a mean daily dietary iron intake of 10.74 mg, 9.87 mg and 14.69 mg, respectively. The White, Black or Spanish American pregnant and lactating women in the "high-income-ratio states" had a mean daily dietary iron intake of 12.05 mg, 11.47 mg and 12.43 mg, respectively.

Liudahl and Johnston (18) investigated the possible relationship of some sociopsychological problems perceived by spouses to selected physiological parameters during and after gestation. All of the pregnant women in the study were patients at the Coleman Clinic in Canton, Illinois. They came to the clinic on Tuesdays or Thursdays from July 1972 to October 1973 and were in their first trimester of pregnancy when admitted to the study. Ninety-one pregnant women were admitted to the study during this period.

The Coleman Clinic in Canton, Illinois, is a private clinic with one obstetrician on staff. The town has a population of 14,530 and includes a junior college. Factories provide a large number of jobs in Canton; farming is also a major occupation of the people in the Canton area.

Each time the subjects attended the clinic they were requested to recall all the food eaten during the previous day. Food models and various size glasses were available to aid in determining the serving size of the foods consumed. To remain in the study the subjects had

to have at least one 24-hour dietary recall in their third trimester of pregnancy. Due to various reasons, such as moving, or attending the clinic on a day other than Tuesday or Thursday, 52 women had 24-hour dietary recalls in their third trimester of pregnancy. Of the 52 women, 15 had at least one 24-hour dietary recall in all three trimesters, 34 had dietary recalls in the second and third trimester and 5 had dietary recalls in the third trimester only.

The age of the subjects ranged from 15-37 years of age, with a mean age of 24. Seven subjects were 15-17 years of age, 44 were 18-34 years of age and one subject was over 35 years of age.

Eight of the subjects had a income between $3,000-$5,999, 10 had incomes between $6,000-$7,999, 21 had an income of $8,000-$9,999 and 13 had an income over $10,000. The preceding incomes were annual incomes.

Twelve of the pregnant women were working, two of whom were working part-time. The pregnant women had the following occupations: Four were secretaries, four were clerks, one was a waitress, one was a L.P.N. and two were beauticians. Seven of the pregnant women were attending high school.

Three of the subjects' husbands were professionals, and seven husbands were in management. The remaining 39 husbands worked in a factory, gas station, or were farmers. Three of the subjects were not married.

The mean number of years that school was attended by the pregnant women was 12 years. School attendance by the subjects ranged from 9-16 years.

One of the subjects was German and one was Irish. The remaining subjects were considered to be Americans. Forty-six of the subjects were members of a religious order that would influence their food intake.

The average number of individuals in a household was three. Only one household had as many as six members in it. Twenty-one households had two members, eighteen households had three members and twelve households had four members.

The mean daily caloric intake for all three trimesters of pregnancy was 1745 kilocalories. The mean daily caloric intake for the first trimester was 1973 kilocalories, second trimester, 1647 kilocalories, and third trimester, 1617 kilocalories. On the average, the subjects consumed 5 mg of dietary iron per 1,000 kilocalories each day.

The mean daily dietary protein intake for all three trimesters of pregnancy was 69 g for the subjects. During the three trimesters, the mean daily dietary protein intake was 72 g, 66 g and 67 g, respectively.

The mean daily dietary iron intake for all three trimesters of pregnancy was 9.7 mg. The first trimester mean daily dietary iron intake was 10.3 mg, 9.5 mg during the second trimester and 9.2 mg during the third trimester. There was not a significant difference between the mean daily dietary iron intake of the second and third trimester, or the first and second trimester of pregnancy for the subjects.

Fifteen pregnant women smoked one pack or more of cigarettes a day. There was no significant difference between the mean daily dietary iron intake of smokers versus nonsmokers.

Only one person was on a special diet. Forty-eight pregnant women did not consume alcohol and four consumed it only rarely.

The study by Liudahl and Johnston (18) demonstrates a need for improved dietary intake by the pregnant women in the sample. This may be achieved through adequate nutrition counseling.

White (19) reviewed a number of studies including data on iron intake and hemoglobin concentration published in the last two decades. The estimated average iron intake of girls and women in the United States was approximately 10 to 12 mg per day based on the review of research data.

Methods Used to Determine the Validity and Reliability of Dietary Studies

Validity and reliability of dietary studies. The objectives of a dietary study determine the methods to be used both for obtaining and processing the dietary data. The dietary method used should be both valid and reliable. Validity is the ability of a dietary method to measure what the investigator wished to describe. Reliability is the error variation in collecting and processing dietary data, that is, its reproducibility. Fulfilling the requirements for both validity and reliability may be difficult. To obtain the greatest reliability in determining what a subject is actually eating, the usual eating pattern may be lost (20).

According to Young and Trulson, the methodology related to validity centers around three main considerations:

> (1) a comparison of results obtained on the same subjects by using various methods of obtaining dietary data; (2) a series of studies concerned with the length of period to be covered by a dietary study (essentially these are concerned with variability of an individual's intake over various periods of time); and (3) errors involved in estimations of dietary intake.

A valid index or history of individuals' usual food intake may be obtained if the individuals are unaware that their food intake is being observed. In this case the individuals will not modify their usual food intake. A food record may be more reliable if the individuals whose food intake is being determined knows prior to obtaining the food record that a record will be requested. Fulfilling the requirements of both validity and reliability may not always be possible. In order to obtain the greatest reliability in what an individual consumes, it may be necessary to sacrifice the usual food pattern. Unfortunately, the usual food pattern may be the most valid one for the objective.

There are limitations in all methods of collecting dietary data, the greatest being the limitations of human error; the full cooperation of the subject is necessary to obtain reliable data. Other factors which may influence the quality of data obtained include: the directions or instructions provided, the subjects' cooperation, the ability of the subject to estimate quantities, the memory of the subject if recall is involved and the skill and training of the interviewer.

Comparisons of the various methods have been made, but valid conclusions have not been reached as to which method is the most accurate or reliable because the accuracy and reliability of the individual methods cannot be measured. On an individual basis, results obtained from one

dietary method cannot be predicted by another method because each measures different dietary information.

The variability of food intake and eating patterns over relatively short periods of time, over seasons and over long spans of time are important factors to be considered in the choice of method. The method used to collect dietary data must be based on certain practical considerations such as: number of subjects to be included, the willingness and ability of the subject to cooperate, the time required per subject, cost, the kind of interview to be used and whether trained interviewers are necessary (20).

Whiting and Leverton (21) conducted a study to determine the reliability in results obtained by calculating the nutritive value of diets from food composition tables. Several nutritionists, using the same food composition tables, obtained different results when they calculated caloric and nutritive values for a series of 21 weighed diets. This difference was due to inadequate description of the food.

Values for dietary iron estimated by calculation using food composition tables have frequently been much different from those obtained by chemical analysis of the food. Leverton (22) found the calculated iron content to be less than that determined by analysis for 81 of 85 mixed diets. Bransby and others (28) reported that the calculated iron values of 33 mixed diets averaged 38 percent less than analytical values.

Monsen and others (24) reported close agreement between average daily iron intake determined by calculation and by analysis. The

average of the mean values for 13 college women (seven days each) was 9.9 mg iron per day by calculation, and 9.2 mg per day by analysis.

Length of study. In conducting a dietary study it is necessary to decide the length of time the measurement of food intake should be recorded. What is the minimal time which reasonably reflects the normal pattern of food consumption? It is recognized that the amounts of different foods consumed varies from day to day. Most researchers (25, 26, 27) agree that it is necessary to measure food intake for at least a week to obtain valid results. These researchers also agree that such a period is sufficient to give a reasonably accurate assessment of the amounts and kinds of foods habitually consumed by individuals.

The diets consumed by two adults were studied by Chappell (28). One subject was a man, age 66 years, whose study lasted for 13 consecutive weeks; the other subject was a woman aged 34 years whose study lasted for 61 weeks, and, later, for another 9 weeks. The diets were weighed by each subject and the kilocalories and nutrients calculated from food tables. The weekly intake of kilocalories and nutrients showed considerable variation for both subjects.

The diets consumed by six young women were studied by Yudkin (29) for four consecutive weeks. The diets were weighed by each subject and the kilocalories and nutrients in them calculated from food tables. The weekly intake of kilocalories and nutrients showed considerable variation. The extent of the variation differed with the different dietary components and with the different subjects. It was found that a person can have an

intake of dietary components which are apparently adequate for one week, and inadequate for another week. Yudkin concluded that dietary surveys of seven days cannot be considered to give a sufficiently accurate assessment of the average intake of kilocalories or nutrients for an individual.

A comparison was made by Young and others (30) of the use of the dietary history versus 24-hour recall, and the seven-day food record versus 24-hour recall as methods of estimating the nutrient intake of an individual and of a group. Data for these comparisons was obtained from the following population groups: grade school children (New York), high school and college students (Rhode Island) and pregnant women (Massachusetts).

For an individual in any of the three population groups studied, the 24-hour recall did not give the same estimate of intake as the dietary recall and the seven-day food record. It was found that the 24-hour dietary recall and the seven-day food record could not be used interchangeably in describing the dietary intake of individuals.

Random repeat 24-hour dietary recalls were obtained by Balogh and others (31) from 100 male civil service employees who were part of the Israel Ischemic Heart Disease Project. Days were selected by random each month and the subjects were asked to recall what they had eaten the day preceding. This random selection of days was continued for one year.

Twelve subjects had 24-hour diet recalls for 11 months and 71 people had 24-hour diet recalls for eight or more months. For most nutrients, two or three monthly 24-hour diet recalls fairly close together did not

reflect as much variation within the diet as was observed if additional months were included.

In a study by Young (25), 18 adults, 23-50 years of age, recorded their dietary intake for 28 days. On both an individual and group basis, the variation in weekly nutrient intake was studied. Variation in the 28-day records was also studied with respect to days, weeks and subjects.

One week was found to be somewhat representative of the 28-day period for kilocalories, protein, phosphorous, iron, vitamin A, thiamin, riboflavin and niacin. Young concluded that the observation period for individuals should exceed seven days for most subjects if more than an approximate indicator of intake was needed.

Approximately 50 percent of the individuals had weekly averages which were within a range of ±10 percent of their 28-day average for kilocalories, protein, phosphorous, iron, thiamin, riboflavin and niacin. Almost 100 percent had weekly averages within ±20 percent of the 28-day average for kilocalories and iron. The pattern of an individual's nutrient intake was observed to remain nearly the same from week to week with the exception of calcium and ascorbic acid.

