El-Masry, Ebtesam Anwer

REASSESSMENT OF THE NUTRIENT INTAKES AND ANTHROPOMETRIC MEASUREMENTS OF ADOLESCENT FEMALES AFTER A TWO-YEAR PERIOD

The University of North Carolina at Greensboro PH.D. 1984

University
Microfilms
International 300 N. Zeeb Road, Ann Arbor, MI 48106

REASSESSMENT OF THE NUTRIENT INTAKES AND

ANTHROPOMETRIC MEASUREMENTS OF

ADOLESCENT FEMALES AFTER A

TWO-YEAR PERIOD

by

Ebtesam A. El-Masry

A Dissertation Submitted to
the Faculty of the Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Greensboro
1984

Approved by

Lucille M. Wakefield, Ph.D.
Dissertation Adviser

APPROVAL PAGE

This dissertation has been approved by the following committee of the Faculty of the Graduate School at the University of North Carolina at Greensboro.

Dissertation Adviser Lucille M. Wakefield

Committee Members Michael Liebman

Nancy White

Barbara Clawson

Elizabeth L. Schiller

January 23, 1984

Date of Acceptance by Committee

December 12, 1983

Date of Final Oral Examination

EL-MASRY, EBTESAM A., PH.D. Reassessment of the Nutrient Intakes and Anthropometric Measurements of Adolescent Females After a Two-Year Period. (1984)
Directed by Dr. Lucille Wakefield. 133 pp.

This study reassessed and compared the nutrient intake and body composition of 92 teenage females, aged 14 and 16 years old, who had participated in the S-150 study in 1981 and 1983. The nutrient intakes were determined by using two 24-hour dietary recalls. The body composition was estimated by using the anthropometric measurements of weight, height, arm circumference, and biceps, triceps, subscapula, and ileac skinfold thicknesses. The changes in the percentage of body fat among subjects over the two-year period was also estimated. A comparison between the two different methods of estimating the percentage of body fat in 1983 was performed. The correlation between energy or protein intakes and the percentage of body fat was investigated.

Over 15% of the entire sample in 1983 consumed less than two-thirds of the RDA for calories, calcium, vitamin A, and ascorbic acid. In certain age-race categories, over 15% of subjects also consumed less than two-thirds of RDA for thiamin and riboflavin. In 1981, nutrients consumed by over 15% of the sample at less than two-thirds of the RDA were calcium, iron, and ascorbic acid. Mean nutrient intakes for the 1983 population from diet alone differed significantly from intakes from diet plus supplements. Mean intakes of calories, protein, calcium, and vitamin A decreased significantly over the period 1981 to 1983.

Mean weight, height, and mid-upper-arm circumference increased significantly over the period 1981 to 1983, but there were no changes in triceps and ileac skinfold thicknesses. Estimated percentage of body fat did not change over the period.

Two methods used in 1983 to estimate percentage body fat gave statistically different (0.001) estimates. An increase in the number of skinfold thicknesses may result in an increase in the accuracy of the rough estimation of the percentages of body fat.

Based on data collected in 1983, there were no significant correlations between caloric intake and percentage of body fat or between protein intake and percentage of body fat. The increase in caloric intake was not associated with a corresponding increase in the percentage of body fat in this population.

ACKNOWLEDGMENTS

My sincere appreciation and deepest gratitude is expressed to Dr. Lucille Wakefield, adviser, for her advice, encouragement, guidance, suggestions, and support throughout the course of my doctoral studies and concomitant research. My heartfelt thanks is expressed for her concern, warmth, inspiration, and consideration which made my stay in a foreign country a rewarding experience.

I am particularly indebted to other committee members: Dr. Michael Liebman, S-150 Project Director, for his assistance, cooperation, and knowledge without which this research would never have materialized; to Drs. Elizabeth Schiller, Barbara Clawson, and Nance White for their assistance, knowledge, constructive evaluation, helpful suggestions, and insightful criticism which added perspective to this study. Their contributions of interest, moral support, warm concern, and consideration to my program are sincerely and deeply acknowledged.

Special thanks go to Dan Shade for his assistance in statistical analyses. Also, my appreciation is extended to Mrs. Alice Rice for editing of the draft and to Mrs. Jan Poole for typing of this dissertation.

A very special thanks is extended to my parents for providing early life experiences which enabled me to know the joy of learning. Being so far away from home, their prayers, sustaining love, and generous spirit were a constant source of inspiration to me while completing this degree.

TABLE OF CONTENTS

Page

CHAPTER

APPENDICES

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Adolescence is a dynamic period of life in which the individual rapidly undergoes a series of sequential physical and emotional changes that transform a child into an adult. Adolescence is the only period of life after birth in which the velocity of growth accelerates. The human body grows and develops more during adolescence than at any other time in life. During puberty, girls gain 50% of their adult body weight and 20% of their linear growth. Increases in skeletal and lean body mass, growth of vital organs, and onset of menarche accompany sexual maturation in girls (Burman, 1979; Tanner, 1962).

Nutrient requirements are strongly influenced by the velocity of growth during adolescence. It is obvious that nutrition is closely related to an adolescent's physical change, and as a result, optimum nutrition is necessary for optimum growth. Adolescent females are recognized as a high risk group in relation to nutritional health; they are thought to be the most nutritionally vulnerable of any age group, and at the same time a group that has the poorest nutrient intake of any in the general population. Poor dietary habits or inadequate dietary intake during adolescence can have lasting effects on the life of the teenager as well as on her future family. Yet, few data are available to indicate the quantitative nutritional requirements of this group or to verify its nutritional status. Moreover, information on the range of food intake of adolescents is insufficient.

Recent studies (National Center for Health Statistics, 1977; Pao & Mickle, 1981) have indicated that adolescents, especially females, have dietary intakes below the recommended levels of several nutrients.

However, even though adolescent females represent a high-risk group in society, their nutritional status has not been evaluated in a longitudinal study. The recommended daily allowances of most nutrients for adolescents are only an estimation based on studies with adults or infants (Alfin-Slater & Mirenda, 1980; Heald, 1979; Winick, 1982). Thus, adolescent females made good subjects for this study, in that many of their nutrient needs parallel their change in body composition which occurs during this period. The overall purpose of this study was to investigate and assess the change in dietary intake and body composition of adolescent females over a two-year period.

Background of the Study

Under the authority of the United States Department of Agriculture, the Agriculture Research Service has conducted a regional project entitled "The Nutritional Health of Adolescent Females." Its main purpose was to assess the nutritional health of adolescent females in the southern United States, including Arkansas, Oklahoma, Alabama, Louisiana, Tennessee, Virginia, South Carolina, and North Carolina. This study was a part of that which was administered by the S-150 Technical Committee.

Most of the procedures and instruments employed were standardized for use in the large project by the participating station so that the final collection of data would be both reliable and meaningful. Other procedures and instruments, however, were developed particularly for use in this study.

This study included 92 of the subjects who participated in 1981, in the first phase of the study, and who were followed up in 1983, the second phase. All subjects were from Guilford County in North Carolina.

Purpose of the Study

The purpose of this study was to investigate and assess the alteration in dietary intake and body composition of adolescent females during a two-year period. This longitudinal study was conducted in 1983 as a follow-up of the cross-sectional study that was undertaken in 1981. The following six specific objectives were formulated:

1. To determine the dietary adequacy of certain nutrients (i.e., total calories, protein, thiamin, riboflavin, niacin, ascorbic acid, vitamin A, calcium and iron) consumed in 1983 based on two 24-hour dietary recalls, using the 1980 Recommended Dietary Allowances (RDA) as the standard of reference.
2. To determine the differences in the nutrient intake of participants in 1983 with and without supplementation.
3. To determine the changes which occurred in nutrient intake during the two-year period of adolescent growth.
4. To assess the girls' anthropometric measurements in 1983 including body weight, height, arm circumference, and triceps, biceps, subscapular and ileac skinfolds.

5. To assess the alterations which occurred in the anthropometric measurements including body weight, height, arm circumference, triceps skinfold and ileac skinfold during the two-year period.
6. To estimate and compare the girls' percentage of body fat (a) in 1981 and 1983 by the use of the formulas of Keys and Brozek (1950) and Sloan, Burt, and Blythe (1962) and (b) in 1983 using two different formulas.
7. To determine whether a relationship exists (a) between total caloric intake and percentage of body fat in the 1983 study and (b) between protein intake and percentage of body fat in the 1983 study.

Statement of Hypotheses

To achieve these objectives, the current study focused on the following hypotheses:

H_1. There are no significant differences in the nutrient intake of participants in 1983 with and without supplementation.

H_2. There are no significant changes in nutrient intake during the two-year period.

H_3. There are no significant alterations in the anthropometric measurements during the two-year period.

H_4. There is no significant difference in the girls' percentage of body fat during the two-year period.

H_5. There is no difference in the estimated percentage of body fat of participants in 1983 when this parameter is calculated by two different methods.

H_6. There is no relationship between either caloric or protein intake and percentage of body fat in the 1983 study.

Definition of Terms

Adolescence. The period from the beginning of puberty until maturity. For the purposes of this study, adolescence refers to the period from 12 to 16 years of age.

Anthropometry. The taking of measurements of the human body or its parts.

Anorexia nervosa. A condition in which there is marked loss of appetite and, therefore, loss of weight accompanied by neurotic symptoms of varying degrees of severity.

Body image. The subjective picture an individual holds of his physical appearance based on his own observation and the reactions of others.

Longitudinal study. Continuous or repeated experimental observation and measurements carried on for an extended period with the same group of human subjects. In this study the period was two years.

Nutrients. One of the components of food such as protein, fat, carbohydrates, minerals, and vitamins.

Nutritional status. The health condition of an individual as influenced by his intake and utilization of nutrients and determined from the correlation of information obtained from physical, biochemical, clinical and dietary studies. In this study nutritional status includes assessment of dietary intake and anthoropmetric measurements.

Recommended Dietary Allowances. The level of intake of essential nutrients considered, in the judgment of the Food and Nutrition Board on the basis of available scientific knowledge, to be adequate to meet the known nutritional needs of almost every healthy person (National Research Council, 1980, p. 137). RDAs were used to assess the adequacy of the subject's dietary intake; intake of specific nutrients greater than or equal to 67% of the RDA were considered adequate.

Skinfold thickness. Measurements by caliper of thickness of a skinfold at a selected body site. These measurements are indicative of subcutaneous fat and of the state of nutriture. Commonly selected sites for measurements, particularly in nutrition surveys, are the triceps and biceps (upper arm), the subscapular region (just below the shoulder blade), and the ileac region (upper abdomen).

Limitations of the Study

Several limitations were recognized for this study. The sample was limited to healthy adolescent females, 12 to 16 years old, who attended Greensboro City and Guilford County Public Schools and participated voluntarily.

Not every individual who participated in 1981 was followed up in the study of 1983 because some could not be located due to change of address, and some were no longer willing to participate. Also, while the study was planned to have an equal number of black and white subjects in both the 1981 and the 1983 studies, the actual sample was more than 50% white.

The 24-hour dietary recall used in this study has certain disadvantages. Subjects may be unwilling or unable to accurately describe the types and amounts of foods eaten. Reported intake tends to be high when true intake is low or low when true intake is high. A further limitation was the variation in skills and coding errors on the part of the interviewers as they analyzed dietary data and recorded information from subjects. Dietary data obtained in 1981, in contrast, were computed and analyzed by using the Nutritional Analysis System (NAS) of the Department of Experimental Statistics, Louisiana State University. This change in analysis procedure was necessary in order to gain access to the data in a reasonable length of time. A random sample of 20 recalls from 1981 was calculated on the program used for 1983. The comparison with the NAS calculation for 1981 was essentially the same. Using two different systems for computing and analyzing the nutrient intake may have led to some variation in the results. Generalization of the results of this study should take into consideration these limitations.

CHAPTER II

REVIEW OF RELATED LITERATURE

The literature reviewed was for information related to nutritional recommendations for adolescent females, food habits of this group, and dietary survey methods. A discussion of anthropometric measurements in relation to the nutritional health of the adolescent females is also included in this chapter.

Nutritional Recommendations for Adolescents and Their Nutrient Intake

The nutrient requirements in adolescence have been determined by direct experimental studies of the age group, but only for a minority of the nutrients for which there are recommended allowances. Interpolation of nutrient requirements determined for adults or younger children is the most common approach taken to fill the gaps in the case of nutrients for which direct data are lacking (Alfin-Slater & Mirenda, 1980; Bass, Wakefield, & Kolasa, 1979). In general, recommended nutrient requirements are higher for adolescents than for any other age group (Heald, 1979). The nutrient needs of adolescents are best understood in the context of changes in body composition which occur during this period. In comparison to males, females experience a smaller increase in the lean body mass, but a greater increase in adipose tissue; thus, females need protein, iron, calcium, and zinc somewhat less than males do. Besides the change in body composition, recommendations regarding nutrient intakes should take into account socioeconomic, emotional, nutritional, psychological, and environmental factors (Tanner & Whitehome, 1962). Activity levels and stages of growth and development also affect nutritional requirements (Greenwood & Richardson, 1979).

Total Calories

The recommended energy allowance through ten years of age, according to 1980 Recommended Dietary Allowance (RDA), is 80 kcal/kg; this amount declines after age ten to become 38 kcal/kg for adolescent females. The RDA for girls 11-14 years of age is 2200 kcal and 2100 kcal for 15-18 year olds. The major components of the energy requirements are those for maintenance of the body both at rest and during physical activity. Recommended energy allowances for adolescents have decreased drastically over the years. The major reason for this decline is decreased physical activity and the increasingly sedentary life style characteristic of most American adolescents (Bass et al., 1979). Hamill, Drizd, Johnson, Reed, Rache, and Moore (1979) suggested that although females' dietary intake of energy is found to be below the recommended allowances throughout the first 15 years of life, their energy intake appears to be adequate for maintenance of satisfactory growth and development. Burman (1979), Lee (1978), and Forbes (1980) suggested that the caloric requirements of adolescents vary widely and that better correlations exist with physiologic stages of development than with chronological age. Winick (1982) reported that girls have their highest caloric intake at sexual maturity, the time of peak growth velocity and that all girls, regardless of income or race, decrease their caloric intake after the year of peak growth velocity. Girls in Daniel's (1976) study consumed 2500 kcal at 12 years of age and decreased their consumption to 1950 kcal at age 17.

In California, Hampton, Huenemann, Shapiro, and Mitchell (1967) studied 93 girls aged 17 years (59 whites, 25 blacks, and 9 orientals). They reported that only 11% did not meet two-thirds of the RDA for calories. In other surveys, the percentage of teenage girls who failed to receive two-thirds of the RDA for calories ranged from 41% (Lee, 1978) to 52% (Prothro, Mickles, & Tolbert, 1976). Lee studied 118 Kentucky teenagers including 51 white and 21 black females with a mean age of 15.5 years. The study by Prothro et al. (1976) included 27 adolescents in Alabama aged 13 to 18 years; 15 subjects were males and 12 were females; 19 subjects were blacks and 8 subjects were whites.

The Ten-State Nutrition Survey (1972) revealed that more than half of the 15- and 16-year-old females surveyed had inadequate intake of calories, or less than 38 kcal per kg. Mean caloric intake was less in the low-income states than in high-income states. Mean intake was less for black females in low-income states than for white or Spanish-American females.

Obesity rather than extreme leanness is the most prevalent energy-associated problem of adolescents (Garn, Clark, & Guire, 1975). One feature of many of the foods liked and consumed by adolescents is the high energy content (Huenemann, Shapiro, Hampton, & Bekucke, 1968).

Leverton (1968) reported that adolescents eat larger amounts of foods, including empty-calorie foods. Wharton (1963) evaluated the daily intake of nutrients for 421 adolescent boys and girls from Illinois aged between 13 and 18 years. The younger adolescents consumed greater proportions of the Recommended Dietary Allowances for calories. The nutrient intake of the black group was significantly better than that of the white group.

Protein

The 1980 protein RDA for adolescent females is 46 gm of protein per day. The recommended allowance for protein decreases from 2.0 gm/kg at ages 6-12 months to 0.6-0.8 gm/kg at age 18. Dwyer (1981) mentioned that from the end of the first year until the adolescent growth spurt protein requirements are fulfilled by an allowance of 1.5-2.0 gm/kg/day. Winick (1982) stated that because adolescence is characterized by rapid physical growth, protein intake should increase to provide for the rapid tissue expansions. From the Ten-State Nutrition Survey (1972) it was found that mean protein intake for all tennage subgroups exceeded dietary standards; however, approximately one-third of the females in the 12- to 16-year-old groups consumed less than 50 gm of protein. The First Health and Nutrition Examination Survey (HÁNES I) by Abraham, Lowenstein, and Johnson (1974) indicated that mean protein intake expressed per 1000 kcal showed little or no variation by race or income within most age groups. Two studies of adolescent females reported more than 10% of the sample had low protein intake. In rural Alabama, 11% of the sample received less than two-thirds of the RDA for protein; in Kentucky, 12% of the white girls and 19% of the black girls did not meet two-thirds of the RDA (Lee, 1978; Prothro et al., 1978). Winick (1982) stated that protein intake in girls from high-income families show no significant difference when compared to that of low-income girls.

Calcium

It is difficult to make dietary recommendations for calcium because calcium absorption can increase with adaptation to low intake, and absorptive efficiency is partially dependent on vitamin D status (Hampton et al., 1968). The recommended allowance for calcium in the United States is currently 1200 mg for both sexes until 18 years and 800 mg thereafter (National Research Council, 1980). Calcium requirements are closely associated with the growth of bone (Forbes, 1975). Total body calcium content differs by sex and by size and increased by approximately 20 gm per centimeter of final height for adults when determinations are made by neutron activation methods (Committee on Nutrition, 1978). Failure to meet the recommended allowance cannot be taken as evidence that a calcium deficiency state exists. Fortunately, even with very low intake, homeostatic mechanisms are sufficient to preserve serum calcium concentration (Forbes, 1975).

Calcium intake has been reported to be marginal in the diets of adolescents (Abraham et al., 1975; Dwyer, 1981; Greenwood & Richardson, 1979; Lee, 1978; Ten-State Nutrition Survey, 1972). Other studies of adolescents reported 49% (Hampton et al., 1967), 67% (Prothro et al., 1978), and 50% (Greger, Higgins, Abernathy, Kirksey, de Corso, & Baligar, 1978) of females consumed less than two-thirds of the RDA for calcium. Wharton (1963) reported in his study that the calcium intake of black girls was significantly better than that of white girls. Low intake of calcium and riboflavin was found to be related to decreased milk intake (Irwin & Kienholz, 1973). An investigation by Phillips and Briggs (1975) indicated that milk consumption in the United States has decreased by 22% while soft drink consumption had increased by 111% between 1966 and 1973.

Iron

The current recommended dietary allowance (1980) for iron throughout the second decade of life is 18 mg for females. Martin and Beal (1978) stated that increased growth during adolescence requires additional iron. Greenwood and Richardson (1979) observed that body requirements for iron are enormously variable during the years from 10 to 20 because of alteration in body size. Sexual maturity ratings are helpful in judging when requirements for iron are likely to be greatest. Iron intake as a percentage of RDA was lowest of all nutrients evaluated in the Ten-State Nutrition Survey (1972). Wharton (1963) evaluated the daily intake of nutrients for 421 adolescent boys and girls 13-18 years of age. He reported that the iron intake of the black group was significantly better than that of the white group.

Hampton et al. (1967) reported that 57% of the girls received less than two-thirds of the RDA for iron. Prothro et al. (1978) reported that 56% of their sample did not meet two-thirds of the RDA for iron. Schorr, Sanjur, and Erickson (1972) observed that 75% of the girls did not receive two-thirds of the RDA. Greger et al. (1978) reported that 55% of the girls were below two-thirds of the RDA, while

Lee (1978) observed that 75% of the black girls' and 78% of the white girls' diets were low in iron.

In the Ten-State Nutrition Survey (1972), more than 80% of all females in all age categories had iron intake below the RDA. Howe and Vaden (1980) reported that 104 adolescents consumed less than two-thirds of the recommended allowances for iron and that it is hard to get adequate iron in the diet of many adolescent girls who keep their caloric intake low. Haider and Wheeler (1980) stated that the mean iron intake of 150 teenagers (except 75 19-year-old blacks) was approximately 50% below the RDA. Adolescent girls were surveyed by Greger et al. (1978) for dietary intake of zinc and iron. The girls consumed means of 60% and 75% of the Recommended Dietary Allowances for iron and zinc, respectively. Huenemann et al. (1968) found that 22 of the 71 girls, 16 to 18 years of age who kept four weekly food records reported taking vitamin pills one or more times during the four weeks. As with the entire sample, the most neglected nutrients were calcium and iron since the more common vitamin supplements do not include these minerals. During adolescence, females experience an increase in need for iron with the onset of menses (Gaines & Daniel, 1974). Menstrual losses of iron in adolescents are widely variable, although losses appear to be correlated with apparent absorption of iron (Greger et al., 1978). A high incidence of iron deficiency anemia was noted among adolescent females in the HANES I (Abraham et al., 1974).

The Ten State Nutrition Survey (1972) and other studies (Dwyer, 1981; Gaines & Daniel, 1974; Hampton et al., 1978; Hodges & Krehl, 1965) have reported that adolescent females are particularly susceptible to iron deficiency, perhaps because of menstrual loss of iron, combined with high iron requirements associated with growth.

