To the Graduate Council:

I am submitting herewith a thesis written by Patricia Anne Driscoll entitled "Physical Growth of Preschool Children Participating in the Cherokee WIC Program." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

Richard L. Jantz, Major Professor

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and recommend its acceptance:

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PHYSICAL GROWTH OF PRESCHOOL CHILDREN
PARTICIPATING IN THE CHEROKEE
WIC PROGRAM

A Thesis

Presented for the

Master of Arts

Degree

The University of Tennessee

Patricia Anne Driscoll

December 1982

To David and Meghan

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ABSTRACT

Physical growth data of 921 Cherokee Indian children who are or who were participants of the Special Supplemental Food Program for Women, Infants and Children (WIC) from 1976 to 1982 was collected. Information was obtained from 390 WIC women with children on the WIC program. Distance and velocity data for height and weight were documented for the WIC children from birth to five.

Mean heights for these children tended to be less than those of Native Americans living in Minnesota and less than or equal to those reported in the National Center for Health Statistics (NCHS) growth charts. Mean weights, however, were greater than those reported in the NCHS charts and slightly less than those of the Minnesota sample. Mean hematocrits of the Cherokee WIC children were lower than the national norm but higher than those of the Minnesota Indians.

Within sample comparisons were drawn by age, sex, center of WIC service, degree of Indian inheritance, infant feeding patterns and number of visits to WIC clinics. Males were generally taller and heavier than females from birth through five years of age. Participants of the Robbinsville clinic were generally taller and heavier than those from the Murphy and Cherokee clinics. Participants from the Murphy clinic were the shortest and thinnest of the participants. After two years of age there was an increase in weight associated with an increase in the degree of Indian inheritance. There was an association between bottle feeding at birth and an increase in

weight during the first two years of life but this trend did not continue past the age of three. Participants who visited WIC regularly tended to be taller and heavier than those who did not.

Significant differences were found between participants of the three Cherokee WIC clinics for height. Participants of the Robbinsville clinic were taller than those from the Murphy and Cherokee clinics.

A covariance analysis revealed significant differences in weight between participants of the three Cherokee WIC clinics. Participants of the Robbinsville clinic were heavier than those from the Murphy and Cherokee clinics.

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INTRODUCTION

This thesis attempts to document the growth patterns of Cherokee children who are or who have been participants of the Special Supplemental Food Program for Women, Infants and Children (WIC). Height, weight and hematocrit measurements of 921 children are analyzed. Means of heights and weights are used to create both distance and velocity data.

These findings are compared to the data from the National Center for Health Statistics (NCHS) growth charts for children under five years of age. Also, the findings are compared to data from pre-school urban Native Americans living in Minneapolis.

A summary of the history of growth studies and discussions of childhood obesity, hematocrits, and diabetes among Native Americans are provided as a background for analysing the results.

CHAPTER I

STATEMENT OF THE PROBLEM

There is a wealth of child growth studies available today for parents and professionals who wish to assess the growth patterns of individual children or entire populations, for example, Hamill et al. (1977), Pomerance (1979), Garn and Clark (1975), Tanner et al. (1966) and Tanner and Whitehouse (1976). But growth patterns are known to vary between different individuals, different populations and even in the same population over time (Garn 1952; Eveleth 1979). Old figures require constant revision and new studies are indicated for ethnic groups which have yet to be studied.

The Eastern Band of the Cherokee Indians is one group for which little published information exists on growth patterns. What information is available, however, indicates that there are statistically significant differences in weight between the Cherokees and their Black and White age peers and that, in fact, obesity is a common condition for the Cherokee (Tompkins 1980; Terry 1982).

Obesity results when energy expenditure does not meet energy intake. It is now a major health problem for many Native American groups (West 1974:847). While some researchers claim that obesity is not a disease by itself (Mann 1974) it is clear that obesity is a physical, mental and social disability (Weil 1981:334). Equally, important, it is a potential health hazard. One of the more serious diseases associated with an obese state is maturity onset diabetes or Type II diabetes.

Maturity onset diabetes is a condition of insulin dependency such that blood glucose is elevated to abnormal levels. If not controlled, it can lead to nerve deterioration, microvascular diseases including those of the kidneys and eyes and microvascular diseases which can lead to the atherosclerotic coronary heart disease which is responsible for more than 60 percent of the deaths of all diabetics (Bierman 1981:153). It also leads to high risk pregnancies.

Approximately two to five percent of the American population is affected by maturity onset diabetes (Cahill 1981:148). The disease is at least three times as prevalent, however, among North American Indians as United States Whites (West 1981:131). In a 1965 study, 24.3 percent of the Cherokees tested had abnormal glucose tolerance (Stein 1965). Today estimates by health officials put the figure closer to 50 percent for those over age 45. It is the number one health problem in Cherokee today (Program Plan Committee, Cherokee Indian Hospital 1978:65).

In addition to obesity, factors known to be associated with maturity onset diabetes include age and a genetic predisposition to the disease. Of these three, only obesity can be altered in any attempt to manage or prevent the disease.

Weight reduction is difficult at any age. It becomes more difficult however, the older one is and the longer one is obese (Stunkard 1976; Alley et al. 1968). Maintaining a diet is rarely easy and in a recent study, Broussard et al. (1982) found that over 85 percent of diabetic Cherokees failed to stick with their prescribed diets. Thus, prevention of obesity may be easier to enact than weight reduction.

Although it is not clear to what degree overweight infants become overweight children and later overweight adults (Weil 1981:336; Taitz 1977:110-111; Charney et al. 1976; Stunkard 1976:182; Forbes 1979:328), prevention of adult obesity should begin at birth.

At the same time that overeating poses a major health concern in Cherokee, North Carolina, iron deficiency poses another nutritional hazard. The WIC Director, Pat Oocumma (Personal Communication) reports that many children enter the WIC program as a result of low hematocrit scores. Iron deficiency is not, however, simply a Cherokee problem but is "believed to be the most common nutritional disturbance among infants and children in the United States (Oski and Stockman 1980:237)."

In spite of already numerous child growth studies available today, the lack of published growth data on the Cherokee preschool population coupled with the seriousness of the continuing trend towards obesity, diabetes and iron deficiency in the Cherokee population, suggests that yet another child growth study is warranted.

Purpose

The administrators of the WIC program in Cherokee, North Carolina have made records of the height, weight and hematocrit levels of each of the program's participants biannually. It is the purpose of this thesis to use these data to find the growth patterns of these children. I hope that these data will aid the WIC staff in evaluating the effectiveness of their program. At the same time, I hope that the study will shed some light on the patterns surrounding the emergence of obesity in the Cherokee population.

Objective

The main objective of this thesis is to find current means for height, weight and hematocrit from birth through five years of age for children who have participated in the Cherokee WIC program. Not only might these data be a basis for development of growth standards in the future but they may help WIC and other Cherokee health professionals to spot children outside of the present norm for growth. By comparing these findings with the national averages and with other Native American populations, it will be possible to gain a clearer understanding of Cherokee child growth patterns.

CHAPTER II

BACKGROUND

History of Growth Studies of North American Indians

Physical growth data of Native Americans has been recorded since the early 1900's when Hrdlicka studied the Navaho Indians (Johnston et al. 1978:1017). Over the years, many of these studies have been of limited value in that the samples have been small, both sexes have not always been represented and the age ranges studied have been narrow (Moore 1972:36).

The large scale longitudinal studies begun early in this century did not include Native Americans (Tanner 1981). Recent national nutrition surveys have included Native Americans but their numbers are generally too few to identify the growth patterns or problems of a particular tribe.

Physical growth data of the Cherokee Indians is scarce. Most of the early physical growth studies of Native Americans were carried out on tribes residing in the western half of the United States and the Eastern Cherokees were not included. Cherokee school children are measured during physicals given periodically through their grammar and high school years but these measurements have yet to be compiled and published. Recently, however, cross-sectional studies of height, weight and triceps skinfolds have been described for Cherokee teenagers ages 13 to 16 (Tompkins 1980) and for adult Cherokee women residing in Robbinsville (Terry (1982).

As part of the WIC mandate, clinics are required to keep records of the growth of their participants. This thesis is a result of the Cherokee WIC staffs' desire to document the growth patterns of their children.

Childhood Obesity

Obesity, easy to spot, is difficult to define or quantify. It is an enlargement of the adipose tissue. The term "obese" is generally assigned to individuals who are 20 percent over their ideal weight for height and age. The term "overweight" is used for people who are 10 percent over their ideal weight for height and age (Weil 1981:336). Obesity also has been defined as weight-for-height values above the 85th percentile.

Researchers continue to investigate the roles environmental and genetic factors play in obesity. Weil (1981:337) cites studies of identical twins reared apart with similar levels of adiposity which indicates a definite genetic component to obesity and then again, studies of adopted and natural children in the same family who also share similar fatness levels. He suspects that genetic factors are connected to energy expenditure and environmental factors are related to energy intake.

