INFANT FEEDING PRACTICES RESULTING IN FOOD COMBINATIONS AFFECTING IRON UTILIZATION OF RURAL AND URBAN OKLAHOMA INFANTS

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Scope and Method of Study: This study compared infant feeding practices between two geographical locations among three races and between two age groups. In particular, feeding practices examined were those which would affect dietary iron intake and utilization. Subjects were 51 infants from rural and urban Oklahoma participating in the Special Supplemental Food Program for Women, Infants, and Children (WIC). Hematocrits and growth rates were analyzed in relation to overall dietary adequacy. Twenty-four hour dietary intakes and questionnaires were used as dietary assessment instruments.

Findings and Conclusions: Statistical analysis found no significant differences between areas for overall dietary intakes except for lower intakes of meat, fish, and poultry for young rural infants. Urban infants had higher intakes of legumes and green beans. Young rural black infants ate iron-fortified cereal more frequently than other groups. Energy levels for black infants were lower than other groups when expressed as kilocalories per kilogram body weight. Red meats and green beans were preferred more frequently by white infants, while preferences for spinach and greens were higher for black infants. Nutrient levels were significantly different between age categories due, in part, to the change from fortified formula to milk at one year of age. Increasing consumption of table foods for the child over one year of age also resulted in nutrient differences between age categories. Total available iron intake was higher for younger infants. As expected, higher growth rates were observed for the younger infants. Changes in hematrocrits correlated positively with intake of available iron from meat, fish, and poultry. Rural infants' hematrocrits significantly demonstrated an overall positive change, while urban infants' hematrocrits demonstrated an overall negative change. Elevation of hematocrits for black infants was apparent, with changing hematrocrit levels three times greater for blacks than whites. Hispanic infants' hematrocrits dropped. Recommendations for nutrition education for mothers of young children were made on the basis of findings.

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CHAPTER I

INTRODUCTION

Impact of Early Nutrition

Infant nutrition and feeding practices have become increasingly visible topics since the turn of the century. Until 1920, solid foods were seldom recommended by the physician as part of the infant's diet (1). With improved technology and processing, commercial baby foods became more and more available for the infant. The huge choice today presents a challenge to the mother as well as the nutrition educator in designing a nutritionally balanced dietary regimen for the infant.

Growth and development during the first year of life are more rapid than at any other time during the life cycle. A full term infant of normal weight will usually double his birth weight by six months and will triple his birth weight by one year of age. The reference full term infant's length will increase by 50% during the first year (2). By the time an infant is one year old the size of his brain and kidneys will have increased two to three times. Brain cell development begins shortly after conception and continues with the increase in number of brain cells until 12 to 15 months of age. Thereafter, brain cells proceed to grow in size and mass until three to four years of age (3). Because this critical time of growth involves vital organ, brain cell, enzyme, gastrointestinal, skeletal, muscular, and hematological development, nutrition during infancy can have dynamic impact on the health, quality of life, and future for the individual.

Purposes of Special Supplemental Food Program for Women, Infants, and Children (WIC)

Infant feeding practices and recommendations have seemingly gone through a cycle of changes during the past 80 years. Iron deficiency anemia and suboptimal growth still exist among infants and children. In an effort to combat these nutritional problems, the federal government designed the Special Supplemental Food Program for Women, Infants, and Children (WIC), which was implemented in 1972 under the direction of the United States Department of Agriculture. The purpose of the WIC Program is to serve women, infants, and children during critical times of growth and development in providing foods with specific nutrients, to improve their health and nutritional status, and to prevent the occurrence of health problems. Participants are encouraged to take part in health services and nutrition education in which parents and children are taught the importance of preventive health care and of proper nutrition, knowledge needed to maintain good health after they leave the program (4).

The effectiveness of the WIC Program has been of value in Massachusetts, as indicated by decreased rates of anemia and low birthweight infants. The results from a study (5) conducted in 19 project sites, indicated a positive effect on health status of participants: greater weight gain during pregnancy, higher birth weight in infants born to

WIC mothers, accelerated growth of WIC children, and a decrease in the rate of anemia.

The effect of WIC on 907 pregnant women in the program was assessed in four geographic locations in Massachusetts (6). They were compared with 463 pregnant women who were not in the program in two control groups--women from the same health facility as the WIC participants and women from a different facility. Statistical analyses showed that birth weights of infants born to WIC mothers were significantly higher ($p<0.01$) than those of infants born to non-WIC mothers of similar socioeconomic status. WIC participation accounted for 40% of the total difference between the two groups. Also, the incidence of low-birthweight infants was lower in the WIC group (6.0%) than in the non-WIC group from the same health facility (10.1%). Taking into account the cost of medical care for low-birth-weight infants, the investigator found a benefit-cost ratio of 3.1:1 favoring WIC.

WIC in Oklahoma

The WIC Program has been operated in Oklahoma through the state and county health departments since 1975. Counties which have the most vulnerable population, according to statistics on infant mortality, low birthweight, and percentage of population below 195% of official poverty level, are presently offering WIC services through child health and maternity clinics (7). This program, designed for the nutritionally-at-risk woman, infant, or child, is available through the local health clinic. Referral to other services such as family planning, immunization, guidance, pediatrics, and venereal disease makes a more complete health care accessible to the participant.

When a woman, infant, or child is determined by the professional authority (physician, nurse, or nutritionist), according to specified criteria (Appendix B), to be nutritionally-at-risk, he or she is given vouchers for foods which are tailored to meet specific nutrient needs for the participant. WIC foods are only supplementary and do not provide enough food for total nutrient needs.

The WIC food package (Appendix A) designed for the infant (birth-12 months) includes iron-fortified infant formula, iron-fortified infant cereal, and vitamin C-fortified juices. WIC foods for the child one to five years of age include iron-fortified cereal, vitamin C-fortified juices, milk, cheese, and eggs. Nutrition education for the participant is provided two times in each six month certification period and includes information pertinent to the specific needs assessed.

Objectives

The objectives for this study are:

1. To describe and compare those infant feeding practices (of WIC recipients) in rural and urban settings and of different ethnicity, particularly those practices which may affect intakes of heme and non-heme iron and which may enhance iron absorption.

2. To relate available dietary iron to hematocrit or hemoglobin values of children.

3. To determine if growth is related to the overall dietary adequacy and to iron nutrition in particular.

4. To identify specific recommendations for feeding infants and young children.

Hypothesis

Feeding habits and nutritional status of infants and children differ between rural and urban areas and between groups of different ethnic backgrounds.

Assumptions

1. There is a need to identify foods commonly used or acceptable in feeding practices of infants and young children which may be used singly or in combination to prevent the development of iron deficiency anemia.

2. There is a need to determine if overall growth is related to iron nutriture.

3. There is a need to provide information about current infant and child feeding practices as the basis for making realistic recommendations for improvements through nutrition education.

CHAPTER II

LITERATURE REVIEW

Findings in Nutrition Surveys

Nutrition surveys have identified low intakes of certain nutrients and slow growth by infants and preschool children (8). The Health and Nutrition Examination Survey (HANES) (9) and the Ten State Nutrition Survey (10) found low intakes of iron, vitamin A, and vitamin C compared with Recommended Dietary Allowances (RDA) (11) for a high percentage of preschool aged children. The HANES found a direct relationship between family income and intakes of energy, protein, and calcium, while in the Ten State Survey, poor nutrition was more common among the blacks, and less common among Spanish Americans, and least among white children.

In the Preschool Nutrition Survey (12) nutritional risk factors in the lower socioeconomic group were substantiated by lower biochemical indices, including hemoglobin, hematocrit, transferrin saturation, and smaller physical size for age (height and weight). The percentage of children with low daily intakes of selected nutrients (iron, calcium, energy, and protein) was consistently higher for children in the lower socioeconomic level. Researchers attributed the lower nutrient intake to lower overall reported consumption of food. Iron deficiency anemia was evidenced by lowered biochemical indices for hemoglobin, hematocrit, and transferrin saturation levels. The prevalence of iron deficciency anemia in infants and preschool children showed an inverse direct correlation to income level; infants from lower income families had a higher incidence of iron deficiency anemia. Lower intakes of iron (9) were found to cut across socioeconomic barriers with 60% above poverty level children and 60% below poverty level children having shown intakes of iron less than eight milligrams per day.

The Preschool Nutrition Survey (12) found higher mean levels of hemoglobin in whites than in blacks. White children who received vitamin mineral supplements evidenced higher mean hemoglobin values than non-supplemented white children. Black children, however, who received supplements did not show higher hemoglobin values than non-supplemented black children. In general, there was little relationship between nutrient intakes and biochemical variables, with the exception of water-soluble vitamins and protein

Current Feeding Practices

Information on feeding practices has been obtained by a series of dietary recalls from the mother (13), or by one-day dietary recalls (14, 15, 16). In studies of minority children (13, 14, 15, 16) from varied income levels (14, 15), intakes of energy and iron were often low (13, 14, 15, 16) for infants 5 months to 18 months of age. Protein intakes met or exceeded the RDA for most infants (13, 14, 16), with highest protein intakes per kilogram of body weight represented by infants fed skim or partially skimmed milk (14, 15). Ascorbic acid intakes were one-half to two times the RDA at all ages of infants studies (13).

Baby foods were used for a longer period of time for Puerto Rican infants as compared to black infants who ate more table food (13). Iron-fortified infant cereals were fed less frequently to black and

Puerto Rican infants than white infants (13, 14, 15), but were found to be used frequently in the study by Malansky (16). Vegetable and meat mixtures and soups were frequently used for black and Puerto Rican infants, whereas little plain meat was used for low and middle income white and low income black infants (15). Fruit and fruit juices were popular for infants throughout a 12 month period (16) and preferred vegetables were mashed potatoes, peas, carrots, and spinach (16). Black mothers offered a larger variety of vegetables than Puerto Rican mothers (16).

Intervention

In a study by Berg and Van Pelt (17), 295 healthy, mature infants were fed in one of six ways. Infants were excluded from the study if they weighed less than 2268 grams at birth, were less than 34 weeks gestation, had a capillary hematrocrit reading less than 44% on the third day, were sensitized to Rh antigen, had sickle cell disease, or had a major medical illness. All families were low income black. Each dietary regimen included iron-fortified cereal, iron-fortified formula or milk. Duplicate hematocrit readings and hemoglobin measurements were made at 0-2, 2-4, 4-7, 7-10, 10-16, and 22-27 months.

Infants were assigned to one of the following dietary regimens:

Group 1 - Choice of formula.

Group 2 - Evaporated milk for three months and then iron-fortified whole milk for one year. Iron-fortified cereal coupons were given from one month of age through one year.

Group 3 - Evaporated milk for first three months and then iron-fortified cereal from one month through one year of age.

Group 4 - Evaporated milk for three months and then choice of formula and iron-fortified cereal.

Group 5 - Breastfeeding and supplemental diet based on personal preference.

Group 6 - Breastfeeding and redeemable coupons for dry iron-fortified cereal from age one month through one year.

The mean durations of cereal consumption in groups 1-6 were 7.1, 7.0, 8.3, 9.5, 6.6, and 11 months. The mean use of iron-fortified formula in groups 1-6 was 7, 2, 3, 2, 4, and 8 weeks, respectively. The median and mode in each group was zero. Only 19 infants were dropped from this study because dietary advice and/or special iron treatment was given due to the fall in their hematocrit and hemoglobin readings to below 30% and 10 g/dl, respectively. Sufficient dietary iron was absorbed by other infants to maintain adequate hematocrit and hemoglobin levels. They concluded that iron absorption was sufficient without recourse to supplemental medicinal iron therapy or iron-fortified formulas. Their conclusion was that recommended feeding practices, i.e., use of iron-fortified cereal and evaporated or whole milk in their population, resulted in a low incidence of reduced hemoglobin and hematocrit.

Andelman and Sered (18) studied 1048 infants from a low socioeconomic population to determine utilization of dietary iron. All infants studied were term infants under four weeks of age and weighed at least 2500 grams. Six hundred three infants were in the study group and were maintained on a formula containing 12 mg iron/quart for six to nine months. The control group contained 445 infants who were put on an evaporated milk formula with a multiple vitamin supplement but no iron. All mothers were directed to feed their infants according to their standard practice. Strained foods were introduced at three months of age and by the time they were six months old full diets of formula, cereal, egg, meat, vegetables, and fruit had been prescribed.

Infants developing anemia, defined as a concentration of less than 10 g/100 ml, were eliminated from further study and were treated with therapeutic iron. Overall attrition rate was high, and 337 infants in the control group and 55 in the study group were removed from further observation when hemoglobin fell below 10 gm/100 ml. The mean hemoglobin for infants in both groups dropped in parallel manner during the first eight weeks; but during the subsequent period, the mean hemoglobin was higher for infants in the experimental study group and remained so for the entire 18 months of observation. All but 38 infants of the 337 in the control group developed iron deficiency anemia by one year of age. Fifty-five infants (9%) in the study group became anemic, but more than half of these not until 6-12 months after they had stopped receiving iron-fortified formula. Infants who developed a hemoglobin of 10 mg/dl or less were removed from the study and were given therapeutic doses of iron.