Vitamin A

The Recommended Dietary Allowances (RDA) for adolescent females for vitamin A is 800 retinol equivalents or 4000 International Units (IU). Dietary studies have shown that intake of vitamin A is often below the recommended level for adolescents (Baker, Frank, Feingold, Christakis, & Ziffer, 1967; Daniel, 1976; Kirksey, Keaton, Abernathy, & Greger, 1978; Schoor et al., 1972). In an extensive review of research related to vitamin A, Rodriquez and Irwin (1972) cited results of seven dietary studies including 1,836 subjects 13 to 19 years old. In their studies, the main daily intake of vitamin A from mixed diets ranged from 5,170 to 8,000 IU.

In California, Hampton et al. (1967) observed that 10% of the students did not receive two-thirds of the RDA; in Alabama, Prothro et al. (1976) stated that 41% of the sample did not meet two-thirds of the RDA; Schorr et al. (1972) in New York reported that 51% did not meet two-thirds of the RDA; Lee (1978) in Kentucky observed that 73% of the white girls and 87% of the black girls did not receive two-thirds of the RDA.

Ascorbic Acid

The RDA for ascorbic acid allowance for girls 11 to 14 years of age is 50 mg and 60 mg for girls 15 to 18 years of age (National Research Council, 1980). The human requirement for ascorbic acid has been estimated from the amount of ascorbic acid necessary to prevent scurvy, the amount metabolized in the body daily, and the amount necessary to maintain adequate reserves (Irwin & Hutchins, 1976).

Contradictory findings have been found in the literature regarding the dietary intake of ascorbic acid by adolescents. Haider and Wheeler (1980) reported that ascorbic acid intake of teenage girls was considerably higher than the 1974 Recommended Dietary Allowances. Abraham et al. (1974) indicated that ascorbic acid intake was adequate for adolescents in all age groups studied in HANES I. Other researchers have also reported adequate intake of ascorbic acid (Brown, Bergan, & Murgo, 1979; Etnyre, 1977; Prothro, Mickles, & Tolbert, 1976; Truswell & Darton-Hill, 1981). On the other hand, a study of adolescents in Indiana conducted by Greger et al. (1978) revealed that 26% of the subjects consumed less than two-thirds of the Recommended Dietary Allowances for ascorbic acid.

Hampton et al. (1967) observed that 15.5% of the students received less than two-thirds of the RDA for ascorbic acid. Schorr et al. (1972) and Prothro et al. (1976) found that 22% of their subjects did not receive two-thirds of the RDA. The study by Schorr included 118 adolescents (54 males and 64 females) in grades 7 through 12. A study by Greger (1978) reported that of 183 girls in grades 6-8, 26% received less than two-thirds of the RDA. Howe and Vaden (1980) found that 104 teenagers ate no breakfast, a habit which was associated with low ascorbic acid intake. Wharton (1963) reported in his study that the ascorbic acid intake of black girls was significantly better than that for the white girls.

The Recommended Dietary Allowances for the essential nutrients are presented in Appendix G. In summary, researchers have reported that American teenagers' diets are frequently deficient in calcium, iron, ascorbic acid, and vitamin A (Abraham et al. 1974; Greenwood & Richardson, 1979; Lee, 1978; Tenn-State Nutrition Survey, 1972; Truswell & Darton-Hill, 1981; Wharton, 1963). The percentages of subjects consuming less than two-thirds of their ascorbic acid, calcium, vitamin A and iron allowances were 21, 44, 51, and 69, respectively (Schorr et al., 1972).

Adolescent Food Habits and Eating Practices

There are both social and biological aspects of adolescent eating habits. These are affected not only by the opportunities that adolescents have to eat with their peers and away from the family, but also by policies of food manufacturers, advertising, and eating establishments aimed at this age group (Winick, 1982).

Lifestyle

Greger, Divilbiss and Adchenbeck (1979) reported that particular feelings and needs are evident in the extremes of behavior that characterize the adolescent lifestyle. Eating habits are influenced by the attitudes that stem from these feelings, so that adolescent behaviors both result in and are the result of poor eating habits. Adolescents eat primarily because they are hungry; however, they generally give a low priority to a healthful diet. Daniel (1976) reported that self-styled dietary regimens are apt to be inadequate in nutrients.

Frequently, adolescents use their behavioral responses through food to identify or isolate themselves (Bruch, 1973). Anorexia nervosa and obesity are examples of conditions in which food is being used as an emotional defense. Schorr et al. (1972), studying teenage food habits in New York, found that the complexity of the dietary pattern increases with lifestyle diversity, occupational level of parents, and higher educational level of the mother.

Meal Pattern and Food Consumption

Adolescents genrally have the reputation of being meal-skippers with breakfast and lunch more frequently missed than dinner/supper (Bass et al., 1979). Huenemann et al. (1968) found that lunch was skipped more often than breakfast was and that obese adolescents omitted breakfast more often than did non-obese adolescents. Teenagers' poor breakfast habits have been noted in other studies. Brown et al. (1979) noted that breakfast contributed less than 25% of the daily intake for a majority of the nutrients. Many adolescents avoid breakfast and engage in dietary practices designed to reduce their weight (Hampton et al., 1967). Girls reported eating breakfast more regularly when they were sixteen years old than when they were older (Huenemann et al., 1968). In California, 122 adolescent females completed food diaries that showed the mean number of meals consumed per week to be breakfact, 5.8 by non-obese and 4.5 by obese; lunch, 5.2; and dinner, 6.4. Samuelson (1971) found that breakfast provided 20%; lunch, 25%, and dinner, 32% of total energy. The remainder came from snacks. Greger et al. (1978) surveyed 133 13-year-old females in Indiana and found that 86% ate breakfast and 99% ate lunch and dinner. Their dietary patterns were usually different on Saturday and Sunday.

Snacking

Omitted meals are sometimes compensated for with snacks. There is no research evidence to indicate that frequent eating is detrimental to health (Leverton, 1968). Adolescents are snackers, eating more of their total food as snacks than adults do, perhaps because of work and school schedules and extracurricular activities or the desire to be independent, and/or to socialize with peers (Winick, 1982).

Truswell and Darton-Hill (1981) have characterized the food habits of adolescents as erratic becuase of their widespread snacking. Adolescents eat frequently during the day, but the time varies from one day to the next. A survey of 290 adolescent females in Indiana reported that 90% of the girls snacked at least once during the day (Greger et al., 1979). Another study reported snacking for 70% (Pao & Mickle, 1980), while the Ten-State Nutrition Survey reported snacking among 78% of the adolescents surveyed. Younger girls snacked more than did older girls, with an average of three to six snacks consumed per day. Lee (1978) reported that the number of snacks per day averaged 2.5 for white girls and 3.8 for black girls.

Howe and Vaden (1980) reported that snacking was an important part of the adolescent eating pattern and made a definite contribution to nutritional intake. Quantity and quality of snacks may play critical roles in determining the nutritive value of teenagers' diets. Brown et al. (1979) found that snacks contributed between 8% and 17% of the RDA for daily intake of all nutrients for 427 girls. It was found that from one-fourth to one-third of the adolescents' total calories came from snacks, a fact which indicated that a significant amount of other nutrients may also come from this source (Cala, Morgan, & Zabik, 1981). Favorite snacks among California girls were (in descending order) pie, cake, pastry, cookies, fruit, cereal and bread, soft drinks, ice cream, milk, eggs, meat, cheese, potato chips, and vegetables.

Some racial and socioeconomic differences were noted upon analysis of the dietary recall information in Huenemann's (1968) study of teenagers. Black girls tended to eat all meals less regularly than white girls did and tended to snack more frequently. Regularity of meals tended to increase with rises in socioeconomic status. However, Hueneman et al. (1968) concluded that eating patterns are more directly associated with ethnic origin than with socioeconomic status.

The family meal is becoming less important in the dietary patterns of teenagers. Even when the adolescents eat meals in their homes, they are more likely to be unconventional in timing or in what is eaten. Meals at odd times (like "brunch" or midnight snacks) are typical time variants of adolescents' meals (Huenemann et al., 1968).

Nutritional Disorders

The most common nutritional disorders are obesity, anemia, anorexia nervosa, and alcohol and drug abuse. Anorexia nervosa is serious but affects only about 1% of girls. It is a complex disorder in which the disturbed eating pattern is a manifestation of deep psychological problems. Because they usually have a warped body image and a fear of being fat, patients with anorexia nervosa starve themselves.

Their extremely low calorie intake seems to be the result of their underlying psychological disturbance (Daniel, 1976).

Obesity affects 10-20% of the population, but larger numbers of adolescents believe themselves to be over weight and worry about it. Obesity is not necessarily a result of high food intake (Heald, 1979). Results of four seven-day dietary records obtained by Hueneman et al. (1968) indicated that, in fact, obese girls tend to eat less frequently and skip meals more frequently than non-obese girls do.

Subjects who expended more energy did not necessarily eat more than subjects who were less active and subjects who consumed more food did not necessarily weigh more than other subjects weighed. Based on a survey of 450 senior high school females, Dwyer, Feldman, and Mayer (1967) described adolescents as "dieters" meaning that the subjects did not eat the kind or the amount of food they liked because they wanted to lose (or gain) weight. Triceps skinfold measurements indicated that 15% of the senior girls were found to be obese, but 61% of the total sample had dieted to lose weight. The reason given for dieting was discontentment with body appearance.

Dietary Survey Methods

Dietary intake studies are an integral part of most nutritional surveys. They can be used to estimate the sources and amounts of nutrients consumed, but by no means can be taken as absolute indicators of adequate nutrition. However, dietary intake studies are widely used to obtain presumptive evidence of dietary inadequacies or excesses in individuals or groups, and they may help in the interpretation of findings from clinical and biochemical studies (Christakis, 1973). Krause and Mahan (1979) mentioned that the most difficult aspect of nutritional assessment is the accurate recording and evaluation of dietary intake of individuals or groups. A number of methods are employed for assessing dietary intakes (Pike & Brown, 1975).

24-Hour Dietary Recall

The 24-hour dietary recall (or the 2- or 3-day recall) is the most popular, the easiest, and the most frequently used method for obtaining dietary intake of individuals or groups (Abraham et al., 1974; Young, Hanan, Tucker, & Foster, 1952). All dietary recalls are attempts to record all types and amounts of food and beverages consumed for any given period in the past; however, recall of amounts of food consumed during the previous 24-hour period provides the most accurate and reliable information. The actual intake can be estimated by household measurements (Bazzarre & Myers, 1979). Numerous studies comparing this technique with more lengthy ones have found that the 24-hour recall saves time for both the interviewer and the subject. The recall usually includes three meals plus snacks, all of which outline a meal pattern for the subjects (Greger & Etynre, 1978).

The use of 24-hour dietary recalls is more applicable to studies dealing with mean population intakes than with intakes of individual subjects. It is reported that the 24-hour recall yields approximately the same results as a 7-day record when used with a group of 50 persons or more and when an error of 10% can be tolerated (Howe & Vaden, 1980). When a large number of subjects is involved, the method is considered to be indicative of the dietary pattern or trend in group intakes (Bazzarre & Myers, 1979). Greger and Etynre (1978) demonstrated that the 24-hour recall provides valid estimates of the protein, energy, calcium, and zinc intake of adolescent females. On the other hand, when applied to individuals, the recall has several limitations: the previous day's intake may not be typical of the usual intake or the individual may not be able to accurately estimate the amounts of food consumed. Participants may withhold or alter information about their usual dietary habits because of poor memory or embarrassment or they may overestimate or underestimate their actual intake (Bazzarre & Myers, 1979; Krause & Mahan, 1979). In comparing the validity of the information from this method, Young, Hanan, Tucker, and Foster (1952) showed that the 24-hour recall tended to be as reliable as the dietary history for gross evaluation of nutritive intake. While one method is considered to be superior to all other methods for measuring dietary intake, a predictive validity exists for the 24-hour recall because of higher response rates and more representativeness (Burk & Pao, 1976).

As a procedure for obtaining the 24-hour recall information, a personal interview is preferred to the self-report technique. The interviewer's contact obtains more complete information and elicits more cooperation from the subjects (Bazzarre & Myers, 1979).

24-Hour Dietary Record

Dietary records are contemporaneous lists of food eaten with amounts of foods recorded either by weight, by household measures, or by menu. The dietary record method assesses the amount of food actually consumed over a specified time period. Weighed food records provide the most accurate food intake data for epidemiological studies (Bazzarre & Myers, 1979). Nutrient contents may be chemically determined or may be calculated from food composition tables. Food may be weighed by the subject or the interviewer, but the reliability and validity of this method vary when the subject weighs the food due to various factors which contribute to systematic bias (Burk & Pao, 1976). While accurate, however, the weighing method is the most expensive and time-consuming technique; therefore, it is usually limited to controlled metabolic studies.

The second type of dietary record, a record obtained by household measures, represents a means of collecting dietary information by volume. The quality of the data is best when subjects are cooperative and highly motivated.

The third type of dietary record is a record by menu, consisting of a list of all or specific food items consumed. The major advantage of the menu record, in comparison to dietary recall, is that all of the food items consumed are recorded at the time of consumption. The effect of memory in recalling the amount of food consumed is eliminated, and the accuracy of information is therefore increased (Bazzarre & Myers, 1979).

Dietary History

The purpose of using the dietary history in research is to compare the average food intake of an essential nutrient or the average level of the diet as a whole with certain clinical and laboratory findings (Burke & Pao, 1976). The major advantage of the dietary history is that it attempts to provide a picture of an individual's usual intake over long periods of time. Burke (1947) considered one month to be the maximum period for which recall might be sufficiently reliable. The problem with dietary history is that the procedure requires at least one hour. Because the method requires extensive interviewing, personnel must be highly proficient in interview techniques (Bazzarre & Myers, 1979). The dietary history provides a check on the completion of the 24-hour recall and additional information about dietary practices (Christakis, 1973).

Food Frequency

The food frequency rating is a tool used to evaluate food patterns by describing how often a specified food is eaten in a given time period, usually one day or one week. The technique employs self-completion questionnaires or interviews as a means of collecting semi-quantitative data on the frequency of consumption of food items (Bazzarre & Myers, 1979). Abraham et al. (1963) found that amounts of food consumed by subjects correlated well with certain biochemical analysis. This method is simple to administer, economical, and provides useful descriptive data; however, detailed information about food intake for measuring nutritional status could not be obtained through this method (Burk & Pao, 1976). The reliability and validity of the food frequency checklist were tested by Axelson and Csernus (1983). For reliability, a food checklist for recalling a subject's intake frequency of 62 food items was considered reliable as a measure of change when administered to the same group of young adults at six-month intervals. The validity was tested by comparing frequencies of food groups consumed by 12- to 14-year-olds in 1965 and by 23- to 34-year olds in 1977. Although recalled frequencies of the two groups were not precisely the same, they were remarkably similar. The similarities suggest that the food checklist reflects a reasonably accurate record of food intake. Results indicated that the food frequency checklist could be useful for evaluation of nutrition programs and in research.

Anthropometric Measurements

Anthropometric measurement is one of the basic techniques for the comprehensive assessment of nutritional status. Body measurements can indicate general growth, body fat stores, and by inference, nutrient intake (Gray & Gray, 1980). Anthropometry also provides valuable information on past nutritional history that cannot be obtained with equal confidence using other techniques (Guthrie, 1976). The advantages of anthropometry are that it is simple to perform, inexpensive, and noninvasive (Heymsfield, McManus, Smith, Stevens, & Nixon, 1982). The rapidity of obtaining anthropometric measurements with tape measure and calipers makes them extremely valuable for assessing the nutritional status of population. Anthropometric equipment is generally portable and relatively inexpensive (Brozek, 1956). However, some limitations are encountered. Guthrie (1976) mentioned that anthropometry provides only limited information on present nutritional status. Anthropometric indicators are not specific and deal only with the surface of the body. Moreover, adequate instruments and careful, standard measurements are necessary. Nutritional anthropometry requires standards against which to evaluate the data collected; it is most valuable when obtained over a period of time with regular, accurate, and consistent recording. The measurements most commonly obtained are height, weight, mid-upper arm circumference, triceps skinfold and subscapular skinfold thickness (Talwar, 1975). Some measurements such as height reflect past nutrition or chronic nutritional status. Others such as weight, mid-arm circumference, and skinfold thickness reflect present nutritional status (Krause & Mahan, 1979).

Weight and Height

The most important anthropometric measurements are weight and height. Miller, Coffman, and Brozek (1956) stated that body weight may be thought of quantitatively, as the sum of body fat plus the lean body mass. The metric system is preferred for recording the data. Lee, Kolonel and Hinds (1981) stated that obesity should ideally be assessed by direct measures of the degree of fatness such as skinfold thickness. However, these measures have been generally impractical to collect in large-scale nutritional investigations. Accordingly, a weight-corrected-for-height index, derived from body weight and height data, is used for estimating obesity indirectly. The underlying assumption in using the weight-corrected-for-height index is that body weight, after correction for height, is highly correlated with a direct measure of obesity. However, in the absence of a direct measure of obesity for comparison, a weight-height-derived index should at least be consistently highly correlated with body weight and independent of height in diverse population. Deficiency of total caloric intake, protein, or any other essential nutrient may be responsible for decreased rate of growth, and ultimately, for abnormally low height or weight. It was found in the Ten-State Nutrition Survey (1972) that adolescents in all population subgroups showed an excess of underweight when compared to standards commonly used in the United States.

Mid-Upper-Arm Circumference

Burgert and Anderson (1979) reported that arm measurements, being relatively easy to make and requiring a minimum of time and equipment, are more frequently used in nutritional surveys. In a study by Seltzer, Goldman, and Mayer (1965), upper-arm circumference was the anthropometric measurement most highly correlated with both body density and body weight. Gurney and Jelliffe (1973) stated that the arm circumference and triceps skinfold measures are useful in assessing nutritional status. The arm circumference alone, however, does not give a precise diagnosis. Frisancho (1981) stated that since the size of muscle is an indirect indicator of protein reserves, measurements of arm muscle size have been used to assess the nutritional status of children. These evaluations are usually made through comparison of the estimated upper-arm circumference of a given population against the "standard." The muscle circumference for children 6 to 15 years was estimated from the arm circumference of British children, reported Tanner and Whitehouse (1962).

Triceps Skinfolds

Bishop, Bowen and Ritchey (1981) and Robson, Bazin, and Soderstrom (1971) said that skinfold or fatfold measurements are simple, rapid, practical, and easily interpreted. The measurement of skinfold thickness is used widely as a quantitative index of caloric reserves, for an estimation of total body surface fat, and for measurement of leanness or obesity. Standards for triceps and subscapular skinfolds have been published to facilitate the evaluation of nutritional status.

The triceps skinfold thickness is correlated with other estimates of body fat derived from radiographic, densitometric, isotape dilution, and 40K counting. Pike and Brown (1975) reported that since the subcutaneous adipose tissue constitutes approximately 50% of the total body adipose tissue stores, skinfold measurements can serve a useful purpose in judging the total body fat of individuals. Himes, Roche, and Webb (1980) stated that the thickness of subcutaneous fat may be measured reliably and is highly correlated with total body fat and with the percentage of body weight that is fat. Cross-sectional fat areas are calculated, assuming that the limb is cylindrical and that the fat is distributed evenly about its circumference. Measuring the thickness of subcutaneous fat and the circumference of the limb at the same level makes it possible to calculate the area of the theoretical annulus of fat with its thickness equal to the fat thickness and its outer circumference equal to that of the limb. Subcutaneous fat thickness, however, is not uniformly distributed around the limb. Seltzer et al. (1965) mentioned that the triceps skinfold measure appears to be the best simple indicator of body density and hence, percentage of total body fat, in obese adolescent females when compared to measures from the subscapular, thigh, abdominal, and knee areas. It was determined that adolescent females with tricep skinfold thickness of 25 mm and over should be considered obese. In the Ten-State Nutritional Survey of 1968 to 1970, triceps skinfold values--20 mm to 24 mm for adolescent females aged 12 to 16 years--were considered an indicator of obesity. Seltzer et al. (1965) proposed a regression equation for the prediction of body density from triceps skinfold measurements, i.e., body density = 1.1516 - 0.09256 log (triceps skinfold). Dugdale and Griffiths (1979) felt that height and weight give a good indication of body mass, but the addition of skinfold thickness to the regression equation used to calculate fat body mass gave a better estimate. Four skinfold measure ments (triceps, biceps, subscapular and ileac) can be used to calculate body fat using the table developed by Durnin and Womersley (1977). Gray and Gray (1980) stated that the triceps skinfold measurements appear more subject to error than the other measurements. It is important that the proper caliper be used; generally, plastic calipers are not adequate.