Cellier and Hankin (26) performed an analysis of variance on 7-day records of 50 pregnant women and found differences in intakes of kilocalories, fat and carbohydrates on weekdays versus weekends. They also studied 4-day intakes of 65 women, recorded at different time periods of pregnancy, and reported significant differences between trimesters for some nutrients. It was found that a 4-day food record with one weekend day retained 90 percent of the data of a 7-day food record.

Dietary method. A review of the literature by Hankin and others (32) in 1969 revealed that no one had yet developed and tested an accurate reproducible dietary method that estimates usual nutrient intakes of noninstitutionalized persons and yields a high response rate with minimal professional cost and time.

One method of estimating the usual food pattern of individuals or groups is the food frequency method. Abramson, Slome and Kosovsky (33) conducted a small scale field test of the food frequency method used in a community program for the control of anemia in pregnant women in Jerusalem, Israel. The objectives of the study were (1) to determine whether the frequency with which specific foods were taken was a reasonable index of the usual quantity of these foods eaten per week and (2) to determine if an association exists between the frequency data and the subjects' hemoglobin levels. The reliability of the method was not tested.

Sixty Jewish women, aged 17-39 in the fifth to eighth months of pregnancy who were receiving antenatal care in the community program, participated in the study. Questions were asked about both frequency and amounts of foods consumed. Frequency data were obtained for the following groups of foods: flesh foods (meat, poultry, fish), green and yellow vegetables, milk, and fresh fruit. Frequency was recorded as the number of times the food was consumed per week and the number of days per week. Amounts of food were recorded in grams or milliliters.

The weekly frequency of dried fruit was the only food that had a significant association with hemoglobin levels. Subjects with a high intake of any two or more groups tended to have "high" hemoglobin values.

The food frequency interview method was not tested against a more objective standard, such as long term dietary studies on individuals using measured quantities and analyzed foods. The main limitation of the method was its inability to provide data on individual nutrients. This method could be used where evidence is sought of an association with a diet in general, rather than with specific nutrients.

Hankin and others (34, 35) analyzed seven-day food records of 73 Japanese-American men, 35-55 years of age, and developed a short dietary questionnaire for estimating individual intakes of kilocalories, protein, fat, carbohydrate and sodium. Stepwise regression analysis of individual nutrient intakes based on the average daily frequencies of food items with stable composition and serving size were performed to obtain the regression equations. A total of 23 food groups, with six to ten in each equation, predicted the five dietary factors. A seven-day recall questionnaire was developed for recording daily frequencies of the food groups included in the regression equation.

Stefanik and Trulson (36) described a method used to obtain diet information on the frequency of food intake and the tests made to determine whether the data obtained was valid and reliable for classifying dietary practices. The frequency of food consumed whether daily, weekly or monthly was kept. Part of the data was collected at the nominal level, such as the kinds of milk, habits of salting food and other items.

To test the validity of the food frequency diet form, this method was compared with the frequency of consumption of food items obtained

by the diet record and research history interview. The data from the diet record and research history forms was converted to a frequency code system.

The food frequency method provided information comparable to that found by the diet record and research history interview. The discrepancies which appeared seemed to arise due to seasonal changes in eating habits. Another problem is that of standardization of the questions used in the food frequency method.

The development of a short method by grouping foods with similar nutritive values together requires preliminary study of food consumption data in order to derive suitable weighting for the items combined into groups. The larger the number of groups, the more homogenous the foods in each group can be, and the better the agreement between the long and short methods. The greater number of days represented by the average food consumption figures, the closer will be the results obtained by the long and short methods. Group values developed in one study for use in one locality may not carry over to another situation; frequent testing of group values against detailed item calculations is necessary. Agreement between results calculated by short methods and by long detailed methods can be expected only (1) when food habits among the subjects are fairly homogeneous and (2) when the food group values are carefully prepared from a sampling of diets included in the study (20).

The dietary history has limitations which must be recognized so that it is not used in an evaluation beyond the limits of its dependability. If the dietary intake for a number of months is needed, the best way this can be obtained is by the dietary history method.

Obtaining dietary histories for research purposes is time consuming. The interviews must be conducted by a nutritionist in an unhurried environment, a circumstance not obtainable in a busy clinic.

Dietary histories should be cross checked for accuracy. In Burke's study (27) the subjects recorded food intake for three consecutive days, excluding Sunday. Cross checking by seven-day food records was preferred by Burke, but she was unable to obtain food records of this length.

The most accurate method of studying dietary intake of an individual is by means of a balance study in which the subject must live under controlled conditions in order that their daily intake and output may be completely measured; this may alter their usual food habits. This method is very time-consuming and costly. Another accurate method of recording dietary intake is to weigh the food eaten at each meal. This can create an artificial situation and result in a change of food habits (20).

Social and Physiological Factors Affecting Nutrient Intake of Pregnant Women

Social factors. The maternal external environment (physical, biological and social) during pregnancy is of greater importance than at any other time during human development. Following birth the physical and biological environment impinge directly on the infant instead of being mediated through the mother (37). A brief review of studies that consider various social, psychological and physiological factors influencing food intake during pregnancy follows:

Murphy and Wertz (38) conducted a study of the influence of socioeconomic factors in the diets of pregnant women. Sixty-five

pregnant women were included in the study. Forty percent of the women received less than two-thirds of the 1948 Recommended Dietary Allowance for iron from food.

Money spent for food did not depend on total income, and adequacy of the diet was not related to expenditures for food. As the size of the family increased, the money spent per family member decreased, but this did not affect dietary quality as reflected in the mother's diet. A relationship was found between the adequacy of the mother's diet, and social level as evidenced by the husband's occupation. Adequacy of the diet was increased with the women's education. Income was not statistically related to dietary intake.

Wives in the professional and student group had more adequate diets than tradesmen or laborers. Students and laborers had the same income. Several other social factors influenced food intake. They were:

1. Formal education of the husband.
2. Greater awareness of nutrition.
3. Intelligence of husband and wife.
4. Education of wife.

Wilhelmy, Young and Pilcher (39) found in their nutritional status survey of Groton township in New York that as family size increased the amount of money spent on food per person decreased. There was no apparent relationship of average nutrient availability to age or formal education of either husband or wife, nor to nutrition education of the wife. Family size may be related to food consumption and the prevalence of anemia.

Physiological factors. In the Ten State Nutrition Survey (17) hemoglobin and hematocrit data were available for 437 pregnant and lactating females. The mean hemoglobin values for pregnant or lactating women were compared with those for nonpregnant and nonlactating women, 13-14 years of age. The nonpregnant and nonlactating women had a mean hemoglobin level of about 0.5 g/ml higher than the pregnant and lactating women. In the Ten State Nutrition Survey the hemoglobin data for pregnant, lactating and nonpregnant women, 13-44 years of age, were included in one group because the difference in hemoglobin values was small.

The approximate mean hemoglobin level for the pregnant and lactating women was obtained from a bar graph presented in the Ten State Nutrition Survey. The pregnant and lactating women in the "low-income-ratio states" that were White, Black or Spanish American had mean hemoglobin levels of 12.4 g/100 ml, 11.4 g/100 ml and 12.1 g/100 ml, respectively, and the White, Black or Spanish American pregnant and lactating women in the "high-income-ratio states" had mean hemoglobin levels of 12.6 g/100 ml, 12.0 g/100 ml and 11.8 g/100 ml respectively.

Hematocrit data correlated well with the hemoglobin data (correlation coefficient of 0.85). The hematocrit data obtained in the survey was not discussed in the study.

Three thousand ambulatory Black inhabitants of Gainsville, Florida, were included in a study by Pearson, McLean and Bridety (40). The subjects ranged in age from infants to teenagers. Hematocrit levels were determined in 213 primigravidas, 14-17 years of age during the third trimester. Twenty-four percent of the subjects were considered to be anemic with a hematocrit level below 32 percent.

Hilman and Smith (41) conducted a retrospective blood hemoglobin status study of 5,597 low income persons in the Brooklyn area. Of the 5,597 hemoglobin values recorded, 34 percent were below 11 g/100 ml, 14.2 percent below 10 g/100 ml and 5 percent below 9 g/100 ml.

The greatest frequency of hemoglobin levels below 11 g/100 ml was observed in younger subjects, in Negroes and to a lesser degree in Puerto Ricans. Women had a significantly greater frequency of hemoglobin levels below 11 g/100 ml than men. Low hemoglobin readings were significantly more common in families receiving public assistance than in those not on welfare.

Cantile, Leeuw and Lowenstein (42) conducted a study to determine whether women of better economic circumstances attending private obstetricians also need supplements of iron during pregnancy. Twenty-seven patients, 1-5 months pregnant, were divided randomly into two groups, one received an iron supplement, one did not.

The two groups were comparable in hematological parameters on their first visit. The patients who did not receive medicinal iron showed signs of iron deficiency during the last trimester of pregnancy. The author (42) recommended an iron supplementation for pregnant women, but this supplementation should not replace sound nutritional counseling.

According to Mayer (43), obstetric patients who need dietary counseling early in pregnancy are often overlooked by the obstetrician because their problems appear to be sociological rather than physiological. Therefore, a predictive model is needed to determine which obstetric patients need dietary counseling.

CHAPTER III

METHODS OF RESEARCH

Statement of the Problem

The purpose of the study was to develop a mathematical model that would predict the mean daily dietary iron intake of pregnant women. The development of the mathematical model was based upon sociological, psychological and physiological factors assumed to be related to the dietary iron intake.

Description of Sample

A total of 69 pregnant women obtained from West Central Illinois were admitted into the study from March 3, 1976 to May 12, 1976. They were private outpatients of two obstetricians at the Macomb Clinic in Macomb, Illinois. All the pregnant women admitted into the study met the following criteria:

1. Caucasian.
2. In second or third trimester of pregnancy.
3. No special diet required.
4. Not a member of a religious order that had a dietary restriction affecting food intake.
5. No illness affecting food intake.
6. Not a vegetarian.

Due to various reasons, 12 pregnant women did not complete the study. One refused to participate after the initial interview, four pregnant

women delivered prior to completing their seven-day food records and seven pregnant women were seen only once or twice due to their appointment times, therefore did not complete the seven days of food records or some of the other forms. All of the subjects volunteered to serve in the study. The pregnant women did not sign a consent form when they participated in the study.

A random sample of the population was not obtained because information about all pregnant women in the clinic was desired. The study was not directed toward measuring a sample population, but was to estimate the iron intake for each individual pregnant woman.

Wednesday of each week was set up for data collection at the clinic. One of the obstetricians had all of his obstetric patients come to the clinic on Wednesday only. The other obstetrician was at the clinic only on Wednesday afternoon, having many of his obstetric patients come in on other days of the week. As a result, all of the pregnant women coming to the clinic in their second or third trimester of pregnancy were not available for the study.