The relationship between obesity in infancy, obesity in childhood and obesity in adult life remains inconclusive (Weil 1981:336; Taitz 1977:110-111; Charney et al. 1976; Stunkard 1976; Forbes 1979:328). It is known, however, that while only a minority of obese infants will become obese adults (Dine et al. 1979), the risk of becoming an obese adult is increased if one was an obese infant.

Infants who have a high risk of becoming obese adults are those whose parents are both obese (Garn and Clark 1976:455), those who gain weight rapidly in infancy (Eid 1970) and those whose parents use food to control behavior (Forbes 1979:328). Environmental elements known to play a role in the growth process include nutrition, disease, socioeconomic status, urbanization, physical activity, phychological stress, season of the year and climate (Eveleth 1979).

A controversial study (Hirsch and Knittle 1971) suggests that obesity in childhood is associated with an increase in both cell size and number while adult onset obesity is only connected to an increase in cell size. This hypothesis has been used to explain the difficulties faced by individuals who have been obese since childhood when trying to lose weight.

Methods for preventing childhood obesity may be difficult in practice but appear abundant in theory. Taitz (1977:113), for instance, opts for slowing down weight gain over actual weight reduction when working with infants. Weil (1981:341) urges that infants be given "less than average" nutrient intake and that parents rely on an infant's hunger mechanism to control the food intake. Garn and Clark (1976:453) caution that obese children are not alone but rather are usually members of obese families and should be treated in a family oriented manner. Finally, Forbes (1979:328) promotes physical exercise and delaying the introduction of solid foods.

Infant Feeding Practices. It is clear that from conception, first the diet of the mother and later the diet of the child will affect the growth of the child (Antonov 1947; Worthington et al. 1977). Less clear are the differences seen in the growth patterns of bottle fed babies compared to breast fed ones. Equally confusing is determining what effect, if any, the timing of the introduction of semi solid foods plays in the growth process. Weil (1981:337) and Pomerance (1979:131) argue that there are no significant differences. The conclusions of these authors are not, however, universally accepted.

Lloyd and Wolff (1980:62) cite studies to show that breast fed babies are less overweight than bottle fed ones. Supposedly breast fed infants are allowed to control how much milk is consumed while bottle fed infants may be "forced" to finish a bottle. Stini et al. (1980:65, 67, 68) on the other hand, report that breast fed infants are heavier than bottle fed ones for the first months of life. They attribute this trend to less illness in breast fed babies who receive the immunological benefits of mother's milk and also to poor sanitation when looking at less developed countries. But, Bergmann and Bergmann (1979:340) conclude that the "similarity of growth performance in breast fed and formula fed infants far outranks the deviations provided that infants are offered nutritionally adequate food. . ."

Because infant feeding practices can and do change they are a prime area for investigating ways to prevent infant and child obesity.

Already a study (Slonim et al. 1981) has been done which shows that over half of the Cherokee women on WIC, who were surveyed, breast fed their youngest child. But 70 percent of these women supplemented breast feeding with formula or fruit juice in the first week of life. Over a fourth of the Cherokee WIC women tested offered their children table food within the first three months of life. This early supplementation of food has been linked with later feeding problems including chronic overeating according to the Pediatric Nutrition Handbook (Forbes 1979:140).

Hematocrit

Hematocrits are percentages of the volume of packed red blood cells found in whole blood. They are obtained by separating the red blood cells from the plasma.

The first instrument to perform this process, Daland's Hematocrit, developed in 1891, gave the measurement its name. The process involved spinning two tubes of non-coagulated blood for more than 30 minutes, at a rate of 8,000 to 10,000 revolutions per minute by hand. The red blood cells were then compared to the whole blood (Albert et al. 1965:7). Today the Cherokee Hospital uses a spun or microhematocrit method, which takes considerably less time and establishes whether WIC participants are anemic or iron deficient (Martin, Personal Communication).

Technical factors affecting the calculation of the hematocrit and possibilities for error are outlined in Platt (1969:63) and Albert et al. (1965:11-15). Genetic and environmental factors affecting the hematocrit level include red cell size, age, sex, emotional change, attitude, exposure to cold, amount of physical exercise, change in posture, smoking and seasonal and diurnal variation (Albert et al. 1965:17-20).

Iron Deficiency and Iron Deficiency Anemia. Iron deficiency anemia is an extension of iron deficiency. In both cases, red cell size and thus, hematocrit, are decreased because of poor iron storage and absorption. Iron deficiency and iron deficiency anemia are common conditions in young children and are associated with irritability, anorexia and poor weight gain among other conditions (Oski and Stockman 1980:242).

According to studies done on children from 6 to 24 months, iron deficiency was reported 29 to 68 percent of the time and iron deficiency anemia was reported 3 to 24 percent of the time (Oski and Stockman 1980:237). Fortunately, there is some evidence that hematocrits in children of all ages may be on the rise (Owen et al. 1975). Reasons given for this increase include greater use of (a) hematocrits by health care professionals, (b) iron fortified formula, (c) iron supplements, and, (d) foods containing or fortified with iron (Owen et al. 1975:447; Farquar 1963).

CHAPTER III

METHODS AND MATERIALS

Most of the people attending the Cherokee WIC Clinics are members of the Eastern Band of the Cherokee Indians. They are descendants of a tribe which was divided in 1836. At that time, many of the tribe were forced to move from the Southeast to the Indian Territory, now Oklahoma. Descendants of the Cherokees who marched west across the "Trail of Tears" are now referred to as Western Cherokees. Those who live in North Carolina today are known as Eastern Cherokees.

The Cherokee Indian Reservation in North Carolina is also known as the Qualla Indian Boundary. It occupies over 56,000 acres in Western North Carolina near the Great Smoky Mountain National Park. As of May 1980, there were 5,620 enrolled members of the Eastern Band of the Cherokee Indians living on the reservation and 3,072 living off the reservation (Cherokee Enrollment Department).

The Cherokee WIC clinics operate in three North Carolina locations: Cherokee, Robbinsville (Snowbird) and Murphy (Tomotla). Robbinsville and Murphy are both located approximately 50 miles from Cherokee. The Murphy clinic has the largest number of White participants while the Robbinsville clinic has mostly full-blooded Cherokees. There is a wide range in the degree of Indian inheritance found among participants of the Cherokee clinic.

The Cherokee WIC Program

The Cherokee and Robbinsville (Snowbird) WIC clinics started service in July of 1976 with 341 recipients (Program Plan Committee, Cherokee Indian Hospital 1977:50). In 1978 the Murphy (Tomotla) clinic opened and by 1981 the whole program had 780 active participants. Budget reductions in October of that year forced the staff to stiffen eligibility requirements and 80 people were dropped from the program.

Twice a year the WIC staff publicizes eligibility requirements of and benefits from the WIC program in local newspapers. Health care professionals often refer clients to the program. But according to the current director, Pat Oocumma (Personal Communication) most participants hear of the program through word of mouth.

To be eligible for the program, one must live in geographical areas approved by the United States Department of Agriculture and be certified to be at nutritional risk by a health care professional. To participate in the Cherokee WIC program an individual must be of Indian decent. To continue on the program it is necessary to be re-certified every six months. People at nutritional risk are said to have a history of or presently have nutritional anemia, an inadequate diet, an inadequate pattern of growth or a high risk pregnancy.

Prior to budget restraints imposed in 1981, the level of one's income did not affect an individual's eligibility for the program (Oocumma: Personal Communication). It has been noted, however, that in the summer months when the Cherokee economy picks up, WIC participation is down (Oocumma: Personal Communication). WIC recipients receive foods or vouchers for foods rich in iron, protein and vitamin C monthly.

The Sample

The sample consists of growth data taken from the records of 921 or 80 percent of 1,145 infants and children who are served by the Cherokee WIC program at Cherokee, Robbinsville and Murphy, North Carolina from July 1976 through March 1982. Additional information from 390 or 75 percent of the 523 women who participated in the program during that time is used.

WIC participants whose files were available and complete on the days that the records were photocopied are included in the sample regardless of the number or regularity of their visits to WIC Clinics. Women without offspring on the WIC program were not included. Also not included were six children who died at birth or within the first four months of life and one child whose legs were paralyzed at birth. None of the participants refused to have his or her records included in the study. A description of the research population, arranged by sex and center of WIC service, is provided in Table 1.

TABLE 1

SAMPLE SIZE BY SEX AND CENTER OF WIC SERVICE

Center	Boys	Girls	Adult Women
Cherokee	420	402	358
Murphy	35	19	18
Robbinsville	30	15	14
Total	485	436	390

Family Participation. The 921 children and their 390 mothers, who were also on the WIC program, make up 674 families. Of the 554 children who had mothers on the program, 353 or 64 percent of the children were responsible for their mothers eligibility while 201 or 36 percent had mothers on the program as a result of a sibling's birth.