Mid-Upper-Arm Muscle Circumference

Frisancho (1981) reported that anthropometric evaluations of the upper arm have become very valuable in the assessment of nutritional status of children and adults. The triceps skinfold thickness provides an estimate of the caloric reserves stored in the form of fat, and the upper-arm muscle circumference provides an indicator of body muscle mass or its main protein reserve. Gray and Gray (1980) stated that the most widely accepted anthropometric method is arm muscle circumference which could be calculated by using the formula: arm muscle circumference = arm circumference - π x triceps skinfold, where all measurements are in millimeters. The authors added that the upper-arm muscle circumference has been shown to be correlated with other measures of total muscle mass. Since muscle serves as the major protein reserve of the body, this measurement can be considered an index of the body's protein reserves. Weight for height and upper arm circumference, however, are composite measures reflecting both fat and muscle mass. Gurney and Jelliffe (1973) reported that the cross-sectional fat (F) and muscle (M) are more logical means for assessing caloric and protein reserves than are the fatfold and arm circumference.

Relationship of Energy Intake and Body Composition

Characterizing changes in body composition during growth is a means for understanding that the changes in body composition during growth are related to energy requirements (Falkner & Tanner, 1978).

The most common variables affecting muscle mass are undernutrition and decreased physical activity. Inadequate food intake directly limits energy for muscle protein synthesis, and indirectly decreases physical activity (Falkner & Tanner, 1978; Keys, Brozek, Hanschel, Mickelson, & Taylor, 1950).

Most body fat--in fact, 15 to 30% of body weight--is adipose tissue, and 50% of this adipose tissue is found in skin or subcutaneous tissue layers (Hirsch & Knittle, 1978). Changes in body composition during growth reflect differential growth rates of the body's components.

Females show an increase in muscle mass and body fat at puberty, particularly as they reach sexual maturity (Frisch, Revelle, & Cook, 1978). A study by Hampton et al. (1967) revealed that 93 16-year-old girls increased their lean body weight, stature, and other parameters from grade 9 to grade 12. The biceps and forearm circumferences increased slightly indicating a growth in musculation during these years. The adolescents' percentage of body fat increased during the tenth and eleventh grades and decreased during the eleventh and twelfth grades.

Johnson, Mastropado, and Wharton (1972) determined the change in energy intake and proportion of energy nutrients and the change in body composition as affected by an exercise program for a 10-week period. They noticed a significant decrease in skinfold measurements, an increase in estimated body density, and a decrease in body fat as a result. The decreased intake of carbohydrates and total calories was significant, whereas that of protein was not. Fat made up a higher percentage of the calories because protein, carbohydrate, and total energy intake decreased whereas fat levels remained approximately the same. Huenemann (1974) found that the leanest subjects had much higher energy intakes and the fattest subjects had lower intakes. Dwyer et al. (1967) indicated that the caloric excesses which lead to weight gain in obese adolescents appeared to arise from low activity levels rather than from high caloric consumption.

In summary, researchers have reported that American teenagers' diets are frequently deficient in calcium, iron, thiamin, vitamin A, and ascorbic acid (Abraham, Lowenstein, & Johnson, 1974; Greenwood & Richardson, 1979; Lee, 1978; <u>Ten-State Nutrition Survey</u>, 1972; Truswell &

Darton-Hill, 1981; Wharton, 1963). The percentages of subjects consuming less than two-thirds of their ascorbic acid, calcium, vitamin A and iron allowances were 21, 44, 51, and 69, respectively (Schorr et al., 1972).

No definitive research was found to explain the change in body composition of adolescent females between 12 and 16 years of age. The question remains whether adolescents change their nutrient intake and body composition over the two-year periods (12 to 14 and 14 to 16 years).

CHAPTER III

METHODS OF PROCEDURE

The study was undertaken at the University of North Carolina at Greensboro as part of a southern regional nutrition project (S-150) conducted by the USDA's Research Service entitled "Nutrition Health of Adolescent Females." The major objectives of the regional study were (1) to assess the nutritional health of adolescent females in the southern region and (2) to relate the nutritional health of adolescent females to socioeconomic factors, food habits, nutritional knowledge, behavioral characteristics, and physiological development.

The S-150 study included both cross-sectional and longitudinal components. The cross-sectional study, conducted in the period from January through May 1981, was used as a baseline data for the longitudinal study. Ninety-two of the 198 girls who were aged 12 and 14 in 1981 were retested. Data collection was scheduled from February through April 1983.

Sample and Selection of Subjects

A total of 92 females (56 white and 36 black) aged 14 and 16 were selected from the 198 females aged 12 and 14 who participated in the cross-sectional study conducted in 1981. These individuals comprised the sample group for this longitudinal study.

The medical history and criteria used for the selection of the cross-sectional sample in 1981 are included in Appendix B. The only criterion for selection of the current longitudinal sample was the willingness of the previous participants to continue in this longitudinal study. All 14- to 16-year-old participants were sent a letter (Appendix A) describing the study objectives and procedures and were invited to participate in the follow-up study. Each girl was then contacted by phone and asked if she wished to participate. In addition, a home visit was scheduled for each participant. Subjects who were willing to participate were asked to sign a consent form. An attempt was made to retest approximately equal numbers by age of white and black adolescent females.

Data Collection

First, approval of the study was obtained from the Department and the University Human Subjects Review Committees. Next, interviewers were trained to collect the appropriate information from participants during both the home visit and the UNC-G visit. During the month prior to the initiation of data collection, training sessions were scheduled in which the goals of the project were explained, and proper procedures and techniques were demonstrated. Interviewers were required to be skilled in dietary intake collection procedures and anthropometric measurement techniques. A Project Procedure Guidelines and Manual for Interviews (1981) was provided to each interviewer. The guideline included: a description of all procedures to be followed and copies of all forms to be administered (Appendix C).

To ensure confidentiality, code numbers were assigned to each participant, and these numbers appeared on all questionnaires, including those eliciting dietary intake information. A free breakfast was provided, and an incentive of ten dollars was given to participants who completed all aspects of the study. Transportation to the university for a Saturday interview and testing procedure was provided if needed.

Data Collection at Home

A home interview was scheduled at a time when both mother and daughter were at home. The questionnaires administered to the mother during the home interview included (1) a medical history of the daughter, (2) socio-demographic information, (3) a parent attitude research inventory, (4) internal-external locus of control information, (5) the Familism Scale, and (6) a nutrition knowledge test. The questionnaires that were administered to the daughter included (1) food recall (Form D-2), (2) food frequency, (3) Rosenberg's self-esteem scale, (4) internal-external locus of control information, and (5) the Familism Scale. All information was collected by a trained interviewer.

The home visit was conducted approximately two weeks before the research center visit. Each participant was provided a verbal explanation of the study including the general procedures to be followed. Both mother and daughter were asked to sign a consent form. The information was collected from both the mother or legal guardian and from the subject by a team of two researchers. Each home interview required approximately one and one-half hours for completion. The daughter's interview was conducted in a separate room to ensure privacy and confidentiality.

The medical history (Appendix B) was administered to determine whether or not the participant had any serious illness or condition which might interfere with normal nutrition. Subjects with nutritional disorders were considered to be disqualified from further participation.

Interviewers administered the 24-hour dietary recall (Form D2) (Appendix E) to the subjects, preferably in the kitchen. Subjects were asked to indicate all foods and beverages consumed during the previous 24-hour period, giving brand names of foods. Methods of preparation and recipes for dishes prepared at home were obtained. If meals had been eaten in restaurants, subjects explained portion sizes and methods of preparation. In addition to usual dietary intake, the dietary recall questionnaire elicited information regarding usual meal and snacking patterns, regularity of eating a family meal, vitamin supplementation, and concern about weight. At the end of the home visit, the subjects were scheduled for the university visit.

Data Collection at the Research Center at UNC-G

Subjects were asked to come to the research center at UNC-G on an assigned Saturday at 8:00 a.m. Data collection and test procedures lasted about four hours. Data collected at the research center included the following: (1) food recall (Form D-2), (2) food frequency questionnaire, (3) nutrition knowledge questionnaire, (4) an exercise and physical activity levels questionnaire, and (5) medical history of subjects. In addition, anthropometric measurements, blood pressure, sexual maturity rating, and a blood sample were obtained from each subject.

The typical schedule for data collection upon arrival was as follows:

1. Each girl was directed to the reception desk to check in.

2. Blood pressure was taken by a registered nurse or a qualified nursing student.
3. A fasting blood sample was obtained.
4. Anthropometric measurements including weight, height, arm circumference, and skinfold thicknesses were taken.
5. Sexual maturity rating was self-assessed.
6. Participants were invited to have breakfast.
7. Questionnaires and dietary recall Form D-2 were administered.
8. Subjects were paid $10.00 and were checked out.

The author participated in planning and coordinating the collection and coding of dietary intakes and in obtaining anthropometric measurements and activity level data.

Research Instruments

Instruments which were used for data collection included two 24-hour dietary recall forms (D1 and D2) and the anthropometric measurements form.

Dietary Intake Data Form

The 24-hour dietary recall method was used for collecting the dietary intake data (Appendix E). Trained interviewers collected the dietary intake information by asking each participant to recall all foods and beverages consumed during the preceding 24-hour period. Portion sizes were estimated in household measurements.

Measuring cups, spoons, and food containers served as models to help participants estimate quantities of actual intakes. Special props were provided to assist in the determination of appropriate portion sizes to ensure more accurate recording of actual intakes. Participants were asked to describe the method of food preparation and the brand names, if possible. Recipes were obtained for dishes prepared at home. For meals eaten out in restaurants, portion sizes and the method of preparation were obtained from the restaurant by the researcher. Total caloric and nutrient intakes were estimated by computer analysis.

Anthropometric Measurements Form

Weight, height, upper arm circumference and triceps, biceps, subscapular and ileac crest skinfold thicknesses were determined at the Research Center at UNC-G. All measurements were recorded on the participant's anthropometric data sheets (Appendix F).

Weight. Each subject was weighed in light clothing and without shoes or slippers on a calibrated single beam balance. In order to estimate nude weight, the weight of remaining clothing was estimated using a table of weight for usual clothing items (University of North Carolina at Greensboro, 1981). Before each weighing the scale was adjusted to zero. The subject was asked to stand on the center of the scale without touching anything. The weight was recorded to the nearest tenth of a kilogram.

Height. Standing height was obtained for each subject and recorded to the nearest centimeter. A nonwoven tape was securely attached with masking tape to a wall. Without shoes, each subject was instructed to stand erect against the meter tape scale, with feet parallel and with heels, buttocks, shoulders, and back of the head in contact with the surface of the wall. The head was held comfortably erect and straight so that the line of sight was horizontal; both arms were relaxed at the sides in a natural manner. A hardwood triangle in contact with the meter tape was lowered to touch the subject's head for determining the height (Jelliffe, 1966).

Upper-arm circumference. This measurement was taken midway between the acromion and olecranon processes on the right arm while it was hanging freely at the side. The midpoint was located with the forearm realxed at a 90^{o} angle and the upper arm hanging down freely. Measurements were recorded to the nearest tenth of a centimeter by using a plastic-coated insertion tape measure (Ensur-tape from Ross Laboratories). The tape was placed around the arm at the midpoint between the acromion and olecranon processes and adjusted accordingly to make it fit smoothly, but firmly around the arm without deforming its contour (Falkner & Tanner, 1978; Grant, 1979).

Skinfold Thicknesses

Skinfold measurements were obtained with a calibrated caliper (Lange Skinfold Caliper, Cambridge Scientific Instruments, Box 265, Moose Road, Cambridge, MD 21612) which met the recommendations of the Committee on Nutritional Anthropometry. The skinfold was firmly grasped and slightly lifted up between the forefinger and the thumb of the right hand, about one centimeter from the site of caliper application. Care was taken not to include underlying muscle. Three measurements were taken for each site and the results were averaged. The subject was asked to stand erect with feet together for all the skinfold measurements. Measurements of skinfold were taken at the triceps, biceps, subscapula, and ileac sites. The procedures to be followed have been described by Grant (1979), by Jelliffe (1966), and by Falkner and Tanner (1978).

Triceps. The tricep skinfold was measured on the back of the arm, halfway down the arm between the tip of the acromion and olecranon processes. The midpoint was located with the forearm flexed at a 90^0 angle and the upper arm hanging down freely. The measurement was obtained with the entire arm hanging relaxed at the side. Three measurements were recorded to the nearest tenth of a millimeter.

Biceps. The subject was asked to face the measurer with the arm held relaxed at her side and the palm facing forward. The skinfold was picked up over the belly of the biceps and one cm above the line marked for the upper arm circumference and triceps skinfold on the vertical line joining the center of the antecubital fossa to the head of the humerus. The caliper was applied to the marked level.

Subscapula. The subscapula skinfold was measured just below the angle of the right scapula. The fold was picked up in a line slightly inclined in the natural cleavage of the skin at approximately 45^0 to the spine.

Suprailiac. With the subject standing sideways with her arm folded, the skin was picked up vertically about one cc above and two cc medial to the anterior suprailiac spine. The caliper was applied just below the fingers. This site varied, depending on the position of the superior anterior ileac spine, and might be in the midaxillary line or anterior to it (Falkner & Tanner, 1978).

Upper-arm muscle circumference. Upper-arm muscle circumference was calculated from measures of the upper-arm circumference and triceps skinfold thickness using the formula given by Gray and Gray (1980): Arm muscle circumference = arm circumference - (π x triceps skinfold) with all measures in mm. Arm muscle circumference is well accepted as a sensitive index of body protein reserves (Grant, 1979).

Body density. Body density was calculated from the triceps skinfold measurement and the ileac crest measurements using the following regression equation: $x_1 = 1.0764 - (0.00081)(x_2) - (0.00088)(x_3)$ where x_1 = density (g/ml), x_2 = ileac crest skinfold thicknesses (mm) and x_3 = triceps skinfold thickness (mm) (Sloan, Burt, & Blythe, 1962).

Percentage of body fat. Percentage of body fat was calculated from body density by use of the formula given by Keys et al. (1950). Percentage of body fat = 4.950/density - 4.500 (Sloan et al., 1962). Body fat was also approximated from the sum of the four skinfold measurements (triceps, biceps, subscapula, and ileac) by using the table developed by Durnin and Womersley (1975). (See Appendix H.)

Analysis of Data

Statistical Analysis

A statistician was consulted for the statistical analysis of the data. Dietary data were analyzed by computer system at the University of North Carolina at Greensboro, with technical assistance through the UNC-G Statistical Consulting Center. The Statistical Analysis System (SAS) (Barr, Goodnight, Sall, Blair, & Chilko, 1979) was utilized for all data analyses.

Nutrient Analysis

Nutrient intake was determined by analyzing the 24-hour dietary recall data. The specific nutrients of interest were total calories, protein, thiamin, riboflavin, niacin, ascorbic acid, vitamin A, calcium, and iron. The dietary data obtained in 1983 were coded by the investigator and analyzed by using the North Carolina Computer Program (SAS), which is based on Agriculture Handbook No. 456 by Adams (1975). Nutrient contents of the dietary data obtained in 1981 were analyzed by using the Nutritional Analysis System (NAS) of the Department of Experimental Statistics, Louisiana State University, Baton Rouge, Louisiana. The NAS system includes nutrient intakes obtained from vitamin and mineral supplements. The UNC-G system, however, did not include the vitamin and mineral supplements in its coding system. Therefore, nutrients provided by vitamin and mineral supplements were computed separately and added to the nutrient intakes derived from the UNC-G computer system. This calculation allowed the comparison between calculated nutrient intakes in 1981 and 1983.

Adequacy of nutrient intakes was assessed by the use of the 1980 RDAs. Two-thirds of the RDA was considered adequate to meet the subjects' nutrient requirements. The selected nutrients of interest were calculated from the dietary recalls and expressed as a percentage of RDA. A two-tailed $\underline{t}$ test was used to evaluate the significance ($\underline{p} \leq 0.05$) of differences between the two years.

The percentage of body fat of each individual who participated in 1981 was compared to the percentage of body fat of each individual who participated in 1983, by the use of the Keys and Brozek (1950) formula.

Body density of the subjects in 1981 and 1983 was estimated by using the formula derived by Sloan, Burt, and Blythe (1962), which is based upon ileac and triceps skinfold measurements. Two additional anthropometric measurements performed in 1983 were the biceps and subscapula skinfolds. Therefore, the table developed by Durnin and Womersley (1974) which is based on biceps, triceps, subscapula and ileac skinfold measurements was also used to calculate the percentage of body fat of the subjects who participated in 1983.

Differences in estimated percentage of body fat obtained by the two methods were evaluated using a two-tailed t test ($p \leq .05$). The relationship between total caloric intake and percentage of body fat was studied to determine whether high caloric intake is associated with increased levels of percentage of body fat using Pearson correlation coefficient technique.

The relationship between protein intake and percentage of body fat is discussed in the results section. The alterations which may have occurred in body weight, height, arm circumference, triceps and ileac skinfolds, and estimated percentage of body fat during the two-year period were also evaluated using a two-tailed t test.

CHAPTER IV

RESULTS AND DISCUSSION

This study reassessed the nutrient intake and body composition of 92 urban teenage females, aged 14 and 16 years old, who had participated in the S-150 study in 1981. The changes in dietary intake and body composition over a two-year period were of particular interest. The distribution of subjects by age and race in 1983 is recorded in Table 1.

Table 1

Distribution of Subjects by Age and Race in 1983

	Age (years)		
Race	14	16	Total
White	32 (35%)	24 (26%)	56 (61%)
Black	17 (18%)	19 (21%),	36 (39%)
Total	49	43	92

Description of Nutrient Intake

The dietary intakes of energy and eight nutrients based on two 24-hour dietary recalls, expressed as mean intakes and percentage of the 1980 RDA (Table 2) were used to determine the adequacy of dietary intakes of participants in 1983 according to their age. The percentage of girls whose intakes were 67% or less than the RDA are presented in Table 3 and Figure 1.

Table 2

Mean Dietary Intakes[a] and Percentage of RDA Based on Two 24-Hour Dietary Recalls for Participants in 1983

Nutrient	14 Years Old (n=49) Dietary Intake $\bar{x} \pm$ SD	14 Years Old (n=49) % of RDA $\bar{x} \pm$ SD	16 Years Old (n = 43) Dietary Intake $\bar{x} \pm$ SD	16 Years Old (n = 43) % of RDA $\bar{x} \pm$ SD
Energy (kcal)	1753.0 ± 386.1[b]	80.7 ± 27.0	1956.0 ± 641.3	91.5 ± 30.0
Protein (gm)	67.6 ± 24.3	144.2 ± 47.4	64.3 ± 22.1	140.0 ± 48.0
Calcium (mg)	799.0 ± 415.1	67.5 ± 34.5	824.1 ± 580.2	69.7 ± 48.1
Iron (mg)	13.6 ± 9.3	76.0 ± 52.5	14.2 ± 11.3	78.8 ± 62.2
Vitamin A (IU)	4834.5 ± 3846.0	120.1 ± 95.0	5415.0 ± 4753.0	133.3 ± 119.0
Thiamin (mg)	2.5 ± 4.3	225.2 ± 393.5	3.2 ± 8.1	294.0 ± 729.0
Riboflavin (mg)	2.9 ± 4.4	230.7 ± 335.7	3.6 ± 8.1	278.0 ± 611.3
Niacin (mg)	23.8 ± 26.1	160.3 ± 175.3	25.0 ± 28.5	185.0 ± 204.1
Ascorbic Acid (mg)	138.1 ± 164.2	280.7 ± 327.0	138.0 ± 150.0	231.0 ± 250.0

n = number of subjects

[a]Includes nutrients provided by supplements.