Approximately 250 babies were delivered per year by the two attending obstetricians at the Macomb Clinic. The number of babies born per month varied; January, February and August were the months with the largest number of births. An average of 40 babies was delivered during each of these three months.

Fifty-four of the pregnant women in the study resided in McDonough County. According to the 1970 Census (44), the population of McDonough County was 36,653. In McDonough County there were 18,588 White females

and 158 Negro females. The average income before taxes for the County was $9,564 with 10.7 percent of the families in McDonough County below the 1970 poverty level. Macomb, the County seat, had a population of 19,643 and was the largest city in McDonough County. The average income before taxes in Macomb was $11,148 with 13.4 percent of the families in Macomb below the 1970 poverty level.

Survey Forms

The research data was collected by means of five survey forms, a noncomprehensive nutrition knowledge test and a personality test. The following forms and tests were used in the study: General Information Form, Socioeconomic Form, Medical Record Form, Food Frequency History Form, Food Frequency History Form Computation Key, Dietary Record Form with directions, Dietary Form, Noncomprehensive Nutrition Knowledge Test and the California Personal Inventory (CPI). Copies of all the survey forms and tests used except for the California Personal Inventory are in the Appendix.

General Information Form. The General Information Form was completed by the researcher. The form contained questions for eliciting information that was used in deciding whether or not a subject met the criteria to participate in the study. Information requested included: race, trimester of pregnancy, special diet, religion, illness affecting food habits and whether they were a vegetarian.

Socioeconomic Form. The Socioeconomic Form was completed by the researcher. Information requested included: age, birth date,

nationality, education and degree or license received by the subject and spouse, present occupation of subject and spouse, approximate gross income, number of pregnancies, history of anemia, number of persons in the household and marital status. The factor of age was recorded as age in years at the initial interview. Education was recorded as years of formal education completed. Income was recorded as gross yearly income to the nearest $1,000 before taxes. The number of pregnancies recorded included the present pregnancy, live births and miscarriages.

Medical Record Form. The Medical Record Form was completed by the researcher based on information obtained by the Obstetric nurses from the subject's medical record. A consent form was signed by the subjects to allow the researcher to obtain data from their medical records. The following items were included on the Medical Record Form: height, weight prior to pregnancy, number of months pregnant at the first prenatal visit, initial hemoglobin, hematocrit, mean cell hemoglobin concentration and mean cell volume.

Food Frequency History Form. The Food Frequency History Form was developed by the researcher based on the diets of 51 pregnant women in an unpublished study by Liudahl and Johnston (18). The form contained a list of foods most frequently consumed by the pregnant women in the study who were residents of West Central Illinois and were patients at a private outpatient clinic in a small town. This form was developed to provide an estimate of the mean daily iron intake of an individual. The Food Frequency History Form consisted of a list of commonly consumed

foods that contained more than 0.5 mg of iron per average portion size, with columns indicating the frequency a food was consumed, and six general questions. The six general questions used on the form were related to the iron intake of the pregnant women in the Liudahl and Johnston study.

A Food Frequency History Form Computation Key was used to score each of the Food Frequency History Forms. The computation key contained the quantity of iron per serving in milligrams for each food item and for the various frequencies in days for each column indicated on the form.

In scoring the Food Frequency History Form each slice of bread or roll consumed was assigned a value of 180 mg per year. This was determined by assigning each slice of bread or roll a value of 0.5 mg of iron and then multiplying this value by 360 days.

A comparison was made of the number of times per day meat was consumed on the meat section of the Food Frequency History Form versus how the pregnant women responded to the following question: On the average, do you have meat at least twice a day? It was noted in some cases the pregnant women had less than two servings of meat per day, but answered "yes" to the question. Others had more than two servings of meat per day, but answered "no" to the question. Therefore, in scoring the Food Frequency History Form, limits were placed on the meat section depending upon whether the individual indicated they had meat at least twice a day.

Five days were arbitrarily not included in the year to allow for atypical eating such as during illness. One average serving of meat was computed to contain 3.0 mg of iron. Based on 360 days as being typical for a year, 3.0 mg/serving × 360 servings/year = 1080 mg/year. If the question was answered "yes," it was assumed they had 1-1/2 to 2-1/2 servings of meat per day, or had limiting values of 1620 mg/year to 2700 mg/year. For example, if a person said they had meat at least twice a day and only scored 1500 mg/year on the meat section, the minimum was imposed and a score of 1620 mg/year used. If a person answered "no," they were assumed to have 3/4 to 1-1/2 servings of meat per day. This imposes minimums and maximums of 810 mg/year and 1620 mg/year, respectively.

Dietary Record Form. The pregnant women recorded their food intake for seven days during their second and/or third trimester of pregnancy. The first set of food records was completed for four consecutive days including a Saturday and Sunday, and the second set of food records was completed for three consecutive weekdays. Information included on the Dietary Record Form was meals and snacks consumed with a complete description of food consumed and amount consumed, time and place eaten, cost if eaten away from home, food code number and percentage.

Food Record—Directions for Keeping Record. The directions for recording the food records was given to each pregnant woman prior to completing the food records. The directions include some examples of information needed when recording food intake on the food record form.

Dietary Form. The information on the Dietary Form was obtained by the researcher after the pregnant women had completed their first set of food records. Questions on the Dietary Form were related to whether or not the pregnant women had a typical diet during the four-day food record period, took vitamin or mineral supplements, were on a special or prescribed diet, were following a diet prescribed by a doctor, had to limit sodium intake, took medication for nausea, had food intolerances, smoked cigarettes, consumed alcohol, alcohol's influence on appetite, craved certain foods or other things, reasons for the cravings and the total weight gain for pregnancy recommended by the doctor.

Noncomprehensive Nutrition Knowledge Test. The Noncomprehensive Nutrition Knowledge Test was completed by the pregnant women. The test questions were developed taking into account the food items listed on the Food Frequency History Form, the function of protein in pregnancy and general questions that may be related to the dietary iron intake of pregnant women. The test was administered to a beginning nutrition course for non-Home Economics majors and a junior Maternal and Child Nutrition course at Western Illinois University. Both classes had covered the sections on the nutrients and the Basic Four Food Groups. Specific questions on the test that had a number of incorrect responses were evaluated by the researcher.

The test contained 15 questions that were answered by circling true, false or N for "no response." The test was scored by subtracting the total number of incorrect responses from the total number of correct responses which penalizes for guessing. It was possible to obtain a

negative score on the test due to guessing. In order to have all positive scores on the test, 15 points were added to each of the test scores. Thus, the scores could range from 0 to 30.

California Psychological Inventory. The California Psychological Inventory (CPI) was completed by the pregnant women. It was a self-administering personality test designed for group or individual administration; it could be mailed to individuals and completed in their homes. It was not essential, according to Megargee (45), to have standardized testing conditions or a time limit for completion of the CPI. Most subjects complete the CPI in about an hour; it requires fourth-grade reading ability. The CPI was developed specifically for a normal population. Its usefulness in differential diagnosis of psychiatric patients is questionable, unless it is used as part of a battery of tests.

The CPI was composed of true-false items which were selected and validated on the basis of such criteria as social class, participation in extracurricular activities and ratings for various traits. During the development of the CPI scales 6,000 males and 7,000 females were used. The sample of males and females were grouped according to age, social status and geographical regions. The peer nomination technique was used for selecting and categorizing criterion subjects rather than psychiatrists. The CPI was organized around the concept of life adjustment as a balance between personal and social adjustment. One half of the test was designed to measure personal adjustment and the other half, social adjustment. The groupings measured under personal

adjustment were self reliance, sense of personal worth, sense of personal freedom, feeling of belonging, withdrawing tendencies and nervous symptoms. The social adjustment portion of the test included social standards, social skills, antisocial tendencies, family relations, occupation relations and community relations (46).

The reliability coefficient of the CPI determined by the retest method ranged from 0.70-0.95 for individual groupings. The validity of each grouping, according to Kleinmuntz (47), was adequate, and was determined by comparing group scores of persons between whom the scale was designed to discriminate. The reliability coefficient for personal adjustment and social adjustment was 0.93. Total adjustment had a reliability coefficient of 0.95 (46).

Assuming the CPI test score was valid, scores above the standard mean score (T = 50) indicate positive adjustment, while those below the mean indicate problem areas. This gross determination must be made in reference to norms established for the most appropriate reference group. The reference group used in this study was adults.

The total adjustment standard score was used as a variable in this study. It was obtained by converting the raw total adjustment scores to percentile ranks and then to standard scores using the charts for adults in the Manual for the California Test of Personality (46).

Pilot Study

A pilot study was conducted on Wednesdays from January through March, 1975 at the Macomb Clinic with obstetric patients in order to

determine the best procedure for obtaining subjects in the clinic and an adequate number of food records.

The obstetrical nurses requested the patients to meet with the researcher for interviews after they had seen the obstetrician. Each time the pregnant women came to the clinic they were requested to recall all the food eaten during the prior 24-hour period.

Twelve obstetric patients were interviewed at the first clinic visit by the researcher. Later, only one to three pregnant women were seen per clinic visit because the obstetricians were attending out-of-town conferences and the pregnant women were scheduled on different days.

After the pilot study, it was obvious that a method for collecting the data had to be developed that could be completed in two or three clinic visits due to appointment changes by the obstetricians or pregnant women.

Collection of Data

A schematic diagram of the clinic and home visit data collection sequence for women in their second or third trimester of pregnancy was as follows:

Interview 1

General Information Form Completed

Accepted into Study	Rejection due to:
1. Socioeconomic Form Completed	1. Refused to participate
2. Part of Medical Record Form Completed	2. Not Caucasian
	3. First trimester of pregnancy

3. Instruction on procedure for recording four-day food records
4. Noncomprehensive Nutrition Knowledge Test Completed

4. Illness affecting food intake
5. Religion that alters food intake
6. Vegetarian

Subsequent Interviews

1. Food Frequency History Form Completed
2. Dietary Form Completed upon completion of four-day food records
3. Instructions on procedure for recording three-day food records upon completion of four-day food records
4. California Psychological Inventory

Following Completion of Interviews

1. Medical Record Form Completed

Interview procedure. The interview procedure used was controlled by:

1. Number of pregnant women seen at the clinic on Wednesdays.
2. Method by which the medical staff referred the pregnant women to the researcher in the clinic.
3. Personnel available to conduct the interviews and their training.

4. Time available for the interview.
5. Facilities available for the interviews.
6. Day and time at which pregnant women would return for appointments.
7. Interviews had to be conducted so as not to interfere with the operation of the clinic.

Only the pregnant women attending the Macomb Clinic on Wednesdays and who were patients of the two obstetricians were admitted into the study. The obstetrical nurses introduced the pregnant women in their second or third trimester of pregnancy to the researcher or the Dietetic Trainees from McDonough District Hospital in Macomb, Illinois.