Maternal Age at the Birth of a Child. Dates of birth have been reported for women on WIC. These dates were used to calculate the age of each woman at the birth of all of her children on WIC and are documented in Table 2. The modal age for having children is 18 and the average age is 22.

Year of Birth. Table 3 describes the year in which each of the infants and children on WIC were born. In recent years, the number of children on the program has remained fairly stable.

Degree of Indian Inheritance. The degree of Indian inheritance was obtained for 158 of the children in the sample who joined WIC at birth and were recertified at least six times before they were three years old. The degrees of Indian inheritance were obtained from the Cherokee Tribal Roll. This record documents Cherokee bloodlines back as far as seven generations. In this subsample, Indian inheritance was divided among the children as follows: 39 or 25 percent had 0 to 25 percent, 42 or 27 percent had 26 to 50 percent, 34 or 21 percent had 51 to 75 percent and 43 or 27 percent had 76 to 100 percent.

TABLE 2

AGE OF WIC WOMEN AT THE TIME OF BIRTH
OF WIC CHILDREN

Age	Number	Percent
12	2	.4
14	3	.5
15	6	1.1
16	32	5.8
17	56	10.1
18	64	11.5
19	57	10.3
20	53	9.6
21	45	8.1
22	41	7.4
23	36	6.5
24	27	4.9
25	26	4.7
26	20	3.6
27	16	2.9
28	11	2.0
29	18	3.2
30	6	1.1
31	9	1.6
32	9	1.6
33	2	.4
34	2	.4
35	5	.9
36	3	.5
37	1	.2
38	1	.2
40	1	.2

TABLE 3

YEARS OF BIRTH OF WIC CHILDREN

Year	Number	Percent
1972	1	0
1973	31	3
1974	109	12
1975	93	10
1976	122	13
1977	122	13
1978	114	13
1979	110	12
1980	112	12
1981	94	10
1982*	10	1

*(Through March).

Bottle and Breast Fed Infants. At birth or at their initial visit to the WIC clinic, 99 infants were breast fed, 62 were bottle fed and 91 were both breast and bottle fed. These figures correspond to Slonim's (1981) findings on food behavior among the Cherokee WIC participants.

Multiple Births. There were nine sets of twins included in the sample. No other multiple births were included. A twin who died in infancy was the only twin eliminated from the study.

Health Problems. Health problems noted on the WIC certification records have been tabulated by the frequency of their occurrences in Table 4. In Appendix A there is a copy of the current WIC certification form which has been in use since 1980. Children's health problems listed in Table 4 which do not appear on the certification record have been added to the record at the discretion of health officials. As the forms have changed over time, the numbers cannot be used to create honest percentages and are given only to provide an idea of the health problems the WIC staff encounters.

Table 4 does not include iron deficiency as this particular health problem is addressed in Chapter 6. Deann Stivers (Personal Communication), a fellow University of Tennessee, Knoxville student, is looking at the complications of pregnancy in the WIC population in a separate thesis.

TABLE 4

HEALTH PROBLEMS OF THE WIC POPULATION AS LISTED ON WIC CERTIFICATION RECORDS

Health Problem	Number of Occurrences	Participants Affected Women (W) Children (C)
Smoking	43	W
Renal	36	W
Toxemia	22	W
Premature birth	14	C
Allergies	13	C
Hypertension	11	W
Otitis media	11	C
Alcohol consumption	9	W
Heart	7	W and C
Pneumonia	7	W and C
Social problems	6	C
Siezures	5	C
Diabetes	5	C
Bronchitis	4	W and C
G.I.	3	W and C
Liver	3	W and C
Other (only one instance each)	11	W and C

The Measurements

Records. All of the WIC certification records for each of the three clinics served by the Cherokee WIC program are kept in the Cherokee office. The certification records have provided the growth data used in this thesis. Degree of inheritance figures were taken from the tribal records by the WIC staff.

Visits. To remain on the WIC program, a recipient must be recertified every six months. At this time, heights, weights, hematocrits and diet histories for mothers and children are recorded. Both male and female children have been recertified an average of four times while on WIC. The mean number of visits per participant to the WIC Clinic are as follows: Cherokee 4.46, Robbinsville 4.48 and Murphy 3.75. The Murphy Clinic was opened after the other two.

Participants of the Cherokee WIC Clinics are recertified at the Cherokee Hospital while the Murphy members use either the County Health Department or the Cherokee Hospital and the Robbinsville recipients use the clinic there. The Robbinsville clinic is staffed by a nurse practioner and visited twice a month by a physician and nutritionist.

Instruction in measuring techniques have been given to the hospital staff by Dr. William Bass, Professor and Head of the Department of Anthropology at The University of Tennessee, Knoxville, and by the Center for Disease Control of North Carolina. If a measurement appears to be of concern, the WIC staff asks the participant to have it repeated.

Infants and children are measured with the shoes and clothes (except underwear) off.

Length and Height. Until the age of two a child is measured lying down using a foot piece for accuracy. Children over two are measured standing next to a tape on the wall while a head piece is lowered to the correct height. Measurements were recorded to the nearest quarter inch.

Weight. Infants are weighed on a baby Detecto scale. Older children are weighed using a Detecto balance beam scale. Once a year the scales are inspected by the State of North Carolina. Weights for the children were taken to the nearest ounce.

Data Reduction and Analysis

Human Subjects Consent Forms. WIC recipients willing to participate in this study signed consent forms which are kept in their WIC folder (Appendix B). At the time that the WIC records were xeroxed, the names and addresses of the participants were covered up. Each participant was assigned a code. They key to the code is kept at the WIC office.

Scan Sheets and Coding. WIC certification records were xeroxed on several occasions. The information from these records was transferred to scan sheets (Appendix C). After the sheets were coded, they were put onto a tape and a print out was made. The sheets were then corrected for any obvious error and a new tape was made.

Before coding the sheets, all of the dates were changed to decimal years using a table in Tanner (1978:172-173). Avoirdupois pounds were multiplied by 0.45359237 to get kilograms and inches were multiplied by 2.54 to yield millimeters on a Texas Instruments T1-55 calculator. Millimeters were changed to centimeters when weights were coded. Centimeters and kilograms were calculated to the nearest one hundredth. Hematocrit scores were rounded to the nearest whole number. All of the coding was done by the author.

Statistical Analysis. All calculations were carried out on the IBM 370 Computer at The University of Tennessee Computing Center (UTCC) using the SAS statistical package.

Samples Used for Comparison. The Cherokee WIC data are compared to the Fels Research Institute data and to the Health and Nutrition Examination survey (HANES) data which make up the reference data for the National Center for Health Statistics (NCHS) growth charts. Also the Cherokee data are compared to growth data obtained from urban Native Americans living in Minneapolis (Johnston 1978).

The Fels Research data, collected from 1960 through 1975, provide the reference data, from birth through 36 months, used in NCHS growth charts. These longitudinal data were obtained from 875 white middle class individuals living near Yellow Springs, Ohio Hamill et al. 1977). For the NCHS growth charts only recumbent length measurements were used.

The HANES survey is a cross-sectional study of a representative sample of the noninstitutionalized U.S. population from 1 through 74 years of age taken from 1971-1974. For this thesis, only the information from HANES participants ages two to five years was used. A problem in the HANES survey appears in the two and three year old categories as the researchers were unclear whether the children had been measured in a recumbent position or not.

The Cherokee data are also compared with data from urban Native Americans living in Minneapolis who attended the Children and Youth project in that city. The children were measured for height in a recumbent position until they could walk.

Assumptions and Limitations

Recommendations for informative and verifiable growth studies have been carefully spelled out in the literature (Cameron 1978; Garn and Shamir 1958; Roche and McKigney 1976; and Owen 1973). Deviations from these recommendations and other limitations of this research are described below.

This study was retrospective. Ideally, growth studies should be prospective; otherwise, the questions which the research can address are limited by the data available. Had this study been a prospective one, for example, other measurements, particularly skinfold measurements would have been included. In this case, even with a retrospective study, an important design element, namely, which parents or children were destined to be diabetic, was not known.

Growth standards are said to describe what is and not what ought to be. But, in this study, the pre-WIC growth pattern of the WIC children cannot be known. The growth of the children may have been altered through food supplements, iron supplements and nutrition education. In fact, that is the goal of the program.

An additional problem with the research design is the lack of a comparative sample. It would be interesting to compare the growth of Cherokee WIC children to that of well nourished Cherokee children.

The measurements themselves are also a source for error. Besides intra- and interobserver error in taking the measurements, the transferring of the data from the hospital records to the WIC records, converting them to the metric system and finally recording them on the scan form provided ample opportunity for making mistakes.