[b]$\bar{x} \pm$ SD

Table 3

Percentage of Girls Whose Intake were 67% or Less Than RDA in 1981 and 1983

	1981					1983				
	12 Years Old		14 Years Old			14 Years Old		16 Years Old		
Nutrients	White (n=32)	Black (n=17)	White (n=24)	Black (n=19)	Total (n=92)	White (n=32)	Black (n=17)	White (n=24)	Black (n=19)	Total (n=92)
Energy	16	6	8	16	12	28	41	13	21	25
Protein	0	12	0	0	2	3	6	4	5	4
Calcium	25	35	21	58	33	47	65	38	84	55
Iron	59	41	21	53	45	63	41	42	79	57
Vitamin A	6	0	8	21	9	31	41	29	63	39
Thiamin	3	0	0	0	1	6	24	4	11	10
Riboflavin	0	0	0	5	1	3	29	4	21	12
Niacin	9	0	0	5	4	13	12	0	5	8
Ascorbic Acid	21	12	8	22	16	22	29	17	47	27

n = number of subjects

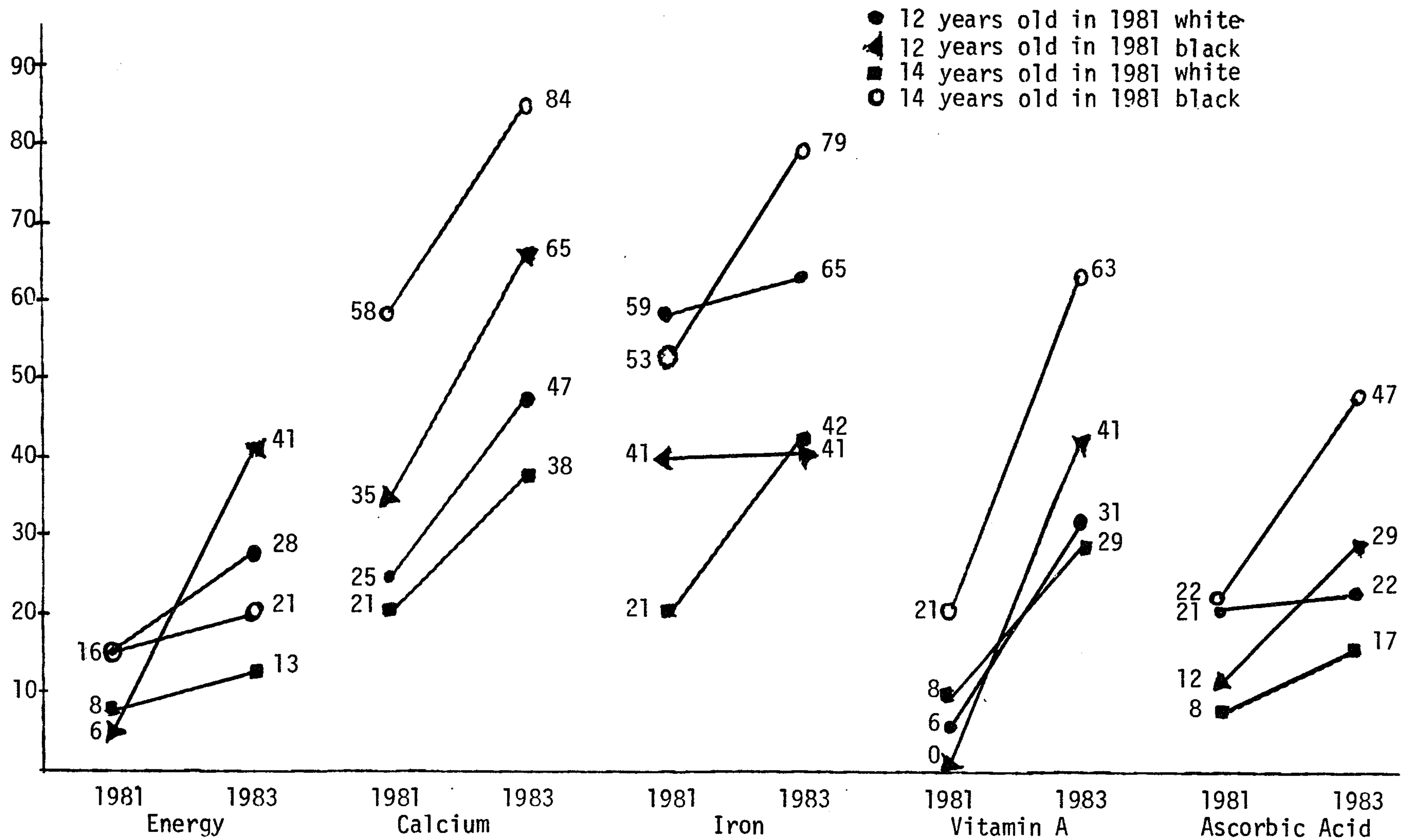

Figure 1: Percentage of Girls Whose Intakes Were 67% or Less than RDA.

Results (Table 2) indicated that the mean intakes of calories, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid met or exceeded two-thirds of the RDA. Calcium and iron mean intakes as percentage of RDA were lower and thiamin, riboflavin, and ascorbic acid mean intakes were higher than those for other nutrients. Findings also indicated that the 16-year-old girls had higher mean intakes of most of the nutrients than the 14-year-old females. Exceptions were protein and ascorbic acid. The group data had a wide range of variation as indicated by the large standard deviations.

The percentages of girls whose intakes were 67% or less of the 1980 RDA were calculated and are presented in Table 3. Findings from 1983 indicated that more than 15% of the subjects failed to receive two-thirds of the 1980 RDA for calories, calcium, iron, vitamin A, and ascorbic acid. The percentages of girls who did not consume two-thirds of the RDA for calcium and iron were 55% and 57%, respectively. Calcium was among the nutrients commonly lacking in the diet of black adolescents. Among 14- and 16-year-old blacks, 65% and 84%, respectively, did not consume two-thirds of the calcium RDA. Iron was a commonly lacking nutrient among the younger whites and the older blacks. The highest percentages of girls who did not consume two-thirds of the RDA for iron were found among the 14-year-old white girls (63%) and the 16-year-old black girls (79%). More than 25% of the subjects did not consume two-thirds of the RDA for energy, vitamin A and ascorbic acid (25%, 39% and 27%, respectively). The highest percentage of girls whose diets were lacking in vitamin A and ascorbic acid were older black girls. Protein, thiamin, riboflavin and niacin intakes were adequate for the majority of the subjects since only a small percentage of the girls consumed less than two-thirds of the RDA. Only 4% and 8% of the girls did not receive two-thirds of the RDA for protein and niacin, respectively. Accordingly, protein and niacin were considered among the best supplied nutrients. Thiamin and riboflavin also were among the best supplied nutrients for the sample groups. The girls who did not receive two-thirds of the RDA for these two nutrients were predominantly 12- and 16-year-old blacks. Except for iron in younger girls, findings revealed that black girls were more likely to have marginal nutrient intakes than white girls.

Discussion

Adolescence is a time when there is a rapidly increasing need for calories and nutrients. Hence, the Recommended Dietary Allowances (RDA) for most nutrients are greater than those for adult females. However, the dietary intakes of teenagers are often poor (Greger et al., 1978; Haider & Wheeler, 1980). Findings of this study indicated that while the mean intakes of the 1983 adolescent females for all nutrients were adequate (Table 2), more than 15% of participants failed to receive two-thirds of the RDA for calories, calcium, iron, vitamin A, and ascorbic acid (Table 3). Researchers have reported that a significant percentage of adolescents consume diets that do not meet two-thirds of the RDA for calcium, iron, vitamin A, and ascorbic acid (Abraham et al., 1974; Greenwood & Richardson, 1979; Greger et al., 1979; Hodges & Krehl, 1965; Lee, 1978; Schorr et al., 1972; "Ten-State Nutrition Survey," 1972; Truswell & Darton-Hill, 1981; Wharton, 1963). In the present study, calcium and iron were consumed in quantities less than two-thirds of the allowances by more than 50% of the participants. Other studies have reported similar findings (Hodges & Krehl, 1965; Lee, 1972; Schorr et al., 1978; Wharton, 1963). Prothro et al. (1976) reported that 57% of the girls studied did not consume two-thirds of the RDA for calcium. In the present study, the highest percentage (84%) of girls who did not receive two-thirds of the RDA for calcium was observed among the 16-year-old blacks. The "Ten-State Nutrition Survey" (1972) and the Health and Nutrition Examination Survey (Abraham et al., 1974) demonstrated that calcium intakes were higher in white adolescents than in blacks. This was consistent with findings of this study. Calcium requirements are closely associated with the growth of lean body mass and the mineral skeleton (Forbes, 1975). Failure to receive adequate intakes of calcium through the adolescent period may lead to a decreased skeletal mass and may cause a predisposition to osteoporosis in later life (Alfin-Slater & Mirenda, 1980; Heald, 1979).

Evaluation of the calcium status among a population, however, cannot be determined solely from calcium intake, because of the effect of other factors in the diet on calcium bioavailability (Pike & Brown, 1975). High protein intakes can negatively affect calcium balance (Krause & Mahan, 1979). The majority of girls in this study consumed a level of protein greater than 100% of the RDA. High levels of protein consumption could exaggerate the problem of low calcium intakes in this population.

Among subjects 14- to 16-years old, 57% did not consume two-thirds of the RDA for iron. Similar results were obtained by several researchers (Greger et al., 1978; Hampton et al., 1967; Lee, 1978; Prothro et al., 1976; Schorr et al., 1972), who reported that 47 to 75% of the girls did not receive two-thirds of the RDA for iron. Similar to the case with respect to calcium, the highest percentage (79%) of girls who did not meet the iron allowance occurred within the 16-year-old black subpopulation. Other investigators have reported that more black girls than white girls did not receive two-thirds of the RDA for iron (Lee, 1972; Winick, 1982). One of the possible reasons for the inadequate iron intake for the majority of subjects could be inadequate calorie intakes in the diet. Twenty-five percent of adolescents received less than two-thirds of the RDA for calories. Howe and Vaden (1980) reported that all students (104) interviewed consumed less than two-thirds of the RDA for iron and that it is hard to get adequate iron in the diet when caloric intake is low. The low iron intake among adolescents observed in this study during a period of rapid growth may predispose the girls to possible nutritional problems such as iron deficiency anemia (Dwyer, 1981; Gaines & Daniel, 1974). Greger et al. (1978) stated that it is impossible to know the state of iron nutriture simply by knowing iron intake since absorption of dietary iron varies. Calories, vitamin A, and ascorbic acid were also consumed in less than two-thirds of the RDA by 25, 39, and 27% of the subjects, respectively. These findings were in agreement with those obtained by Dwyer (1981), Hampton et al. (1967), Lee (1978), and Prothro et al. (1976) for calories; and by Prothro et al. (1976), Schorr et al. (1972) for vitamin A; and Greger et al. (1978) and Truswell and Darton-Hill, (1981) for ascorbic acid.

Protein, thiamin, riboflavin, and niacin were consumed in less than two-thirds of the RDA by 4, 10, 12, and 8% of participants, respectively. Several investigators reported that protein intake is more than adequate among American adolescents (Greger et al., 1978; Hodges & Krehl, 1965; Lee, 1978; Prothro et al, 1976). The intakes of thiamin, riboflavin, and niacin were relatively high, as judged by the small percentages of girls who did not receive two-thirds of the RDA. These findings were in agreement with Greger et al. (1978) and Hampton et al. (1967), but in contrast with the findings from other studies (Lee, 1978; Prothro et al., 1976).

Generally, the diet of more than 50% of the subjects studied was inadequate in one or more nutrients under consideration. The low intake may have resulted from lack of knowledge about nutrient content of the diet.

Use of Supplements

Hypothesis 1 stated that there are no significant differences in the nutrient intakes of participants in 1983 with and without supplements. A two-tailed _t_ test was used to test this hypothesis and the hypothesis was rejected. The distribution of subjects who used supplementation by age and race is recorded in Table 4.

The dietary intake of seven nutrients expressed as means and percentages of the 1980 RDAs with and without supplementation are presented in Table 5 for the total subject population and in Table 6 for only the 26 subjects who used supplements.

Table 4

Distribution of Subjects Who Used Supplementation by Age and Race in 1983

Race	Age (Year) 14	Age (Year) 16	Total
Whites	14 (54%)	10 (38%)	24 (92%)
Blacks	2 (8%)	0 (0%)	2 (8%)
Total	16	10	26

Twenty-eight percent (n=26) of the participants in the study took vitamin and/or mineral supplements on at least one of the two days for which dietary recalls were conducted. Of those participants, 16 subjects were aged 14 years and 10 were aged 16 years. The majority of these girls (92%) were white and two (8%) were black.

Mean intakes for the total group (n=92) came very close to meeting or exceeding the allowances for all seven nutrients studied when dietary intakes and nutrient supplements were considered together (Table 2). More than 15% of the participants, however, failed to receive two-thirds of the RDA for most of the nutrients (Table 3). The effect of supplementation by 26 subjects upon the mean dietary intakes of the entire group was investigated. Data for all participants indicated that there were significant differences (Table 5) in the percentages of RDA between nutrient intakes computed with and without supplementation. Exceptions were calcium in both age groups, and iron, thiamin and riboflavin in the 16-year-old girls.

Table 5

Mean Percentage of RDA of Nutrients With and Without Supplementation for Participants in 1983

Nutrients	14 Years Old (n=49)		16 Years Old (n=43)	
	W/O Supp.	W. Supp.	W/O Supp.	W. Supp.
Calcium	65.7 ± 36.7[a]	67.5 ± 34.5	66.0 ± 33.3	69.7 ± 48.1
Iron	59.2 ± 28.9	76.0 ± 52.5*	61.1 ± 24.3	78.8 ± 62.2
Vitamin A	98.0 ± 72.0	120.1 ± 95.0*	99.4 ± 81.5	133.3 ± 118.6*
Thiamin	108.0 ± 47.0	225.2 ± 393.5**	114.4 ± 49.9	294.0 ± 729.0
Riboflavin	123.0 ± 51.3	230.7 ± 335.7*	131.6 ± 63.3	278.0 ± 611.3
Niacin	101.0 ± 41.2	160.3 ± 175.3**	114.4 ± 48.1	185.0 ± 204.1**
Ascorbic Acid	184.0 ± 167.1	280.7 ± 327.0**	174.5 ± 165.9	231.0 ± 250.0*

[a] $\bar{x}$ ± SD

*$\underline{p} \leq 0.01$

**$\underline{p} \leq 0.05$

Further analysis of the data was performed to investigate the mean percentage of RDA of nutrient intakes for the 26 girls who used supplements (Table 6). Results indicated that there were significant differences in the percentages of RDA between nutrient intakes computed with and without supplementation. Again, exceptions were calcium in both the age groups as well as thiamin and riboflavin in the older girls. The 14-year-old girls did not supplement their diets with calcium. A noteworthy observation for iron only was that both age groups had mean intakes of less than two-thirds of the RDA before supplementation. A particularly large range of variation was observed in thiamin and riboflavin intakes with supplementation in older girls which may have partially accounted for the lack of significant differences between nutrient intakes with and without supplementation for these two nutrients.

Discussion

The wide variation observed for vitamins and the high mean intakes of certain vitamins such as thiamin and riboflavin (294% and 278% of RDA, respectively) (Table 2) among the older girls may reflect contribution of high intakes from nutrient supplements used by a small number of subjects.

Twenty-eight percent of the subjects in this study used supplements. Lee (1978) reported that 26% of the adolescent females in his study indicated they took supplements. Huenemann et al. (1968) found that 30% of the girls reported taking nutrient supplements. Sumner (1982) reported from the S-150 study that only 15% of the adolescent

Table 6

Mean Percentage of RDA of Nutrient Intakes With and Without Supplementation for 26 Participants Who Used Supplements in 1983

Nutrients	14 Years Old (n=16)		16 Years Old (n=10)	
	W/O Supp.	W Supp.	W/O Supp.	W Supp.
Calcium	65.8 ± 37.3[a]	65.8 ± 37.3	81.1 ± 40.3	96.5 ± 79.8
Iron	61.5 ± 27.1	109.3 ± 75.7*	60.4 ± 27.6	134.8 ± 105.5**
Vitamin A	101.0 ± 84.7	169.0 ± 126.0*	108.1 ± 64.0	250.4 ± 134.3*
Thiamin	108.9 ± 50.2	475.9 ± 634.5**	116.0 ± 48.5	868.5 ± 1389.3
Riboflavin	126.3 ± 55.4	461.8 ± 528.0**,	146.4 ± 61.1	760.8 ± 1161.3
Niacin	117.7 ± 37.0	298.6 ± 253.4**	108.8 ± 27.5	405.4 ± 330.4**
Ascorbic Acid	230.0 ± 211.4	533.0 ± 454.0*	231.8 ± 227.8	469.3 ± 363.6**

[a] $\bar{x}$ ± SD

*$\underline{p} \leq$ 0.01

**$\underline{p} \leq$ 0.05

girls who were subjects in 1981 took nutrient supplements. In her study the majority of subjects who received supplements were white as was also true in the 1983 population. Findings also indicated that there were significant differences in the nutrient intakes of the 26 girls with and without supplementation. The exceptions were thiamin and riboflavin in the 16-year-olds which could be partially attributed to high standard deviations; and calcium for both age groups. None of the 14-year-olds received a calcium supplement. Wharton (1963) reported that the more common nutrient supplements do not include calcium. Iron intakes without including iron derived from supplements were less than two-thirds of the RDA. Supplementation of iron raised the intake to more than 100% of the RDA. Hampton et al. (1968) reported that approximately a third of the girls in their study took nutrient supplements which increased the dietary adequacy, particularly in relation to iron.

Advertising claims and/or imagined benefits from taking vitamin and mineral preparations may lead many teenagers to take supplements. The consumption of a balanced diet would be a more appropriate way to meet the RDAs than the excessive reliance upon supplements. Nutrition education programs are needed to encourage adolescent females to consume diets rich in calcium, iron, vitamin A, and ascorbic acid. Discussion of the importance of nutrition in adolescent growth should be part of the nutrition education program. Establishing an awareness of the need for nutrients and an understanding of their importance could not only be of value during adolescent growth, but could serve as a basis for improved nutrition of the children of these future adults.

Changes in Nutrient Intakes Over A 2-Year Period

Hypothesis 2 stated that there are no significant changes in nutrient intakes as percentages of RDAs during the two-year period. When the data were analyzed by a two-tailed t test, this hypothesis was not rejected for calories, protein, calcium, and vitamin A. However, this hypothesis was rejected for the rest of the nutrients studied.

Table 7 lists the mean nutrient intakes of girls in both age groups for the two-year period as percentages of the 1980 RDAs. The RDAs for the 12-, 14-, and 16-year-old females are very similar with a slight decrease in the RDA for calories and niacin and a slight increase in ascorbic acid for the 16-year-olds (see Appendix G).

A comparison of the girls' nutrient intakes in 1983 with those in 1981 indicated that both 14- and 16-year-old participants had a tendency to decrease their nutrient intakes as percentages of RDAs with age. Exceptions were observed for thiamin and riboflavin in younger girls, and for niacin in both age groups. These nutrients showed an increase during the two-year period. For nutrient intakes which decreased during the two-year period, the reduction was statistically significant for calories, protein, calcium, and vitamin A in both age groups (Table 7). Nonsignificant decreases were also noted for iron and ascorbic acid in both age groups as well as thiamin and riboflavin in 14-year-olds in 1981 who became 16 years old in 1983. Even after grouping the girls by age, there was still a wide variation in most of the nutrients among individuals within each group, as indicated by large standard deviations. The largest variations among subjects were noted

Table 7

Changes in Mean Percentage of RDA of Nutrient Intakes With Supplementation During the Two-Year Period

Nutrients	1981 12 Y/O (n=49)	1983 14 Y/O (n=43)	1981 14 Y/O (n=49)	1983 16 Y/O (n=43)
Energy	101.7 ± 28.0	80.7 ± 27.0***	111.0 ± 31.1	91.5 ± 30.0**
Protein	163.8 ± 56.0	144.2 ± 47.4*	174.0 ± 62.3	140.0 ± 48.1**
Calcium	90.3 ± 36.4	67.5 ± 34.5***	83.6 ± 39.0	69.7 ± 48.1*
Iron	82.6 ± 47.4	76.0 ± 52.5	110.5 ± 145.0	78.8 ± 62.2
Vitamin A	248.3 ± 219.0	120.1 ± 95.0***	182.0 ± 122.1	133.3 ± 118.6*
Thiamin	218.4 ± 298.0	225.2 ± 393.5	505.2 ± 1630.0	294.0 ± 729.0
Riboflavin	225.2 ± 253.7	230.7 ± 335.7	388.0 ± 1212.0	278.0 ± 611.3
Niacin	128.3 ± 102.5	160.3 ± 175.3	163.1 ± 145.0	185.0 ± 204.1
Ascorbic Acid	359.0 ± 917.1	280.7 ± 327.0	370.2 ± 705.1	231.0 ± 250.0

[a]$\bar{x}$ ± SD

Y/O = years old

*$p \leq 0.05$

**$p \leq 0.01$

***$p \leq 0.001$

for thiamin and riboflavin and for ascorbic acid in both age groups. Calories showed the least variation among individuals as indicated by the smallest standard deviations.

The percentages of girls whose nutrient intakes were less than 67% of the RDA in 1983 were compared to those in 1981 by age and race (Table 3). In general, participants had higher nutrient intakes in 1981 as compared to 1983, as demonstrated by the smaller percentages of girls in 1981 who consumed less than 67% of most of the nutrients. The percentages of girls who consumed less than two-thirds of the RDA for energy, protein, and niacin in 1983 were approximately twice as great as the corresponding figures for 1981. In 1981, none of the white girls consumed less than two-thirds of the RDA for riboflavin, and none of the black girls consumed less than two-thirds of the RDA for thiamin.

The question as to whether the trends observed in nutrient intakes during the two-year period could be partially attributed to different rates of supplementation among subjects between 1981 and 1983 was addressed. Twenty percent (n=18) of the participants in 1981 reported supplement usage on at least one of the two 24-hour recalls compared to 28% (n=26) in 1983.

As was observed in 1983, calcium, iron, and ascorbic acid were nutrients often consumed by more than 15% of the 1981 participants in quantities less than two-thirds of the RDA. Also, as was observed in 1983, calcium was among the nutrients commonly lacking in black girls; 35% and 58% of the 12- and 14-year-old black girls, respectively, did not consume two-thirds of the RDA for calcium in 1981. Iron was a commonly lacking nutrient among the 12-year-old white girls (59%), and the 14-year-old black girls (53%). The clinical findings of other researchers working in this study indicated that in 1981, 8.9% of the adolescent girls had transferrin saturation levels less than 16% saturation. In 1983, researchers reported 18% of the girls had less than 16% transferrin saturation. The finding that twice as many girls in 1983 had transferring saturation levels below the norm suggested a higher prevalence of iron deficiency in 1983.

In general, findings from the longitudinal study indicated that calcium, iron, vitamin A, and ascorbic acid appear to be the most commonly lacking nutrients in this adolescent population. Their intakes declined with age as judged by the larger percentages of girls in 1983 than in 1981 who did not consume two-thirds of the RDA. This trend was particularly pronounced among the 16-year-old black girls. In this study the largest percentages of girls who consumed less than two-thirds of the RDA for calcium, iron, vitamin A, and ascorbic acid (84%, 79%, 63%, and 47%, respectively) were 16-year-old black girls.