The personnel used in conducting the interviews, in addition to the researcher, were two Dietetic Trainees who had a B.S. degree in Foods and Nutrition, and had completed at least five months of a Dietetic Traineeship. These Dietetic Trainees had experience in patient counseling and giving diet instruction. The Dietetic Trainees did not conduct any interviews until instructions were given by the researcher and the Dietetic Trainees had observed the researcher conducting interviews for one day. The researcher then observed the Dietetic Trainees conducting interviews for a day.

Four patients were scheduled to see the two obstetricians every 15 minutes. At times all four of the patients would be participants in the study and the two interviewers would have to complete the interviews and observe the pregnant women entering the clinic so that pregnant women previously admitted to the study were not missed. At the same time,

pregnant women were completing forms in the clinic which were to be returned to the interviewers. Some of the pregnant women were in a hurry to leave after their appointment as they had ridden with someone else and would not return to the interviewers to complete a form.

The interviews were conducted in an examining room not used by the obstetrician, while the pregnant women waited to see the obstetrician, usually 5-15 minutes unless the obstetrician had not arrived, or had to leave.

The examining room used for the interviews was not large enough for two interviewers so one interviewer might have to stand or conduct the interview in the waiting room.

Interviews were conducted in three of the subjects' homes in order to complete the Food Frequency History Form, Dietary Form and California Personality Inventory. Five interviews were scheduled on days other than Wednesdays at the Macomb Clinic, but only one of the five women kept her appointment.

The pregnant women were requested at the completion of each interview to inform the researcher of the date and time of their next appointment. At the end of each day at the clinic the researcher would check the appointment book to validate the next appointment time for all of the subjects seen. Also, the appointment times for patients coming the next Wednesday were rechecked.

During the initial interview, upon being accepted into the study based on the General Information Form, the researcher or the Dietetic Trainees would collect the information from the pregnant women on the

Socioeconomic Form. In addition, their height, weight prior to pregnancy and number of months pregnant at first prenatal visit were entered on the Medical Record Form.

The pregnant women in the study were requested to record their food intake on the forms provided for four days, including a Saturday and Sunday, and mail them in a stamped, addressed envelope to the researcher. The pregnant women were instructed on how to record items on their food record forms. This was done by demonstrating, using plastic food models, measuring cups, spoons and glasses of various sizes. The subjects were requested to measure, by the use of standard measuring cups, the amount of fluid the glasses they used at home held, and to use these as a guide for estimating the number of cups consumed. A discussion of all items on the food record instruction sheet was held with each of the pregnant women in the study.

Possible error and inaccuracy on the part of the subjects in reporting food eaten was recognized by the researcher. Reasons for error and inaccuracy may be due to:

1. Inexperience in estimating the size of servings.
2. Failure to include the method of food preparation.
3. Omission of descriptive terms helpful in establishing size of serving and kind of food.
4. Reluctance to report actual food intake for personal reasons.
5. Food items inadvertently omitted.

During the initial interview the Noncomprehensive Nutrition Knowledge Test was completed by the pregnant women in their examining

rooms while waiting for the obstetrician. A brief explanation of the directions was given prior to completion of the test. Before leaving the clinic the pregnant women returned the Noncomprehensive Nutrition Knowledge Test to the researcher or Dietetic Trainee.

During the second interview, the pregnant women were requested to record their food intake for three days, excluding Saturday and Sunday, on the food forms provided and mail them to the researcher in the stamped, addressed envelope. Information on the Dietary Form was obtained from the pregnant women by the researcher or Dietetic Trainees. If the first set of food records requested was not completed, the pregnant women were asked to complete the food records and mail them to the researcher and were not instructed to complete three more days of food records.

During the third or subsequent interviews the pregnant women were reminded to complete their three days of food records if they had not completed them. The California Personality Inventory (CPI) was administered to the pregnant women only after seven days of food records were obtained. Thirty-three pregnant women completed the CPI forms in the Macomb Clinic. Nine of the pregnant women completed the CPI form at home. The researcher was present in the home while four of the CPI forms were completed. All of the CPI forms were completed by the pregnant women prior to birth of infant.

Medical record information. Information from the medical records was obtained for each pregnant woman after the seven-day food records were obtained and the pregnant women had signed a permission form to

release the information from their medical record regarding certain blood values obtained during pregnancy. The blood values used were those obtained after the first prenatal visit and before the second prenatal visit for hemoglobin, hematocrit, mean cell hemoglobin concentration and mean cell volume.

System of Coding Food Records, Computer Analysis of Food Records and Scoring of Tests

Each food item on the food record was assigned a code number and a percentage. The code number of the food item corresponded with the code number of the same food item in the computer program master deck, and the percentage represented the percentage of a serving consumed.

The codes for the nutritive value per specified food unit used in the computer program were obtained from the publication, Calculating the Nutritive Value of Diets, compiled by the U.S. Department of Agriculture (USDA) Agricultural Research Service (48). A master food deck of nutritive value per specified unit of food developed by the United States Department of Agriculture based on the Home and Garden Bulletin No. 72, Nutritive Value of Foods, revised September 1964, was used. A small number of food items were not included in the USDA publication, therefore, it was necessary to develop cards punched with the required information. Additional food cards were punched based on information in the Composition of Foods—Raw, Processed, Prepared, Agricultural Handbook No. 8 (49), or Church and Church, Food Values of Portions Commonly Used (50). One card was punched for each food item. A Research Assistant with a B.S. degree in Foods and Nutrition and one of the Dietetic

Trainees coded all the food items on the food record forms. All of the food records, after being coded, were rechecked by the researcher for possible errors.

Computation of the iron content of the diets was done using an IBM computer in the University Computer Center, Western Illinois University, Macomb, Illinois. The Dietary Analsyis Computer Program for Pregnant Women (51) computed the seven-day mean dietary iron intake for each subject and also for the entire sample.

The Noncomprehensive Nutrition Knowledge Test and the California Personality Inventory were scored by the Research Assistant and then rechecked by the researcher for possible errors. The Food Frequency History score for iron was determined by the researcher using an adding machine.

Statistical Technique

The statistical technique employed was stepwise linear multiple regression which allowed the development of equations which would predict the daily dietary iron intake of pregnant women. The dependent variable in stepwise linear multiple regression is the y variable. Variables on which y depends or on which y regresses, are termed x variables. The independent variables that approach having continuous-type data and that may influence the iron intake of pregnant women were used in an attempt to establish the best regression formula to estimate the dietary iron intake of pregnant women. The independent variables used included:

1. Age
2. Height
3. Weight Prior to Pregnancy
4. Educational Level of Subject
5. Educational Level of Spouse
6. Gross Yearly Income to Nearest $1,000
7. Number of Pregnancies
8. Number Living in the Household
9. Noncomprehensive Nutrition Knowledge Score
10. Food Frequency History Score
11. Total California Personality Inventory Standard Score
12. Hemoglobin
13. Hematocrit
14. Mean Cell Hemoglobin Concentration
15. Mean Cell Volume

The predictive equation that resulted from the regression analysis contained only those independent variables significantly related to the seven-day mean dietary iron intake of the pregnant women.

The BMD Biomedical Computer Program BMD02R Stepwise Regression (52) was used for the development of the predictive equations. This program computed a sequence of multiple linear equations in a stepwise manner.

Scatter diagrams were made of the dependent variable versus each of the independent variables prior to using the BMD02R stepwise regression program. The scatter diagrams were used to determine if the relationship between the dependent and the independent variables might be linear or

curvilinear. If the dependent and independent variables did not have a linear relationship, which is an underlying assumption in the linear multiple regression analysis, a transformation of the independent variable could be attempted in order to possibly develop an equation to better represent the scatter diagram. The BMD02R stepwise regression program (52) has a special section on transformations. The term transgeneration is used in the program to include the transformation of the independent variable and creation of a new independent variable prior to the computations performed by the program.

The value R, computed by the BMD02R program, is called the coefficient of linear multiple correlation. It is a measure of the linear relationship between the dependent variable and independent variable or variables. If a linear equation is assumed, and the independent variable yields an R value near +1.00 or -1.00, the variable is highly positively or negatively correlated. An R value near zero means that there is no linear correlation between the variables, although a high nonlinear correlation between the variables may exist. The correlation coefficient measures only the goodness of fit of the equation actually assumed to the data.

The BMD02R program (52) also calculated the standard error of estimate for each multiple linear regression equation. The standard error of estimate is a measure of the scatter about the regression line of the dependent variable versus the independent variable or variables. It has properties similar to those of the standard deviation. For example, if two lines were constructed parallel to the regression line

of the dependent variable versus the independent variable at vertical distances of one standard error of estimate, approximately 68 percent of the points should fall in this band, assuming the number of points is large and normally distributed about the regression line. Two and three standard errors of estimate would include respectively 95 percent and 99.7 percent of the sample points (53).

CHAPTER IV

RESULTS AND DISCUSSION

Description of Sample

Fifty-seven pregnant women were included in the study. All of the pregnant women were patients of two obstetricians at the Macomb Clinic, Macomb, Illinois.

Demographic data. Fifty-five of the pregnant women were of mixed national origin and were classified as American. One of the pregnant women was Polish and another was Belgian. The religious orders of the pregnant women were Catholic, Protestant and Salvation Army; the number of pregnant women in each of the religious orders respectively was 14, 37 and 1. Two of the pregnant women indicated that they had no religious affiliation.

Age was expressed as age at the initial interview. The pregnant women ranged in age from 18-33 years with a mean age of 23 years. The pregnant womens' height was expressed in inches, without shoes. Their height ranged from 61-70 inches with a mean height of 65 inches. Weight prior to pregnancy of the women ranged from 98 pounds to 246 pounds with a mean weight of 135 pounds.

The educational level of the pregnant women and their spouses was expressed as the number of years of school completed. Both the pregnant women and their spouses had a mean education level of 13 years, with a range of 9-17 years for the pregnant women and a range of 9-19 years

for their spouses. Using Green's (54) Socioeconomic Status (SES) scores for educational categories, the scores received by the pregnant women and their spouses ranged from 35-69, with a mean score for each of the groups of 62.

A degree or license had not been obtained by 38 of the pregnant women. Similarly, 38 of the spouses did not have degrees or licenses. Nineteen pregnant women had Master's degrees, bachelor's degrees, associate of arts degrees or were licensed beauticians. The number of pregnant women with the respective degrees or licenses was 1, 12, 4 and 2. Three of the spouses had Master's degrees, 12 had bachelor's degrees and 1 was a licensed auto mechanic.