In this study 76% of the infants in the control group became anemic. These infants were from a low socioeconomic population whose diet had been recommended under pediatric supervision. In comparison, only 9% of the study group became anemic when dietary supervision was modified by giving an iron-containing formula for the first six to nine months. These results indicate that simple recommendations of solid food dietary for the infant in a low socioeconomic population does not prevent anemia.

Iron Requirements and Absorption

The requirements and advisable intake of iron must be an amount which is sufficient to provide the infant's needs for growth, blood volume expansion, and replacement of losses. Iron endowment at birth has wide variability when considering the differences in circulating red cell mass at the time of birth as well as the differences of iron content of tissues at birth (19).

It is not certain that the maternal iron status during pregnancy has a direct relationship to the iron stores of the infant. The birth weight of the infant has direct relationship to iron stores in the infant's body. Apte and Iyengar (20) found lower iron content of fetuses from a low socioeconomic population, when compared to fetuses from a presumably adequately nourished population. They suggested that nutrient by the stores of the developing fetus can be influenced by the state of maternal nutrition.

The requirement for iron during infancy is based on the need to absorb 200 to 250 mg for the first year. Based on 10% absorption rate, a total of 2500 mg of iron would be required for a year for the normal full term infant (21, 22). Because the absorption rate varies with each individual infant, it is difficult to be definite about a recommended intake of iron.

The RDA (11) advises an iron intake of 10 mg/day for infants 0-6 months and 15 mg/day for infants 7-36 months. Though this is higher than Fomon's (21) advisable intake of iron for infants, it must be recognized that the RDA's for most nutrients include a percentage above and beyond the average nutrient requirements for optimal nutrition. Although there are many factors to be considered as possible causes of iron deficiency anemia, there are recent indications that certain food combinations affect the absorption and, subsequently, the utilization of iron in the body.

The absorption of nonheme iron from foods is affected by a variety of influences. Determining the bioavailability of dietary iron in human diets could prove to be an important consideration in preventing or treating iron deficiency anemia with a dietary

One method to determine availability of nonheme iron is based on the release of iron from foods subjected to treatment with pepsin hydrochloride at pH 1.35 and subsequent adjustment of the pH to 7.5, somewhat simulating the conditions prevailing in the stomach and intestine, respectively. Iron becomes soluble when it comes into contact with hydrochloric acid in the stomach, but when it enters the duodenum, the pH becomes alkaline (compared to the gastric pH) and the iron becomes relatively insoluble, depending on factors in the diet. Inhibitors like phytic acid and tannin may be precipitated as iron complexes, while promoters like ascorbic acid and meat extracts may render iron soluble even at the alkaline pH (23).

To the extent that it duplicates conditions in the gut, this in vitro procedure provides a method for screening a large number of foods and diets for predicting the bioavailability of iron from them. This method can be used to determine the extent to which availability of iron can be improved by manipulation of diets. Ionizable iron from foods and diets determined at pH 7.5 could be used to predict bioavailability. This was demonstrated by showing that these values corresponded highly with the actual per cent absorption observed with the diets in adult male subjects. Additional evidence comes from the observation that the ionizable iron at pH 7.5 increased considerably when the diets included ascorbic acid or meat extract.

On the basis of recent studies of iron absorption employing extrinsic tag techniques, the availability of heme iron has been defined, and estimates of the availability of nonheme iron based on the amounts of enhancing substances appear possible. Two major forms of natural dietary iron are heme and nonheme. Heme iron, which comes from myoglobin and hemoglobin of meat, fish, and poultry, accounts for approximately 40% of the iron in these foods. Nonheme iron is available in grains, fruits, and vegetables and is approximately 60% of iron found in meat, fish, and poultry. A model has been developed whereby the availability of iron in a given meal may be estimated on the basis of: 1) the amount of heme iron and its average availability, 2) the amount of nonheme iron and its availability as influenced by the meal's content of enhancing factors (24), and 3) the individual's iron status.

Growth in Relationship to Iron Nutriture

Beal and Meyers (25) analyzed a study done by the Child Research Council in which 59 Caucasian children were studied for the effects of iron nutriture on hemoglobin and growth. Physical measurements for these children were done at birth with subsequent measurements and nutritional histories at monthly intervals during the first year and quarterly during the second year. Hematology was done between 48 and 72 hours of life, and at monthly intervals for three months and each three months for the remainder of two years. The children were under private care of physicians, received no continuous supplemental iron even when hemoglobin was below 10 mg, and were free of serious or prolonged illness. No significant relationship was found among dietary iron intake, hemoglobin, and growth rate. As growth rates increased, however, total energy intake increased so that the diet contained enough iron to support the needed relative acceleration of hemoglobin synthesis. Only Caucasian children were included in this study and all were under private physicians' care, which seemed to indicate that socioeconomic status was at least moderate to high.

Growth in Relationship to Iron, Protein, and Calorie Nutriture

Crawford, Hankin, and Huenemann (26) cite results from a longitudinal study of factors in early life which may affect body weight later. The sample consisted of 448 six month old infants (226 boys and 222 girls) and was racially distributed as follows: 319 Caucasians; 85 Negroes; 28 Orientals; and 16 others (which included Mexican-Americans, American Indians, East Indians, Filipinos, and Vietnamese). Data were collected at six months and at one, two, three, four, and six years. Anthropometric measurements included weight, length, five circumferences, and four skinfolds. Three-day measured food intake records and one-day activity records were obtained at each time period.

Dietary intakes, supplemented with home interviews for accuracy, indicated an increase by age for calories and most nutrients. There was a higher proportion of nutrients-to-calories for the 6-12 month infants. Sex differences were not significant, although boys generally tended to eat more than girls at all ages. Negro children had higher intakes of calories at ages two to four years and of fat and sodium at all ages.

Lower mean intakes of iron at two years were due to decreased use of iron-fortified infant cereals, whereas subsequent increases were likely attributable to the frequent use of regular iron-fortified dry cereals. Decrease in milk consumption which accompanied increase in solid foods at one and two years was associated with lower intakes of calcium, vitamin A, and riboflavin.

Growth in Relationship to Ethnic Status

Body measurements by ethnic groups were similar for Caucasians and Negroes until three years of age, whereas subsequently, Negroes tended to have higher values. Boys were taller and heavier than girls among Caucasians and Negroes but the reverse was true for the Orientals. Measurements of Caucasian children were compared with HANES values and found to be significantly less for height, weight, and skin-fold for both sexes and most ages. Techniques used for these studies were presumably similar (26).

Findings in nutrition surveys and studies indicate low intakes of dietary iron, energy, vitamin C, and protein. Problems associated with these nutrient deficiencies are iron deficiency anemia and reduced growth rates. Although these findings were characteristic of the lower socioeconomic population and some minority races, iron deficiency anemia has been found in infants regardless of socioeconomic and racial status.

CHAPTER III

PROCEDURE AND METHODOLOGY

The purpose of this study was to look at feeding practices which would affect the utilization of dietary iron and overall growth in infants. In order to study feeding practices of infants, the following sampling procedures and instruments were developed and utilized.

Population

A total sampling of 51 infants participating in the Special Supplemental Food Program for Women, Infants, and Children (WIC) was taken from a rural and an urban county in Oklahoma. These counties represented the typical urban and rural counties with their inherent differences in availability of medical care and marketing choices and distribution of ethnic representation. Jackson County has the following ethnic representation for its population of 36,400: white, 90%, black, 8%; Indian, 1%; other, 1%. Oklahoma County, with a population of 615,700, has the following ethnic groups: white, 87%: black, 10%; Indian, 2%; other, 1%. These statistics were taken from the 1970 census using the projected 1980 estimate (27). Birth rates for both counties had a range of 16.1-19.0 live births per 1000 population for 1978 (28). The 1978 birth rate for the state was 15.9, with a high of 20.8 in Comanche County and a low of 9.0 in Greer County. Income levels for participants in the WIC program must not exceed 195% of poverty level (7).

Twenty-seven infants served by the Jackson County Health Department, from Altus and the surrounding area, represented three ethnic groups from rural Oklahoma: Caucasian, black, and Hispanic. Twenty-four infants, served by the Mary Mahoney Health Center located in urban Oklahoma City-County area, represented two ethnic groups: Caucasian and black.

Ages of the infants ranged from 6 to 24 months and were ethnically distributed as described in Table I. Mothers' ages ranged from 21 to 29 years, with a mean age for all groups of 24 years. Educational levels were from 8.5 to 13.2 years completed in school, with a mean educational level of 11.5 years. A course in home economics had been taken by 86% of the mothers.

Instruments and Data Collection

The mother of each infant was asked to sign a consent form (Appendix C) which released information from the medical record and advised participants of the nature and confidentiality of the study. Each participant in the urban area was interviewed individually by the researcher. Participants from the rural area were interviewed individually by the public health nutritionist who was assigned to the southwestern counties or by the researcher. Consistency in interviewing techniques were assured by following the same format, using similar food models, and alternately observing pilot interviews by each researcher.

Questionnaires in nutrition surveys were adapted from those used by Fomon (29) for nutritional assessment. They were adapted for this study by addressing foods which would supply iron or affect iron

TABLE I

DESCRIPTION OF POPULATION STUDIED*

Area	Race	Age (Months)	Number	Mother's Age (Years)	Mother's Education (School Years Completed)	No. Receiving Home Economics Course for Mothers
Rural	White	6-12	5	24	11.6	5
		13-24	7	28	11.2	6
	Black	6-12	5	23	11.2	5
		13-24	4	24	10.5	4
	Hispanic	6-12	2	21	8.5	1
		13-24	4	23	10.7	3
Urban	White	6-12	5	21	11.8	2
		13-24	8	23	11.0	7
	Black	6-12	5	24	13.2	5
		13-24	6	29	11.8	6

*Raw means

utilization and by eliminating questions about availability of refrigerator or working stove.

Questionnaires were designed as two-part forms (Appendix D). The first part included growth data and hematocrit or hemoglobin levels obtained from the medical record, as well as other information, such as mother's age, date of initial certification for WIC, and location of origin (e.g., originally from a rural or an urban setting).

Procedures by the health departments for evaluating body size and growth of children have been described by the Department of Health Education and Welfare (30). Lengths of infants were taken with the child in a recumbent position and by use of an infantometer which was marked to the nearest sixteenth of an inch and coded to 0.1 inch. To ensure accuracy, the procedure was done as recommended with the use of two people, one to hold the legs extended and one to hold the head in position. Weights were taken on beam-balanced scales with non-detachable weights and were recorded in ounces. Weights and heights were recorded on National Center for Health Statistics Growth Charts (Appendix E) (31), and were included as part of the medical record. Hemoglobins were determined and recorded to the nearest 0.1 gram per deciliter and hematocrits were recorded to the nearest per cent.

The second part of the questionnaire was designed with specific questions which would further elucidate information derived from a 24-hour dietary recall. Questions were designed to investigate the intake of iron-containing foods and the combinations of foods which enhance iron utilization. A few questions addressed the consumption of foods which might have limited iron consumption and/or utilization.

A 24-hour dietary recall (Appendix F) of the infant's intake was taken from the mother. She was asked to name chronologically everything that her baby had eaten or drunk from six a.m. the previous day until six a.m. on the day of the interview. She was asked to give brand names when appropriate and sizes of portions that the child consumed. Food models, baby food jars, baby bottles, and various sizes of measuring cups and spoons were used to aid the mother in recalling portion size.

Available iron (Appendix G) was estimated according to Monsen's model (24) which was adapted to separate nonheme food iron from fortified (inorganic) iron sources. Calculations of available dietary iron from the 24-hour recall were executed by determining intakes of heme, nonheme food, and nonheme fortification iron, of ascorbic acid, and of meat, fish, and poultry from the Nutritive Value of American Foods in Common Units (32), as well as from labels and product handbooks from formula companies. Subtotals of each meal combination were used to determine availability level of iron in that meal based on the amount of meat, fish, and poultry present and/or the amount of ascorbic acid present. A high availability meal was determined by the presence of: 90 grams of lean raw meat, fish, of poultry; 75 mg of ascorbic acid; or 30 grams of meat, fish, or poultry plus 25 mg of ascorbic acid. The medium availability meal was determined by the presence of 30-60 grams of lean raw meat, fish, or poultry or 25-75 mg of ascorbic acid. The low availability meal was determined by the presence of less than 30 grams of lean raw meat, fish, or poultry or less than 25 mg of ascorbic acid.

Computations were performed by using percentages in Table II to determine the available iron from heme iron (meat, fish, or poultry) and from nonheme iron (other food iron and fortified iron). Although iron stores were probably not existent for all infants in this study, the lack of information about iron stores led to the assumption of normal iron stores for purposes of calculations.