While most visits to WIC Clinics occurred approximately six months from the previous visit, these visits did not coincide with the individual's birthdate. This necessitated increasing the tolerance of days around the birthdate at which a visit was made, when calculating longitudinal data, from the Fels Research Institute recommendations (Garn and Shamir 1958:16). The tolerance equalled that used by Pomerance (1979:20-21).

Despite these problems, the Cherokee WIC population is unique and deserves study. Measurements of WIC participants have been carefully recorded for years. When these individual measurements are combined and viewed as a whole, they receive new meaning. Because this sample is so large and the problems with it are spelled out and are not unusual, the data can be useful in evaluating the growth patterns of the WIC population, in comparing the WIC patterns to the national ones and in evaluating the WIC project.

CHAPTER IV

ANALYSIS OF LENGTHS AND HEIGHTS

Length at Birth

Table 5 describes the lengths at birth for 200 Cherokee girls and 198 Cherokee boys by the WIC Clinic which they frequent. Gestational ages at birth are not known. Cherokee males in this sample average 51.44 centimeters at birth, while Cherokee females average 50.85 centimeters at birth. The differences seen in lengths at birth between the different clinics for females are greater than those for males, but may be due to the small sample size of the Robbinsville and Murphy participants.

When compared with a predominantly White New York City sample (Pomerance 1979:42) the Cherokee males are longer at birth than the New York City males (50.6 centimeters) and the Cherokee females are longer than the New York City females (49.9 centimeters). When compared with the Fels data (Hamill et al. 1977:20-21) the Cherokee males are longer at birth than the White males from Ohio (49.9 centimeters median) and the Cherokee females are longer at birth than the White females from Ohio (49.3 centimeters median).

Distance Results

In calculating tables for distance, children are represented as often as they had measurements made which satisfied the requirements of the table.

TABLE 5

LENGTHS AT BIRTH OF WIC CHILDREN: MEANS AND STANDARD DEVIATIONS IN CENTIMETERS

Sex	Center	Number of WIC Children	Number, Length Known	Mean of Known Lengths	S.D.
Female					
	Cherokee	402	188	50.86	3.26
	Murphy	19	6	48.63	2.07
	Robbinsville	15	4	53.50	1.82
	Total	436	198	50.85	3.24
Male					
	Cherokee	420	190	51.44	3.28
	Murphy	35	4	51.44	1.64
	Robbinsville	30	6	51.44	1.92
	Total	485	200	51.44	3.22

Length and Height by Age and Sex. Except at .2 years, Cherokee males were slightly taller than Cherokee females at each age group (Table 6; Figure 1).

Length and Height by Age, Sex and Center of WIC Service. For both males and females in the Cherokee WIC sample, those who attended the Robbinsville clinic were the tallest, on average, at each age category except for the 18 months at which time females from the Cherokee clinic were the tallest (Table 7). Participants of either the Cherokee or the Murphy clinics were the shortest individuals at each age level although the Murphy clinic participants seemed to be the shorter ones more frequently.

The differences in length and height seen in Table 7 were found to be significant when tested by covariance analysis. The model used was:

$$\text{Model Height} = b_0 + b_1 \text{ (age)} + b_2 \text{ (log age)}$$

When the slopes were tested for homogeneity, $F = 60.54$ and $P<.0001$. Age and log age were significant factors contributing to the differences seen in length and height between the centers.

Lengths and Heights by Degree of Indian Inheritance: Sexes Combined. The relationship between the degree of Indian inheritance and length or height is described in Table 8. A covariance analysis revealed that there were no significant differences in the slopes for length and height between individuals of varying degrees of Indian inheritance. There were, however, significant differences

TABLE 6

STATURES OF WIC CHILDREN BY AGE AND SEX

Age and Sample Size			Stature in Centimeters		
Age in Years	Midpoint	Number	Mean	S.D.	Median
		Males			
.13- .38	.2	30	57.36	4.20	57.15
.38- .63	.5	188	67.21	3.56	67.31
.63- .75	.7	29	69.97	3.85	69.85
.75-1.25	1.0	218	74.89	3.83	74.93
1.25-1.75	1.5	212	80.84	3.36	81.28
1.75-2.25	2.0	230	85.41	3.51	85.50
2.25-2.75	2.5	218	89.73	4.36	89.54
2.75-3.25	3.0	210	93.92	3.97	93.98
3.25-3.75	3.5	216	97.69	4.41	97.79
3.75-4.25	4.0	187	101.86	4.49	101.60
4.25-4.75	4.5	171	105.00	4.24	104.14
4.75-5.25	4.9	66	108.53	5.13	107.95
		Females			
.13- .38	.2	37	58.00	3.44	58.42
.38- .63	.5	173	65.78	3.28	66.04
.63- .75	.7	33	68.47	3.15	67.31
.75-1.25	1.0	204	74.15	3.61	74.30
1.25-1.75	1.5	213	79.82	3.38	80.01
1.75-2.25	2.0	206	84.47	3.48	84.46
2.25-2.75	2.5	201	88.48	3.68	88.90
2.75-3.25	3.0	204	92.38	4.05	92.08
3.25-3.75	3.5	176	96.43	4.01	96.52
3.75-4.25	4.0	178	100.43	4.83	100.33
4.25-4.75	4.5	159	104.17	5.02	104.14
4.75-5.25	4.9	58	106.40	4.76	106.05