Twenty-four of the fifty-seven pregnant women were employed. Fifteen of the women were employed as clerical workers, 6 were professionals, 2 were laborers and 1 was a student. The SES (54) standard scores for the pregnant women's occupation ranged from 24-66.

Occupations of the pregnant women's spouses were laborers, managers, farmers, students and professionals. The number of spouses in each occupation was 21, 11, 8, 7 and 5 respectively. One of the spouses was not employed. The SES (54) standard scores for spouses ranged from 43-75.

The gross yearly family income of the pregnant women ranged from $2,000-$50,000 with a mean gross income of $11,759. The SES (54) scores of family income ranged from 34-81 with a mean of 54. The upper income values were those of pregnant women whose spouses had a business or were farmers.

Three of the pregnant women were not married, one was living with a man and his children. During the study one of the women obtained a divorce.

The number of pregnancies per woman ranged from 1-10 including the present pregnancy, previous pregnancies, miscarriages and abortions. The pregnant women had a mean number of pregnancies of 1.8.

The mean number of individuals in the household with the pregnant women was 2.7 individuals with a range from 2-9 individuals. None of the pregnant women lived with relatives other than their children. All of the unmarried pregnant women lived alone or with friends.

Thirty women were accepted into the study during their second trimester of pregnancy and 27 were accepted into the study during their third trimester of pregnancy. Nine of the pregnant women had a previous history of anemia.

Dietary iron intake. Studies (11, 12, 13, 15, 17, 18) indicate that one of the least adequately supplied nutrients in the diets of pregnant women is iron. The mean daily dietary iron intake for the 57 pregnant women in the study was 10.9 mg with a range of 3.8 mg-16.4 mg. None of the pregnant women's mean daily dietary iron intake met the 1973 Recommended Daily Allowance (RDA) (55) of 18 mg of iron for nonpregnant women. This is even more serious when one considers that a daily supplement of 30-60 mg of iron is recommended during pregnancy (55).

At the end of the four-day dietary record period the pregnant women were asked whether or not their food records were typical of

their food intake. Seven of the women indicated that their food records were atypical. Some of the reasons given for the atypical diets were traveling, moving or attending a wedding.

The mean daily dietary iron intake of the pregnant women who considered their four-day food records atypical and those who considered their four-day food records typical was 11.1 mg and 10.8 mg, respectively, with a range of 7.5 mg-16.4 mg and 3.8 mg-15.4 mg, respectively. The difference between the mean daily dietary iron intake of pregnant women who considered their food records atypical and those who considered their food records typical was not statistically different ($p < .01$).

Breakfast was skipped every day by seven women and one skipped lunch every day. The pregnant women who skipped breakfast had a mean daily dietary iron intake of 9.1 mg, with a range of 3.8 mg-14.3 mg. Those that ate breakfast had a mean daily dietary iron intake of 11.2 mg. The difference between the mean daily dietary iron intake of pregnant women who skipped breakfast and those who did not skip breakfast was not statistically different ($p < .01$). The one pregnant woman who skipped lunch had a mean daily dietary iron intake of 7.5 mg.

The mean daily dietary iron intake of the pregnant women accepted into the study during the second and third trimester of pregnancy was 10.8 mg and 11.1 mg, respectively. The difference between the mean daily dietary iron intake of the pregnant women whose food records were kept during the third trimester of pregnancy and those who kept their food records during the second trimester of pregnancy was not statistically different for this study, or in a previous study by Liudahl and

Johnston ($\underline{p} < .01$) (18). In a study by Darby (14), the pregnant women had a mean daily dietary iron intake of 14 mg for trimester 2, and 13 mg for trimester 3.

The mean daily dietary iron intake of the pregnant women with a previous history of anemia was 10.9 mg with a range of 8.3 mg-16.4 mg. The forty-eight pregnant women who did not have a history of anemia had a mean dietary iron intake of 10.9 mg with a range of 3.8 mg-15.4 mg. The difference between the mean daily dietary iron intake of pregnant women with and without a history of anemia was not statistically different ($\underline{p} < .01$).

The mean daily dietary iron intake for the working women was 10.9 mg with a range of 7.5 mg-14.8 mg. Thirty-three of the pregnant women were housewives. Their mean daily dietary iron intake was 10.1 mg with a range of 3.8 mg-16.4 mg. The difference between the means for the two groups was not statistically significant ($\underline{p} < .01$).

Test scores. The Noncomprehensive Nutrition Knowledge scores for the pregnant women ranged from 14-30. Thirty was a perfect score on the test. The mean score obtained by the pregnant women was 24.

The Food Frequency History score was the estimated total number of milligrams of iron that would be consumed in 360 days. Food Frequency History scores ranged from 1988 mg-6050 mg, with a mean score of 3998 mg. On a per day basis this would be 5.5 mg-16.8 mg of iron, consumed by the pregnant women.

The pregnant women stated on the Food Frequency History Form that they consumed 0-12 slices of bread per day. Forty of the pregnant

women consumed 2-4 slices of bread per day. Jeans, Smith and Stearns (16) reported that bread and potatoes was the common mainstay of the diet of pregnant women in Iowa. The women consumed on the average six slices of bread daily.

The California Personality Inventory scores were expressed as standard scores. The total personal adjustment standard score obtained by the pregnant women ranged from 37-67, with a mean standard score of 55. Standard mean scores above 50 indicate positive adjustment, while scores below 50 indicate problems in personal adjustment.

Hemoglobin, hematocrit, mean cell volume, mean cell hemoglobin concentration and consumption of vitamin and mineral supplements. Blood samples were analyzed by the McDonough District Hospital Laboratory, or other laboratories if the patients transferred to the Macomb Clinic prior to the second prenatal visit to the obstetrician. All of the pregnant women made their first prenatal visit prior to their third month of pregnancy, therefore all of their blood samples were taken prior to the third month of pregnancy. An increase in blood volume begins at the end of the first trimester of pregnancy (4). The hemoglobin and hematocrit levels, if determined later in the pregnancy may have been lower due to the increase in blood volume since both of these levels are based on blood volume. During pregnancy a truer index of anemia than hemoglobin and hematocrit levels are the mean cell hemoglobin concentration and mean cell volume which are easier to determine than other acceptable methods of determining iron status.

Fifty-five of the fifty-seven women were given some type of iron supplement which contained varying amounts of iron, after the blood values used in the study were determined. Twelve pregnant women took prenatal vitamin pills that contained 65 mg of ferrous sulfate. A prenatal vitamin pill plus various quantities of iron supplements was taken by 40 of the pregnant women. The number of women taking ferrous sulfate as a supplement and the amount taken in milligrams was: 23, 390 mg; 10, 715 mg; 4, 1040 mg and 2, 1690 mg. One pregnant woman took a prenatal vitamin pill plus iron shots, another took an iron supplement of 18 mg of ferrous fumarate plus a supplement of ascorbic acid and one took a one-a-day vitamin-mineral supplement containing 18 mg of ferrous fumarate. The only supplement taken by one pregnant woman was a calcium pill. Two of the pregnant women did not take any type of vitamin or mineral supplement.

The pregnant women had a mean hemoglobin level of 12.3 g/100 ml of blood. Their hemoglobin levels ranged from 9.8-14.9 g/100 ml of blood. Two of the fifty-seven pregnant women had hemoglobin levels below the acceptable level of 11 g/100 ml of blood (56).

The hematocrit levels of the pregnant women ranged from 30 percent to 44 percent. Their mean hematocrit level was 37 percent. One pregnant woman had a hematocrit level below the acceptable level of 33 percent (56).

The mean cell hemoglobin concentration was 34 percent. The pregnant women's mean cell hemoglobin concentration ranged from 31-37 percent. One pregnant woman has a mean cell hemoglobin concentration below the normal value of 34 percent for adult females (57).

The mean cell volume ranged from 71 cμ to 96 cμ. The average mean cell volume was 86 cμ. One pregnant woman had a mean cell volume below 85 cμ which is normal for adult females (57).

Other descriptive information about the sample. None of the pregnant women were consuming special diets either prescribed by the obstetrician or by themselves. The normal intake of the pregnant women in the study was not restricted. Two of the pregnant women were taking medication for nausea, but did not feel nauseated while completing their seven-day food records.

An intolerance to certain foods was indicated by some of the pregnant women. The type of food that was not tolerated and the number of women having these intolerances were: spicy food, 9; pork, 1; hamburger, 1; eggs, 1; orange juice, 2; and sweets, 2.

Some of the cravings indicated by the pregnant women were chocolate, 7; spicy foods, 4; ice cream, 9; sweets, 9; peanuts, 1; chicken, 1; peanut butter, 1; french fries, 1; mashed potatoes, 1; fruit, 1; broccoli, 1; milk, 1; and popsicles, 1.

A specific weight gain was not recommended to 36 of the pregnant women by the obstetrician. Twenty-one of the pregnant women were directed to gain from 30-35 pounds during the pregnancy.

In a study conducted by Liudahl and Johnston (18) using 52 pregnant women, it was found that 15 women smoked more than 1 package of cigarettes per day. A significant difference ($p < .01$) was not found between the mean daily dietary iron intake for the smokers and nonsmokers. In the

present study, none of the pregnant women smoked more than one package of cigarettes per day and six women smoked less than one package per day.

None of the pregnant women consumed alcohol more than once a month. Six pregnant women consumed alcohol less than once a month. Alcohol consumption in the study by Liudahl and Johnston (18) was similar to the present study.

Development of a Mathematical Model to Predict the Iron Intake of Pregnant Women

Linear stepwise multiple regression analysis was employed to develop equations which would predict the dietary iron intake of the pregnant women in the study. The dependent variable used in the linear stepwise multiple regression analysis was the mean daily dietary iron intake obtained from seven-day food records, including a weekend kept by the pregnant women during their pregnancy. Young (25) and others (26, 27) agree that it is necessary to measure food intake for at least a week in order to obtain a reasonable assessment of the amount and kinds of foods habitually consumed by individuals.

Selection of independent variables. The independent variables used in the study were selected based on previous studies and assumptions made by the researcher. Based on the literature search, some of the independent variables selected for this study were related to overall adequacy of the diet and not specifically to dietary iron intake. The independent variables used were age, height, weight prior to pregnancy, educational level of subject, educational level of spouse, income,

number of pregnancies, number living in household, noncomprehensive nutrition knowledge score, food frequency history score, total California Personality Inventory standard score, hemoglobin, hematocrit, mean cell hemoglobin concentration and mean cell volume (see Tables I and II).

Scatter diagrams. Prior to the use of the BMD02R stepwise linear multiple regression program, scatter diagrams were made of the mean daily dietary iron intake for seven days versus each of the independent variables. Only the mean daily dietary iron intake versus the food frequency history score appeared to have a linear-type relationship. The other plots appeared to be random scatter diagrams.