TABLE II

IRON AVAILABILITY OF MEAL COMBINATIONS, ASSUMING NORMAL IRON STORES

Availability of Iron in Meal	Heme Iron	Nonheme Iron (Other Food Iron and Fortification Iron
High	14%	8%
Medium	12%	5%
Low	11%	3%

The data on growth parameters were recorded to the nearest tenth of an inch for height and to the nearest ounce for weight. Infants' ages were calculated in weeks from recorded birth dates. Each subject was assigned an identification number which included a subject number, geographical location, and race. The mother's age was recorded in years and her participation in the WIC program during pregnancy was tabulated as a yes-no answer. The time the infant had been on WIC was recorded in months and prematurity was identified by a yes-no answer. Weight for height was recorded as percentage of the median from the National Center for Health Statistics (NCHS) data (30). Hematocrit values were written in percentages. Hemoglobin values were recorded to the nearest tenth of a gram per deciliter and converted to equivalent hematocrits by a factor derived from analysis of the same sample by both procedures in the two laboratories. Calories were recorded to the nearest whole number. Dietary iron from the three scores was recorded to a tenth of a milligram and available iron, a hundredth of a milligram. Ascorbic acid was noted to the nearest milligram and figures for meat, fish, and poultry were estimated to the nearest gram.

Length of time that the child had been receiving vitamins or vitamins with iron was entered in months. Milk intake was described as whole, low fat, iron-fortified formula, or breast milk. Other beverages were divided into four categories composed of nutritious beverages (milk, juice), non-nutritious beverages (tea, Koolaide, Coke, punch), water, and alcohol. Consumption of tea and milk were reported to the nearest ounce. If the child was on the bottle, the usual beverage in the bottle was identified by assigned codes.

Meats were divided into four basic categories: red meat (including beef, pork, and lamb), fish, fowl, and salted meats (including ham, lunch meat, sausage, and bacon). Frequency of ingestion of various types of foods was then tabulated. For example, the frequency of meat ingestion ranged from three times a day to two times a week, whereas the frequency of intake of dried beans or peas ranged from daily to once a month. Sizes of servings of meats and vegetables were converted from ounces and tablespoons to teaspoons.

Feeding problems were identified by the following categories: eating too much or too little, problems with swallowing, spitting up, too many empty-calorie foods, eating same foods, persistent hunger, problems with specific foods, or none. Illnesses were classified in the following manner: infections, colds, allergies, and digestive, metabolic, or congenital disorders. The yes-no questions addressing sources of instruction on infant feeding were coded according to person or place from which the mother had received information. Persons and places were assigned to the following categories: physicians, registered nurses, registered dietitians, relatives, television or magazines, pamphlets, or friends, neighbors, or teachers.

Data Analysis

All data were coded for analysis. Data cards were keypunched and analyzed by the Statistical Analysis System (33) package. Raw means are reported with standard deviations. A general linear regression model was used for analysis of variance to determine effects of geographical area, race, and age and to compute least squares means by these variables. Simple correlation coefficients were calculated for some variables, and frequencies were compared by chi-square tests. Differences or effects were considered significant if $p \leq 0.05$.

CHAPTER IV

RESULTS AND DISCUSSION

The purposes of this study were to determine if ethnic, geographic, or age differences existed in infant feeding practices between infants from urban and rural Oklahoma which might affect iron utilization. The 51 infants selected represented three ethnic groups and all were participating in the WIC program.

Interviews, including recalls of 24-hour intakes, were taken from the mothers in regard to their infants' dietary habits. Each participant's health department medical record was used as a source of anthropometric and hematological values for two separate visits to the health department.

Intakes of Energy, Iron, and Enhancing Factors

Energy and total available iron were calculated from a recall of a 24-hour dietary intake (Table III). Least squares means of specific nutrients were determined for blacks and whites from each area and age group. Hispanic groups were eliminated from analysis of variance, since the urban sample included no Hispanics, but raw means are reported for them.

Total energy intakes differed significantly between age categories. Older infants (13-24 months) consumed 1243 $\pm$ 88 kilocalories as opposed to younger infants (6-12 months) who consumed 983 $\pm$ 95

TABLE III

ENERGY AND AVAILABLE IRON FROM A DAY'S INTAKE

Area	Race	Age (Months)	Number	Energy		Meat, Fish, Poultry (MFP) Iron	Nonheme Iron	Fortification Iron	Ascorbic Acid	MFP	Available MFP Iron	Available Nonheme Iron	Available Fortification Iron	Total Available Iron
				kcal	kcal/kg	mg				g	mg			
Part A. Raw Means for All Subjects														
Rural	White	6-12	5	1057±475*	135±46	0.3±0.5	2.9±2.3	20.7±17.1	108±74	17±24	0.04±0.06	0.13±0.11	0.68±0.57	0.85±0.56
		13-24	7	1517±789	146±74	2.9±2.0	4.9±3.4	4.9± 7.1	63±81	60±48	0.28±0.23	0.25±0.22	0.19±0.24	0.71±0.52
	Black	6-12	5	681±252	93±39	0.5±0.6	1.6±1.0	15.4± 5.8	105±74	3±3	0.05±0.06	0.06±0.04	0.54±0.17	0.65±0.21
		13-24	4	1179±226	108±20	1.5±1.0	3.4±1.2	2.9± 4.8	75±52	59±43	0.18±0.11	0.16±0.02	0.02±0.02	0.37±0.13
	Hispanic	6-12	2	839±244	99±10	0.6±0.8	3.1±0.1	12.5± 4.9	85±23	14±20	0.07±0.09	0.08±0.01	0.42±0.09	0.57±0.21
		13-24	4	1619±862	134±30	1.6±2.2	5.7±2.3	0.3± 0.6	153±29	48±59	0.22±0.32	0.29±0.07	0.01±0.02	0.52±0.31
Urban	White	6-12	5	1107±287	149±54	1.8±1.6	3.3±1.7	9.0± 5.2	113±27	62±69	0.21±0.21	0.13±0.05	0.28±0.18	0.63±0.11
		13-24	8	1154±300	127±46	2.0±1.9	4.3±1.5	4.4± 9.8	61±49	43±28	0.24±0.24	0.19±0.08	0.14±0.29	0.58±0.34
	Black	6-12	5	1087±200	133±25	1.4±0.9	3.6±1.3	25.3±35.9	124±34	68±79	0.17±0.12	0.18±0.09	0.79±1.08	1.14±1.04
		13-24	6	1123±351	106±39	1.6±0.6	4.9±1.1	1.6±2.0	80±85	58±20	0.18±0.06	0.18±0.06	0.05±0.06	0.42±0.09
Part B. Least Squares Means from Analysis Excluding Hispanics														
Categories														
Rural			21	1109	121	1.3†	3.2	11.0	88	35†	0.13	0.14	0.35	0.64
Urban			24	1118	129	1.7†	4.0	10.1	94	58†	0.20	0.17	0.31	0.69
	F Value			0.03	0.02	0.43	1.56	0.16	0.04	2.25	1.30	0.34	0.32	0.00
	Probability			NS‡	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
White			25	1209	140	1.8	3.9	9.7	86	46	0.19	0.17	0.32	0.69
Black			20	1017	110	1.3	3.4	11.3	96	47	0.14	0.14	0.35	0.64
	F Value			2.71	3.97	2.61	0.85	0.36	0.55	0.00	1.31	1.32	0.22	0.06
	Probability			NS	0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS
6-12 Months			20	983	128	1.0†	2.9	17.6	113	37†	0.12	0.12	0.57	0.82
13-24 Months			25	1243	122	2.0†	4.4	3.4	70	55†	0.22	0.19	0.10	0.52
	F Value			3.97	0.28	5.85	6.82	10.29	4.84	1.26	3.90	4.23	11.87	3.99
	Probability			0.05	NS	0.02	0.01	0.002	0.03	NS	0.05	0.04	0.001	0.04

Note: *=Standard Deviation; †=Interaction between areas and ages at $p<0.05$; ‡=NS, not significant at $p>0.05$.

kilocalories. When energy was expressed as kilocalories per kilogram of body weight, a significant difference between black infants (110 $\pm$ 11 kcal/kg) and white infants (140 $\pm$ 9 kcal/kg) was observed.

RDA's for energy are 105 kilocalories per kilogram of body weight for infants (6-12 months) and 1300 kilocalories for children (1-3 years) (11). Energy intakes met the RDA's when expressed as kilocalories per kilogram of body weight but did not meet the RDA's when expressed as total kilocalories for the older age group of children. Findings for overall energy intakes were comparable to intakes in previous studies (26, 34) in that they met at least two-thirds of the RDA's. Lower energy intakes, when expressed in kilocalories per kilogram, for black infants, were consistent with findings from the Ten State Survey (10).

No significant differences were observed for nutrients affecting iron utilization for urban versus rural infants nor for white versus black infants. Significant differences were calculated for all nutrients and food (except for meat, fish, and poultry) for the two different age categories of infants.

Iron from meat, fish, and poultry (MFP) sources was significantly higher for older infants. Younger infants ate about half the amount of iron from MFP sources as the older infants. A significant interaction between the geographic locations and age categories was observed for iron intake from MFP. The highest values of MFP iron were found among older urban infants, while the lowest values were found among the young rural infants. Nonheme iron intake from vegetables, nuts, and legumes was significantly higher for older infants at a level almost twice the value of nonheme iron intakes for younger infants. Iron intake from fortified foods such as cereals and formulas (included in the WIC food package, Appendix A) was significantly higher for younger infants (17.6 $\pm$ 3.2 mg) when compared to older infants (3.4 $\pm$ 3.0 mg).

Iron needs, according to the RDA's, can be met by 15 mg for infants from both age categories (6-24 months) (11). Calculations for total food iron intake (iron from meat, fish, and poultry, from nonheme sources and from fortification iron sources) had a range of 7.8-30.3 mg, with a mean intake of 14.8 mg. Iron intakes from previous studies generally indicated lower daily intakes for both ages of infants than are reported here (9, 10, 12, 13, 25, 34). It may be that infants in this study received more iron from fortified foods than in previous studies mentioned.

Filer (34) found a close relationship of educational level of the mother to the daily intake of iron by her infant. The highest iron intake of 30.3 mg per day was from the group of mothers with the highest educational level of 13.2 years (see Table I), while the lowest intake of iron of 7.6 mg daily was from a group with a mean educational level of 10.7 years (not the lowest educational level in the study).

Ascorbic acid intakes were significantly higher for younger infants. The level of vitamin C intake for all infants and children studied met the RDA, which is 35 mg for infants (6-12 months) and 45 mg for children (13-24 months) (11).

Meat, fish, and poultry intakes indicated no significant differences for geographic, racial, or age categories. However, an interaction between geographical and age category was noted. Raw mean intakes for young rural infants were 17 $\pm$ 24 grams MFP for whites and 3 $\pm$ 3 grams MFP for blacks. Young urban infants were shown to have MFP intakes of 62 ± 69 grams for white infants and 68 ± 79 grams for black infants.

Both ascorbic acid and protein (meat, fish, and poultry) intakes exceeded the RDA in other studies (13, 26) which are consistent with findings in this study, with the possible exception of lower MFP intakes for the young rural infants. Protein from other sources such as formula, milk, cereal, and eggs were not included with calculations for protein from meat, fish, and poultry sources.

Available meat, fish, poultry, and nonheme iron levels were lower for younger infants and levels of available iron from fortified foods were higher for younger infants. Total available iron intakes were significantly higher for younger infants than for older infants. The mean total available iron calculated for all infants was 0.67 ± 0.48 mg. The lowest total available iron intakes were 0.37 mg for rural black infants (13-24 months) and 0.42 mg for the urban black infants (13-24 months).

Assuming an overall absorption rate of iron at 10%, the recommendation for absorbable iron would be approximately 1.5 mg per day (11). Young urban blacks had a mean intake of 1.14 mg available food iron, which was the highest figure for any group studied. No group met the recommended level for absorbable iron.

Preferences for Meat, Fish, and Poultry

Percentages of children preferring different types of meat were tested by chi-square for significance (Table IV). No significant differences of preference were evidenced for either geographic or age

TABLE IV

PERCENTAGE OF PREFERENCES FOR THREE FAVORITE MEATS, AS INDICATED BY MOTHER

Groups		Red Meat		Fowl		Fish		Salted Meat	
		Number Responses	Yes Responses %	Number Responses	Yes Responses %	Number Responses	Yes Responses %	Number Responses	Yes Responses %
Area	Rural	27	66	26	50	26	7	26	42
	Urban	24	83	24	62	24	8	24	80
	Probability	NS*+		NS		NS+		NS	
	Correlation Coef.	0.19		0.12		0.01		0.20	
	Chi-square	1.85		0.79		0.00		4.91	
Race	White	25	92	20	58	24	8	24	51
	Black	20	55	20	55	20	5	20	65
	Hispanic	6	66	6	50	6	16	6	49
	Probability	0.01+		NS		NS+		NS	
	Correlation Coef.	-0.31		-0.05		0.04		-0.01	
	Chi-square	8.22		0.14		0.86		3.10	
Age	6-12 Months	22	68	21	47	21	4	21	42
	13-24 Months	29	79	29	62	29	10	29	66
	Probability	NS		NS		NS+		NS	
	Correlation Coef.	0.12		0.14		0.10		0.33	
	Chi-square	0.81		1.03		0.51		7.71	

Note: *=NS, not significant at $p>0.05$; +=One or more cells had <4 individuals other than Hispanics.

category but were observed for between races for red meats (which included beef, pork, and lamb). Twenty-three of 25 (92%) white infants preferred red meat, 11 of 20 (55%) black infants preferred red meat; and 4 of 6 (66%) Hispanic infants preferred red meat. No differences were found among races for poultry, fish, or salted meats. With the exception of frequent usage of meat dinners, specific preferences for meat types were not clearly indicated in other studies (15, 16, 26, 34).