Discussion

Nutrient intake data from 92 adolescent females studied in 1981 and 1983 were compared to determine whether nutrient intakes were altered during the two-year period. Since computed nutrient intakes from 1981 included the contribution of supplements, nutrient intakes with supplements from 1983 were used for the purpose of comparison.

General findings indicated that adolescent girls had a tendency to decrease their nutrient intakes with age. Calcium, iron, and ascorbic acid appeared to be the most commonly lacking nutrients especially among older black girls. Since a smaller percentage of participants took supplements in 1981 compared to 1983, changes in the adolescents' dietary intakes rather than alterations in supplement usage appeared to be responsible for the reduction in nutrient intakes with age. These findings are in agreement with findings obtained by other researchers (Daniel, 1976; Hamill, Drizd, Johnson, Reed, Roche, & Moore, 1979; Hampton et al., 1967; Heald, 1979; Hodges & Krehl, 1965; Huenemann et al., 1968; Inana & Pringle, 1975). These investigators reported that most adolescent girls in the United States decrease their calorie and nutrient intakes after the 12th year, the year of peak growth velocity for the majority of adolescent females.

Several reasons for the reduction in nutrient intakes by adolescents have been suggested. Daniel (1976), Heald (1979), and Winick (1982) reported that girls decreased their caloric intake after they had passed the peak of their growth spurt in approximately the 12th year. In addition, most girls in the United States wish to be trim, and middle to late adolescence is a period during which girls often intentionally decrease their food intake. Huenemann et al. (1968) stated that girls may decrease their nutrient intake because of a decrease in needs, a lessened gratification associated with eating, or to reduce weight. About 50% of the girls in their study expressed willingness to decrease their food intake in order to lose weight; this number increased as the girls grew older.

Adequate and balanced diets, however, are unequivocally the best for adolescents. Findings of this study revealed that the diets of almost 50% of the adolescents studied were inadequate in one or more of the nutrients under consideration. The data also suggested that the girls' diets became less adequate with age during a time of rapid growth and rate of maturation. Low dietary intake during this critical period could affect growth and/or body composition. Possible dietary effects upon body composition were the concern of the next hypothesis.

Evaluation of Body Composition

Body composition was one of the main concerns of this study. Anthropometric measurements were estimated to determine the change in body composition and to assess the percentage of body fat. These measurements include weight, height, arm circumference, and triceps, biceps, subscapular, and ileac skinfold thickness. In 1981, biceps and subscapular skinfold thicknesses were not measured. The biceps and subscapular skinfold thicknesses were assessed in the 1983 population and were used in conjunction with the triceps and ileac skinfold to estimate the percentage of body fat according to the Durnin and Womersley (1974) table.

Hypothesis 3 stated that there are no significant alterations in the anthropometric measurements during the two-year period. This hypothesis was rejected for measurements of weight, height, and arm circumference, but was not rejected for triceps and ileac skinfolds.

The means and standard deviations for selected anthropometric measurements by age for the two years studied are presented in Table 8. A two-tailed t test was used to determine whether significant differences occurred in the measurements during the two-year period of study.

Table 8

Changes in the Anthropometric Measurements According to Age During the Two-Year Period

Variables	1981 12 Y/O (n=49)	1983 14 Y/O (n=43)	1981 14 Y/O (n=49)	1983 16 Y/O (n=43)
Weight (kg)	45.7 ± 12.1[a]	53.4 ± 12.5***	51.3 ± 7.4	54.7 ± 9.8**
Height (cm)	153.0 ± 7.0	160.0 ± 6.3***	161.9 ± 6.4	164.5 ± 6.5***
Arm Circumference (mm)	23.7 ± 3.7	25.8 ± 4.2***	24.1 ± 2.7	25.5 ± 3.0***
Triceps Skinfold (mm)	16.4 ± 7.1	15.7 ± 6.7	15.1 ± 5.7	14.0 ± 7.2
Ileac Skinfold (mm)	12.2 ± 8.8	12.6 ± 7.5	10.5 ± 6.2	10.6 ± 7.3

[a]$\bar{x}$ ± SD

Y/O = years old

**$p \leq 0.01$

***$p \leq 0.0001$

Results indicated that there were significant changes in the measurements of weight ($p \leq 0.001$ and $p \leq 0.005$), height ($p \leq 0.001$, $p \leq 0.001$), and arm circumference ($p \leq 0.001$, $p \leq 0.001$) during the two-year period in the 14- and 16-year-olds, respectively. All the anthropometric measurements of girls were higher in 1983 than in 1981, except for triceps skinfold measurement which showed a slight reduction with age. The increase in the measurements was found to be larger in younger girls than in the older girls during the two-year period.

Discussion

Adolescence is the only period of life after birth in which the velocity of growth accelerates. It is obvious that nutrition is closely related to these physical changes and optimal growth requires an adequate supply of many nutrients (Winick, 1982).

The degree of the inadequacy of nutrient intakes cannot be projected from dietary intake alone because of the wide variability of individual requirements, the ability to adapt to changing levels of intake, and the inherent problems in methods of collecting and analyzing dietary data (Pike & Brown, 1975). Therefore, most investigations of nutritional status include additional criteria such as clinical, biochemical and anthropometric measurements. Miller et al. (1980) indicated that measurements of weight, height, and skinfold thicknesses are generally thought to be the most definitive anthropometric indicators of nutritional status. Gray and Gray (1980) stated that anthropometric measurements are one of the basic techniques for comprehensive assessment of nutritional status. These body measurements are indicative of general growth, body fat stores, and by inference, of nutrient intake.

This study included an evaluation of the various anthropometric measurements taken on adolescent females studied in the two-year period. Interpretation of the anthropometric data revealed that girls increased their body measurements by age in most instances (Table 8). These findings were in agreement with results obtained by Greger et al. (1978), Johnson et al. (1972), Noppa, Anderson, Bengtsson, Bruce, and Isaksson (1980), and Wells, Parizokva, Bohanan, and Kohl (1978). Such patterns of body structure were expected since girls were studied during a period of rapid growth. The findings that the increment in the anthropometric measurements were found to be larger in younger girls than in the older girls are also expected since growth is most rapid during early adolescence. There was a nonsignificant slight decrease in the triceps skinfold thickness as a possible result of the decrease in the caloric intake.

Changes in the Percentages of Body Fat Over a Two-Year Period

Hypothesis 4 stated that there is no significant difference in the girls' percentage of body fat during the two-year period. This hypothesis was not rejected.

The mean and standard deviation of the girls' percentage of body fat for both age groups during the two-year period is recorded on Table 9. The two-tailed t test was used to determine whether there were significant differences between the mean values.

The percentage of body fat was estimated to evaluate the change in body composition during the two-year period. Percentage of body fat of participants in 1981 and 1983 was estimated from body density by

Table 9

Comparison of Percentage of Body Fat During the Two-Year Period

	Year			Year	
	1981	1983		1981	1983
Variable	12 y/0 (n=49)	14 Y/0 (n=43)		14 Y/0 (n=49)	16 Y/0 (n=43)
Percentage of body fat	20.5 ± 5.9[a]	20.4 ± 5.7		19.5 ± 4.3	19.1 ± 5.6

a = $\bar{x}$ ± SD
Y/0 = years old

using the equation of Keys and Brozek (1950). Body density was calculated from the regression equation of Sloan, Burt, and Blyth (1962). This method for calculating percentage of body fat used triceps and ileac measurements only since these measurements were available from both years of the study. The data presented in Table 9 indicated that there was a very slight but nonsignificant decrease in the percentage of body fat of girls from both age groups during the two-year period.

Discussion

The previously reported findings indicated a significant decrease in total caloric intake and nonsignificant slight decrease in triceps skinfold thickness measurements during the two-year period. A comparison of the percentage of body fat for the two periods, 1981 and 1983, indicated a very slight but nonsignificant reduction in the percentage of body fat of girls in both age groups during the two-year period. Hampton et al. (1967) stated that there was a slight but nonsignificant decrease in the percentage of body fat of girls between 14 and 15 years of age, perhaps as a result of voluntary caloric restriction by many of the subjects. Himes et al. (1980) reported that percentage of body fat shows a decrease during late adolescence (12 to 17 years old). In this study, the slight, nonsignificant decrease in the estimated percentage of body fat during the two-year period was consistent with the slight, nonsignificant decrease observed in the triceps skinfold thicknesses and the reduction in the total caloric intakes. Johnson et al. (1972) observed that a decrease in triceps skinfold occurred with a corresponding decrease in the percentage of body fat. Dugdale and Griffiths (1979), Pike and Brown (1975), and Gray and Gray (1980) reported that measurements of subcutaneous fat are suitable for studying the change in body fat deposits.

Gray and Gray (1980) stated that triceps skinfold thickness is correlated with other estimates of body fat derived from radiographic, densitometric isotope dilution, and 40K counting.

Hypothesis 5 stated that there is no difference in the estimated percentage of body fat of participants in 1983 when this parameter is calculated by two different methods. This hypothesis was rejected.

The two-tailed $\underline{t}$ test was used to test hypothesis 5. A comparison of two methods for estimating percentages of body fat in 1983 is presented in Table 10.

There are several methods for calculating the percentage of body fat; two of which were used in this study. The first method, based on estimation of body density, has been described. The second method used a table developed by Durnin and Womersley (1974) which predicts the

Table 10

Comparison of Two Methods for Estimating Percentages of Body Fat in 1983

	14 Y/O (n=49)	16 Y/O (n=43)
	%	%
Body Fat Equation (1)	20.43 ± 5.7^{a}	19.05 ± 5.6
Body Fat Table (2)	24.69 ± 6.3***	23.5 ± 5.4***

a = $\bar{x} \pm SD$

***$p \leq 0.001$

Body Fat Equation = Percentage of body fat estimated by using Keys and Brozek's equation, and Sloan, Burt, and Blythe's regression equation.

Body Fat Table = Percentage of body fat estimated by using Durnin and Womersley's table.

Y/O = years old

percentage of body fat from triceps, biceps, subscapula, and ileac crest skinfolds. The percentage of body fat was higher by Durnin and Womersley's table in the two age groups. A significant difference ($p \leq 0.001$) was found between percentage of body fat calculated by the two methods.

Discussion

Since the two estimates of body fat differ, it is of interest to consider which method is more accurate. Seltzer et al. (1963) stated that no single formula is generally valid for the estimation of body fat. Since the subcutaneous fat layer varies in thicknesses from place to place and the distribution is not the same in all subjects, the sampling of several sites may allow a useful rough estimate of the total body fat.

Himes et al. (1980) stated that a combination or average of fat thicknesses on arm, such as biceps and triceps, is to be preferred to single measurements for estimating body fat. Noppa et al. (1980) suggested that the average of triceps and biceps skinfold is slightly more highly correlated with percentage of body fat than single thickness at biceps or triceps. Himes et al. (1980) reported that a combination of the thicknesses of subcutaneous fat at different selected sites are best indicators of total body fatness. The method of Durnin and Womersley is perceived to be more accurate since an increase in the number of skinfold thickness sites may result in an increase in the accuracy of the rough estimation of the percentage of body fat.

Relationship Between Calories, Protein Intake, and Body Fat

Hypothesis 6 stated that there is no relationship between caloric or protein intake and percentage of body fat in the 1983 study. This hypothesis was not rejected.

Pearson correlation coefficients were computed between the energy or protein intake and the percentage of body fat to test hypothesis 6. The percentages of body fat in 1983 were calculated by the two different methods and are presented in Table 11. Findings indicated that

Table 11

Pearson Correlation Coefficients for Energy or Protein Intakes with Percentage of Body Fat

	1981[a]		1983			
	12 Y/O[b] (n=49)	14 Y/O (n=43)	14 Y/O (n=49)		16 Y/O (n=43)	
Variables	BF 1[c]	BF 1	BF 1	BF 2[d]	BF 1	BF 2
Energy	-0.239	-0.062	-0.139	-0.149	0.031	-0.039
Protein	-0.164	0.007	-0.117	-0.141	-0.069	-0.033

[a]Body fat was not estimated using Durnin and Womersley's table 1981.
[b]Y/O = years old
[c]BF 1 = Percent of body fat estimated by using Keys and Brozek's equation.
[d]BF 2 = Percent of body fat estimated by using Durnin and Womersley's table.

there were no relationships between either caloric or protein intake and girls' percentage of body fat calculated by either of the two methods.

Discussion

The lack of correlation between energy intake and percentage of body fat is consistent with the findings of Hampton et al. (1967), Wells, Parizokva, Bohanan, and Jokl (1978), and Johnson et al. (1972). Johnson et al. (1972) reported that there was no correlation between the caloric intake and percentage of body fat as determined by the Keys and Brozek equation. They suggested that a high caloric intake in the diet did not necessarily result in a high percentage of body fat. The results from this study were in agreement with the aforementioned findings. Dwyer et al. (1967) indicated that the caloric excesses which lead to weight gain in obese adolescents appeared to arise from low activity levels rather than from high caloric consumption. In this study, findings also indicated that there was no relationship between protein intake and percentage of body fat. No previous study was found which could confirm this finding.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This study reassessed the nutrient intake and body composition of 92 teenage females, aged 14 and 16 years old, who had participated in the S-150 study in 1981. The sample in 1983 consisted of 49 girls 14 years of age and 43 girls 16 years old.

Of the 14-year-old girls, 32 were white and 17 were black. Of the 16-year-old girls, 24 were white and 19 were black. All participants were urban.

The nutrient intake was determined by using two 24-hour dietary recalls. The body composition was estimated by using the anthropometric measurements of weight, height, arm circumference, and biceps, triceps, subscapula, and ileac skinfold thicknesses. The changes in the percentage of body fat among subjects over the two-year period was also estimated. A comparison between two different methods of estimating the percentage of body fat in 1983 was performed. The correlation between energy or protein intake and the percentage of body fat was investigated.

Significant relationships were found for four of six null hypotheses formulated and tested in this study. Summarized below are the results of the hypotheses tested:

Over 15% of the entire sample in 1983 consumed less than two-thirds of the RDA for calories, calcium, vitamin A, and ascorbic acid. In certain age-race categories, over 15% of subjects also consumed less than two-thirds of RDA for thiamin and riboflavin. In 1981, nutrients consumed by over 15% of the sample at less than two-thirds of the RDA were calcium, iron, and ascorbic acid.

Hypothesis 1 stated that there are no significant differences in the nutrient intake of participants in 1983 with and without supplementation. This hypothesis was rejected. Mean nutrient intake for the 1983 population from diet alone differed significantly from intake from diet plus supplements.

Hypothesis 2 stated that there are no significant changes in nutrient intake during the two-year period. This hypothesis was not rejected for calories, protein, calcium, and vitamin A but was rejected for the rest of the nutrients. Mean intake of calories, protein, calcium, and vitamin A decreased significantly over the period 1981 to 1983.

Hypothesis 3 stated that there are no significant alterations in the anthropometric measurements during the two-year period. This hypothesis was rejected for measurements of weight, height, and arm circumference but was not rejected for triceps and ileac skinfold thicknesses. Mean weight, height, and mid-upper-arm circumference increased significantly over the period 1981 to 1983, but there were no changes in triceps and ileac skinfold thicknesses.

Hypothesis 4 stated that there is no significant difference in the girls' percentage of body fat during the two-year period. This hypothesis was not rejected. Estimated percentage of body fat did not change over the period 1981 to 1983.

Hypothesis 5 stated that there is no difference in the estimated percentage of body fat of participants in 1983 when this parameter is calculated by two different methods. This hypothesis was rejected. Two methods used in 1983 to estimate percentage of body fat gave statistically different (0.001) estimates. An increase in the number of skinfold thicknesses may result in an increase in the accuracy of the rough estimation of the percentage of body fat.

Hypothesis 6 stated that there is no relationship between caloric or protein intake and percentage of body fat in the 1983 study. This hypothesis was not rejected. Based on data collected in 1983, there were no significant correlations between caloric intake and percentage of body fat or between protein intake and percentage of body fat. The increase in caloric intake was not associated with a corresponding increase in the percentage of body fat in this population.

Recommendations

After consideration of the findings of this study, the following recommendations were made for future study:

1. Activity levels of subjects should be analyzed in conjunction with dietary intake to better evaluate the relationship between energy intake and changes in body composition.
2. Some differences in nutrient intakes were attributed to race in this research. Racial differences in anthropometric measurements were not evaluated. Further study should investigate the effect of race on sources of nutrient intake and anthropometric measurements.

3. The imbalance in the level of calcium and protein intake is of concern. Further investigation is needed to confirm the association and interaction between specific nutrients noted. Investigation should be done on the dietary protein and its relationship to dietary calcium in girls defined as at risk for calcium deficiency.
4. More than 50% of the subjects failed to receive two-thirds of the RDA for calcium and iron. Those girls are at risk of nutritional problems such as iron deficiency anemia or osteoporosis. Further evaluation of laboratory data for these subjects would help to explain the physiologic significance of these findings.
5. This study should be replicated to the northern area of the United States for regional comparison.
6. Information about dietary intake should be collected at different seasons to investigate the seasonal effect on nutrient intake of adolescents.
7. The majority of subjects failed to receive adequate amounts of calcium, iron, vitamin A, and ascorbic acid. Nutrition education programs should be focused on teenagers to encourage them to consume diets rich in these nutrients. Discussion of the importance of nutrition in adolescent growth should be part of the nutrition education program. Establishing an awareness of the need for nutrients and an understanding of their importance could not only be of value during adolescent growth but could serve as a basis for improved nutrition of children of these future adults.

BIBLIOGRAPHY

Abraham, S., Lowenstein, F., & Johnson, C. (1974). Preliminary findings of the first health and nutrition examination survey (HANES I), United States, 1971-72: Dietary intake and biochemical findings (DHEW Pub. No. (HRA) 74-1219-1) Washington, DC: National Center for Health Statistics.

Adams, C. F. (1975). Nutritive value of American foods in common units. (Agricultural Handbook No. 456). Washington, DC: United States Department of Agriculture.

Alexon, J. M., & Csernus, M. M. (1983). Reliability and validity of food frequency checklist. American Dietetic Association Journal, 83, 152.

Alfin-Slater, R. B., & Mirenda, R. (1980). Nutrient requirements: What they are and basis for recommendation. In R. B. Alfin-Slater & D. Kritchevsky (Eds.), Nutrition and the adult: Micranutrients. New York: Plenum Press.

American Academy of Pediatrics. (1978). Calcium requirements in infancy and childhood. Pediatrics, 62, 826-834.

Baker, H., Frank, O., Feingold, S., Christakis, G., & Ziffer, H. (1967). Vitamins, total cholesterol, and triglycerides in 642 New York city school children. American Journal of Clinical Nutrition, 20, 850.

Barr, A. J., Goodnight, J. H., Sall, J. P., Blair, W. H., & Chilko, D. M. (1979). SAS user's guide. Raleigh, NC: SAS Institute.

Bass, M. A., Wakefield, L. M., & Kolasa, K. M. (1979). Community nutrition and individual food behavior. Minneapolis: Burgess.

Bazzarre, T. L., & Myers, M. P. (1979). The collection of food intake data in cancer epidemiology studies. Nutrition and Cancer, 1, 23.

Bishop, C. W., Bowen, P. E., & Ritchey, S. J. (1981). Norms for nutritional assessment of American adults by upper arm anthropometry. American Journal of Clinical Nutrition, 34, 2530-2539.

Brown, P. T., Bergan, J. G., & Murgo, C. F. (1979). Current trend in food habits and dietary intakes of home economics students in three junior high schools in Rhode Island. Home Economics Research Journal, 7, 324-333.

Brozek, J. (1956). Body measurements and human nutrition. Detroit: Wayne State University Press.

Bruch, H. (1973). Eating disorders. New York: Basic Books.

Burgent, S. L., & Anderson, C. F. (1979). An evaluation of upper-arm measurements used in nutritional assessment. American Journal of Clinical Nutrition, 32, 2136-2142.

Burke, B. S. (1947). The dietary history as a tool in research. American Dietetic Association Journal, 23, 1041.

Burk, M. C., & Pao, E. M. (1976). Methodology for large-scale survey of household and individual diets (Home Economics Research Report No. 40). Washington, DC: U. S. Department of Agriculture.

Burman, D. (1979). Adolescent nutrition. Practitioner, 222, 615-623.

Cala, R. F., Morgan, R. J., & Zabik, M. E. (1981). The condition of children's snacks to total dietary intakes. Home Economics Research Journal, 10, 150-159.

Christakis, G. (1973). Nutritional assessment in health programs. Washington, DC: American Public Health Association.

Daniel, W., Jr. (1976). Nutrition and adolescence. Dietetic Currents, 3, 4.

Dorland's medical dictionary (24th ed.). (1965). Philadelphia: Saunders.

Dugdale, A. E., & Griffiths, M. (1979). Estimating fat body mass from anthropometric data. American Journal of Clinical Nutrition, 32, 2400-2403.

Durnin, J. V. G. A., & Womersley, J. (1974). Body fat assessed from total body density and its estimation from skinfold thickness: Measurements on 481 men and women aged from 15 to 72 years. British Journal of Nutrition, 32, 77-97.