Multiple regression analysis. The BMD02R Stepwise Regression Program (52) computed a sequence of multiple linear regression equations or mathematical models in a stepwise manner. At each step one independent variable was added to the regression equation. The *F* levels for entrance of an independent variable into the equations was first set at the 5 percent level and then the 1 percent level (58) for the various number of cases (see Table III). At the 5 percent *F* level all of the variables entered into the equations had a 5 percent probability of being entered by chance. With *F* at the 1 percent level, there was only a 1 percent probability of the variable being entered into the equation by chance due to the nature of the sample. The number of cases per run varies due to the lack of certain independent variables for all of the cases.

The first and second runs had 34 cases with all 15 independent variables. At the 5 and 1 percent *F* level the first independent

TABLE I

DEPENDENT AND INDEPENDENT VARIABLES INCLUDING SEVEN-DAY MEAN DIETARY IRON INTAKE AND SPECIFIC SOCIOECONOMIC DATA FOR 57 PREGNANT WOMEN AT A PRIVATE OUTPATIENT CLINIC IN MACOMB, ILLINOIS

	Dependent Variable	Independent Variables							
Case No.	Mean Dietary Iron* mg/d	Age yrs	Ht. in	Wt. lbs	Educational Level yrs	Educational Level of Spouse yrs	Income**	Number of Pregnancies***	Number Living in Household
1	3.8	33	67	220	10	9	4,000	10	9
2	11.3	24	62	155	14	17	8,000	3	3
3	11.9	22	64	246	12	10	8,000	3	4
4	11.7	25	63	110	14	16	9,000	2	3
5	9.9	19	62	115	12	12	15,000	1	2
6	13.9	18	61	130	12	12	5,000	1	2
7	8.3	30	62	130	14	16	30,000	2	3
8	9.0	20	64	113	10	12	9,000	2	2
9	12.2	24	64	110	16	18	17,000	1	2
10	14.7	25	66	115	14	12	25,000	2	3
11	12.1	26	68	125	17	19	7,000	1	2
12	9.5	22	67	135	17	—	2,000	2	2
13	10.1	24	69	140	16	12	20,000	1	2
14	12.3	19	64	110	14	14	3,000	1	2
15	15.4	28	66	130	12	12	25,000	3	4
16	11.7	18	66	125	12	12	5,000	1	2
17	7.8	21	63	145	12	12	17,000	1	2
18	12.6	22	64	130	16	16	5,000	1	2
19	7.8	22	61	115	13	16	8,000	1	2
20	12.1	27	66	108	13	—	2,000	2	2
21	7.5	25	68	200	12	11	9,000	3	4

TABLE I (continued)

Case No.	Dependent Variable Mean Dietary Iron*	Independent Variables Age	Ht.	Wt.	Educational Level	Educational Level of Spouse	Income**	Number of Pregnancies***	Number Living in Household
	mg/d	yrs	in	lbs	yrs	yrs			
22	9.0	21	64	130	12	12	13,000	2	3
23	7.9	21	64	126	12	16	7,000	1	2
24	12.4	25	64	150	16	13	14,000	4	3
25	12.0	22	66	160	13	16	13,000	2	3
26	11.4	21	68	140	14	16	3,000	1	2
27	15.5	20	70	150	12	14	10,000	2	3
28	13.4	21	64	125	12	14	10,000	1	2
29	7.7	25	65	125	16	16	12,000	2	3
30	14.3	19	66	150	13	14	6,000	1	2
31	13.5	23	66	140	13	16	9,000	2	3
32	7.5	23	59	110	12	13	17,000	1	2
33	15.4	28	65	165	16	14	18,000	3	4
34	9.9	19	64	160	12	10	3,000	3	4
35	8.5	19	63	118	12	12	15,000	1	2
36	11.2	24	66	203	16	14	11,000	1	2
37	14.8	33	65	138	17	17	15,000	3	3
38	11.2	20	66	130	12	12	7,000	1	3
39	6.2	21	66	118	16	16	9,000	1	2
40	11.4	22	65	118	12	16	7,000	1	2
41	8.6	19	64	165	9	12	5,000	2	2
42	10.2	25	63	141	14	12	10,000	3	4
43	11.2	28	68	140	16	17	50,000	2	3
44	10.0	22	62	119	12	12	15,000	1	3
45	16.4	18	61	98	11	12	3,000	2	3
46	10.5	18	64	120	13	13	5,000	1	2
47	13.1	24	65	109	14	17	20,000	1	2

TABLE I (continued)

Case No.	Dependent Variable: Mean Dietary Iron*	Independent Variables: Age	Ht.	Wt.	Educational Level	Educational Level of Spouse	Income**	Number of Pregnancies***	Number Living in Household
	mg/d	yrs	in	lbs	yrs	yrs			
48	8.6	25	64	115	12	12	10,000	1	2
49	12.9	22	66	130	13	18	9,000	1	2
50	9.7	26	64	127	16	—	18,000	1	5
51	12.4	26	70	130	14	15	10,000	2	3
52	8.4	25	62	107	12	16	21,000	2	3
53	10.5	24	68	135	12	12	15,000	2	3
54	13.7	23	64	110	14	14	9,000	2	3
55	7.5	25	64	115	16	12	14,000	1	2
56	9.6	29	66	132	12	16	15,000	2	3
57	11.8	21	63	130	12	16	11,000	1	2

*Mean value for seven days of diets including a Saturday and Sunday.

**Gross yearly income to the nearest $1,000.

***All pregnancies including the present pregnancy.

TABLE II

DEPENDENT AND INDEPENDENT VARIABLES INCLUDING SEVEN-DAY MEAN DIETARY IRON INTAKE, TEST SCORES AND SELECTED BLOOD VALUES FOR 57 PREGNANT WOMEN AT A PRIVATE OUTPATIENT CLINIC IN MACOMB, ILLINOIS

	Dependent Variable	Independent Variables						
Case No.	Mean Dietary Iron*	Noncomprehensive Nutrition Knowledge Score	Food Frequency History Score	Total California Personality Inventory Score	Hemo-globin	Hemato-crit	Mean Cell Hemoglobin conc.	Mean Cell Volume
	mg/d				gm/100 ml	%	%	cμ**
1	3.8	14	1988	—	12.4	37	33	96
2	11.3	25	3103	42	12.1	36	33	87
3	11.9	25	4079	—	11.5	37	31	96
4	11.7	26	5135	57	11.8	35	34	89
5	9.9	19	2862	53	11.9	36	33	92
6	13.9	26	3399	50	11.4	36	32	91
7	8.3	22	4057	37	13.2	39	—	—
8	9.0	19	5187	42	13.4	40	—	—
9	12.2	22	3648	53	12.5	37	34	90
10	14.7	26	4735	67	12.0	36	33	84
11	12.1	26	3201	63	11.7	35	33	95
12	9.5	28	3416	45	12.9	—	34	—
13	10.1	23	3452	53	14.9	—	34	—
14	12.3	25	3312	59	11.8	34	35	—
15	15.4	25	5474	67	12.7	39	33	84
16	11.7	24	3184	53	12.8	39	33	90
17	7.8	23	4180	48	12.3	37	33	92
18	12.6	21	3385	55	13.3	39	34	86
19	7.8	23	2417	42	11.8	36	—	—
20	12.1	25	5821	42	12.4	37	—	—

TABLE II (continued)

Case No.	Dependent Variable: Mean Dietary Iron*	Independent Variables: Noncomprehensive Nutrition Knowledge Score	Food Frequency History Score	Total California Personality Inventory Score	Hemo- globin	Hemato- crit	Mean Cell Hemoglobin conc.	Mean Cell Volume
	mg/d				gm/100 ml	%	%	cµ**
21	7.5	26	3017	48	12.0	35	34	85
22	9.0	26	3466	48	12.0	37	33	85
23	7.9	18	3248	63	11.4	33	34	93
24	12.4	30	4858	53	12.1	36	33	83
25	12.0	26	4034	59	14.1	39	36	86
26	11.4	19	2968	53	13.2	38	34	82
27	15.5	22	5682	—	13.9	41	34	88
28	13.4	25	3891	—	12.6	34	37	91
29	7.7	22	2842	63	12.2	35	35	83
30	14.3	23	2889	—	11.5	33	35	88
31	13.5	22	5156	—	13.1	44	33	91
32	7.5	27	3092	—	12.9	38	34	92
33	15.4	25	4657	55	13.5	40	34	87
34	9.9	22	5890	48	11.8	35	35	92
35	8.5	25	4948	48	11.2	33	34	90
36	11.2	28	4086	50	11.3	34	33	85
37	14.8	28	5211	67	12.4	38	33	84
38	11.2	21	4627	—	11.0	33	—	—
39	6.2	27	2625	55	12.0	36	33	85
40	11.4	28	3723	50	11.6	35	33	92
41	8.6	20	4233	—	11.7	35	33	87
42	10.2	26	5675	—	12.6	38	—	—
43	11.2	27	2990	—	12.0	36	33	71
44	10.0	27	3959	—	12.3	36	34	87

TABLE II (continued)

Case No.	Dependent Variable: Mean Dietary Iron*	Independent Variables: Noncomprehensive Nutrition Knowledge Score	Food Frequency History Score	Total California Personality Inventory Score	Hemo-globin	Hemato-crit	Mean Cell Hemoglobin conc.	Mean Cell Volume
	mg/d				gm/100 ml	%	%	cμ**
45	16.4	24	4419	—	11.1	33	34	88
46	10.5	27	5155	53	9.8	30	33	92
47	13.1	27	5317	63	14.1	42	34	92
48	8.6	26	3186	42	11.8	36	33	93
49	12.9	29	3939	48	12.8	37	35	84
50	9.7	23	3378	67	14.2	43	33	94
51	12.4	20	4825	53	11.3	34	34	93
52	8.4	22	3514	—	10.5	33	32	88
53	10.5	22	4358	—	12.0	36	33	87
54	13.7	24	6050	50	13.6	40	34	91
55	7.5	23	3455	55	13.0	39	34	92
56	9.6	28	3782	59	11.3	34	33	88
57	11.8	27	2712	67	13.0	40	33	85

*Mean value for seven days of diets including a Saturday and Sunday.