Frequency of Use of Legumes

A chi-square test for positive responses (Table V) to a yes-no question about consumption of dried beans and peas revealed significantly more positive responses for urban infants (91%) as compared to rural infants (72%). Dried beans and peas were eaten once a week or more by 50% of the urban infants as compared to 12% of the rural infants. Rural infants' intakes indicated consumption of dried beans and peas twice a month or less at a rate of 60% as compared to 41% for urban infants. No significant differences were noted between racial or age categories in preferences for dried beans and peas.

More urban than rural infants tended to accept peanut butter, but the difference was not significant (p=.06). Older infants were fed peanut butter more often than younger infants. Other studies did not mention usage of legumes in infant dietaries (15, 16, 34).

Selected Vegetable Consumption

Green beans, corn, peas, potatoes, and spinach were the five most frequently preferred vegetables among all infants studied, whereas Malansky (16) found infants most often preferred mashed potatoes, peas,

TABLE V

FREQUENCIES OF INTAKES OF DRIED BEANS AND PEANUT BUTTER

		Dried Beans and Peas				Peanut Butter			
		No. of Responses	Yes Responses %	Times Eaten $\geq$ 1xWeek %	Times Eaten $\leq$ 2xMonth %	No. of Responses	Yes Responses %	Times Eaten $\geq$ 2xWeek %	Times Eaten $\leq$ 1xWeek %
Area	Rural	25	72	12	60	27	40	16	24
	Urban	24	91	50	41	24	71	49	22
	Probability		0.02				NS*		
	Correlation		-0.05				0.19		
	Chi-square		9.41				9.01		
Race	White	24	83	29	54	22	66	40	26
	Black	19	77	31	46	19	52	26	26
	Hispanic	6	83	33	50	5	20	20	0
	Probability		NS				NS		
	Correlation		-0.11				-0.26		
	Chi-square		2.55				4.89		
Age	6-12 Months	22	67	27	40	20	30	25	5
	13-24 Months	27	91	33	58	26	74	37	37
	Probability		NS				0.01		
	Correlation		0.17				0.51		
	Chi-square		7.05				11.98		

Note: *=NS, not significant at p>0.05.

carrots, and spinach. The three selected vegetables which contributed nonheme iron at a rate of 1.0 mg per 1/2 cup edible portion were green beans, peas, and spinach (Table VI). Other vegetables were not tabulated because they did not contain as much iron.

TABLE VI

FREQUENCIES OF SELECTED VEGETABLES* PREFERRED

Group		Number Responding	Preference for: Green Beans %	Peas %	Spinach %
Area	Rural	27	51	51	26
	Urban	24	92	38	42
Race	White	24	79	63	21
	Black	20	54	20	55
	Hispanic	6	66	66	25
Age	6-12 Months	22	77	32	27
	13-24 Months	29	66	55	38

Note: *=Vegetables were selected which provide ≥1.0 mg iron per 1/2 cup edible portion.

High percentages of preference for green beans were noted among younger infants, urban infants, and white infants. Peas were preferred by more rural, white, and Hispanic infants, and older infants.

Spinach was most frequently preferred by urban black and older infants. A greater variety of vegetables served to infants was not noted for blacks as was found by Malansky (16).

Frequency of vegetable consumption was not different for geographical, racial, or age categories when analyzed for blacks and whites. The mean size serving of vegetables for blacks and whites was 14 $\pm$ 9 teaspoons and was not different for area, race, or age category.

Fortification Iron Sources

Iron-fortified foods available to all WIC participants were iron-fortified cereal and iron-fortified formulas. Although some other foods such as breads, noodles, and other cereals (not distributed by WIC) are also fortified with iron, the major sources of fortification iron in the infants' intakes were from WIC cereals and formulas. Table VII indicates the frequency of use of these items. There were no significant differences in the use of iron-fortified cereals by geography, race, or age. Twenty-four of 27 (88%) rural infants consumed iron-fortified cereal in comparison to 16 of 23 (69%) of the urban infants. Ingestion of iron-fortified cereals was most frequent for rural infants (70%), black infants (85%), and young infants (66%), although none of these figures were significantly different from other groups.

Iron-fortified formula was used by 11 of 27 (40%) rural infants and 11 of 23 (47%) urban infants. Ten of 25 (40%) white infants, 10 of 20 (50%) black infants, and 2 of 6 (33%) Hispanic infants consumed iron-fortified formulas. Eighteen of 21 young infants (85%)

TABLE VII

FREQUENCY AND CONSUMPTION OF IRON-FORTIFIED
CEREAL AND FORMULA

Group		Iron-Fortified Cereal				Iron-Fortified Formula	
		No. of Responses	Yes Responses %	Frequency of Intake Daily	Frequency of Intake < Daily	No. of Responses	Yes Responses %
Area	Rural	27	88	70	28	27	40
	Urban	23	69	59	22	23	47
	Probability		NS*	NS+			
	Correlation		0.24	-0.11			
	Chi-square		2.89	3.99			
Race	White	25	84	47	43	25	40
	Black	19	68	85	10	20	50
	Hispanic	6	100	66	2	6	33
	Probability		NS	NS+			
	Correlation		-0.01	-0.11			
	Chi-square		3.34	8.52			
Age	6-12 Months	21	90	66	23	21	85
	13-24 Months	29	72	64	32	29	14
	Probability		NS	NS+			
	Correlation		0.22	0.03			
	Chi-square		2.48	4.93			

Note: *=NS, not significant at $p>0.05$; +=Interaction between area, race, and age at $p<0.05$.

were consuming iron-fortified formulas, whereas only 2 of 29 older infants (14%) were receiving the same. Usage of iron-fortified formulas was minimal, and usage of iron-fortified cereals was inconsistent in previous studies on infant dietaries (14, 16, 34).

Sources of Ascorbic Acid

Fruit juices appeared to be the primary source of ascorbic acid in the infants' diets. The most frequently consumed juices were apple juice and orange juice, which were consistent with findings by Maslansky (16). WIC juices are required to contain 100% USRDA vitamin C (60 mg) in four ounces for women and children, and 120% USRDA vitamin C (42 mg) in four ounces for infants (Appendix F). Iron-fortified infant formula also contains vitamin C at a level of 55 mg per liter. Other sources of ascorbic acid in the diet were fruits, vegetables, and mixed dinners.

Although the RDA was met for all infants in this study, lower intakes of vitamin C among the older infants than in younger ones was apparent in both geographical areas (with the exception of Hispanics) (see Table III). This may have resulted, in part, from the change in the WIC food package at one year of age. Younger infants received at least two sources of ascorbic acid (one from fruit juice, and the other from iron-fortified formula), which may have been responsible for higher intakes of vitamin C.

Availability of Iron from Meals

The availability of iron from meals was determined by rating each meal combination as high, medium, or low. The determination of meal combinations was accomplished by the method described in the procedure (24).

Since infants can rarely consume adult size portions of food (i.e., 90 gram portion of meat), and since at least two groups of infants consumed less than 75 mg ascorbic acid, a scoring system was designed for availability of iron from meal combinations. It may serve as an index for quick evaluation when iron stores are unknown, and, hence, exact availability cannot be calculated. Further factors used to calculate availability may not apply to infants.

Each meal combination was assigned the following scores: high availability = 4; medium availability = 2; and low availability = 1. The total score for each infant's daily intake was then divided by the total number of meals or meal combinations consumed that day. Infants were found to eat at an average of seven times per day, which was consistent with findings by Crawford (26). The resultant figure was referred to as an available iron score. The mean available iron score was 1.44, with a standard deviation of 0.34. Table VIII describes the correlation of the available iron of meal combinations with daily total intakes of specific nutrients.

Correlation coefficients of the iron availability score with calories and calories consumed per kilogram of body weight were significant. This would indicate that as energy increased in the diet, as well as kilocalories for unit body weight, the meal combinations yielded a higher score for iron availability. Iron from fortified foods correlated negatively with iron availability scores but not at a significant level. Responses to two yes-no questions concerning

TABLE VIII

RELATIONSHIP OF IRON AVAILABILITY SCORES TO VARIOUS DIETARY CHARACTERISTICS

Iron Availability Score*	Calories	Calories/ Kilogram	Fortification Iron	Juice Served with Meal+	Juice Served with Meat‡
Probability	0.01	0.03	NS#	NS	NS
Correlation Coefficient	0.34	0.29	-0.14	-0.08	-0.16
Number	51	50	51	40	49

Note: *=Calculation of iron availability score from meal combinations. Each meal combination was given a score as follows: High Availability=4; Medium Availability=3; Low Availability=1. Total score for each infant's daily intake was then divided by the number of meals consumed that day, resulting in an available iron score. +=Juice served with meal was a yes or no question answered by the mother. ‡=Juice served with meat was a yes or no question answered by the mother. #=NS, not significant at $p>0.05$.

the serving of juice with a meal or with meat were not significant when correlated with available score.

Diet and Hematocrit for Infants Receiving and Not Receiving Iron Supplementation

Nineteen infants (37%) who received iron supplementation for an average of 2.8 months had a mean hematocrit of 33.6% $\pm$ 2.1 (Table IX). Beal reported 25% of the children studied were taking vitamin-mineral supplements but did not demonstrate hematologic response (25). Change in hematocrits did not correlate significantly with the second hematocrit for those given iron supplementation. The Preschool Nutrition Study (12) also reported similar findings for blacks. Hematocrits correlated negatively with growth rates expressed as changes in weights and heights. A negative correlation of -0.61 and -0.72 for growth rate of weight and height, respectively, would indicate that as hematocrits increased, growth rates of weight and height decreased, which is inconsistent with findings by Judisch (35) and coworkers, who directly correlated rapid weight gain with iron therapy.

Twenty-nine infants who received no iron supplementation had a mean hematocrit of 35.5% $\pm$ 2.7. Significant correlations of the most recent hematocrit to a change in hematocrit at a level of 0.84 was observed for 15 infants. (Hematocrit values were available for 15 of 29 non-supplemented infants.) A positive correlation of hematocrit to the size of servings of meat was significant for the 27 infants consuming meat. This would seem to indicate a positive effect of meat, fish, and poultry on the hematocrit levels.

TABLE IX

CORRELATION OF DIET AND HEMATOCRIT LEVELS FOR INFANTS RECEIVING IRON SUPPLEMENTS AND FOR INFANTS NOT RECEIVING IRON SUPPLEMENTS

	Change in Hematocrit	Weight	Height	Meat, Fish, Poultry Intake	Size of Meat Servings	Fortification Iron Intake	Total Available Iron	Total Food Iron
Hematocrit Level with Iron Supplementation								
Probability	NS+	0.004	0.0004	NS	NS	NS	NS	NS
Correlation*	0.48	-0.61	-0.72	0.39	-0.19	-0.02	-0.12	-0.20
Number	19	19	19	19	19	19	19	19
Hematocrit Level without Iron Supplementation								
Probability	0.0001	NS	NS	NS	0.03	NS	NS	NS
Correlation	0.84	-0.21	0.07	0.07	0.41	-0.07	-0.08	-0.04
Number	15	29	29	29	27	28	29	29

Note: *=Pearson correlation coefficient; +=NS, not significant at p>0.05.

Growth Rate and Hematocrit

Raw means for rates of growth and measurement of hematocrit values are listed in Table X. Measurements for weight, height, weight for height, and hematocrit were taken from the most recent measurements documented in the patient's medical record. Calculations for growth rate have been explained in the procedure.

Least squares means were analyzed for growth rates and hematocrits of blacks and whites. Hispanics were eliminated from this analysis because the urban population had no Hispanic representation. No significant differences in growth or hematocrit values existed between geographical or ethnic groups. Differences in measurement of growth rates occurred at significant levels for the two age categories studied. No significant difference existed between age categories in hematocrits.

Growth Rate in Relationship to Overall Dietary Adequacy

Growth in weight and height were correlated with iron fortification levels and available iron fortification levels (Table XI). This indicates that as growth rate increases during the first year of life an increase of foods fortified with iron is evidenced in the diet. Conversely, the study by Beal (25) supports that increased growth rates precipitate increased hemoglobin synthesis without necessity of fortification of dietary iron.