Dwyer, J. (1981). Nutritional requirements of adolescence. Nutrition Reviews, 39, 56.

Dwyer, J. T., Feldman, J. I., & Mayer, J. (1967). Adolescent dieters: Who are they? American Journal of Clinical Nutrition, 20, 1045.

Etnyre, G. M. (1977). Nutritional assessment of female adolescents: Anthropometric measurements and validity check of the 24-hour dietary recall. Unpublished master's thesis, Purdue University.

Falkner, F., & Tanner, J. M. (1978). Human growth: Postnatal growth. New York: Plenum Press.

Forbes, G. B. (1975). Biological implications of the adolescent growth process: Body composition. In J. I. McKigney & H. N. Munro (Eds.), Nutrient requirements in adolescents. Cambridge: MIT Press.

Forbes, G. B. (1980). Nutritional requirements in adolescents. In R. B. Susskind (Ed.), Pediatrics nutrition. New York: Raven Press.

Frisancho, A. R. (1981). New norms of upper limb fat and muscle areas for assessment of nutritional status. American Journal of Clinical Nutrition, 34, 2540-2545.

Frisch, R. E., Revelle, R., & Cook, S. (1978). Components of the critical weight at menarche and at initiation of the adolescent growth spurt: Estimated total water, lean body mass and fat. In F. Falkner & J. M. Tanner (Eds.), Human growth: Postnatal growth. New York: Plenum Press.

Gaines, E. G., & Daniel, W. A. (1974). Dietary iron intakes of adolescents. American Dietetic Association Journal, 65, 275-280.

Grant, A. (1979). Nutritional assessment guidelines. Seattle: Wash.: Anne Grant, 1979.

Garn, S. M., Clark, D. C., & Guire, K. E. (1975). Growth, body composition, and development of obese and lean children. In M. Winick (Ed.), Childhood obesity. New York: Wiley.

Gray, G. E., & Gray, L. K. (1980). Anthropometric measurements and their interpretation: Principles, practices, and problems. American Dietetic Association Journal, 77, 534-539.

Greenwood, C. T., & Richardson, D. P. (1979). Nutrition during adolescence. In G. H. Bourne (Ed.), World review of nutrition and dietetics, 33, 1-41.

Greger, J. L., Divilbiss, L., & Aschenbeck, S. K. (1979). Dietary habits of adolescent females. Ecology of Food and Nutrition, 7, 213-218.

Greger, J. L., & Etynre, G. M. (1978). Validity of 24-hour dietary recalls by adolescent females. American Journal of Public Health, 68, 70.

Greger, J. L., Higgins, M. M., Abernathy, R. P., Kirksey, A., de Corso, M. B., & Baligar, P. (1978). Nutritional status of adolescent girls in regard to zinc, copper, and iron. American Journal of Clinical Nutrition, 31, 269-274.

Gurney, J. M., & Jelliffe, D. B. (1973). Arm anthropometry in nutritional assessment nonogram for rapid calculation of muscle circumference and cross-sectional muscle and fat areas. American Journal of Clinical Nutrition, 26, 912-915.

Guthrie, H. A. (1976). Nutritional status measured as predictors of nutritional risk in preschool children. American Journal of Clinical Nutrition, 29, 1048.

Haider, S. Q., & Wheeler, M. (1980). Dietary intake of low socioeconomic black and white Hispanic teenage girls. American Dietetic Association Journal, 77, 677-681.

Hamill, P. V. V., Drizd, T. A., Johnson, C. T., Reed, R. B., Roche, A. F., & Moore, W. M. (1979). Physical growth: National center for health statistics percentiles. American Journal of Clinical Nutrition, 32, 607-629.

Hampton, M. C., Huenemann, R. L., Shapiro, L. R., & Mitchell, B. W. (1967). Caloric and nutrient intakes of teenagers. American Dietetics Association Journal, 50, 385.

Heald, F. P. (1979). The adolescent. In D. B. Jelliffe & E. F. P. Jelliffe (Eds.), Nutrition and growth. New York: Plenum Press.

Heymsfield, S., McManus, C., Smigh, J., Stevens, V., & Nixon, D. W. (1982). Anthropometric measurements of muscle mass: Revised equations for calculating bone, free arm muscle area. American Journal of Clinical Nutrition, 36, 680-690.

Himes, J. H., Roche, A. F., & Webb, P. (1980). Fat areas as estimates of total body fat. American Journal of Clinical Nutrition, 33, 2093-2100.

Hirsch, J., & Knittle, J. L. (1978). Cellularity of obese and nonobese human adipose tissue. In F. Falkner & J. M. Tanner (Eds.), Human growth: Postnatal growth. New York: Plenum Press.

Hodges, R. E., & Krehl, W. A. (1965). Nutritional status of teenagers in Iowa. American Journal of Clinical Nutrition, 17, 100.

Howe, S. M., & Vaden, A. G. (1980). Factors differentiating participants and nonparticipants of the National School Lunch Program: Nutrient intake of high school students. American Dietetic Association Journal, 76, 451-457.

Huenemann, R. L. (1974). Teenage nutrition and physique. Springfield, IL: Charles C. Thomas.

Huenemann, R. L., Hampton, M. C., Shapiro, L. R., & Bekucke, A. R. (1968). Adolescent food practices associated with obesity. Federation Proceeding, 25, 4-10.

Huenemann, R. L., Shapiro, L. R., Hampton, M. C., & Mitchell, B. W. (1968). Food and eating practices of teenagers. American Dietetic Association Journal, 53, 17.

Inana, M., & Pringle, D. J. (1975). Dietary survey of low-income, rural families in Iowa and North Carolina: II. Family distribution of dietary adequacy. American Dietetic Association Journal, 66, 361.

Irwin, M. I., & Hutchins, B. K. (1976). A conspectus of research on vitamin C requirements of man. Journal of Nutrition, 106, 823-879.

Irwin, M. I., & Kienholz, E. W. (1973). A conspectus of research on calcium requirements of man. Journal of Nutrition, 103, 1019.

Jelliffe, D. (1966). The assessment of the nutritional status of the community (Monograph #53). Geneva: World Health Organization.

Johnson, F. E. (1981). Anthropometry and nutritional status. In Assessing changing food consumption patterns. Washington, DC: Food and Nutrition Board, National Research Council.

Johnson, R. E., Mastropaolo, J. A., & Wharton, M. A. (1972). Exercise, dietary intake, and body composition. American Dietetic Association Journal, 61, 399.

Keys, A., Brozek, J., Hanschel, A., Mickelson, O., & Taylor, H. L. (1950). The biology of human starvation. Minneapolis: University of Minnesota Press.

Krause, M. V., & Mahan, L. K. (1979). Food, nutrition, and diet therapy. Philadelphia: W. B. Saunders.

Krehl, W. A., & Hodges, R. E. (1965). The interpretation of nutritional survey data. American Journal of Clinical Nutrition, 17, 191.

Lee, C. J. (1978). Nutritional status of selected teenagers in Kentucky. American Dietetic Association Journal, 31, 1453.

Lee, J., Kolonel, L. N., & Hinds, M. W. (1981). Relative merits of the weight-corrected-for-height indices. American Journal of Clinical Nutrition, 34, 2521-2529.

Leverton, R. M. (1968). The paradox of teenage nutrition. American Dietetic Association Journal, 53, 13.

Martin, E. A., & Beal, V. A. (1978). Robert's nutrition work with children (4th ed.). Chicago: University of Chicago Press.

Manual for nutrition survey (2nd ed.). (1963). Washington, DC: Interdepartmental Committee on Nutrition for National Defense.

Mayer, J. (1960). Food composition tables: Basic, uses, and limitations. Postgraduate Medicine Journal, 28, 295.

Miller, T. M., Coffman, J. G., & Linke, R. A. (1980). Survey on body image, weight, and diet of college students. American Dietetic Association Journal, 77(11), 561-566.

Moody, D. L., Wilmore, J. H., Girandole, R. N., & Royce, J. P. (1972). The effects of a jogging program on the body composition of normal and obese high school girls. Medical Science Sports, 4, 210.

National Center for Health Statistics. (1977). Dietary intake findings: United States, 1971-77 (DHEW Pub. (HRA) 77-1647). Rockville, MD: Author.

National Research Council. (1980). Recommeded dietary allowances (9th ed.). Washington, DC: National Academy of Sciences.

Noppa, H., Anderson, M., Bengtsson, C., Bruce, A., & Isaksson, B. (1980). Longitudinal studies of anthropometric data and body composition. American Journal of Clinical Nutrition, 33, 155-162.

Pao, E. M., & Mickle, S. J. (1980, November). Nutrients from meals and snacks. Speech given at the 1981 Agricultural Outlook Conference, Washington, DC.

Phillips, M. C., & Briggs, G. M. (1975). Milk and its role in the American diet. Journal of Dairy Science, 58, 1751.

Pike, R. L., & Brown, M. L. (1975). Nutrition: An integrated approach (2nd ed.). New York: John Wiley.

Pipes, P. L. (1977). Nutrition in infancy and childhood. St. Louis: C. V. Mosby.

Prothro, J., Mickles, M., & Tolbert, B. (1976). Nutritional status of a population sample in Macon County, Alabama. American Journal of Clinical Nutrition, 29, 94-104.

Robson, J. R. K., Bazin, M., & Soderstrom, R. (1971). Ethnic differences in skinfold thickness. American Journal of Clinical Nutrition, 24, 864.

Rodriquez, M. S., & Irwin, M. L. (1972). A conspectus of research on vitamin A requirements in man. Journal of Nutrition, 102, 909-968.

Samuelson, G. (1971). An epidemiological study of child health and nutrition in a northern Swedish county: II. Methodological study of the recall technique. Nutrition and Metabolism, 12, 321.

Schorr, B. C., Sanjur, D., & Erickson, E. C. (1972). Teenage food habits. American Dietetic Association Journal, 61, 415.

Seltzer, C. C., Goldman, R. F., & Mayer, J. (1965). The triceps skinfold as a predictive measure of body density and body fat in obese adolescent girls. Pediatrics, 36, 212.

Sloan, A. W., Burt, J. J., & Blythe, C. S. (1962). Estimation of body fat in young women. Journal of Applied Physiology, 17, 967.

Stefanik, P. A., Bullen, B., Heald, F. P., & Mayer, J. (1981). Physical performance, skinfold measurements, activity expenditures and food consumption of college women. Health Physical Education, 32, 229.

Stone, C. P., & Barker, R. C. (1939). The attitude and interests of premenarcheal and postmenarcheal girls. Journal of Genetic Psychology, 54, 27.

Sumner, S. K. (1982). Vitamin A and ascorbic acid nutriture and snacking patterns of female adolescents. Doctoral dissertation, University of North Carolina at Greensboro.

Talwar, P. P. (1975). Developing indices of nutritional level from anthropometric measurements on women and young children. American Journal of Public Health, 65, 1170-1173.

Tanner, J. M. (1962). Growth at adolescence (2nd ed.). Oxford [England]: Blackwell.

Tanner, J. M., & Whitehome, R. H. (1962). Standard for subcutaneous fat in British children. British Medical Journal, 1, 446.

Ten-state nutrition survey. (1972). Nutrition Today, 8, 4.

Truswell, A. S., & Darton-Hill, I. (1981). Food habits of adolescents. Nutrition Reviews, 39, 43.

University of North Carolina at Greensboro, School of Home Economics. (1981). Project procedural guidelines and manual for interviewers. Greensboro: Author.

Wells, J. B., Parizokva, J., Bohanan, J., & Jokl, E. (1978). Growth, body composition and physical efficiency. In F. Falkner & J. M. Tanner (Eds.), Human growth: Postnatal growth. New York: Plenum Press.

Wharton, M. A. (1963). Nutritive intake of adolescents. American Dietetic Association Journal, 42, 306.

Winick, M. (1982). Adolescent nutrition. New York: John Wiley.

Young, C. M., Hanan, G. C., Tucker, R. E., & Foster, W. E. (1952). A compromise of dietary study methods: II. Dietary history versus 7-day record versus 24-hour recall. American Dietetic Association Journal, 28, 218.

APPENDIX A

LETTER TO PARTICIPANTS

THE UNIVERSITY OF NORTH CAROLINA

AT GREENSBORO

February 3, 1983

School of Home Economics
Department of Food-Nutrition-Food Service Management
(919) 379-5332; 5313

Dear

Nearly two years ago you and about 200 other girls from Guilford County participated in a teenage nutrition project conducted at UNC-G. The main purposes were to assess the nutritional status of teenage grils and to assess the influences of food habits, nutrition knowledge and other factors on the food consumption patterns of teenage girls.

The data collected in 1981 made up one-half of this project; so we would like to retest those girls who are now 14 and 16 years old and measure the changes that have occurred during the past two years. The procedures will be about the same. There will be one home interview (including questionnaires for you and your parent or guardian) and one Saturday data collection day at UNC-G. There will not be as many questionnaires as you were given two years ago and not as much blood will be drawn. Payment for participation ($10.00) will be given on the Saturday data collection day.

Please share this letter with your parent(s). The success of this project depends upon your continued participation. One of my assistants will be calling you within the next 1-2 weeks to find out when we can schedule your home interview.

Your results from the dietary assessment and nutritional status tests conducted in 1981 have been tabulated and we would like to share these results with you at the end of your participation this year. Because we wanted to collect data again this year, we could not share your results earlier. This knowledge could possibly have influenced your diets and lifestyle in such a way that the results obtained in 1983 would be altered.

I hope you will be able to participate, and I look forward to seeing you again when you come to UNC-G.

Sincerely,

Michael Liebman, Ph.D.
Assistant Professor

P.S. If you cannot participate in the second phase of this study and would like your 1981 results sent to you, please call 379-5313 or write me at the School of Home Economics, UNC-G, Greensboro, NC 27412.

GREENSBORO, NORTH CAROLINA / 27412-5001

APPENDIX B

MEDICAL HISTORY

S-150 REGIONAL PROJECT
Form A2
SUBJECT NO. ________________
DATE ______________________

SUBJECT ___________
STATE ___________
STATION ___________
YEAR 1 OR 3 _______

MEDICAL HISTORY
(to be asked of subjects)

We would like to ask you the following questions because the menstrual cycle and certain drugs can affect the outcome of some of the analyses we are doing. Your replies will be kept very confidential.

NOTE: Ask question 1 and 2 only if answer was "no" to question 1 in year 1.

1. Have you started your menstrual periods? 1 = yes 2 = no ______
   If yes, answer questions 2-5B. (If no, omit.)

2. How old were you when your menstrual periods started? ___________
   Age in years and months ___________________
   (Interviewer calculate and record in months.) ___________

3. Are your menstrual periods regular? 1 = yes 2 = no ___________
   If yes, what is the length of time between the first day of one period and the first day of the next one? ___________

   ____________ number of days.
   (Interviewer calculate and record. If irregular, leave blank.) ___________

4. Date when last period started ________________________________
   Day Month Year

   _________Day in cycle.
   (Interviewer calculate and record. Begin with date last period started and end with interview date.) ___________

5. Do you take medication for any of the following?
   If yes to A, B, or C, please specify the name of the medication.
   1 = yes 2 = no

   A. Pain related to menstruation ___________
      Specify __________________________
   B. To control regularity or flow of menstruation ___________
      Specify __________________________
   C. To control acne ___________
      Specify __________________________

6. Have you taken birth control pills? 1 = yes 2 = no ________
If yes, answer parts A-C.

A. Are you taking birth control pills now? 1 = yes
2 = no ________

B. If you are not taking them now, how long since you stopped taking them? ________number of months (record) ______

C. If you have taken the pill, what is the total length of time you took it? ______number of months (record) ______

7. If you are presently taking birth control pills, what type do you take: ________

0. Do not know
1. Brevicon, Midicon, Ovcon-35
2. Envoid E or #21
3. Demulen
4. Loestrin 1.5/30
5. Loestrin 1/20
6. Norinyl 1/50, Norlstebin 1/50, Ovcon-50, Orthro-Novum 1/50
7. Norinyl 1/80, Ortho-Novum 1/80
8. Ovral
9. Ovulen 21 or Ovulen 28
10. Other, specify ____________________

8. How often do you use each of the following? We need to know since they could affect the way the body uses food.

0 = never 1 = rarely 2 = 1X/mo 3 = 2X/mo
4 = 1-2X/wk 5 = 3-6X/wk 6 = 1X/day 7 = 2X or +/day

A. Smoking tobacco ____________ ________
B. Using pot (Marijuana)____________ ________
C. Drinking alcohol ____________ ________
D. Additive drugs, specify____________ ________

9. For each of the above used, how long have you used them. (Record time as months to nearest month starting with 1)

A. Smoking tobacco ________ ________
B. Pot ________ ________
C. Alcohol ________ ________
D. Additive drugs ________ ________

10. Have you taken an antibiotic during the past week?
1 = yes 2 = no ________

____

APPENDIX C

GUIDELINES FOR TRAINING AND CERTIFICATION OF INTERVIEWERS

Guidelines for Training and Certification of Interviewers Collecting 24-Hour Recalls[1]

These guidelines have been developed to complement and support the "General Instructions for Obtaining Dietary Information" provided by the Nutrition Analysis Systems (NAS) of the Department of Statistics at Louisiana State University. These guidelines were developed as a means of standardizing the training and certification of interviewers collecting dietary information in the S-150 project. Ideally training and certification procedures should be conducted by a trained team of nutritionists who have worked with the LSU system.

Each state (or station) should conduct training sessions for all interviewers at the same time. The purpose of the S-150 study as well as its goals and objectives should be reviewed for all attendees.

Interviewers should be required to read all dietary data collection information and review the NAS code book prior to attending the training session. After the NAS system and attached guidelines have been described, respondents should be given at least five examples of food items which need transcribed and coded.

Interviewers should then find a partner and complete a 24-hour recall. The recalls should be collected in the training session. Each recall should be reviewed for omissions and errors in documentation. All omissions and errors should then be presented orally for all interviewers. While the omissions and errors from the 24-hour recall training trial are being reviewed, interviewers should be given a standard recall to code using the NAS codebook and the guides for calculating amounts that we have provided from the National Heart, Lung, and Blood Institute (NHLBI). Examples used in the training session should be selected to illustrate as many (preferably all) of the features of the NAS system, and guides for making calculations.

After the training session, each interviewer should be required to code three standard recalls[2] and three community recalls. The nutritionist responsible for training and certification should review both sets of recalls. If five (5) or more errors in coding are found, the interviewer must code another set of recalls, achieving an accuracy rate of four (4) or fewer errors. If five or more errors in documentation are observed, then the interviewer must complete another set of

---

[1]Direct questions to Dr. Terry Bazzarre, Department of Food, Nutrition, and Food Service Management, School of Home Economics, University of North Carolina at Greensboro, Greensboro, NC 27412
Phone: (919) 379-5313

[2]Standard recalls used at UNC-G are available upon request.

three community recalls. (Community recalls should be completed with study-age subjects if possible.) When the interviewer has successfully completed this phase of training, they qualify for certification. A letter of certification should be mailed to the interviewer. A copy of this letter with supporting information should be kept on file with the project leader.

Since respondents may feelthat their diets are being "judged" by interviewers, it is important to discuss this issue with interviewers. Interviewers should create a sense of rapport with each respondent, greeting each respondent and explaining a way to help remember food eaten. Example:

> "I would like you to tell me about the things you had to eat and drink yesterday. Sometimes it's hard to remember everything. We've found that if you recount the sequence of your activities, that it helps you remember what you ate. It's important for us to collect as complete and accurate information as possible. We are not here to judge your diet as good or bad, so please feel free to tell me as much as you can remember. Tell me what is the first thing you had to eat or drink after you got out of bed yesterday morning."

If a respondent seems nervous, it is important to make her feel as relaxed as possible. In this regard, preface the beginning of the interview with opening remarks that express your genuine interest. Some suggestions are:

> "How are you feeling?"
> "What school do you attend?"
> "I really like the sweater you're wearing." etc., etc.

Be patient. Don't rush the respondent! They're helping us!

Errors will occur in collecting data. Interviewers and coders are the major sources of such errors (does a computer ever make an error?!). The two major types of errors will result from either incomplete or inaccurate information, and from coding errors. The following suggestions may reduce the source of errors:

<u>Documentation</u>

1. If beverages contain ice, ask respondents to estimate how much ice was present. A 16-oz cup <u>packed</u> with ice may hold only 6-oz liquid.

2. Be sure to get a complete description. For any food item that cannot be evaluated in household units, be sure to get dimensions (cakes, pies, cookies, breads, cuts of meat, etc.).

3. For recipe items, document all ingredients or components so that the coder doesn't have to create data (i.e., the coder doesn't have to interpret the data). For example, (1) low-fat milk should be recorded and not just milk; (2) brownie, homemade with Fleishman's margarine, 2 x 2 x 1 inch square, no nuts, chocolate icing 1/4" thick made with cocoa and butter.

4. We will not use code number 3 for general snack since there are four time categories (e.g., pre-morning (?), morning, mid-day, post-night (?)).