**Cubic microns.

TABLE III

BMD LINEAR STEPWISE MULTIPLE REGRESSION ANALYSIS FROM DATA OBTAINED FROM PREGNANT WOMEN AT A PRIVATE OUTPATIENT CLINIC IN MACOMB, ILLINOIS

Run No.	F Level	No. of Cases	Number of Independent Variables	Steps	Regression Equation	Multiple R	Standard Error of Estimate in mg
1	5%	34	15*	1	Est. Iron = 0.00120FFH + 6.32401	0.4808	2.1978
				2	Est. Iron = 0.00116FFH + 0.40327HCT - 8.24981	0.6296	1.9785
2	1%	34	15*	1	Est. Iron = 0.00120FFH + 6.32401	0.4808	2.1978
				2	Est. Iron = 0.00116FFH + 0.40327HCT - 8.24981	0.6296	1.9785
3	5%	53	12**	1	Est. Iron = 0.00128FFH + 5.88595	0.4733	2.3937
				2	Est. Iron = 0.00140FFH + 0.33073EDSP + 0.77857	0.5527	2.2872
4	1%	53	12**	1	Est. Iron = 0.00128FFH + 5.88595	0.4733	2.3937
5	1%	57	1***	1	Est. Iron = 0.00125FFH + 5.93705	0.4797	2.3136

FFH—Food Frequency History Score; HCT—Hematocrit; EDSP--Education Level of Spouse.

*All Independent Variables were used.

**All Independent Variables were used except Mean Cellular Hemoglobin Concentration, Mean Cell Volume and California Personality Inventory Standard Score.

***Only the Food Frequency History Score was used.

variable entered was the food frequency history score; the second step entered the food frequency history score and the hematocrit level.

Fifty-three cases were used in an attempt to develop a new regression equation in runs three and four. All of the independent variables were used except mean cellular hemoglobin concentration, mean cell volume and the total standard score for the California Personality Inventory. These were omitted because they were not entered into the regression equation with 34 cases, and this information was not available for 20 of the pregnant women. With an F level of 5 percent in run three, the first independent variable added was the food frequency history score and the second variable added to the equation was the educational level of the spouse. In run four, with F at the 1 percent level, only the food frequency history score entered into the equation.

Since the food frequency history score was the first variable entered with 34 or 53 cases at both the 5 and 1 percent F levels, run five was made including all 57 cases using only the food frequency history score as the independent variable and F at the 1 percent level.

For each run and at the various steps, the multiple R and the standard error of estimate in milligrams of iron was computed. This was done by the BMD02R program (53) (see Table III).

In step one of runs one and two, with 34 cases at the 5 percent and 1 percent F levels, the variable entered was the food frequency history score, with a multiple R value of 0.4808 and a standard error of estimate of 2.1978 mg of iron. In step two of runs one and two, the hematocrit level was added to the equation resulting in a multiple R of 0.6296

and a standard error of estimate of 1.9785 mg of iron. The addition of the hematocrit level to the equation increased the multiple *R* by 0.1488 and the standard error of estimate decreased 0.2193 mg.

In step one of runs three and four, with 53 cases at the 5 percent *F* level the first variable entered was the food frequency history score; the multiple *R* was 0.4733 and the standard error of estimate was 2.3937 mg of iron. At the 5 percent *F* level the second variable entered was education of spouse; the multiple *R* was 0.5527 and the standard error of estimate was 2.2872 mg of iron. At the 1 percent *F* level the only variable entered was the food frequency history score which had a multiple *R* of 0.4733 and a standard error of estimate of 2.3937 mg of iron. At the 5 percent *F* level the education of spouse must have entered the equation by mere chance, as it was not entered into the equation with 34 cases. Addition of the education of spouse to the equation increased the multiple *R* 0.0794 and the standard error of estimate decreased 0.1065 mg.

Run five included 57 cases and the only independent variable used was the food frequency history score. The multiple *R* was 0.4797 and the standard error of estimate was 2.3136 mg of iron.

It was an unexpected result in the 53 case run when the hematocrit level, which was entered at the 1 percent *F* level with 34 cases, was not entered even at the 5 percent *F* level with the addition of 19 cases to the original 34 cases. There are two possible explanations for the hematocrit level not being entered into the equation with the 53 cases:

1. The run with 34 cases was a very homogeneous sample with respect to the hematocrit levels, and it was entered merely by chance at the 5 and 1 percent *F* levels. The addition of 19 more cases possible represented a more normal population, hence the hematocrit level was no longer significantly related to the mean dietary iron intake.
2. The original 34 cases may have represented a normal population and the hematocrit level was definitely significantly related. The added 19 cases may have had very diverse hematocrit levels in relation to the mean daily dietary iron values and food frequency scores, resulting in a population that was no longer normal, and the hematocrit level was not entered into the equation.

In either case, a sampling distribution problem exists in the data with respect to hematocrit levels.

If this model were to be used as a case-finding tool in nutritional programs, the equation to use would be the one including only the food frequency history score due to the simplicity of using only one variable. The equation with all 57 cases should be used in a clinic situation. The equation is:

$$\text{Estimated Daily Dietary Iron Intake} = 0.00125\ (\text{Food Frequency History Score}) + 5.93705$$

One standard error of estimate for this model was 2.3136 mg of iron, which for a normal population includes 68 percent of the population.

An example of how this model functions would be to consider a hypothetical pregnant woman with a food frequency history score of 4000. The estimated dietary iron intake for the pregnant woman would be found as follows:

Estimated Daily Dietary Iron Intake = 0.00125(4000) + 5.93705

Estimated Daily Dietary Iron Intake = 5.00 + 5.93705

Estimated Daily Dietary Iron Intake = 10.9 mg of iron

This model has a standard error of estimate of 2.3 mg of iron, so the nutritionist in a clinic would be 68 percent confident that this pregnant woman's mean daily dietary iron intake was equal to or greater than 8.6 mg, but less than or equal to 13.2 mg. In using this model as a case finding tool, the main concern of a nutritionist is the pregnant woman with a low mean daily dietary iron intake. When using the model in the preceding example the nutritionist would be 84 percent confident that this pregnant woman's mean daily dietary iron intake would be equal to or greater than 8.6 mg.

The mathematical model was developed based upon the data obtained from 57 pregnant women in a private outpatient clinic. Further studies should be conducted in order to determine the reliability and validity of the model with other pregnant women in various regions of the country and its possible application to population groups other than pregnant women.

CHAPTER V

SUMMARY

Mathematical models using linear stepwise multiple regression analysis were developed that predict the daily dietary iron intake of pregnant women. The development of the mathematical model was based upon sociological, psychological and physiological factors assumed to be related to the daily dietary iron intake of pregnant women.

Data was obtained from 57 pregnant women at a private outpatient clinic in Macomb, Illinois. The pregnant women recorded their food intake for seven days. The seven-day mean dietary iron intake was used as the dependent variable in development of the equations. Information was obtained regarding eight socioeconomic factors, one personality score, two food and nutrition variables and four blood determinations. This information was used as the independent variables and considered in the development of the equations.

In the development of equations using linear stepwise multiple regression analysis, 34 cases, 53 cases and the total sample of 57 cases were used. The number of cases in each sample run varied in order to include all of the independent variables, and, also, the total sample of pregnant women.

In the 34 and 53 case sample the food frequency history score was the first variable entered in the equation. The multiple $\underline{R}$ ranged from 0.4733-0.4808, and the standard error of estimate ranged from 2.1978 mg-2.2927 mg of iron. The only variable used in the 57 case sample was the

food frequency history score. The resulting equation had a multiple R of 0.4797 and a standard error of estimate of 2.3136 mg of iron.

In the sample of 34 cases, the second variable entered into the equation at both the 5 and 1 percent F levels was the hematocrit level of the pregnant women. The multiple R was 0.6296 and the standard error of estimate was 1.9785 mg of iron.

The second variable entered into the equation with a 53 case sample was education of spouse. This was not entered in the 34 case run and was entered only at the 5 percent F level in the 53 case run. It appears that the education level of the spouse entered the equation only by chance.

The hematocrit level was entered in the 34 case sample, but not in the 53 case sample. It appears that a sampling distribution problem exists in the data. Further studies should be conducted to determine if the hematocrit level is significantly related to the mean daily dietary iron intake of pregnant women.

The mathematical model may be used as a case-finding tool in nutrition programs. The best equation to use would be the one with only the food frequency history score, developed in the 57 case run. The mathematical model would be:

Estimated Mean Daily Dietary Iron Intake of Pregnant Women =
0.00125 (Food Frequency History Score) + 5.93705

This equation has a standard error of estimate of ±2.3 mg of iron. This mathematical model may apply to other pregnant women in a different

locality, but further study would be needed to test the reliability and validity of the model under various settings.

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LITERATURE CITED

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APPENDIX

SOCIOECONOMIC FORM

CODE NO._____ NAME___________________________

____________Date of Interview

________________ ______________ _______________ ______________ Home Address

Street City State Zip Code

____________Home Phone Number

GENERAL INFORMATION

________ 1. Age

________ 2. Birth date

________ 3. National origin

________ 4. Total years of education completed

________ 5. Total years of education completed by spouse

________ 6. Degree or license received by respondent

________ 7. Degree or license received by spouse

________ 8. Present occupation of respondent

________ 9. Present occupation of spouse

________10. Approximate income of the family to the nearest $1,000 (before taxes)

________11. Number of pregnancies (including present pregnancy, live births and miscarriages)

________12. Any history of anemia

________13. Number of persons present in the household

________14. Marital status: single, divorced or married

MEDICAL RECORD FORM

CODE NO._____ NAME_____________________________

________1. Height

________2. Weight prior to pregnancy

________3. Number of months pregnant at first prenatal visit

________4. Hemoglobin

________5. Hematocrit

________6. Mean Cell Hemoglobin Concentration (MCHC)

________7. Mean Cell Volume (MCV)

FOOD FREQUENCY HISTORY FORM

CODE NO._____ NAME_____________________________

Directions: How often do you have the following for a meal? Check the appropriate box.

FOOD ITEM(S)	al-most every day	3 times a week	2 times a week	once a week	every 2 weeks	every 3 weeks	once a mo.	rarely	never
Organ Meats (liver, heart)									
Ham or Pork									
Hamburger									
Corned Beef									
Beef or Veal (not hamburger)									
Chicken									
Turkey									
Fish Patties or Sticks									
Tuna									
Chili									
Spaghetti & Meat Balls									
Hot Dogs									
Pork & Beans (or Franks)									
Pot Pies									
Luncheon Meat									
Black-Eyed Peas									
Green Peas									
Kidney or Navy Beans									
Green Beans									

FOOD FREQUENCY HISTORY FORM (continued)

FOOD ITEM(S)	al-most every day	3 times a week	2 times a week	once a week	every 2 weeks	every 3 weeks	once a mo.	rarely	never
Lima Beans									
Corn									
Spinach									
Broccoli									
Tomatoes									
Squash or Sweet Potatoes									
Sauerkraut									
Eggs									
Tomato Juice									
Prune Juice									
Raisins or Dates									
Peanut Butter									
Instant Cream of Wheat									
Cream of Wheat									
Instant Oatméal									
Instant Farina									
Kelloggs 19, Post Fortified Oat Flakes or Total									
All Other Cereals									
Rice, Noodles or Macaroni									

Circle Yes or No

Yes No 1. Do you usually skip breakfast?
Yes No 2. Do you usually skip lunch?
Yes No 3. On the average, do you have meat at least twice a day?
Yes No 4. Do you live with relatives? (parents, grandparents, etc.)
_______ 5. On the average, how many slices of bread(s) or rolls do you consume per day? Indicate answer on the blank.
_______ 6. Please indicate your age group. 18 or under, 19-29, 30 or over.