Increase in height correlated negatively with nonheme iron and available nonheme iron sources. This reflects increased intakes of

TABLE X

GROWTH AND HEMATOCRIT OF INFANTS

Area	Race	Age (Months)	Number	Age and Measurements Taken at Second Visit: Age	Weight	Height	Weight for Height	Growth Rate*: Weight	Height	Weight for Height	Second Hematocrit
				(Weeks)	(oz.)	(in.)	(%)	(oz./wk.)	(in./wk.)	(%/wk.)	(%)
Part A. Raw Means											
Rural	White	6-12	5	25±14	266± 69	26.4±3.1	50±17	5.87±0.76	0.22±0.05	0.21±1.69	32.8±1.3
		13-24	7	65±21	371± 37	29.7±1.6	72±17	3.39±2.43	0.12±0.09	0.28±1.47	35.1±2.7
	Black	6-12	5	27± 1	251± 18	26.6±0.7	23±18	4.99±0.87	0.23±0.05	0.19±1.25	36.7±3.2
		13-24	4	77±26	390± 61	32.3±2.2	46±33	2.08±1.34	0.11±0.04	-0.15±0.31	36.2±5.9
	Hispanic	6-12	2	32± 6	297± 56	27.0±1.4	62±17	4.69±1.45	0.17±0.09	0.50±0.70	33.0±4.2
		13-24	4	59±19	410±142	30.0±3.3	72±25	3.71±0.96	0.11±0.02	0.17±1.00	34.0±2.8
Urban	White	6-12	5	31±11	275± 37	26.8±1.5	46±32	5.25±2.27	0.22±0.10	0.55±0.68	35.1±1.9
		13-24	8	61±19	338± 60	30.2±2.6	38±16	2.47±1.43	0.10±0.03	0.56±1.39	34.0±1.1
	Black	6-12	5	36± 8	294± 54	27.1±2.2	55±20	4.73±1.08	0.16±0.07	1.09±1.46	33.8±1.3
		13-24	6	72±19	389± 63	31.0±1.4	62±28	2.13±0.97	0.09±0.05	-0.14±0.90	34.9±1.9
Part B. Least Squares Means from Analysis, Excluding Hispanics											
Rural			21	48	319	28.7	48‡	4.08	0.17	0.13	35.2
Urban			24	50	324	28.8	50‡	3.65	0.15	0.51	34.4
F Value				0.24	0.07	0.17	0.12	1.74	2.06	0.77	0.62
Probability				NS#	NS	NS	NS	NS	NS	NS	NS
White			25	45	312	28.3	51‡	4.24	0.17	0.40	34.2
Black			20	53	331	29.2	46‡	3.48	0.15	0.24	35.4
F Value				0.86	0.78	1.09	0.17	1.17	0.20	0.23	1.94
Probability				NS	NS	NS	NS	NS	NS	NS	NS
Age		6-12	20	30	271	26	43	5.21	0.21	0.51	34.6
		13-24	25	69	372	30	55	2.52	0.11	0.13	35.0
F Value				50.33	34.93	37.10	2.08	30.63	22.02	0.87	1.94
Probability				.0001	.0001	.0001	NS	.0001	.0001	NS	NS

Note: *=Growth rates were calculated: second parameter-first parameter/second age-first age; †=Hematocrit values were the most recent value recorded in medical records; ‡=Calculation of change in hematocrit (second hematocrit-first hematocrit).

TABLE XI

GROWTH RATE AND CHANGE IN HEMATOCRIT IN RELATIONSHIP TO OVERALL DIETARY ADEQUACY

Variable	Number	Energy	Meat, Fish, Poultry (MFP) Iron	Nonheme Iron	Fortification Iron	Ascorbic Acid	MFP	Available MFP Iron	Available Nonheme Iron	Available Fortification Iron	Total Available Iron
Growth Rates*											
Weight for Height	50										
Probability		NS†	NS	NS	NS	NS	NS	NS	NS	NS	NS
Correlation		0.00	0.17	-0.13	0.16	-0.00	0.05	0.25	-0.01	0.13	0.22
Weight	50										
Probability		NS	NS	NS	0.01	NS	NS	NS	NS	0.01	NS
Correlation		-0.10	-0.18	-0.25	0.32	0.06	-0.03	-0.07	-0.19	0.33	0.25
Height	50										
Probability		NS	NS	0.01	0.05	NS	NS	NS	0.03	0.03	NS
Correlation		-0.22	-0.24	-0.33	0.27	0.13	-0.02	-0.20	-0.30	0.30	0.14
Change in Hematocrit‡	26										
Probability		NS	NS	NS	NS	NS	0.03	NS	NS	NS	NS
Correlation		0.15	0.35	0.08	0.20	-0.02	0.42	0.21	0.08	0.08	0.21

Note: *=Growth rates were calculated: second parameter-first parameter/second age-first age; †NS=not significant at p>0.05; ‡=Calculation of change in hematocrit (second hematocrit-first hematocrit).

foods supplying nonheme iron as the growth rate decreased during the second year of life.

Change in Hematocrit in Relationship to Overall Dietary Adequacy

Change in hematocrit was calculated for 26 infants for whom two hematocrit values were recorded, by subtracting the first value from the second (Table XII). Correlation (r=0.42) of meat, fish, and poultry intake with change in hematocrit values was significant. Thus, as meat, fish, and poultry content of the diet increased, the hematocrit also increased. No other dietary variables correlated with change in hematocrit.

Change in Hematocrit in Relationship to Geography, Race, Age Category, and Sex

Least squares means were calculated for change in hematocrit by geographical locations, race, age, and sex (Table XII). Significant differences between geographical locations were evidenced with a mean change in hematocrit for rural infants at 2.4 and for urban infants at -2.0. Raw means for rural infants' hematocrits were 34.6%; less than 31% is anemic according to WIC criteria (7). Studies on rural infants have found anemia at a rate of 10-15% of preschool children (36, 37). Significant differences among the changes in hematocrit for races were: white, 1.13; blacks, 3.16; Hispanics, -3.74. Mean hematocrit value for blacks was 35.4% as compared to an average of 31.1% for blacks of the same ages in a study by Gutelius (38).

TABLE XII

CHANGE IN HEMATOCRIT IN RELATIONSHIP TO AREA, RACE, AGE, AND SEX FOR 25 INFANTS

		N	Change in Hematocrit*
Area	Rural	12	2.4
	Urban	13	-2.0
	F Value		8.88
	Probability		0.0077
Race	White	12	1.1
	Black	10	3.2
	Hispanic	3	-3.7
	F Value		5.32
	Probability		0.0146
Age	6-12 Months	3	-0.2
	13-24 Months	22	0.6
	F Value		0.15
	Probability		NS
Sex	Male	14	-0.1
	Female	11	0.5
	F Value		0.08
	Probability		NS

Note: *=LS means for change in hematocrit.

CHAPTER V

SUMMARY AND RECOMMENDATION

This study attempted to show factors in infant feeding practices such as geography, race, and age which would affect dietary iron intake and utilization. Hematocrits and growth rates as documented in each medical record were analyzed in relationship to overall dietary adequacy. Twenty-four hour dietary intakes and questionnaires were used as dietary assessment instruments.

The population studied was selected from rural and urban areas in Oklahoma with representation from various ethnic and age categories. Most of the infants had been involved in the WIC Program for a minimum of six months.

Overall intakes of nutrients were not significantly different between rural and urban infants (whites and blacks only); however, young rural infants had lowest intakes of meat, fish, and poultry. No significant differences were noted between areas for meat preferences. Higher frequencies of intakes for sources of nonheme food iron (dried beans, peanut butter, and green beans) were noted for urban infants.

Energy levels, when expressed as kilocalories per kilogram body weight, were significantly lower for black infants. Preferences for red meats and green beans were higher for white infants, while preferences for spinach and greens were higher for black infants.

Nutrient levels were significantly different between age categories of infants, except for kilocalories per kilogram body weight and grams of meat, fish, and poultry. Younger infants consumed more fortification iron, ascorbic acid, and total available iron, while older infants ate more energy and iron from meat, fish, poultry, and nonheme sources. Obvious nutrient differences between age categories were reflected by the use of iron-fortified formula, which is routinely issued to infants under one year of age. It contributed to higher fortification iron, ascorbic acid, and total available iron levels for the younger infants. No specific preferences for meats were noted between age categories. Peanut butter was fed to older infants at a significantly higher rate. Both age groups preferred green beans over peas and spinach.

The usage of iron-fortified cereal was not significantly different between areas, races, and ages. However, a significant interaction indicates a more frequent usage of iron-fortified cereal for young rural black infants.

Combinations of foods resulting in an iron availability score indicated that as calories increased, the scores also increased. Fortification iron intakes decreased as available iron scores increased. These correlations seemed to indicate that as the child grew older and consumed more calories, meal combinations increased, resulting in higher iron availability scores with subsequent decrease in usage of iron-fortified foods. However, due to the great usage of iron-fortified formula by younger infants, total available iron was significantly higher for the young infants.

Growth rates for infants receiving iron supplementation appeared to drop as hematocrit levels went up. Changes in hematocrit and size of servings of meat correlated positively with hematocrits in infants receiving no iron supplementation. Significantly higher growth rates in weight and height (for blacks and whites) were observed for younger infants than the older ones, which would be expected, since growth rates are most rapid during the first year of life. No significant differences of growth rates were noted for area or race. Growth rates for weight and height correlated significantly with fortification iron, which would indicate rapid growth in the young infants who were receiving higher levels of fortification. Change in hematocrits correlated positively with available iron from meat, fish, and poultry.

Hematocrits for rural infants demonstrated an overall positive change, while hematocrits for urban infants demonstrated an overall negative change. Elevation of hematocrits for white and black infants were apparent, with hematocrit levels three times higher for blacks than whites. Hispanic infants' hematocrits dropped considerably.

Recommendations for application of findings for nutrition education for mothers of young children are as follows:

1. Emphasize meal combinations which enhance iron availability for children over one year of age, especially for those not receiving iron-fortified formulas. (Use rapid assessment of iron availability score.)

2. Encourage the use of less expensive dietary iron sources in enhancing combinations (i.e., iron-fortified cereal with juice or vegetables, beans with ham, peanut butter sandwiches and orange juice; juice, meat, and vegetables, particularly the inclusion of meat).

3. Investigate size portions of meat, fish, and poultry fed to child and individual meal plan and portions according to need.

4. Encourage use of juice and other ascorbic acid sources with meals instead of for snacks.

5. Follow Oklahoma State Department of Health, Maternal and Child Health Pediatric Division protocol for use of vitamin-mineral supplementation.

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APPENDIXES

APPENDIX A

CODES FOR CERTIFICATION CRITERIA (WIC)

CODE FOR CERTIFICATION CRITERIA OF PREGNANT AND POSTPARTUM WOMEN

Code	Criteria
W01	Age - Below 18 years of age and over 35 years of age
W02	Frequent Conception - Less than 24 months between dates of Conception.
W03	High Parity - 3 or more pregnancies
W04	Nutritional Anemia - Hemoglobin less than 12_g/100 ml. or Hematocrit less than 36%.
W05	Low Pre-Pregnancy Weight -10% or more underweight
W06	Insufficient Weight Gain During Pregnancy- (24 Pounds) - Use prenatal weight grid.
W07	Overweight or Obesity Before, During and After Pregnancy - over 15% overweight
W08	Inadequate Diet - Less than recommended Dietary Allowance (RDA) for calories, protein, vitamins, and minerals for age as established by diet history and documented by health professional (physician, nurse, or qualified nutritionist).
W09	Complications of Pregnancy - For example, excessive vomiting, pre-eclampsia, multiple pregnancy, uterine bleeding.
W10	History of previous Pregnancy Complications - Placenta Previa, Cephalopelvic Disproportion, Uterine Bleeding.
W11	Presence of Metabolic Disease - For example, Chronic Hypertension, Diabetes, Heart Disease,Renal Disease,Malignancy, Tuberculosis.
W12	History of Stillborn, Premature Infant, Premature Spontaneous Abortion, Low Birth Weight, Infant Neonatal Death, Infant with Congenital Abnormality, or Overweight Infant, Special Neonatal Care.
W13	History of Alcoholism or Drug Addiction. Excessive use of Cigarettes (over 10 cigarettes per day).
W14	History of Frequent infections
W15	Breastfeeding Woman whose Infant is determined to be Nutritionally at Risk.

CODE FOR CERTIFICATION CRITERIA OF CHILDREN 1-5 YEARS OF AGE

Code	Criteria
C01	Weight for Height Below the 5th Percentile for a child of same sex in reference population.
C02	Weight Below the 5th Percentile for a child of same sex in reference population.
C03	Height Below the 5th Percentile for a child of same sex and age in reference population.
C04	Weight for Height Greater Than the 95th Percentile for a child of the same sex and age in reference population.
C05	Low Hemoglobin or Hematocrit - 12-24 Months - Hematocrit less than 31 or Hemoglobin less than 10; 2-5 Years - Hematocrit less than 34 or Hemoglobin less than 11.
C06	Conditions which predispose persons to inadequate nutritional patterns, for example, chronic respiratory or gastrointestinal infections.
C07	Inadequate Diet - less than recommended dietary allowance of calories, protein, minerals or vitamins.
C08	Presence of Inborn Errors of Metabolism - (example, PKU) or milk protein intolerance (for example, milk allergy).
C09	Prevention of Regression.