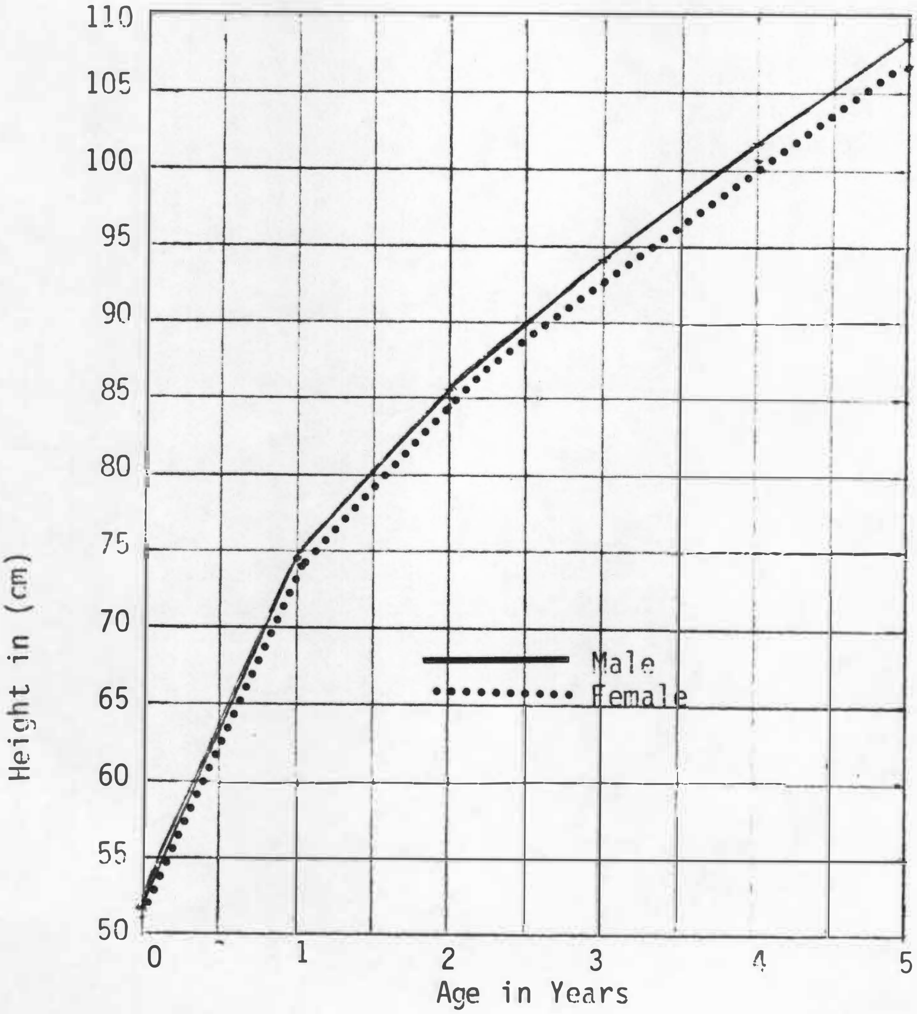

FIGURE 1. Mean Heights of Cherokee WIC Males and Females Ages 0-5

TABLE 7

STATURES OF WIC CHILDREN BY AGE, SEX AND CENTER OF WIC SERVICE IN CENTIMETERS

	Males			Females		
	N	Mean	S.D.	N	Mean	S.D.
6 Months						
Cherokee	178	67.20	3.59	168	65.74	3.27
Murphy	5	65.78	2.92	2	67.31	0.00
Robbinsville	5	68.83	2.64	3	67.31	5.08
12 Months						
Cherokee	197	74.91	3.88	195	74.09	3.54
Murphy	11	74.30	3.81	5	73.28	2.40
Robbinsville	10	75.06	2.97	4	78.10	6.43
18 Months						
Cherokee	186	80.75	3.32	198	79.98	3.34
Murphy	16	81.16	3.95	9	76.91	3.55
Robbinsville	10	82.04	3.12	6	78.85	3.02
24 Months						
Cherokee	204	85.44	3.31	190	84.64	3.21
Murphy	14	84.86	4.29	11	80.70	3.74
Robbinsville	12	85.56	5.72	7	86.49	7.20
30 Months						
Cherokee	184	89.50	4.32	185	88.49	3.62
Murphy	16	89.34	3.96	8	88.02	3.47
Robbinsville	18	92.43	4.40	8	88.82	5.52
36 Months						
Cherokee	179	93.72	3.85	189	92.41	4.08
Murphy	17	93.42	4.39	9	91.37	4.62
Robbinsville	14	97.06	3.93	6	93.24	1.77
42 Months						
Cherokee	180	97.52	4.50	164	96.41	3.94
Murphy	20	97.22	3.87	7	96.06	6.07
Robbinsville	16	100.29	3.25	5	97.79	3.11
48 Months						
Cherokee	157	101.75	4.55	166	100.30	4.63
Murphy	18	101.42	3.92	6	98.43	3.90
Robbinsville	12	103.82	4.46	6	106.14	7.72
54 Months						
Cherokee	143	104.90	4.32	154	104.25	5.07
Murphy	14	105.05	3.40	8	102.39	4.55
Robbinsville	14	105.95	4.34	8	104.25	4.68

TABLE 7 (Continued)

	Males			Females		
	N	Mean	S.D.	N	Mean	S.D.
60 Months						
Cherokee	53	108.31	5.48	49	106.53	4.71
Murphy	9	109.01	3.95	6	104.78	4.54
Robbinsville	4	110.33	1.31	3	107.53	7.22

TABLE 8

STATURES AND WEIGHTS OF WIC CHILDREN BY AGE AND DEGREE OF INDIAN INHERITANCE: SEXES COMBINED

Age and Degree of Inheritance	Stature in Centimeters			Weight in Kilograms		
	N	Mean	S.D.	N	Weight	S.D.
6 Months						
0.00-0.25	29	67.29	2.96	29	7.93	0.70
0.26-0.51	33	67.52	3.90	33	8.44	1.26
0.51-0.75	27	65.19	2.93	27	7.58	1.04
0.76-1.00	25	66.33	2.88	25	7.84	0.98
12 Months						
0.00-0.25	34	74.47	3.67	35	9.87	1.21
0.26-0.50	42	75.13	3.56	42	10.24	1.29
0.51-0.75	30	74.57	3.28	31	9.74	1.20
0.76-1.00	39	74.11	3.45	40	9.70	1.05
18 Months						
0.00-0.25	39	80.35	3.09	39	11.04	1.13
0.26-0.50	40	81.03	3.10	40	11.60	1.42
0.51-0.75	31	79.95	3.51	32	11.02	1.39
0.76-1.00	44	79.81	2.92	42	11.35	1.35
24 Months						
0.00-0.25	39	85.11	3.32	40	12.13	1.22
0.26-0.50	42	85.31	2.95	42	12.79	1.27
0.51-0.75	34	85.40	3.32	32	12.65	1.73
0.76-1.00	46	84.79	3.58	45	12.81	1.54
30 Months						
0.00-0.25	39	88.86	3.46	39	13.31	1.26
0.26-0.50	42	89.02	3.65	41	13.92	1.73
0.51-0.75	35	88.76	3.80	35	13.56	1.91
0.76-1.00	42	88.30	4.11	42	13.94	1.89
36 Months						
0.00-0.25	35	92.96	3.25	34	14.30	1.32
0.26-0.50	40	93.43	3.77	39	15.02	1.91
0.51-0.75	30	93.54	4.47	30	14.77	2.00
0.76-1.00	44	92.93	3.36	44	15.21	1.72
42 Months						
0.00-0.25	28	96.39	4.15	27	15.52	1.24
0.26-0.50	27	96.99	4.28	26	16.30	1.73
0.51-0.75	23	96.52	4.19	23	15.80	2.61
0.76-1.00	35	97.34	3.30	36	16.53	1.96

TABLE 8 (Continued)

Age and Degree of Inheritance	Stature in Centimeters			Weight in Kilograms		
	N	Mean	S.D.	N	Weight	S.D.
48 Months						
0.00-0.25	24	100.70	3.90	24	16.48	1.45
0.26-0.50	23	101.57	3.75	23	17.45	2.11
0.51-0.75	13	101.50	3.90	13	18.23	3.53
0.76-1.00	24	102.07	4.29	25	18.47	2.51
54 Months						
0.00-0.25	16	103.45	4.14	16	17.28	2.15
0.26-0.50	12	106.39	3.60	12	19.22	2.91
0.51-0.75	9	105.20	1.85	9	17.82	2.82
0.76-1.00	17	105.64	4.90	17	19.84	3.89

in the age-adjusted means for heights by degree of Indian inheritance. As the degree of Indian inheritance increased, height decreased until the highest degrees of inheritance are reached. At that time height increases again as can be seen below:

0-25 percent Indian	299 measurements	85.49 centimeters
26-50 percent Indian	317 measurements	85.34 centimeters
50-75 percent Indian	253 measurements	84.35 centimeters
76-100 percent Indian	339 measurements	85.37 centimeters

Comparison With Other Studies

Minneapolis Sample. Mean lengths and heights of the Cherokee WIC children are compared with those of urban Native Americans living in Minneapolis and with participants of the HANES survey in Table 9. Cherokee males were taller than the Minneapolis sample in about one-half of the categories for which they were matched. Cherokee females were shorter than their Minneapolis counterparts at each age level after six months and through 54 months.

NCHS Sample. Percentiles of stature for age of Cherokee WIC children are described in Table 10 and are compared with those of the NCHS growth charts in Figures 2, 3, 4 and 5. Percentiles were calculated using the Proc Univariate procedure of the SAS package.

During the first year of life the height for age percentiles of the Cherokee WIC girls follows the NCHS growth charts closely.

TABLE 9

COMPARISON OF MEAN HEIGHTS FROM CHEROKEE WIC CHILDREN, MINNEAPOLIS URBAN NATIVE AMERICANS,[1] AND THE HANES[2] DATA IN CENTIMETERS

	Cherokee			Minneapolis			HANES		
Age in months	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
Males									
6 months	188	67.2	3.56	100	65.7	7.9			
12 months	218	74.9	3.83						
18 months	212	80.8	3.36	76	82.0	4.9			
24 months	230	85.4	3.51						
30 months	218	89.7	4.36	54	91.1	5.1	157	91.4	4.0
36 months	210	93.9	3.97				147	95.0	3.7
42 months	216	97.7	4.41	57	96.3	4.8	146	98.1	4.1
48 months	187	101.9	4.49				152	102.7	4.3
54 months	171	105.0	4.24	39	105.7	5.2	162	105.7	4.5
60 months	66	108.5	5.13				135	108.9	5.0
Females									
6 months	33	68.5	3.2	128	65.4	7.3			
12 months	204	74.2	3.6						
18 months	213	79.8	3.4	86	80.2	4.8			
24 months	206	84.5	3.5						
30 months	201	88.5	3.7	67	89.5	4.5	147	90.2	4.0
36 months	204	92.4	4.1				110	95.0	3.1
42 months	176	96.4	4.0	37	97.4	5.4	149	97.4	3.7
48 months	178	100.4	4.8				135	100.8	4.0
54 months	159	104.2	5.0	37	103.7	5.4	145	103.7	4.5
60 months	58	106.4	4.8				146	107.9	4.9

[1]Source: Johnston, Francis E. et al. (1978).

[2]Source: Hamill, Peter V. et al. (1977).

TABLE 10.