FOOD FREQUENCY HISTORY FORM COMPUTATION KEY

CODE NO._____ NAME______________________________

Directions: How often do you have the following for a meal? Check the appropriate box.

Frequency in days:		360	156	104	52	26	17	12	4	0
FOOD ITEM(S)	iron value/ serving*	al-most every day	3 times a week	2 times a week	once a week	every 2 weeks	every 3 weeks	once a mo.	rarely	never
Organ Meats (liver, heart)	5.0	1800	780	520	260	130	85	60	20	0
Ham or Pork	2.2	792	343	229	114	57	37	26	9	0
Hamburger	3.0	1080	468	312	156	78	51	36	12	0
Corned Beef	3.7	1332	577	385	192	96	63	44	15	0
Beef or Veal (not hamburger)	2.7	972	421	281	140	70	46	32	11	0
Chicken	1.1	396	172	144	57	29	19	13	4	0
Turkey	1.1	396	172	144	57	29	19	13	4	0
Fish Patties or Sticks	0.6	216	94	62	31	16	10	7	2	0
Tuna	0.8	288	125	83	42	21	14	10	3	0
Chili	4.2	1512	655	437	218	109	71	50	17	0
Spaghetti & Meat Balls	3.7	1332	577	385	192	96	63	44	15	0
Hot Dogs	0.8	288	125	83	42	21	14	10	3	0
Pork & Beans (or Franks)	2.3	828	359	239	120	60	39	28	9	0
Pot Pies	3.0	1080	468	312	156	78	51	36	12	0
Luncheon Meat	0.6	216	94	62	31	16	10	7	2	0
Black-Eyed Peas	5.1	1836	796	530	265	133	87	61	20	0
Green Peas	2.9	1044	452	302	151	75	49	35	12	0
Kidney or Navy Beans	4.7	1692	733	489	244	122	80	56	19	0
Green Beans	0.8	288	125	83	42	21	14	10	3	0
Lima Beans	3.9	2124	920	614	307	153	100	71	24	0
Corn	1.0	360	156	104	52	26	17	12	4	0
Spinach	4.0	1440	624	416	208	104	68	48	16	0
Broccoli	1.4	504	218	146	73	36	24	17	6	0

FOOD FREQUENCY HISTORY FORM COMPUTATION KEY (continued)

Frequency in days:		360	156	104	52	26	17	12	4	0
FOOD ITEM(S)	iron value/ serving*	al-most every day	3 times a week	2 times a week	once a week	every 2 weeks	every 3 weeks	once a mo.	rarely	never
Tomatoes	1.2	432	187	125	62	31	20	14	5	0
Squash or Sweet Potatoes	1.6	576	250	166	83	42	27	19	6	0
Sauerkraut	1.2	432	187	125	62	31	20	14	5	0
Eggs	1.1	396	172	114	57	29	19	13	4	0
Tomato Juice	2.2	792	343	229	114	57	37	26	9	0
Prune Juice	2.5	900	390	260	130	65	43	30	10	0
Raisins or Dates	0.5	180	78	52	26	13	8	6	2	0
Peanut Butter	0.6	216	94	62	31	16	10	7	2	0
Instant Cream of Wheat	4.5	1620	702	468	234	117	77	54	18	0
Cream of Wheat	1.3	468	203	135	68	34	22	16	5	0
Instant Oatmeal	2.5	900	390	260	130	65	43	30	10	0
Instant Farina	2.0	720	312	208	104	52	34	24	8	0
Kellogs 19, Post Fortified Oat Flakes or Total	5.0	1800	780	520	260	130	85	60	20	0
All Other Cereals	1.7	612	265	177	88	44	29	20	7	0
Rice, Noodles or Macaroni	1.4	504	218	146	73	36	24	17	6	0

*Serving size based on the diets of 51 pregnant women (18)

_____ slices of bread/day × 180 = _______
Meat Score = _______ Meat limits imposed: _______ to _______

Final Meat Score .... _______
Vegetable Section Score .... _______
Cereal and Other Products Score ..... _______
Bread Score .... _______

Total Score ..... _______

DIETARY RECORD FORM

CODE NO._____ DATE_______________ NAME________________________________

Food Record

Please do not write in the columns entitled Food Code No. and %.

Meal	Food (complete description)	Amount	Food Code No.	%
BREAKFAST Time eaten Place eaten Cost if eaten away from home				
SNACKS Time eaten				
LUNCH OR DINNER Time eaten Place eaten Cost if eaten away from home				
SNACKS Time eaten				
DINNER OR SUPPER Time eaten Place eaten Cost if eaten away from home				
SNACKS Time eaten				

FOOD RECORD

Directions for Keeping Food Record

This food record is to be kept for ______ days, indicating all food and water and the amounts of each consumed at meals and between meals. Use the forms provided to record the food intake.

Examples of recording food items

Milk—Whole, 2 percent or skimmed in cups or 8 ounce glasses. Malted milk—kind and amount in cups.

Juices—Indicate whether it is made from a frozen concentrate, is canned, fresh, diet or a drink such as orange drink or grape drink in cups or ounces.

Cheese—Kind and amount in cubic inches, size of slices, cups or ounces.

Eggs—Number and method of preparation, such as scrambled, fried or poached.

Butter or Margarine—Amount in teaspoons, tablespoons or pats.

Fruit and Vegetables—In cups or when used fresh in terms of size and measurement, such as a medium sized apple, 2-1/2" in diameter. One average serving of cooked fruit or vegetable approximates 1/2 cup. Indicate method of preparation for fruits and vegetables such as baked apples, creamed peas, fried potatoes and canned peaches.

Meat, Fish and Poultry--Number of servings, amount and method of preparation. An average serving is three ounces. Indicate measurement such as roast beef, 4-1/2" × 3" × 1/2".

Cereal—Kind and amount in cups. An average serving of cold or cooked cereal approximates 3/4 cup.

Bread—Kind and number of thin, average or thick slices.

Casseroles or Mixed Dishes--List the ingredients and amounts of each and the total amount that was eaten (noodle casserole: 1/2 cup noodles, 1/8 cup tuna and 1/4 cup of mushroom soup).

Soup—Kind and amount in cups (1 cup of tomato soup); if homemade, list the ingredients.

Pizza—Kind and size of pizza and the size of the portion eaten. (1/4 of a 12-inch cheese pizza).

Desserts—Ice cream, ice milk and sherbet given in cups and kind.

Pie: Give kind, size and amount (1/6 of a 9-inch cherry pie).

Cake: Give kind, size and amount (2-inch section of lemon sponge cake).

Other Desserts—Give kind, size and amount including ingredients (3" square of graham cracker dessert—graham crackers and vanilla pudding).

Candy—Number, kind and size of pieces. For candy bars, give kind, price and number of ounces.

Cookie--Kind and diameter (2-inch sugar cookie).

Beverage—Kind and number of cups or size of can or bottle (12 ounce can of coke).

DIETARY FORM

CODE NO._____ NAME____________________________

1. Is this a typical food intake? ____yes, ____no. If not, how and why is it not typical?

2. Were any vitamin or mineral supplements taken during the time the food record was kept? ____yes, ____no. If so, give type and their content.

3. Are you on a special or prescribed diet? ____yes, ____no. If so, please specify.

4. Was dieting prescribed by a doctor? ____yes, ____no.

5. Has the doctor recommended a limit on the amount of sodium intake? ____yes, ____no.

6. Are you taking any medication for nausea? ____yes, ____no.

7. Have you developed an intolerance to any food that was tolerated prior to pregnancy? ____yes, ____no. If so, please specify.

8. Do you smoke cigarettes? ____yes, ____no. If yes, what is the average number of cigarettes smoked per day? ____________

9. How frequently is alcohol consumed? ____daily, ____weekly, ____monthly, ____other (if so specify).

10. How does alcohol affect your appetite? ____increase, ____decrease.

11. Do you have any cravings, food or otherwise? ____yes, ____no. If yes, please specify.

    What are the reasons for these cravings?

12. What total weight gain has the doctor recommended for you? ______

NONCOMPREHENSIVE NUTRITION KNOWLEDGE TEST

CODE NO.______ NAME________________________________

Read each statement and circle the appropriate letter to the left of the question. Circle T if true, F if false and N if the answer is not known. A higher score will be obtained if N is circled rather than making a guess.

T F N 1. Anemia (tired blood) can result when a person does not eat enough foods which have iron in them.

T F N 2. Extra food containing iron is needed in the diet during pregnancy.

T F N 3. Milk, cheese and ice cream are good sources of iron.

T F N 4. Enriched bread contains added iron, thiamin, riboflavin and niacin.

T F N 5. Liver is a good source of iron.

T F N 6. Raisins are not a good source of iron.

T F N 7. Protein is necessary during pregnancy for the growth and development of the baby.

T F N 8. It is necessary to take vitamin and iron pills even when an individual is not pregnant.

T F N 9. Pregnant women need more protein than women who are not pregnant.

T F N 10. Milk, cheese, eggs and meat are good sources of protein.

T F N 11. Navy beans are not very nutritious because they contain little protein.

T F N 12. Peanut butter is a good source of protein.

T F N 13. Four servings of bread or cereal should be eaten each day.

T F N 14. Corn, rice, macaroni, noodles and bread are fattening and should be eliminated from a pregnant woman's diet.

T F N 15. Pork and beans and spaghetti should be eliminated from a pregnant woman's diet because they are fattening.

VITA

Waneed Ann Liudahl was born in Devils Lake, North Dakota, on January 25, 1944. A 1961 graduate of Devils Lake High School, she received a Bachelor of Science degree in home economics from North Dakota State University, in 1964. In 1969 she received a Master of Science degree from North Dakota State University with a major in foods and nutrition. She served as an instructor from 1969-1973 and was appointed Assistant Professor in Home Economics at Western Illinois University in 1973. She is a Member of the American Dietetic Association, Society for Nutrition Educators, American Public Health Association, American Home Economics Association, and Phi Upsilon Omicron. She is married to Timothy Liudahl and has two children, Darcy, age 11, and Lane, age 1.