CODE FOR CERTIFICATION CRITERIA FOR INFANTS (0-12 MONTHS)

Code	Criteria
I01	Prematurity - Live births which occur prior to 37 weeks gestation period, regardless of weight gain.
I02	Low Birth Weight - birth weight less than 2500 grams or 5 1/2 pounds, regardless of gestational age.
I03	Mother on WIC.
I04	Infants born of women whose medical record documents that they were at risk during pregnancy.
I05	Weight for Height below the 5th percentile for infant of same sex and age in the reference population.
I06	Height Below the 5th Percentile for an infant of the same sex and age in the reference population.
I07	Weight Below the 5th Percentile for an infant of the same sex and age in the reference population.
I08	Obesity - Weight for height is greater than the 95th percentile for an infant of the same sex in the reference population.
I09	Low Hemoglobin or Hematocrit - 6 months to 1 year - Hematocrit less than 31 or hemoglobin less than 10.
I10	Inadequate Dietary Intake - for example, less than 20 ounces of iron fortified formula from birth to 6 months, or less than 24 ounces of formula or milk between 6 months and 1 year of age, or less than dietary allowance for calorie, protein, vitamins, or minerals, or less than 10 mg. of Fe for children 0 to 6 months, and less than 15 mg. of Fe from 6 months to 1 year, or absence of introduction of all solid foods at 8 months of age.
I11	Conditions which predispose persons to inadequate nutritional patterns, for example, chronic respiratory or gastrointestinal infections.
I12	Medical Disorders Related to Nutrition - for example, PKU, allergies, disaccharide intolerance, diabetes (medical diagnosis and prescription necessary).
I13	Prevention of Regression - Removal from program would again place patient at nutritional risk.

APPENDIX B

CONSENT FORM

CONSENT FORM

Infant Feeding Practices in Urban and Rural Oklahoma

I understand the information on infant feeding will be used to study meals fed to my baby/child which may help to correct or prevent iron deficiency anemia. Benefits to me will include an individualized consultation about how best to feed my baby to improve and maintain health.

I am willing to participate in this study by answering the interview questions and agreeing to complete the 24 Hour Dietary Intake on my infant and return it to the clinic at or before my next appointment.

I give my permission to use information from the medical record. I understand that my name will not be used when the information is summarized by the Oklahoma State Department of Health and Oklahoma State University.

This study has been described and explained to me and I have been given opportunity to ask questions regarding it. I understand that participation in this program is voluntary and is not required for me to receive health care or WIC benefits. I also understand that I may withdraw from this study at any time.

Signed______________________________

Date______________________________

Researcher______________________________

Witness______________________________

Date______________________________

Interpreter's Statement____

Interpreter's Signature____

APPENDIX C

INTERVIEW FOR MOTHERS

INTERVIEW FOR MOTHERS

Date:

Information on mother: (from chart)

Mother's name______________________________

Mother's age________

Ethnic background______________________________

No. of older children________

Geographical location______________________________

Place of origin: rural______ urban_______

Date of initial certification for WIC____________________

Information on child: (from chart)

Child's name______________________________

Child's age_________ Birthdate____________________

Child's birth weight______________ Birth Length___________

Comparative data:

	1	2
Date	__________	__________
Weight	__________	__________
Height	__________	__________
Weight for Height	__________	__________
Hematocrit	__________	__________
Hemoglobin	__________	__________

Eating habits of child:

1. Does your child drink: whole milk____ 2% milk____
   breast milk____ formula____ (iron-fortified)
2. How many ounces of milk does he drink in 24 hours?_____
3. What other beverages does he drink?
   (Name three favorites)______________________________
   Brand names______________________________
   How many ounces per day?_________
4. Does your child take a bottle to bed? ____ Yes ____ No
   If yes, what is usually in the bottle? ____________________

5. How many times a day does your baby eat?________
   How many bottles does he take during a 24 hour period?________
6. What kinds of meat does your child eat?
   (Name 3)____
   What is the usual size serving?____________
   How often does he eat meat?______________________________
7. Does your child drink fruit juice or eat fruits?
   Yes_________ No___________
   If yes, what kind? (Name 3)______________________________
   How often does he take juice?____________________________
   Is juice taken with a meal? Yes________ No_________
   Is juice usually taken with a meal in which meat is served?
   Yes__________ No____________
8. How often does your child eat cereal?_________________
   Kinds (brand names)______________________________________
   How much does he eat for a serving?______________________
9. Does your child eat dried beans, peas, or peanut butter?
   Yes__________ No____________
   Every day? Yes_______ No_________
   Every other day? Yes_______ No_________
   2 times a week? Yes_______ No_________
   Are the beans cooked with ham, salt pork, or fat back?
   Yes__________ No____________ Name one____________________
   If ham is used, how much is served with beans?____________
10. Does your child eat vegetables every day? Yes_______ No______
    Every other day? Yes_______ No______
    2 times a week? Yes_______ No______
    What vegetables does he eat? (Name 3)
    ____
    What is the usual size of a serving?_____________________
    Is the vegetable usually eaten at a meal when meat is served?
    Yes__________ No____________
11. Does your child take vitamins? Yes_________ No_________
    Kind______________________
    How many?______________________

Do they contain iron? Yes_______ No_______

Are they taken daily? Yes_______ No_______

How long has he been receiving this vitamin?________________

12. Do you cook in cast iron cookware? Yes_______ No_______

What kinds of food do you cook in cast iron?____________________

13. Does your child have a feeding problem?_________________________

Describe____

14. Has your child had any illness? Yes_______ No_______

Explain____

15. Name places or people who have taught you about feeding your baby.

Doctor_______________ Magazines______________

Nurse _______________ Pamphlets______________

Nutritionist__________ Other__________________

Mother_______________ Friend_________________

Grandmother__________ Neighbor_______________

Relative_____________ Teacher________________

TV___________________

16. How many grades have you finished in school?________

17. Have you had a course in home economics? Yes_______ No_______

APPENDIX D

NCHS GROWTH CHARTS

GROWTH CHARTS
WITH REFERENCE PERCENTILES FOR GIRLS BIRTH TO 36 MONTHS OF AGE

Length for Age
Weight for Age
Head Circumference for Age
Weight for Length

NAME ______________________ **RECORD #** ______________________

DATE OF BIRTH ______________________

Date of Measurement	Age in Months	Recumbent Length	Weight	Head Circumference	

These charts to record the growth of the individual child were constructed by the National Center for Health Statistics in collaboration with the Center for Disease Control. The charts are based on data from the Fels Research Institute, Yellow Springs, Ohio. These data are appropriate for young girls in the general U.S. population. Their use will direct attention to unusual body size which may be due to disease or poor nutrition.

Measuring: Take all measurements with the child nude or with minimal clothing and without shoes. Measure length with the child lying on her back fully extended. Two people are needed to measure recumbent length properly. Use a beam balance to measure weight.

Recording: First take all measurements and record them on this front page. Then graph each measurement on the appropriate chart. Find the child's age on the horizontal scale; then follow a vertical line from that point to the horizontal level of the child's measurement (length, weight or head circumference). Where the two lines intersect, make a cross mark with a pencil. In graphing weight for length, place the cross mark directly above the child's length at the horizontal level of her weight. When the child is measured again, join the new set of cross marks to the previous set by straight lines.

Interpreting: Many factors influence growth. Therefore, growth data cannot be used alone to diagnose disease, but they do allow you to identify some unusual children.

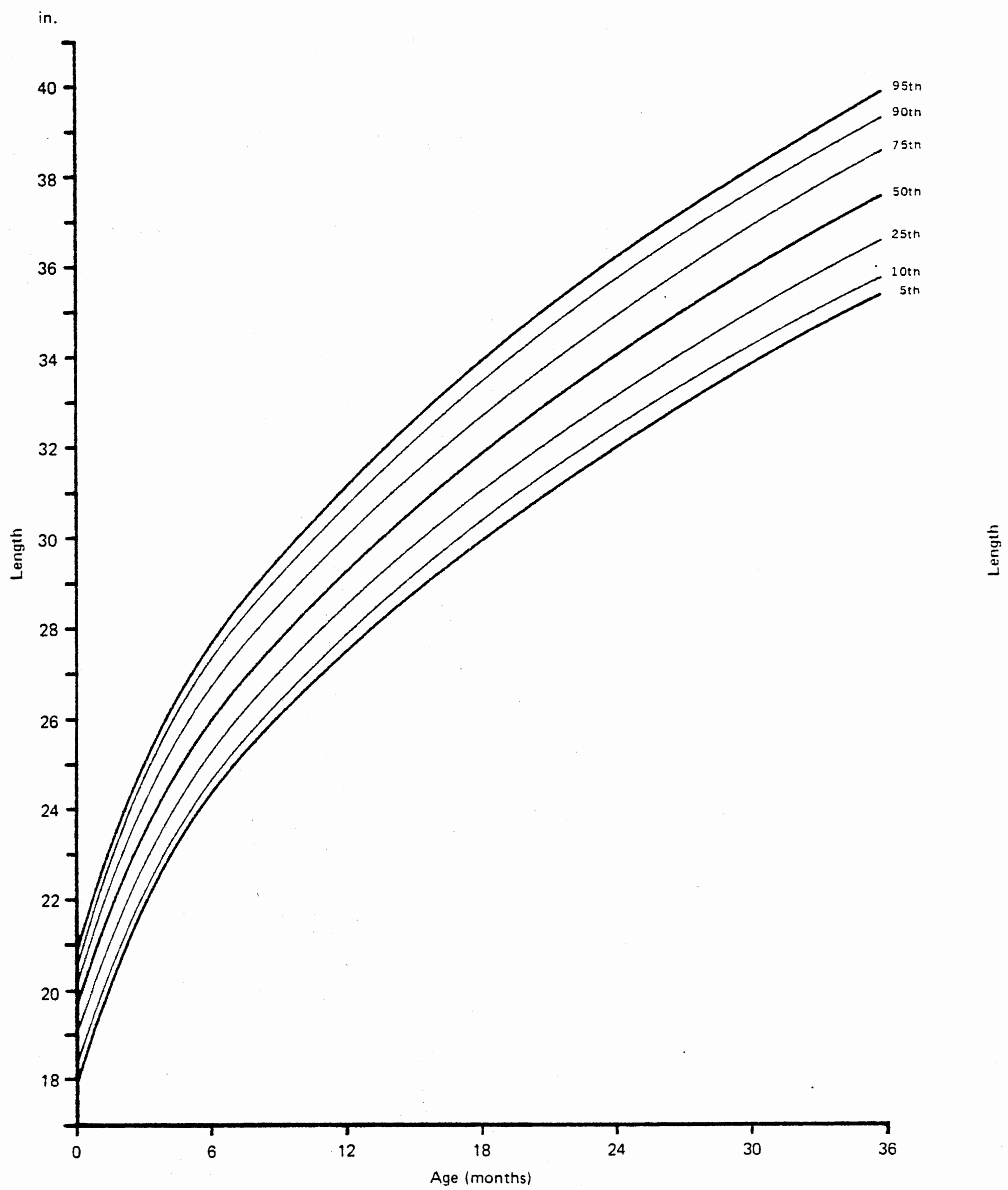
Each chart contains a series of curved lines numbered to show selected percentiles. These refer to the rank of a measure in a group of 100. Thus, when a cross mark is on the 95th percentile line of weight for age it means that only five children among 100 of the corresponding age and sex have weights greater than that recorded.