SAMPLE SIZE, MEAN, STANDARD DEVIATION AND THE 5TH, 25TH, 50TH, 75TH AND 95TH PERCENTILES BY AGE AND SEX FOR STATURE (IN CENTIMETERS) OF WIC CHILDREN

Age in Years	N	Mean	Std. Dev.	Percentiles 5th	25th	50th	75th	95th	Low	High
Males										
0.2	30	57.36	4.20	51.77	54.61	57.15	58.58	68.58	51.44	68.58
0.5	188	67.21	3.56	62.23	64.93	67.31	69.22	72.11	55.88	88.90
0.7	29	69.97	3.85	62.23	67.31	69.85	72.71	78.10	60.96	80.01
1.0	221	74.89	3.83	68.58	72.39	74.93	77.47	81.28	60.96	86.36
1.5	212	80.84	3.36	75.98	78.74	81.28	82.55	86.36	68.58	89.54
2.0	230	85.41	3.51	79.73	83.66	85.50	87.63	91.09	74.93	96.52
2.5	218	89.73	4.35	83.19	87.63	89.54	92.24	95.25	66.04	105.41
3.0	210	93.91	3.97	88.61	91.44	93.98	96.52	100.33	76.20	106.68
3.5	216	97.69	4.41	91.44	95.25	97.79	100.97	104.23	76.20	109.22
4.0	187	101.86	4.50	94.48	99.06	101.60	105.41	108.59	86.36	115.57
4.5	171	105.00	4.24	97.54	102.24	104.14	107.95	111.76	91.44	116.21
4.9	66	108.53	5.13	100.77	105.41	107.95	111.13	118.72	93.98	121.92
Females										
0.2	37	58.00	3.44	50.67	55.88	58.42	59.69	64.83	49.53	65.41
0.5	173	65.78	3.28	60.77	64.14	66.04	67.31	70.68	53.34	80.01
0.7	33	68.48	3.15	64.39	66.04	67.31	71.12	74.39	63.50	79.07
1.0	204	74.15	3.61	68.11	72.39	74.30	76.20	79.38	59.69	87.63
1.5	213	79.82	3.39	73.66	77.47	80.01	81.92	85.72	69.85	87.63
2.0	206	84.47	3.47	78.74	82.55	84.46	86.36	90.17	73.66	98.43
2.5	201	88.48	3.68	82.55	86.36	88.90	91.44	93.98	76.20	97.79
3.0	204	92.38	4.05	86.36	90.17	92.08	94.62	99.54	78.74	104.14
3.5	176	96.43	4.01	90.17	93.35	96.52	99.06	102.87	85.09	106.68
4.0	178	100.43	4.83	93.98	97.79	100.33	103.03	107.95	79.38	119.38
4.5	159	104.17	5.02	95.25	101.60	104.14	106.68	113.03	91.44	121.92
4.9	58	106.40	4.76	100.30	101.60	106.05	109.38	115.57	97.79	115.57

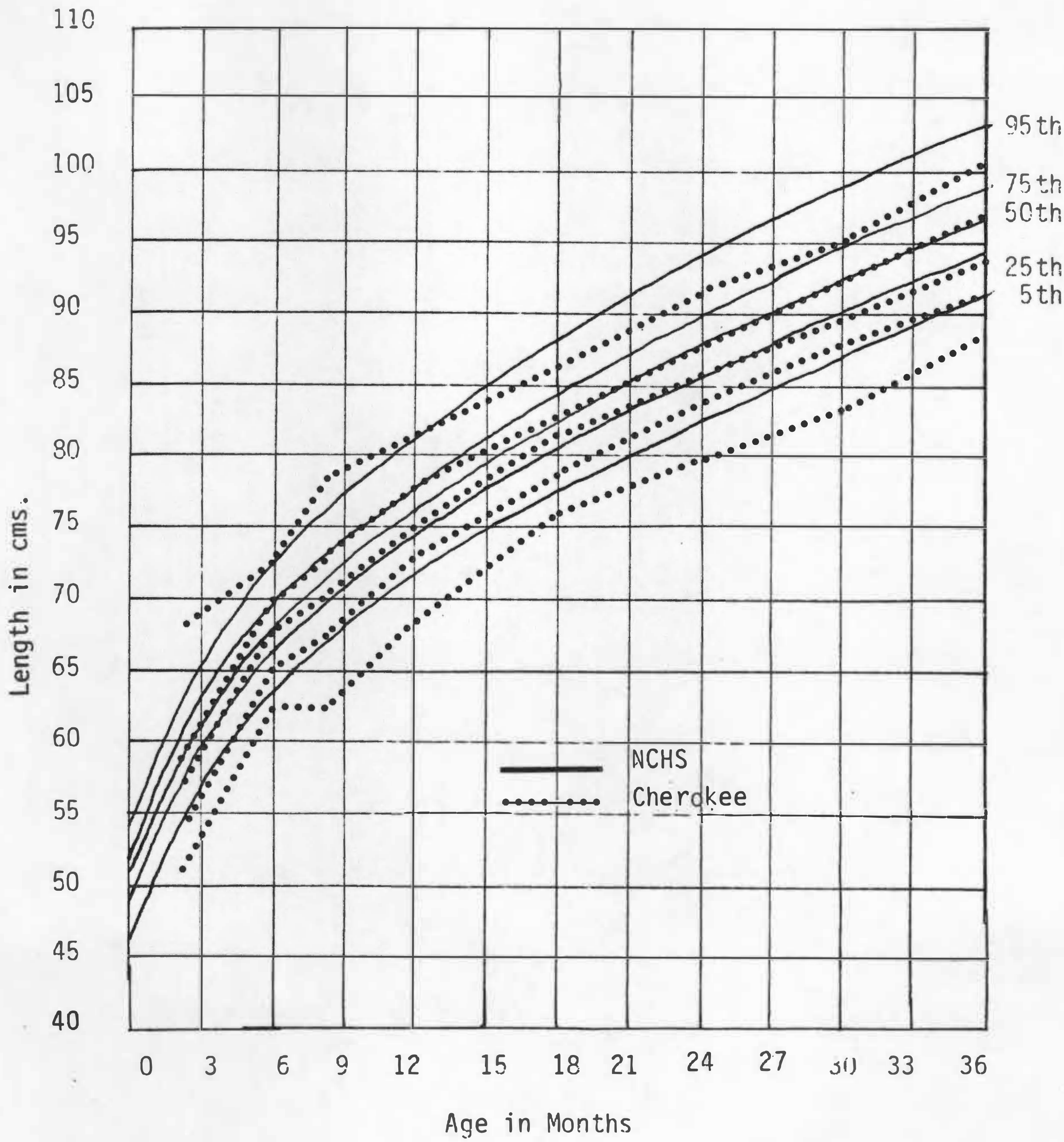

FIGURE 2. Comparison of the 5th, 25th, 50th, 75th and 95th Percentile of Length for Age and WIC Boys Ages 0-3 Years to Growth Curves of the National Center for Health Statistics (Fels)