Coding

The NAS computer analysis system does not calculate amounts (weight) of food items consumed. Since dimensions vary for may items we are providing self-explanatory guides that may facilitate conversions. A medium-sized cookie can vary quite a bit, especially if one person eats 10 (3-inch diameter) medium-sized cookies, and another person eats 10 (2-inch diameter) medium-sized cookies. These guides are from the NHLBI Code Book. If all stations used these guides, the data collected would be coded by standardized procedures. (Selected pages from these guides are included in this manual, pages 23-1 through 23-27. Pages are printed on purple ditto! Yes, the numbering system is curious!)

We can give you values in ounces or grams for specific items (e.g., chitterlings, cooked, 1 cup = 161 grams; bagel, 3" diameter = 55 grams). Some of these guides provide conversions only to amounts in cubic inches; however, the guide "Common Measurements" provides conversions from cubic inches to cup equivalents. Hopefully this conversion will work for all calculators. We will adapt these guides as necessary when we begin our coding operations. Any additions or changes that we discover, will be forwarded to those of you who request this information.

General Instructions for Obtaining Food Recall and Dietary Information

Two forms have been developed for obtaining food recall and dietary information. Recall #1 (Form D1) contains questions related to the dietary pattern of the subject as well as questions relating to the particulars of what the subject consumed in the previous 24-hour period (24-hr recall). Recall #2 (Form D2) is similar to Recall #1 except the dietary pattern questions are removed. Each form will be administered once between January and May during the first and third years of data collection.

It is highly desirable that those taking the food recalls have a background in foods and nutrition and that they be trained by a person experienced in taking food recall information. General guidelines for taking 24-hour recall follow. Recalls should be taken from each girl in private, if possible, but certainly out of the hearing range of other participants. Recalls of the kinds of foods eaten should precede quantification of amounts eaten to reduce the chance that looking at food models will suggest that certain foods should be reported when, in fact, they were not eaten. In asking questions and in setting up the physical environment for the interview, care should be taken to avoid suggesting responses to the participants. In estimating amounts of foods consumed, it is suggested that 3-dimensional food models and/or glasses, bowls, spoons, and other utensils whose volumes have been calibrated be used. It is also helpful to have the subject draw on a piece of paper the serving size of a particular food item (i.e., serving of steak, piece of cake, homemade cookie). Interviewers should try to get as much descriptive information from the participants as possible about how the food consumed was prepared. For example, if potatoes were eaten, be sure to find out whether they were fried, baked, mashed; if mashed, find out if they were eaten plain or with gravy, etc.

Forms D1 and D2

These two forms (D1 and D2) will allow the interviewer to probe the subject so the needed information is obtained. Interviewers need to fill in all information on these forms. When obtaining the data have the subject describe completely the consumed food including method of preparation and brand name where applicable and if known. The size of a serving (household units) as well as the number of servings (frequency of household units) must be acquired from the subject:

Example:

A subject had two 6-ounce glasses of milk

Amount in household units - 6 oz.
Frequency of household units - 2

On the forms, five colums of information are found for each question asking "What did you eat or drink?"

(A) Food/Drink
(B) Amount in household units
(C) Frequency in household units
(D) NAS ID
(E) Weight in grams

These questions are to be used to obtain the information from the subject as well as to serve as a work sheet to ease the transfer of the data to the code sheet. Only A, B, and C need to be filled in during the interview. Afterwards, the interviewer, using the NAS title listing, will record the other two columns--D and E. The appropriate food identification number will be found in the title listing along with conversion factor which allows for the changing of household measurements to grams. The "frequency of household units x the weight of a serving (grams)" gives the total amount consumed (grams). An example of this process can be found in the NAS User's Guide. When the data are transferred to the recall code sheets, only columns C, D, and E will be needed.

Introductory Procedures

The respondent's first reaction to the interview situation is likely to be a mixture of curiosity and a desire to be courteous to a stranger. While this amount of interest is not sufficient to conduct a full interview, it does allow the interviewer time to demonstrate friendly intentions and to describe the survey in such a way that the respondent's further interest is stimulated.

Naturally, the first thing the respondent notices about the interviewer is appearance. Aim for simplicity and comfort; a simple suit or dress is best. Avoid identification with groups or orders (pins or rings, for instance, of clubs or fraternal orders). The respondent should be led to concentrate on you as a person, and the interview you want to conduct and not on the way you are dressed.

Making the Introduction

The wording of the introduction should be developed to fit the particular individuality of the interviewer and that of the respondent. It should be one that makes both feel at ease and leads directly into the interview. There are four basic points which should be kept in mind in an introduction:

1. Identify yourself by name as a representative of the University of North Carolina at Greensboro (other schools in region insert own names here).

2. Tell the respondent what you are doing. The instruction book for the survey will give you background information. Try to have this information clearly in mind, since it must be explained to the respondent in a way to stimulate interest.

3. Thank the respondent for agreeing to participate. It is important that the respondent understand she and her daughter are part of a "cross-section" survey.

4. Assure the respondent that the information will be held strictly confidential and will not be used to her disadvantage in any way whatsoever. The information for any one family is added to that for many other families and released as a report for the group as a whole with no individual cases pinpointed.

The manner in which you adapt yourself to the situation from the respondent's point of view determines considerably the rapport that will develop. A little discussion about the weather, the children, the dog, gardening, homemaking--are topics in which you can establish a joint interest in the respondent as a person and your good intentions may be more firmly established in this manner.

The most natural approach to an interviewing situation is the best. When you go to a family for an interview, your approach will need to be adapted to the situation. Some of the following points may be helpful for you:

> "Hello, my name is ____________. I'm working with UNC-G in the nutritional health project you agreed to help us with. I would like to ask you some questions about your daughter, subject, and your family in general if I may. This will take over an hour of your time. There are also questions for subject to answer."

> "The information you give me is confidential and will be used only in combination with information from all the other parents we talk to."

Mothers and daughters may be sensitive to some of the questions. Therefore, a preliminary reassurance is in order so that parents and daughters will not be offended. You may reassure them by incorporating this statement into the interview conversation:

> "Questions were designed for a wide range of people in many different states; therefore, some of the questions may not seem appropriate to the age or situation of your daughter. We are aware of these differences and realize that you may be sensitive to some topics. We must ask all questions, however, in order that all people are given a chance to respond in the way that best fits them--their situation and their opinions or feelings."

Appointments for the Interview

Once a time has been set for an interview, it is important that the interviewer keep the appointment on time. Being either early or late for an appointment might inconvenience the respondent and result in an unpleasant situation.

It takes time for an interview. It takes time to get acquainted; to create the friendly atmosphere that is necessary for a satisfactory interview. However, it is up to you to pace the interview. If you sense that things are not going well and that you should schedule completion at a later time, arrange the details with the respondent.

Putting the Respondent at Ease

The best way to put the respondent at ease is to act and feel at ease yourself. Act natural and make your own remarks conversational. If possible, notice what the respondent is doing, or some interesting feature of the home, or activity you notice--something she can rightly take pride in. We all know, of course, that the subject of weather has for years served as a useful topic for comment in getting acquainted.

An Interview is a Private Affair

It is not good policy to interview a person in the presence of a group such as neighbors or peers. Each person's privacy must be respected. If you ask questions in the presence of others, the respondent will put little faith in your statements that the information he gives will be kept confidential. He is less likely to give actual facts. The presence of other family members should not prevent an interview; but, it would be desirable to interview each respondent as independently and privately as possible.

Instructions for Using the Interviewing Schedule

The following are general instructions for using the interview forms. Specific instructions for each form are included in Section 111 B. Refer to those instructions and learn the guidelines for administering the various forms.

Recording

1. Record responses to the interview questions in pen or pencil, whichever you prefer. When you recheck your questionnaire, do all marking in the other medium (pen, if you have interviewed in ink). WRITE LEGIBLY. Be sure that every relevant question is answered or an explanation is given for no answer.

2. Use an appropriate method to record responses. Be very careful that marks clearly indicate the response they apply to.

3. On checklist questions, record if possible something of the actual answer. Even a word or phrase is helpful. This is especially necessary when the response is not clear from the checkmark alone. A note should be made if the response is unusual, or particularly strong, or if respondent is confused and does not understand the question.

4. On open-end questions, it is necessary to record responses as fully as possible, word for word if at all possible.

Asking Questions

The questions must be asked as specified on the questionnaire and must not be reworded. They must be asked naturally and informally, or as though they were being read from the questionnaire. When a question is not understood, it must be repeated in the same words, not paraphrased.

The questions must be asked in the order presented on the schedules. Every question on the questionnaire must be asked unless there is a question which may be skipped because a certain answer was given in a preceding question. These items will always be indicated. NOTE: Every question must be asked even if the respondent has already answered this in dealing with previous questions. In such cases, the interviewer should indicate she realizes this and has been attentive, saying, "I know you've already mentioned this, but . . ." or "I think we've touched on this earlier, but I must ask . . ." etc.

When a question is not understood or is misinterpreted, it may be carefully reworded only if it does not destroy the original meaning

Questions which respondents hesitate or refuse to answer initially must be handled tactfully in order not to destroy rapport. Ask questions which might be sensitive ones (such as income) in a matter-of-fact manner. Do not give any hint that you suspect the question to be a sensitive one. If the respondent then shows signs of hesitation or refuses to answer, the interviewer may remind her of the confidential nature of the answers and tell her that all answers are handled as a group of figures. Do not exert excessive pressure to obtain answers. You may lose rapport. It is sometimes possible at the very end of the interview, to return to a question which was skipped because of the respondents' sensitivity to a subject. This can be done under the disguise of going over the interview as a whole, clarifying a certain point, etc. You even prepare the ground for this by saying, "Perhaps we can come back to this later, if you would like," at the time he skips a sensitive question.

Using Probes

Probes (phrases or questions) are used to obtain information from R in addition to that which she first gives in response to a question. Some probes are included in the questionnaire (letter a, b, c, d, etc., under a general question). Other probes are used at the discretion of the interviewer and require insight, judgment, and alertness on her part as they must be made up "on the spot." In this survey, probes will be suggested in connection with certain multiple-choice questions and with some open-end questions.

Examples of probes:

"Anything else?" "Could you tell me more about that?" "What else can you think of?" "Does anything else come to your mind?"	Used to obtain fuller information when the first response was vague, or too incomplete or general to be useful.
"I don't quite see what you mean--" "Could you give me an example of that?" "Why is that . . .?" "Could you explain a little more than you mean by . . .?"	Used to encourage R to explain a response that was not clear or did not make sense in the context of the question.

"How do you personally feel about that?" "Is that what you really think? . . . or "How do you <u>really</u> feel?" "How do you <u>you</u> feel about that?"	Used to bring out R's real feelings about a situation, or to "pin down" a "pat" answer or a response that was hasty and probably not carefully considered one where someone else's ideas were quoted, or "lip service" was given an idea.

Probes must be used tactfully to <u>encourage, not to challenge</u>, the respondent.

Probes must not suggest the answer even though the interviewer thinks he knows what the Respondent means or thinks. The interviewer <u>must</u> <u>assume</u> that there is no way of knowing what the respondent means, feels, or thinks until R herself expresses it.

<u>Finally</u>

If you are in doubt about what category you should check under any question, write out the answer or answers. This is better than checking a possible wrong answer. If any list of possibilities does not include a point which the mother or daughter mentions, write in what she has said.

REFER NOW to Section III B for specific directions accompanying each interview schedule.

APPENDIX D

CONSENT FOR PARTICIPATION

Consent for Participation

I have received an explanation of the nutrition study to be conducted at the University of North Carolina at Greensboro as part of the Southern Regional Nutrition Project: Nutritional Health of Adolescent Females (S-150). The project will be directed by Michael Liebman, faculty member in the Department of Food, Nutrition and Food Service Management in the School of Home Economics.

The study objectives are (1) to assess the nutritional health of adolescent females in the Southern region and (2) to relate the nutritional health of adolescent females to socioeconomic factors, food habits, nutrition knowledge, behavioral characteristics, physiological development, and other appropriate factors.

I understand that I will be asked to answer questions about socioeconomic background (such as education, occupation of parents, etc.), food habits, overall health, and life style. I understand that I will be asked to take tests which are designed to assess my personality and attitudes. I am also aware that I will be asked to donate a urine sample and a blood sample after a short period of fasting. The blood sample will be taken by a qualified blood drawer.

The potential risks of this study (such as fainting, bruising, or infection from the blood drawing; and stress during the interviews and tests) have been explained to me. I understand that I will receive $10.00 for being a subject in this study, payable at the end of my participation.

I understand that I am free to withdraw from the study at any time. I understand that all information will be considered private, will be treated confidentially and will not be revealed so as to cause embarrassment. Dr. Liebman or one of the other members of the research staff will be free to answer any questions I may have regarding this study.

Understanding the above, I agree to participate.

____
Signature, Subject

Understanding the above, I agree to my daughter's participation.

____________________ ______________________________
Date Signature, Parent or Guardian

____________________ ______________________________
Social Security Number Signature, #Interviewer

APPENDIX E

FOOD RECALL #2

S-150 REGIONAL PROJECT
FORM D2
SUBJECT NO. ______________
DATE ______________

SUBJECT ______________
STATE ______________
STATION ______________
YEAR 1 OR 3 ______________

FOOD RECALL #2

1. Did you eat anything before breakfast yesterday? yes no ______

2. Where did you obtain the food if you ate something prior to breakfast yesterday? (Select one.) ______

   1. Home
   2. School cafeteria
   3. Fast food restaurant or grocery
   4. Other restaurant (not fast food type)
   5. Vending machine or school snack bar other than cafeteria
   6. A friend's or relative's home
   7. Other: Please specify ______________

3. What did you eat and/or drink prior to breakfast yesterday?

A. Food/ Drink	B. Amount in Household Units	C. Freq. of Units	D. NAS ID	E. Wt. in Grams

4. Did you eat breakfast yesterday? yes no ______

5. Where did you obtain the food if you ate breakfast yesterday? (Select one.)

   1. Home
   2. School cafeteria
   3. Fast food restaurant or grocery
   4. Other restaurant (not fast food type)
   5. Vending machine or school snack bar other than cafeteria
   6. A friend's or relative's home
   7. Other: Please specify ______________

6. What did you eat and/or drink for breakfast yesterday?

A. Food/ Drink	B. Amount in Household Units	C. Freq. of Units	D. NAS ID	E. Wt. in Grams

7. Did you eat or drink anything during the morning yesterday between breakfast and lunch? yes no ______

8. Where did you obtain the food if you ate something at this time yesterday? (Select one.) ______

1. Home
2. School cafeteria
3. Fast food restaurant or grocery
4. Other restaurant (not fast food type)
5. Vending machine or school snack bar other than cafeteria
6. A friend's or relative's home
7. Other: Please specify ______________________

9. What did you eat and/or drink between breakfast and lunch yesterday.

A. Food/ Drinks	B. Amount in Household Units	C. Freq. of Units	D. NAS ID	E. Wt. in Grams

10. Did you eat lunch yesterday? yes no ______

11. Where did you obtain the food if you ate lunch yesterday? (Select one.) ______

1. Home
2. School cafeteria
3. Fast food restaurant or grocery
4. Other restaurant (not fast food type)
5. Vending machine or school snack bar other than cafeteria
6. A friend's or relative's home
7. Other: Please specify ______________________________

12. What did you eat and/or drink for lunch yesterday?

A. Food/ Drink	B. Amount in Household Units	C. Freq. of Units	D. NAS ID	E. Wt. in Grams

13. Did you eat or drink anything during the afternoon yesterday between noon and the evening meal? yes no ______

14. Where did you obtain the food if you ate something yesterday at this time? (Select one.) ______

1. Home
2. School cafeteria
3. Fast food restaurant or grocery
4. Other restaurant (not fast food type)
5. Vending machine or school snack bar other than cafeteria
6. A friend's or relative's home
7. Other: Please specify ______________________________

15. What did you eat and/or drink for an afternoon snack yesterday?

A. Food/ Drink	B. Amount in Household Units	C. Freq. of Units	D. NAS ID	E. Wt. in Grams

16. Did you eat an evening meal yesterday? yes no ______

17. Where did you obtain the food if you ate an evening meal yesterday? (select one.) ______

    1. Home
    2. School cafeteria
    3. Fast food restaurant or grocery
    4. Other restaurant (not fast food type)
    5. Vending machine or school snack bar other than cafeteria
    6. A friend's or relative's home
    7. Other: Please specify ______________________________

18. What did you eat an/or drink for an evening meal yesterday?

A. Food/ Drink	B. Amount in Household Units	C. Freq. of Units	D. NAS ID	E. Wt. in Grams

19. Did you eat or drink anything between the evening meal and the time you went to bed last night? yes no ______

20. Where did you obtain the food if you ate something yesterday at this time? (Select one.) ______

    1. Home
    2. School cafeteria
    3. Fast food restaurant or grocery
    4. Other restaurant (not fast food type)
    5. Vending machine or school snack bar other than cafeteria
    6. A friend's or relative's home
    7. Other: Please specify ______________________________

21. What did you eat and/or drink for an evening snack yesterday?

A. Food/ Drink	B. Amount in Household Units	C. Freq. of Units	D. NAS ID	E. Wt. in Grams

22. Did you take nutritional supplements such as vitamins, minerals or protein in addition to the foods you ate yesterday?
yes no ______

23. What supplements did you take yesterday, how many capsules or tablets, and what time were they taken?
(Be sure if the supplements is a single nutrient that the concentration in each tablet is obtained. Under column E below, record the meal code or snack code corresponding to the time period when the supplement was consumed.)

A. Vitamin/ Mineral Supplement	B. Conc. of Tablet	C. Freq.	D. NAS ID	E. Time of Day	F. How Long?

24. Are you presently trying to ______ weight?
Gain = 1 Lose = 2 Neither = 3 ______

25. Are you dieting to lose weight? yes = 1 no = 2 ______

______

The following information needs to be answered by the interviewer.

A. Subject's age category (circle one). 12 14 16 years

B. Yesterday was (circle one). Su M Tu W Th F Sa

C. Is this recall being taken on the day blood is drawn? (Please circle). yes = 1 no = 2

THIS RECALL USED FORM D2.

APPENDIX F

ANTHROPOMETRIC MEASUREMENTS FORM

S-150 REGIONAL PROJECT
FORM A3-A
SUBJECT NO. ________________
DATE ________________

SUBJECT ____________
STATE ____________
STATION ____________
YEAR 1 OR 3 ____________

ANTHROPOMETRIC MEASUREMENTS

Measurements taken by: 1 = nutritionist, 2 = anthropologist, 3 = nurse
4 = student, 5 other (specify) ____________

NOTE: Ask subject to remove shoes and all heavy outer garments.

1. Birthdate ____________. Calculate age to the nearest month. Record. ________

2. Weight ________ lbs / 2.2 = ________ KG
   Record weight in kilograms ________

3. Clothing estimate ____________G
   (note clothing list in #7) ________

4. Height ____________ CM ________

5. Triceps circumference ____________ CM ________

6. Triceps skinfold ____________ MM ________

7. Check the clothing items worn when subject was weighed in order to obtain clothing estimate. Calculate and record in #3.