Inspect the set of cross marks you have just made. If any are particularly high or low (for example, above the 95th percentile or below the 5th percentile), you may want to refer the child to a physician. *Compare* the most recent set of cross marks with earlier sets for the same child. If she has changed rapidly in percentile levels, you may want to refer her to a physician. Rapid changes are less likely to be significant when they occur within the range from the 25th to the 75th percentile.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, PUBLIC HEALTH SERVICE
HEALTH RESOURCES ADMINISTRATION, NATIONAL CENTER FOR HEALTH STATISTICS, AND CENTER FOR DISEASE CONTROL

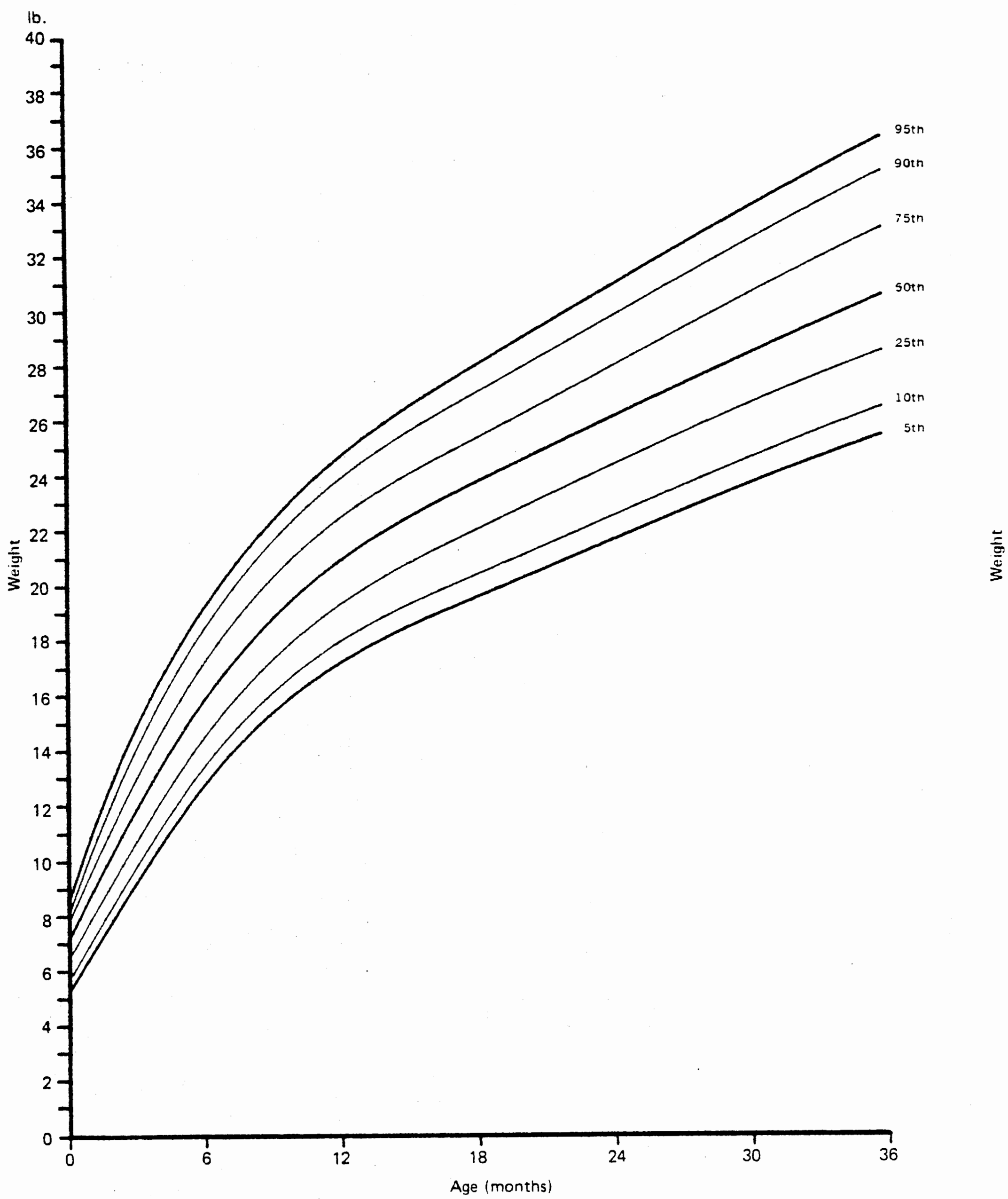
GIRLS FROM BIRTH TO 36 MONTHS

LENGTH FOR AGE

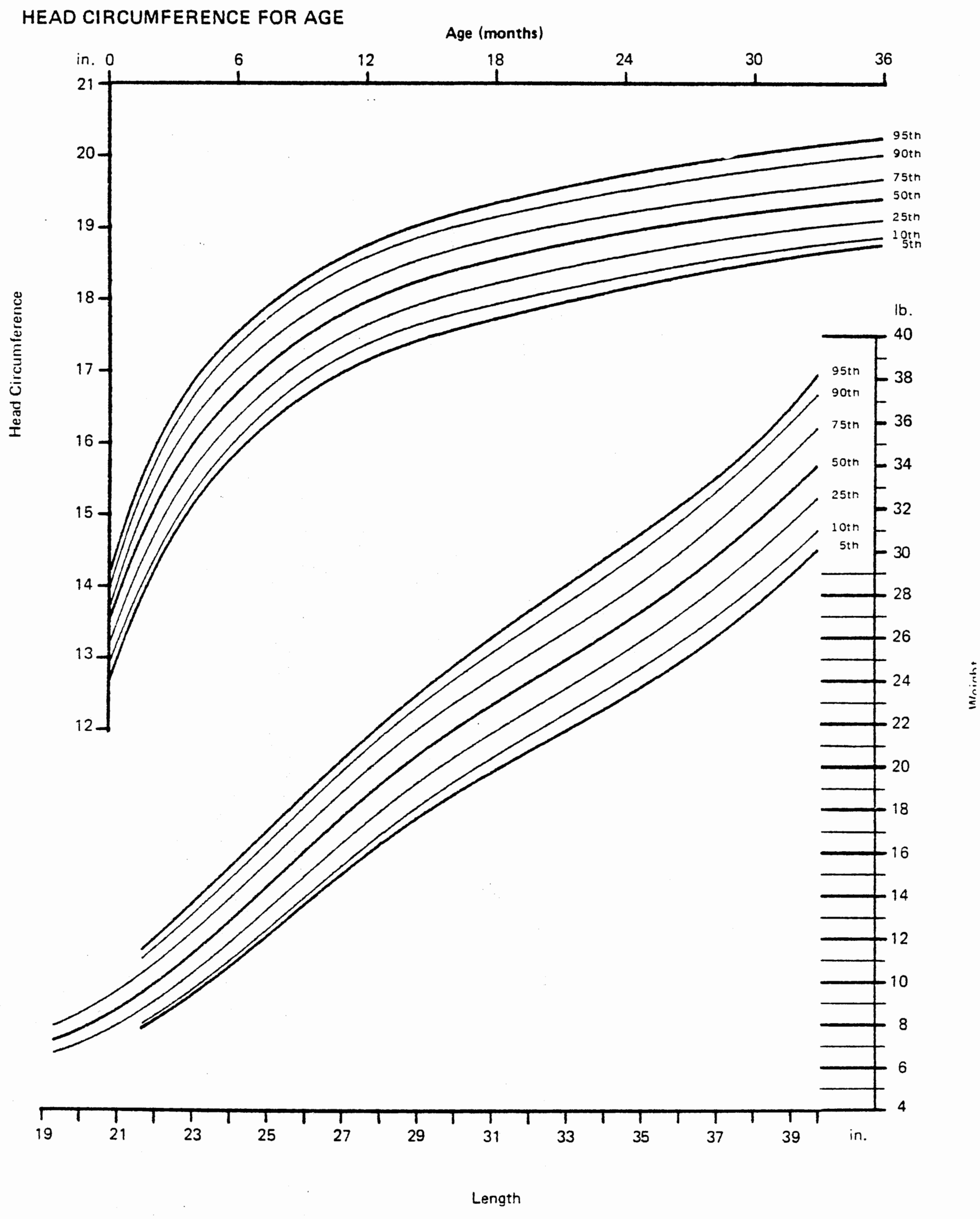


GIRLS FROM BIRTH TO 36 MONTHS

WEIGHT FOR AGE



GIRLS FROM BIRTH TO 36 MONTHS



L-B51-5-78

GROWTH CHARTS
WITH REFERENCE PERCENTILES FOR BOYS BIRTH TO 36 MONTHS OF AGE

Length for Age
Weight for Age
Head Circumference for Age
Weight for Length

NAME ______________________ **RECORD #** ______________________

DATE OF BIRTH ______________________

Date of Measurement	Age in Months	Recumbent Length	Weight	Head Circumference	

These charts to record the growth of the individual child were constructed by the National Center for Health Statistics in collaboration with the Center for Disease Control. The charts are based on data from the Fels Research Institute, Yellow Springs, Ohio. These data are appropriate for young boys in the general U.S. population. Their use will direct attention to unusual body size which may be due to disease or poor nutrition.

Measuring: Take all measurements with the child nude or with minimal clothing and without shoes. Measure length with the child lying on his back fully extended. Two people are needed to measure recumbent length properly. Use a beam balance to measure weight.

Recording: First take all measurements and record them on this front page. Then graph each measurement on the appropriate chart. Find the child's age on the horizontal scale; then follow a vertical line from that point to the horizontal level of the child's measurement (length, weight or head circumference). Where the two lines intersect, make a cross mark with a pencil. In graphing weight for length, place the cross mark directly above the child's length at the horizontal level of his weight. When the child is measured again, join the new set of cross marks to the previous set by straight lines.

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Inspect the set of cross marks you have just made. If any are particularly high or low (for example, above the 95th percentile or below the 5th percentile), you may want to refer the child to a physician. *Compare* the most recent set of cross marks with earlier sets for the same child. If he has changed rapidly in percentile levels, you may want to refer him to a physician. Rapid changes are less likely to be significant when they occur within the range from the 25th to the 75th percentile.

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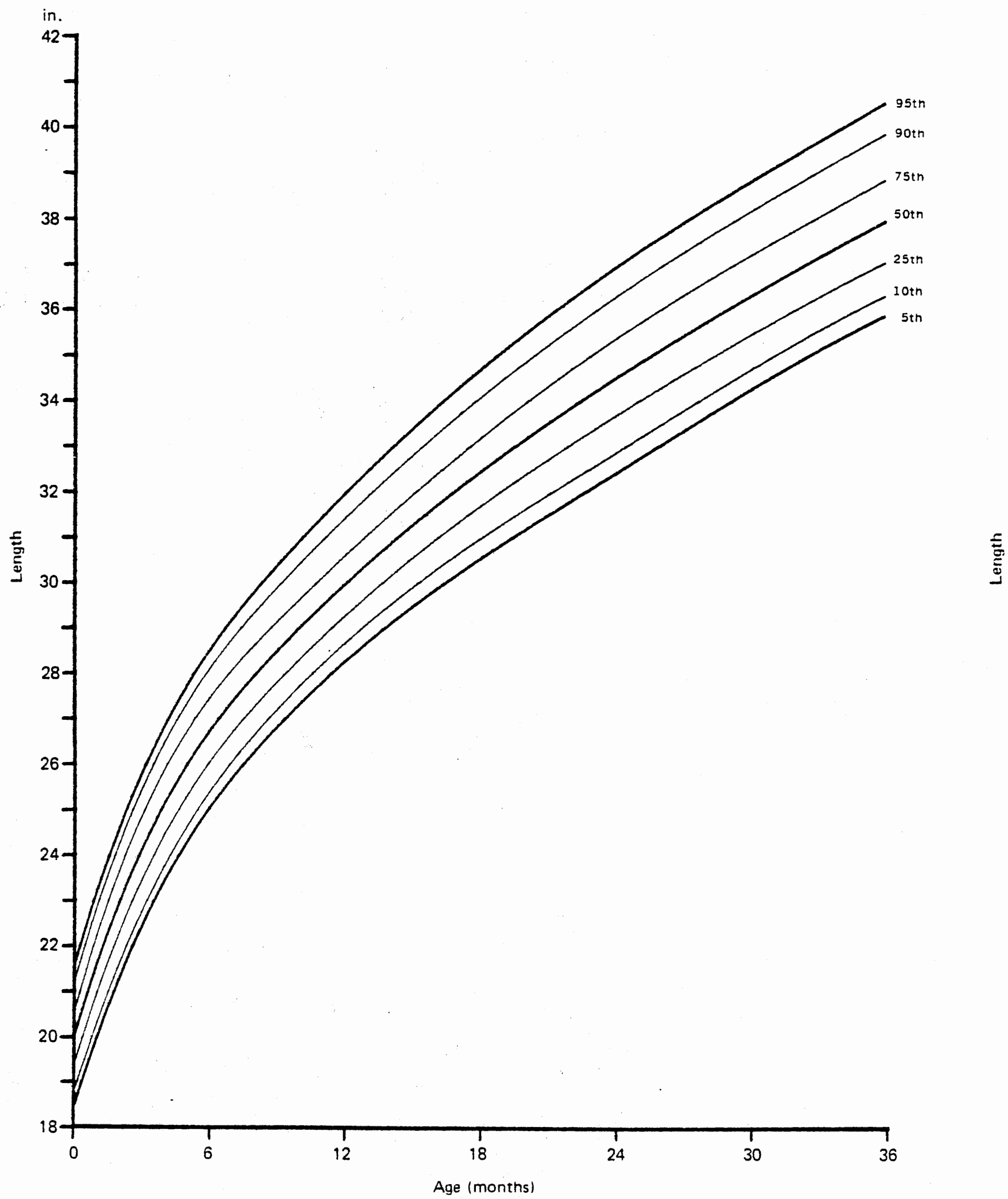
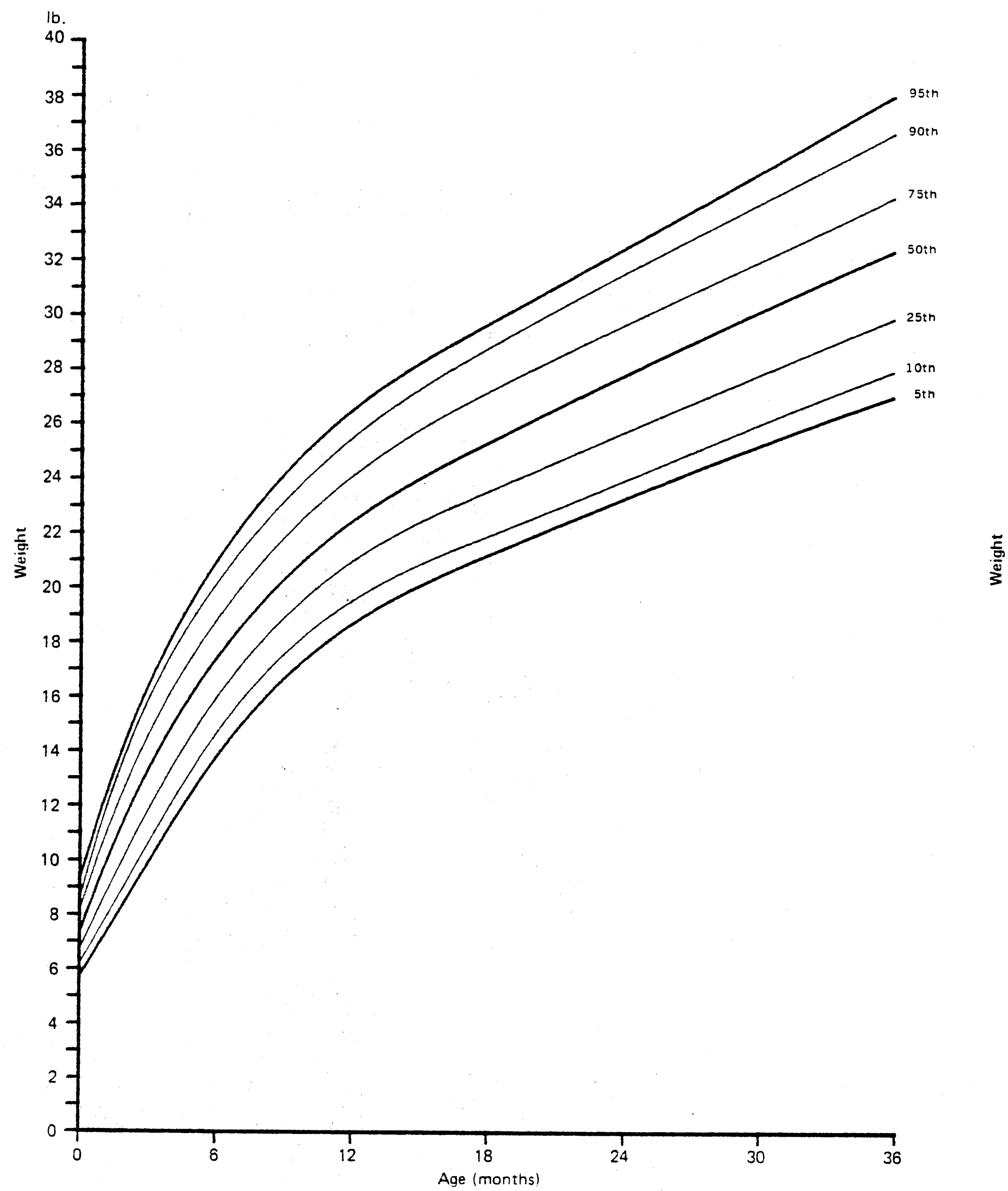
BOYS FROM BIRTH TO 36 MONTHS