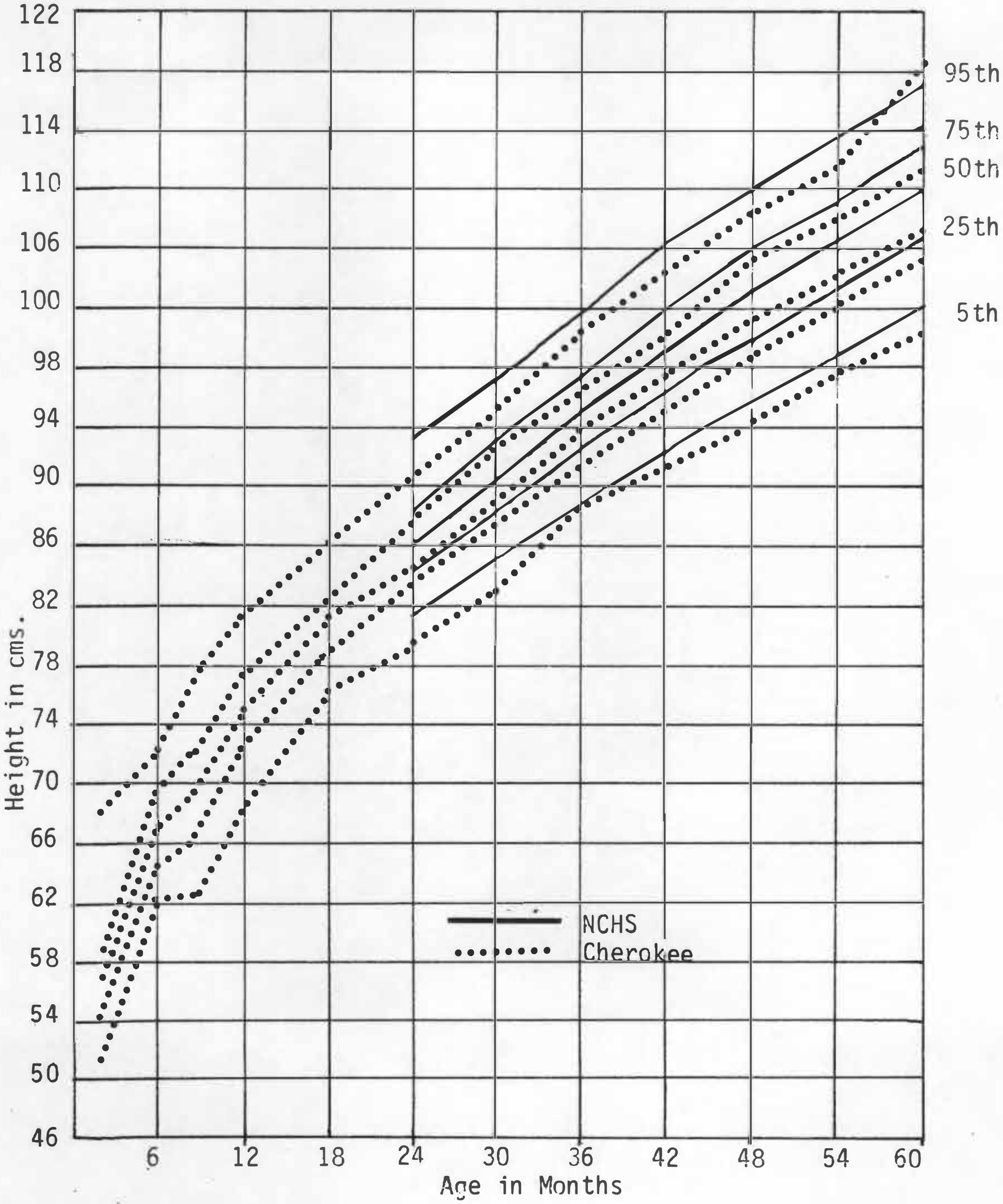

FIGURE 3. Comparison of the 5th, 25th, 50th, 75th and 95th Percentiles of Height for Age of WIC Boys Ages 3 Months to 60 Months to Growth Curves of the National Center for Health Statistics (HANES)

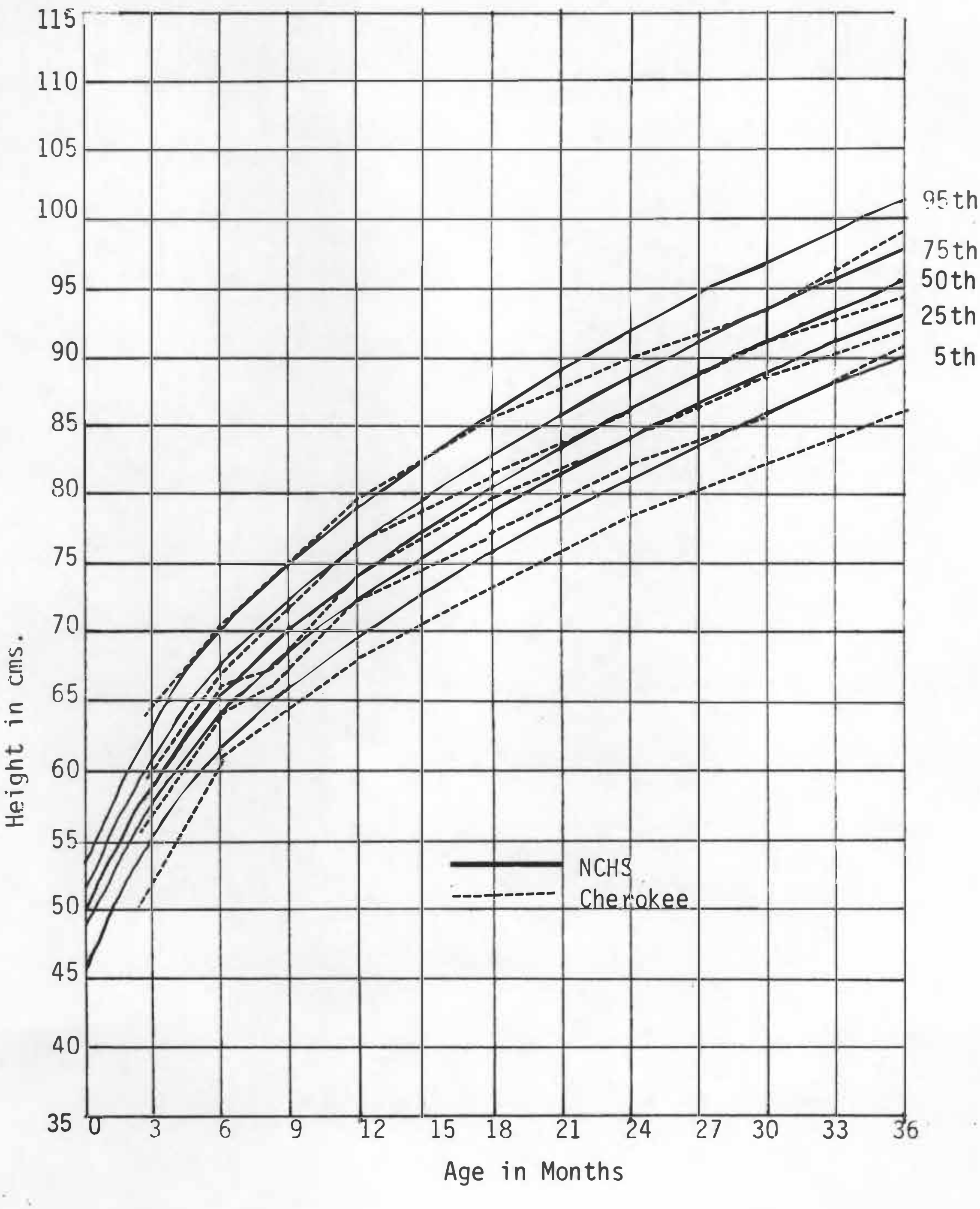

FIGURE 4. Comparison of the 5th, 25th, 50th, 75th and 95th Percentiles of Length for Age of WIC Girls Ages 30 Months to 36 Months to Growth Curves of the National Center for Health Statistics (Fels)

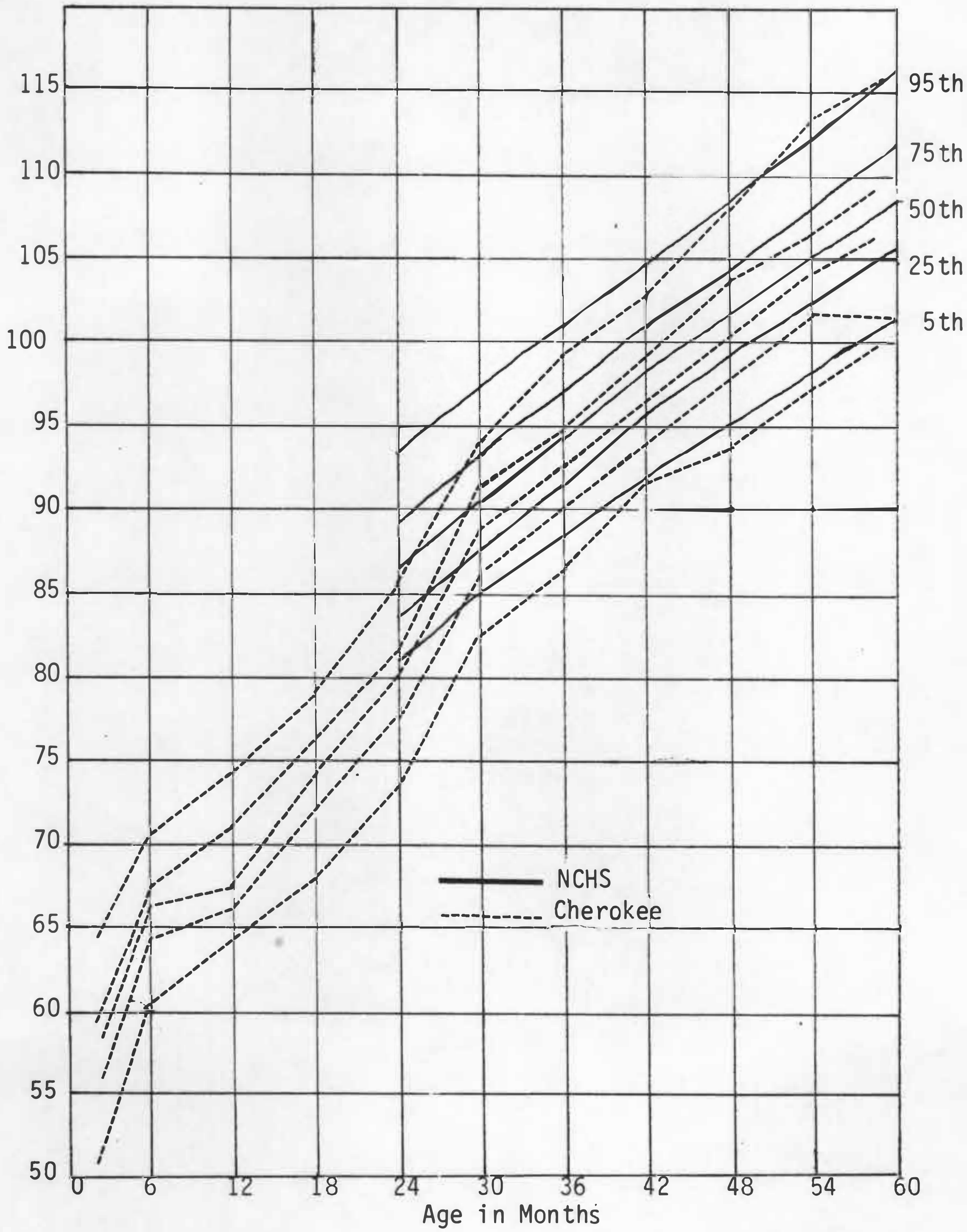

FIGURE 5. Comparison of the 5th, 25th, 50th, 75th and 95th Percentiles of Height for Age of WIC Girls Ages 3 Months to 60 Months to Growth Curves of the National Center for Health Statistics (HANES)

But after 12 months, heights of the Cherokee girls started decreasing relative to the NCHS percentile. Percentiles for Cherokee males tend to differ only slightly from those of the NCHS charts from birth through five years of age.