   CLOTHING LIST:

   Bra: natural (25 G) Padded (40 G)

   Panties: nylon (18 G) cotton (20 G)

   Slip: full (110 G) half (80 G)

   Socks: footlets (30 G) short socks (35 G) knee socks (50 G)

   Sheer hose: knee length (25 G) panty hose (60 G)

   Slacks: polyester (250 G) cotton (360 G) jeans (440 G)

   Skirt: light (250 G) medium (360 G) heavy (420 G)

   Blouse: light (100 G) medium (190 G) heavy (280 G)

   Sweater: light (320 G) medium (390 G) heavy (440 G)

   Belt: light (60 G) medium (100 G) heavy (140 G)

   Other: List and weigh similar items

   ____

APPENDIX G

RECOMMENDED DIETARY ALLOWANCES OF ADOLESCENTS (1980)

Recommended Dietary Allowances (1980)

of Adolescent Females

	12-14 Years Old	16 Years Old
Energy (kcal)	2200	2100
Protein (gm)	46	46
Calcium (mg)	1200	1200
Iron (mg)	18	18
Vitamin A (IU)	4000	4000
Thiamin (mg)	1.1	1.1
Riboflavin (mg)	1.3	1.3
Niacin (mg)	15	14
Ascorbic Acid (mg)	50	60

APPENDIX H

DURNIN AND WOMERSLEY'S TABLE

Durnin and Womersley's Table

Skinfolds (mm)	Females (age in years)			
	16-29	30-39	40-49	50+
15	10.5	-	-	-
20	14.1	17.0	19.8	21.4
25	16.8	19.4	22.2	24.0
30	19.5	21.8	24.5	26.6
35	21.5	23.7	26.4	28.5
40	23.4	25.5	28.2	30.3
45	25.0	26.9	29.6	31.9
50	26.5	28.2	31.0	33.4
55	27.8	29.4	32.1	34.6
60	29.1	30.6	33.2	35.7
65	30.2	31.6	34.1	36.7
70	31.2	32.5	35.0	37.7
75	32.2	33.4	35.9	38.7
80	33.1	34.3	36.7	39.6
85	34.0	35.1	37.5	40.4
90	34.8	35.8	38.3	41.2
95	35.6	36.5	39.0	41.9
100	36.4	37.2	39.7	42.6
105	37.1	37.9	40.4	43.3
110	37.8	38.6	41.0	43.9
115	38.4	39.1	41.5	44.5
120	39.0	39.6	42.0	45.1
125	39.6	40.1	42.5	45.7
130	40.2	40.6	43.0	46.2
135	40.8	41.1	43.5	46.7
140	41.3	41.6	44.0	47.2
145	41.8	42.1	44.5	47.7
150	42.3	42.6	45.0	48.2
155	42.8	43.1	45.4	48.7

Skinfolds (mm)	Females (age in years)			
	16-29	30-39	40.49	50+
160	43.3	43.6	45.8	49.2
165	43.7	44.0	46.2	49.6
170	44.1	44.4	46.6	50.0
175	-	44.8	47.0	50.4
180	-	45.2	47.4	50.8
185	-	45.6	47.8	51.2
190	-	45.9	48.2	51.6
195	-	46.2	48.5	52.0
200	-	46.5	48.8	52.4
205	-	-	49.1	52.7
210	-	-	49.4	53.0

APPENDIX I

RAW DATA

Nutrient Intakes of 14-Year-Old Girls[a]

with Supplementation in 1983

	Percent RDA						
I.D.	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Ascorbic Acid
004	46.0	56.0	484.0	215.0	220.0	300.0	800.0
006	84.5	50.0	126.0	181.8	192.0	145.0	468.0
042	30.0	224.0	41.5	1450.0	1229.0	795.0	1248.0
094	124.0	75.0	250.0	165.0	220.0	122.0	167.5
097	19.0	25.5	50.6	87.0	90.0	144.0	72.0
099	129.0	283.0	130.0	184.0	214.0	131.2	577.0
104	98.0	192.0	348.0	1115.0	938.0	852.0	524.0
105	121.0	91.0	115.5	171.8	218.4	202.0	166.0
109	58.0	28.0	69.5	512.7	834.6	736.0	278.5
115	25.5	82.0	74.0	131.0	120.7	125.0	91.0
124	22.0	135.0	163.0	212.7	182.0	193.0	343.0
160	41.0	55.0	23.0	2372.0	2000.0	256.0	648.0
163	49.0	55.0	251.5	218.0	246.0	123.0	215.0
165	55.0	135.5	200.0	251.8	261.5	274.0	175.0
167	61.0	183.0	275.0	263.0	266.0	238.0	1542.0
185	90.0	79.0	102.0	83.0	156.0	140.0	1214.0

[a]n = 16

Nutrient Intakes of 16-Year-Old Girls[a]

with Supplementation in 1983

	Percent RDA						
I.D.	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Ascorbic Acid
003	42.0	57.5	75.5	379.0	400.0	425.0	89.2
005	74.0	49.0	50.0	4672.0	3969.0	452.8	46.5
008	60.0	92.0	153.0	174.5	187.7	221.0	386.6
014	129.0	401.0	273.0	390.0	422.0	284.0	228.0
017	54.0	36.0	269.0	79.0	97.0	88.9	890.0
040	80.0	155.0	316.8	260.0	288.0	235.7	183.0
046	311.0	133.0	486.0	1235.0	830.7	1139.0	1172.5
066	95.0	166.0	337.8	1023.0	953.8	816.0	456.5
147	41.5	90.5	351.6	190.9	198.5	133.6	655.0
198	78.0	167.8	191.7	281.8	261.5	257.8	585.8

[a]n = 10

Nutrient Intakes of 14-Year-Old Girls[a] Without Supplementation in 1983

	Percent RDA								
I.D.	Energy	Protein	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Ascorbic Acid
002	72.0	124.0	83.0	50.0	159.0	99.0	106.0	76.0	483.0
004	66.0	174.0	46.0	56.0	359.5	78.0	89.0	69.5	681.0
006	79.0	116.0	84.5	49.6	95.5	136.0	147.0	101.0	408.0
016	59.0	155.4	46.0	47.0	50.0	58.0	95.0	105.0	35.0
020	95.5	211.0	125.5	100.0	86.5	240.5	191.0	12.0	82.0
029	62.0	119.5	45.0	47.5	42.0	126.0	88.0	88.0	334.5
034	76.0	138.0	73.5	57.0	67.0	113.0	131.0	94.0	113.5
037	73.0	131.0	69.0	39.0	28.5	80.0	110.0	76.0	51.5
042	104.5	147.0	30.0	74.0	41.5	87.0	75.0	128.0	48.5
049	68.0	129.0	66.0	44.0	59.0	78.0	104.6	76.0	63.5
052	39.0	54.0	37.0	27.0	21.0	57.0	62.0	39.0	146.5
054	69.0	110.0	38.0	44.5	22.5	87.0	86.0	74.0	32.5
055	48.6	102.6	37.0	144.4	87.0	94.6	106.0	87.0	83.0
059	81.7	131.8	86.0	40.0	81.0	84.0	141.0	59.0	39.0
077	94.0	170.0	84.0	68.5	61.5	127.0	134.0	114.0	255.0
084	86.0	179.5	113.0	108.6	112.5	145.0	210.0	106.0	383.0
087	70.0	82.6	22.6	31.0	26.0	84.0	56.0	69.0	108.5
088	56.0	139.0	74.7	37.8	147.5	90.0	127.0	90.0	97.0
094	110.5	197.5	124.0	75.0	188.0	165.0	220.0	122.0	167.5

I.D.	Percent RDA								
	Energy	Protein	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Ascorbic Acid
097	59.0	97.0	19.0	25.5	25.8	44.0	43.5	99.0	12.0
099	121.0	219.0	129.0	117.5	130.0	184.0	214.0	131.2	577.0
104	134.0	205.0	98.0	92.0	99.0	179.0	171.0	183.0	124.0
105	137.0	221.0	121.0	91.0	84.0	123.6	172.0	157.0	74.5
106	71.0	142.0	76.0	51.0	48.0	72.0	115.0	99.0	134.0
109	56.0	101.0	58.0	28.0	69.5	94.0	123.0	69.0	278.5
112	53.0	137.0	29.0	36.5	157.0	62.0	60.0	179.0	365.0
114	76.0	152.0	39.5	67.0	58.0	125.0	98.0	101.0	133.0
115	45.0	76.0	25.5	32.0	11.5	67.0	59.0	58.0	31.0
116	96.0	152.0	52.5	77.0	199.5	169.0	139.0	101.0	108.5
117	57.0	150.0	70.0	54.0	205.0	98.0	124.0	92.5	239.0
118	95.0	184.0	124.0	71.0	267.0	111.0	191.0	101.0	200.0
119	94.0	143.0	31.0	86.0	23.0	138.0	60.0	82.5	42.5
120	134.0	251.0	54.0	101.0	93.0	177.0	166.0	265.0	62.0
123	91.0	115.0	48.5	57.0	98.5	133.0	100.0	83.0	386.0
124	42.0	90.0	22.0	35.0	38.0	77.0	52.0	66.0	222.5
126	106.0	213.0	141.5	64.0	150.0	121.0	213.0	105.0	238.5
128	118.0	191.0	88.0	78.0	242.0	180.0	145.0	127.0	551.0
132	108.0	210.0	123.7	70.0	180.0	165.0	221.0	113.0	239.0
137	124.0	131.0	33.5	74.0	86.0	50.0	64.0	76.5	45.0

I.D.	Percent RDA								
	Energy	Protein	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Ascorbic Acid
159	58.0	85.5	56.0	33.0	37.5	62.0	86.7	52.0	38.0
160	83.8	129.0	41.0	55.0	23.0	102.0	78.0	90.0	149.5
163	73.6	136.5	49.0	55.0	126.5	120.0	154.0	123.0	95.0
164	89.0	162.6	80.0	75.0	72.0	126.0	152.0	104.0	78.5
165	63.0	151.0	55.0	36.0	75.0	115.0	132.6	141.0	55.5
167	85.0	153.0	61.0	84.0	150.0	164.0	135.0	105.0	542.0
170	62.0	117.0	81.0	46.0	84.5	71.0	136.0	65.0	54.5
171	16.0	16.0	5.0	9.0	1.0	13.0	11.0	11.0	7.5
185	127.5	192.6	90.0	78.9	102.0	83.0	156.0	140.0	214.0
191	68.5	101.5	66.5	49.0	113.3	78.0	122.0	64.0	88.0

[a] n = 49

Nutrient Intakes of 16-Year-Old Girls[a] Without Supplementation in 1983

	Percent RDA								
I.D.	Energy	Protein	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Ascorbic Acid
003	86.5	144.0	42.0	57.5	75.5	80.0	108.0	104.0	89.2
005	83.0	156.0	74.0	49.0	50.0	79.0	122.0	95.5	46.5
008	87.0	153.0	60.0	42.0	91.0	106.0	122.5	149.0	337.0
009	90.0	100.0	50.0	53.5	138.0	90.0	108.0	81.0	93.0
010	117.0	97.0	63.0	49.0	38.0	96.0	97.5	119.0	92.5
011	15.0	17.3	7.0	7.5	5.0	14.0	11.0	18.0	5.0
012	48.5	107.2	14.5	46.0	12.5	70.8	47.0	91.0	38.5
013	106.0	162.4	40.5	73.0	47.5	100.0	90.5	110.0	147.5
014	128.0	163.8	129.6	67.0	73.0	124.4	161.0	141.0	62.0
017	79.5	103.7	54.0	36.0	46.0	79.0	97.0	86.9	57.5
018	166.0	242.8	128.0	107.4	126.0	194.5	221.0	213.0	212.0
019	91.0	185.4	92.0	101.0	55.0	220.0	160.0	110.0	36.0
022	77.9	85.0	41.5	51.0	40.0	97.0	64.0	84.5	55.0
023	109.0	95.0	43.0	39.5	36.0	93.0	73.0	104.8	315.5
026	83.5	173.3	121.5	68.0	133.0	131.0	195.0	110.0	307.5
028	68.5	125.0	81.0	51.6	153.0	110.0	145.0	83.0	174.0
030	60.0	104.0	70.0	43.0	65.0	61.0	251.0	77.0	28.5
033	91.0	83.5	44.5	40.8	46.0	79.0	71.5	71.0	377.5
039	59.0	124.2	59.5	44.0	77.8	73.0	98.0	85.7	98.5

I.D.	Percent RDA Energy	Protein	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Ascorbic Acid
040	72.8	124.5	80.0	56.0	191.5	123.0	158.0	93.0	83.0
044	179.0	251.0	112.0	98.0	166.0	260.1	272.0	332.0	212.0
046	133.0	231.0	177.5	133.0	173.4	235.0	296.0	140.0	506.0
047	124.0	245.0	133.0	97.0	343.0	123.0	203.0	125.0	192.0
048	59.5	112.5	47.0	40.5	24.4	59.0	88.0	73.0	39.0
053	124.5	169.0	63.5	80.0	61.5	190.0	173.6	166.0	566.0
060	95.8	160.0	80.0	65.0	358.5	147.0	180.0	138.0	249.0
066	86.0	145.0	95.0	55.0	88.0	115.0	185.0	102.0	40.5
069	92.6	141.0	38.5	85.0	207.0	154.0	190.0	164.0	140.0
070	76.0	116.5	28.5	46.0	29.0	77.0	64.0	94.0	32.5
071	101.5	151.0	62.0	50.0	33.0	111.0	117.5	89.0	29.5
072	119.0	172.0	76.0	63.0	37.0	114.0	77.0	148.0	296.0
075	89.0	159.0	49.0	68.0	107.0	87.0	98.0	101.0	55.0
083	101.0	167.0	101.0	117.0	185.0	169.6	176.0	119.0	511.0
086	47.0	100.0	8.7	38.7	5.0	78.6	44.0	90.0	29.5
090	79.0	124.0	77.0	51.0	56.0	115.0	120.0	105.0	252.0
147	58.0	61.0	41.5	41.0	225.5	73.0	83.0	62.0	611.5
151	62.5	171.0	61.0	64.0	57.0	121.0	109.0	123.0	123.5
169	91.0	141.0	47.0	72.0	85.5	93.0	79.9	84.0	37.5
173	85.0	163.0	56.0	57.0	168.0	113.0	192.0	149.0	65.0

	Percent RDA								
I.D.	Energy	Protein	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Ascorbic Acid
180	90.0	139.0	75.0	55.0	144.5	153.6	208.0	142.0	88.0
184	99.5	139.0	67.0	56.0	130.0	80.0	145.0	116.9	136.5
196	108.0	93.5	45.0	51.0	56.0	93.0	91.0	112.0	282.5
198	107.6	138.6	78.0	67.6	67.0	146.0	131.0	115.0	485.0

[a] n = 43

Anthropometric Measurements for 14-Year-Old Girls[a] in 1983

I.D.	Weight kg	Height cm	Arm Circum. cm	Triceps mm	Biceps mm	Sub-scapula mm	Ileac mm	Body Fat[b] %
002	56.8	171.0	24.8	9.0	7.0	10.0	17.0	24.4
004	70.0	164.0	32.7	27.0	14.5	18.0	22.0	33.4
006	49.0	155.0	26.4	12.0	7.0	10.0	11.0	23.4
016	70.5	137.0	30.9	20.3	14.0	24.0	25.0	33.7
020	58.2	163.0	27.6	15.5	8.0	14.5	13.3	26.8
029	43.4	157.0	24.8	14.5	7.0	7.5	11.5	23.6
034	50.1	168.0	21.6	10.0	4.5	7.0	6.5	12.7
037	46.0	157.0	21.9	11.0	6.0	8.0	8.0	20.7
042	52.1	164.0	24.8	14.0	12.0	16.5	16.0	28.7
049	81.4	164.0	33.9	37.5	19.0	35.0	34.0	39.7
052	54.1	159.0	28.6	22.5	7.5	14.0	19.0	29.8
054	57.7	169.0	27.5	16.5	6.0	11.5	12.0	25.3
055	67.4	163.0	30.5	23.5	19.0	22.0	20.0	33.9
059	40.7	155.0	22.0	11.5	7.5	7.0	7.0	20.7
077	41.2	156.0	24.1	7.0	5.0	7.0	5.0	16.3
084	42.7	160.0	22.2	7.0	4.0	5.5	5.0	14.9
087	47.0	160.0	23.4	10.0	6.0	9.0	6.0	19.9
088	70.2	164.0	32.7	26.0	21.0	21.5	32.0	36.4
094	46.0	160.0	23.3	10.0	6.5	11.0	10.0	22.5

I.D.	Weight kg	Height cm	Arm Circum. cm	Triceps mm	Biceps mm	Sub-scapula mm	Ileac mm	Body Fat[b] %
097	58.3	160.0	38.3	21.5	14.5	12.5	17.5	30.4
099	46.5	165.0	21.9	11.0	5.5	7.0	9.0	20.5
104	59.4	160.0	29.2	26.5	8.0	17.0	17.5	31.0
105	48.4	156.0	24.2	12.0	4.0	12.0	13.0	23.7
106	42.5	163.0	21.2	9.5	4.0	6.5	5.5	17.1
109	48.0	157.0	26.5	20.0	9.5	10.0	8.5	25.9
112	50.0	166.0	23.6	12.0	6.0	12.0	12.0	24.0
114	49.0	166.0	23.3	12.0	6.0	10.0	6.0	21.1
115	49.0	153.0	24.6	14.0	6.0	14.0	7.0	23.7
116	44.6	160.0	22.3	8.0	4.0	7.0	6.5	17.1
117	108.0	166.0	43.5	45.0	15.0	39.0	35.0	40.7
118	53.6	164.0	23.4	11.5	6.0	10.0	6.0	20.9
119	48.0	166.0	24.5	11.5	7.0	10.0	10.0	22.8
120	53.1	159.0	24.9	16.0	6.0	13.0	11.0	25.3
123	46.0	161.0	22.9	11.0	6.0	7.5	5.0	19.2
124	59.2	154.0	28.1	17.0	7.5	16.5	14.0	27.8
126	58.0	169.0	25.9	16.0	8.0	15.0	17.0	28.1
128	41.6	154.0	23.0	9.0	4.0	10.0	6.0	18.9
132	59.3	172.0	24.4	9.0	5.0	9.0	6.0	29.7
137	63.4	160.0	26.9	19.0	7.5	19.5	16.5	20.0

I.D.	Weight kg	Height cm	Arm Circum. cm	Triceps mm	Biceps mm	Sub-scapula mm	Ileac mm	Body Fat[b] %
159	55.6	160.0	26.1	21.0	8.2	12.5	14.0	27.9
160	46.8	161.0	24.1	13.0	7.0	10.0	8.0	22.6
163	41.0	149.0	24.3	13.0	7.0	11.0	9.5	23.6
164	54.4	155.0	27.7	23.5	9.0	10.5	21.0	29.9
165	40.2	153.0	22.1	10.0	4.0	8.0	6.0	18.4
167	34.2	148.0	20.5	11.5	6.0	6.0	6.0	19.0
170	48.2	162.0	24.4	15.0	7.5	10.0	10.0	24.2
171	48.0	164.0	21.7	6.0	5.0	9.0	7.0	17.9
185	41.2	157.0	21.0	10.0	4.0	6.0	5.0	16.8
191	73.3	162.0	31.9	28.0	16.0	18.5	19.5	33.5

[a]n = 49

[b]Percentage of body fat calculated by Durnin and Womersley's table.

Anthropometric Measurements for 16-Year-Old Girls[a] in 1983

I.D.	Weight kg	Height cm	Arm Circum. cm	Triceps mm	Biceps mm	Sub-scapula mm	Ileac mm	Body Fat[b] %
003	51.5	166.0	25.0	18.0	7.0	12.0	8.0	25.0
005	57.4	166.0	27.3	16.0	8.0	11.0	11.0	25.3
008	67.0	169.0	31.3	25.5	11.0	22.0	23.0	23.4
009	47.6	158.0	24.1	8.0	4.0	9.5	5.0	17.6
010	45.7	163.0	23.0	7.5	6.0	6.0	5.0	16.5
011	51.0	167.0	21.4	7.0	3.5	9.5	8.0	18.4
012	51.5	162.0	45.4	14.5	8.0	14.0	8.5	25.0
013	52.0	172.0	24.6	15.0	7.5	15.5	14.5	27.1
014	55.3	160.0	25.3	12.0	8.0	15.5	9.0	25.0
017	57.3	171.0	25.1	11.0	4.0	8.0	8.0	19.9
018	52.3	166.0	22.6	11.0	6.0	7.0	6.5	19.7
019	49.5	160.0	23.6	12.0	5.5	11.5	7.5	22.1
022	48.3	161.0	24.7	9.0	7.0	13.0	5.0	21.1
023	46.6	154.0	24.0	15.0	6.5	12.0	14.0	25.8

I.D.	Weight kg	Height cm	Arm Circum. cm	Triceps mm	Biceps mm	Sub-scapula mm	Ileac mm	Body Fat[b] %
026	57.0	160.0	28.6	20.0	11.0	10.0	12.5	27.4
028	57.2	166.0	27.6	17.0	7.0	12.0	16.5	27.2
030	71.6	172.0	27.8	16.5	7.0	15.5	10.0	26.2
033	58.2	170.0	23.3	8.5	4.0	7.5	5.0	61.8
039	34.3	163.0	26.1	19.0	9.0	13.0	15.0	27.5
040	56.0	174.0	24.3	10.5	3.5	11.0	5.0	19.5
044	57.2	165.0	28.5	24.0	10.5	21.0	22.0	32.7
046	52.0	171.0	23.6	6.0	4.0	7.0	5.0	15.2
047	49.0	158.0	24.2	11.0	4.5	9.5	10.0	21.5
048	49.8	162.0	23.5	13.0	6.0	11.0	10.5	23.6
053	60.3	175.0	26.6	14.0	5.0	12.0	7.0	22.6
060	43.0	156.0	21.4	11.0	6.0	10.5	5.5	20.7
066	51.7	169.0	25.2	14.0	8.0	11.0	11.0	24.7
069	63.6	164.0	27.9	17.5	8.0	17.0	15.0	28.5
070	53.0	159.0	25.8	16.0	7.0	14.0	15.0	27.0
071	45.4	156.0	23.6	6.5	4.0	8.5	5.0	16.3
072	44.7	161.0	23.2	10.0	4.5	9.5	7.5	20.1
075	50.3	175.0	23.0	9.0	3.0	7.5	7.0	17.6
083	61.5	176.0	25.7	12.5	5.0	7.0	7.0	20.1
086	52.3	163.0	26.0	13.0	5.0	11.0	5.0	21.1

I.D.	Weight kg	Height cm	Arm Circum. cm	Triceps mm	Biceps mm	Sub-scapula mm	Ileac mm	Body Fat[b] %
090	62.0	166.0	26.9	15.0	7.0	12.0	18.0	27.0
147	59.0	169.0	26.9	16.0	9.0	18.0	18.0	29.3
151	64.4	166.0	28.1	17.5	7.0	16.0	10.0	26.6
169	60.0	166.0	52.2	14.5	7.5	12.0	11.0	25.0
173	59.1	164.0	27.3	13.5	7.5	11.0	11.0	24.4
180	54.0	163.0	25.2	9.0	5.0	11.5	5.0	19.7
184	49.5	161.0	23.8	12.0	7.0	8.0	13.0	23.4
196	98.5	163.0	39.4	52.0	24.0	44.0	44.5	43.7
198	47.0	141.0	21.8	11.0	5.0	7.5	4.5	18.4

[a] n = 43

[b] Percentage of body fat calculated by Durnin and Womersley's table.