LENGTH FOR AGE

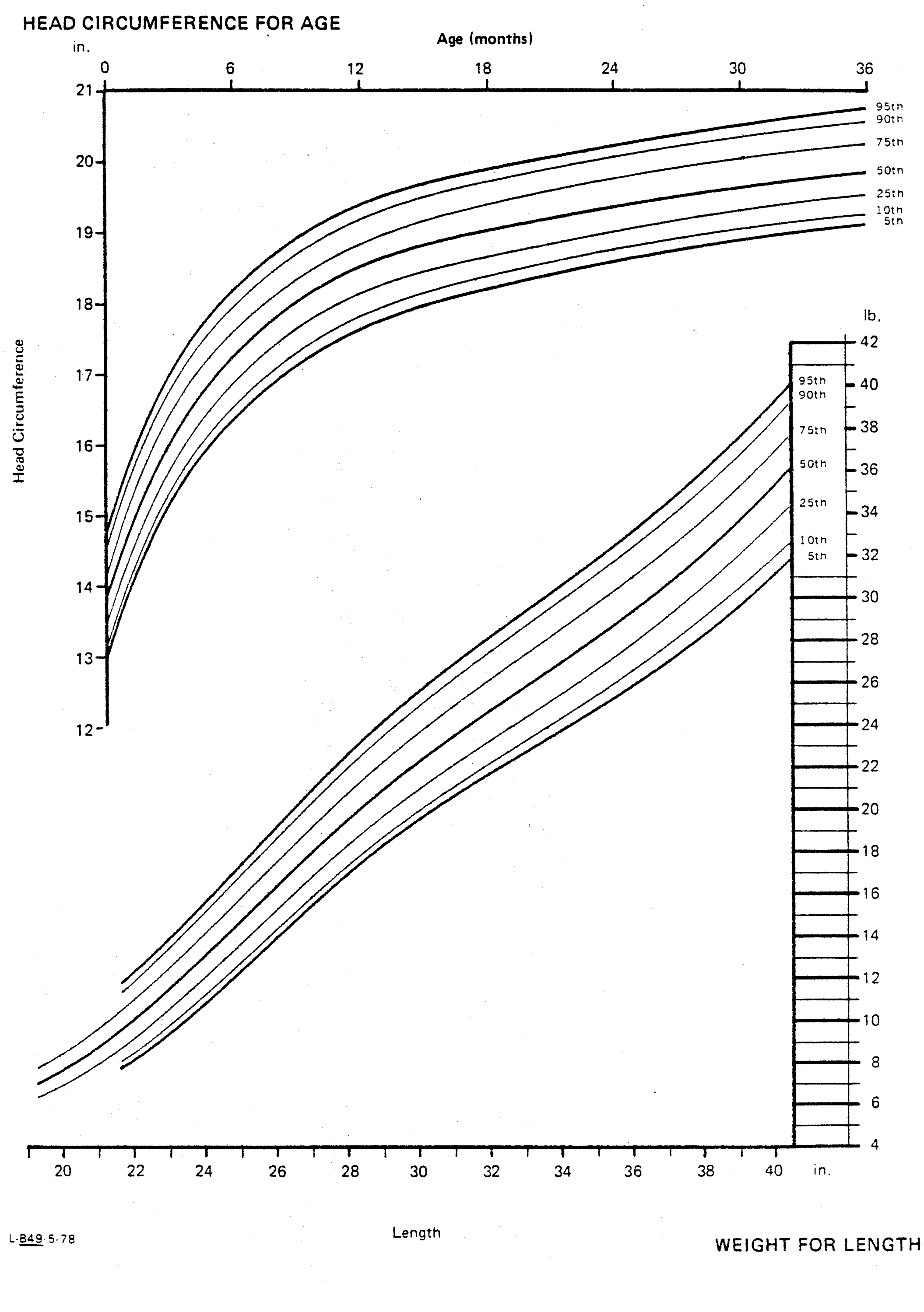


BOYS FROM BIRTH TO 36 MONTHS

WEIGHT FOR AGE



BOYS FROM BIRTH TO 36 MONTHS



APPENDIX E

24-HOUR DIETARY RECALL

24-Hour Dietary Recall

Date____________________

Name______________________________

Child's Name______________________ Age______

TIME OF DAY	FOOD EATEN--KIND	AMOUNT
(a.m. or p.m.)	(baby food or table food) (Give brand name, if possible)	(ounces, tea-spoons, baby food sized jar, bottle or unit--such as 1/4 banana or 1/2 slice bread

Was this a normal day for your baby?	Yes_____ No_____
Was your baby feeling well on this day?	Yes_____ No_____
Did your baby spit up on this day?	Yes_____ No_____
If so, how much?	________________
Did you take care of your baby all day?	Yes_____ No_____
If no, who cares for him?	________________
Is your baby taking vitamins?	Yes_____ No_____
If yes, what brand?	________________
Does this vitamin contain iron?	Yes_____ No_____

If possible, please enclose a label or box from the vitamins you use for your baby when you return this form.

Thank you for your help.

APPENDIX F

CALCULATION OF AVAILABLE IRON FORM

Calculation of Available Iron from a Typical Day's Intake

Time of Day	(1) Food/Beverage in Meal Snack Groupings	(2) Wt. (g)	(3) Calories	(4) MFP* Iron (mg)	(5) Other** Iron Food Fort. (mg)		(6) Ascorbic Acid (as served)(mg)	(7) MFP (g)	(8) Availability of Meal Iron H	M	L	(9) Avail. MFP Iron	(10) Avail. Other Iron Food Fort. (mg)		(11) Total Avail. Iron (mg)
a.m.															
	Sub Totals														
a.m.															
	Sub Totals														
p.m.															
	Sub Totals														
p.m.															
	Sub Totals														
p.m.															
	Sub Totals														
p.m.															
	Sub Totals														
	Total Avail. Iron														

APPENDIX G

AUTHORIZED WIC W/C FOOD ITEMS

AUTHORIZED WIC W/C FOOD ITEMS

Product Authorized	Container Size Allowed	Type Authorized	Minimum Standards	Brand Name
100% Fruit Juice (Not Fruit Drink)	6 oz. frozen, 46 oz. can, 64 oz. bottle	All Orange & Grapefruit; also, any Pineapple or other juice fortified to 100% RDA of vitamin C	100% U.S. RDA of vitamin C	Dole Pinneapple and others if 100% RDA of vitamin C; i.e., Senecca Apple Juice
Milk	Gallon and half gallon	Whole, Skin, and Low Fat	Vitamin A and D fortified	All
Cheese	Pound	American, Colby, Cheddar, etc.	Real Cheese (Cheese Food, product, and spread are NOT AUTHORIZED)	All
Eggs	Dozen		Grade "A" Large	All
Cereal	Assorted		45% RDA of Iron	Total, Kix, Most, BucWheats, Product 19, Malt-O-Meal, Cream of Wheat, Post Fortified Oak Flakes, Country Corn Flakes, Morning Power, Corn Total

AUTHORIZED WIC INFANT VOUCHER FOOD ITEMS

Infant Formula	13 oz. Concentrate; 32 oz. Ready to Feed; 1 lb. Powdered	Examples: SMA, Similac with Iron and Enfamil with Iron	At least 10 mg Iron	Others as prescribed by physician, including iron-fortified Isomil, Prosobee, Nutramagen, Nursoy, Soyalac
Infant Juice	4 oz.	Apple, Orange, and Others	120% RDA vitamin C	All
Infant Cereal	8 oz.	Rice, Barley, and Others without Fruit	45% RDA Iron	All
Milk	Quart	Whole	Vitamin A and D fortified	All

VITA

Sari Marie Catt

Candidate for the Degree of

Master of Science

Thesis: INFANT FEEDING PRACTICES RESULTING IN FOOD COMBINATIONS AFFECTING IRON UTILIZATION OF RURAL AND URBAN OKLAHOMA INFANTS

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Education: Graduated from Shawnee High School, Shawnee, Oklahoma, in May, 1957; received Bachelor of Science degree in Food, Nutrition and Institution Administration from Oklahoma State University in 1961; completed internship in Dietetics at Wadsworth Veteran's Administration Hospital in Los Angeles, California, in July, 1962; completed requirements for the Master of Science degree at Oklahoma State University in May, 1981.

Professional Experience: Veteran's Administration Hospital, Oakland, California, 1962; Therapeutic Dietitian, University of California, 1962; Therapeutic Dietitian, University of California, Los Angeles Medical Center, Los Angeles, California, 1962-63; Consultant Dietitian, Indio Community Hospital, Indio, California, 1964-67; Consultant Dietitian, Inland Health Services for small hospital and nursing homes, Riverside, California, 1967-71; Therapeutic Dietitian, South Community Hospital, Oklahoma City, Oklahoma, 1972-74; Consultant Dietitian, small hospitals and nursing homes, El Reno, Bethany, Guthrie, Shawnee, Midwest City, Oklahoma City, 1974-77; Public Health Nutritionist, Nutrition Education Coordinator, Oklahoma State Department of Health, Oklahoma City, Oklahoma, 1977-present.

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Nu Honor Society; Oklahoma Dietetic Association Adviser to the Hospital, Institutional, Educational Food Service Society, 1974-75; Oklahoma Dietetic Association Chairman and Co-chairman, Entertainment Committee Spring Convention, 1976-78; Oklahoma Dietetic Association Circulation Manager, 1979.