Longitudinal Results for Lengths and Heights

Despite a sample of 921 individuals from which to draw, it was impossible to locate enough participants, who had been regularly measured close enough to their birthday anniversaries to create any long term longitudinal data. Instead, Table 11 depicts only growth of individuals over 6 month periods.

To be included in the sample used in Table 11, an individual had to have been measured within seven days of his or her birthday anniversary at six and 12 months, within 30 days from 15 to 24 months and within 45 days from 30 to 60 months. Additionally, participants had to have met the measurement date requirements for at least two consecutive six month periods so that actual growth could be calculated.

Males in Table 11 shows a steady decrease in the rate of growth in height from birth through five years. In each six month period they tended to gain fewer centimeters in height than they did during the previous six month period. Cherokee females follow the same general scheme as males do, but they have a more erratic growth pattern between 18 and 54 months where they often gain more in one six month period than they did the previous six months.

The greatest difference in the amount of height gained during a six month period between males and females occurred between six and

TABLE 11

HEIGHT GAIN OF WIC CHILDREN BY SIX MONTH PERIODS IN CENTIMETERS

	Male			Female		
	N	Mean	S.D.	N	Mean	S.D.
Birth-6 months	23	15.68	3.80	17	14.20	3.59
6 months-12 months	4	10.48	0.64	6	7.52	1.86
12 months-18 months	11	5.48	2.24	8	6.19	2.35
18 months-24 months	22	4.53	2.57	23	5.72	2.47
24 months-30 months	21	4.43	2.71	26	3.30	1.96
30 months-36 months	18	4.23	3.19	24	4.29	2.12
36 months-42 months	20	4.13	3.27	18	3.92	2.37
42 months-48 months	18	3.32	2.42	17	4.63	1.60
48 months-54 months	16	2.98	3.25	17	3.62	3.28
54 months-60 months	3	2.54	1.27	2	2.23	0.44

12 months when males gained 2.96 centimeters more than females. This figure must be looked at with caution, however, as the sample sizes at that time were extremely small.

When the longitudinal means for growth at each period are added together, male means equal 57.8 centimeters and female means equal 55.62 centimeters. When these figures are added to the average length at birth for Cherokee males and females (Table 5) the female score differs from the mean distance (Table 6) for height at age five by only 0.1 centimeters and the male score differs from the distance mean for height by age five by 0.7 centimeters.

CHAPTER V

ANALYSIS OF WEIGHTS

Birth Weight

Birth weights of Cherokee WIC children are documented in Table 12 and are arranged by the WIC center which the children attend. Also included in the table is birth weights of Cherokee children born between July 1, 1964 and June 30, 1966 as reported by Adams and Niswander (1973:352). Gestational age for the WIC children is not known.

Birth Weights By Sex and Center. Children attending the Robbinsville clinic have considerably heavier birth weights than those attending the other two clinics. Participants attending the Murphy clinic have the lowest birth weights in the sample. They also display the greatest discrepancy in birth weights between the sexes. Murphy male newborns weigh an average of .5 kilograms more than Murphy females at birth.

Birth weight patterns seen between the three WIC clinics follow those seen for lengths at birth. In each case, individuals from Robbinsville were the largest, those from Murphy were the smallest and the difference between the sexes was greater for participants from Murphy.

Change in Birth Weights Over Time. Birth weights of Cherokee WIC children born between 1972 and 1982 are virtually identical to those of Cherokee children born 6 to 18 years earlier (Table 12).

TABLE 12

BIRTH WEIGHTS OF WIC CHILDREN: MEANS AND STANDARD DEVIATIONS IN CENTIMETERS

Sex	Group	Number of WIC Children	Number, Birth Weight Known	Mean of Known Weights	S.D.
Female					
	Cherokee WIC	402	223	3.35	0.53
	Murphy WIC	19	6	2.84	1.00
	Robbinsville WIC	15	4	3.66	0.34
	Total WIC	436	233	3.35	0.55
	Cherokee (1964-1966)[1]	1233	1207	3.35	0.54
Male					
	Cherokee WIC	420	216	3.42	0.66
	Murphy WIC	35	11	3.30	0.45
	Robbinsville WIC	30	8	3.83	0.57
	Total WIC	485	235	3.43	0.65
	Cherokee (1964-1966)	1313	1292	3.44	0.58

[1]Source: Adams, M. S. and J. D. Niswander (1973).

<u>Comparisons With Other Studies.</u> When the Cherokee WIC birth weights are compared to the birth weights of 25 other Native American groups (Adams and Niswander 1973:352) their birth weights fall in the middle. Males from 12 other tribes have higher birth weights than the Cherokee, while males from 13 other tribes have lower birth weights than the Cherokee WIC males. Females in 11 other tribes have higher birth weights than Cherokee WIC females and females from 14 other tribes have lower birth weights. Birth weights of Cherokee males are .06 kilograms less than those of the Cheyenne, the tribe with the highest birth weight, but .23 kilograms more than the Hopi, the tribe with the lowest birth weights. Birth weights of female Cherokees are .11 kilograms less than the Cheyenne but .25 kilograms more than the Hopi.

Cherokee males are .14 kilograms heavier at birth than males from a virtually all-White New York City sample and Cherokee females are .18 kilograms heavier at birth than females from the same sample (Pomerance 1979:37). The mean birth weight for Cherokee males is .03 kilograms higher than the median birth weight for males in the Fels sample and the mean birth weight for Cherokee females is .10 kilograms higher than the median weight for females from the same sample (Hamill et al. 1977:22-23).

<u>Birth Weights by Mother's Age.</u> Mean birth weights of children in the Cherokee WIC sample with mothers also on WIC were grouped by sex and mother's age. There was no clear increase or decrease in mean birth weight with mother's age. Sample sizes were small and

ranged from 0 to 28 (for male births of 18 year old WIC women). There was, however, a pattern present when mother's ages were grouped by decades and the percent of age categories, within each decade, with weights above or below the mean for children of the same sex were calculated:

14-20 years	39 percent above mean	54 percent below mean
21-30 years	60 percent above mean	35 percent below mean
31-40 years	42 percent above mean	58 percent below mean

In two instances, the mean birth weight for the age category equalled the mean birth weight for that sex. It appears then, that for Cherokee women, age may play a role in a child's birth weight.

Distance Results

Weight by Age and Sex. Means, standard deviations and medians for weight for age of the Cherokee WIC children are provided in Table 13. At each age category, males and females were heavier than at the previous level. The greatest increases in weight gain were seen during the first year of life for both boys and girls. At each age category, males were heavier than females with the greatest difference in weights occurring around age five (Figure 6).

Weight by Age, Sex and Center of WIC Service. When mean weights of Cherokee WIC children are arranged by age, sex and center, male

TABLE 13

MEANS, STANDARD DEVIATIONS AND MEDIAN WEIGHTS OF
WIC CHILDREN BY AGE AND SEX

Age and Sample Size			Weight in Kilograms		
Age in Years	Midpoint	Number	Mean	S.D.	Median
		Males			
.13- .38	.2	33	5.45	1.04	5.44
.38- .63	.5	191	8.17	1.32	8.25
.63- .75	.7	33	8.73	1.49	8.85
.75-1.25	1.0	221	9.97	1.34	9.98
1.25-1.75	1.5	218	11.36	1.48	11.34
1.75-2.25	2.0	232	12.78	1.67	12.70
2.25-2.75	2.5	218	14.04	1.87	13.72
2.75-3.25	3.0	216	15.25	1.83	14.97
3.25-3.75	3.5	219	16.34	2.09	16.22
3.75-4.25	4.0	192	17.74	2.45	17.41
4.25-4.75	4.5	173	18.88	3.08	18.37
4.75-5.25	4.9	65	20.05	3.23	19.73
		Females			
.13- .38	.2	41	5.32	1.01	5.24
.38- .63	.5	177	7.61	1.02	7.54
.63- .75	.7	39	8.16	1.03	8.08
.75-1.25	1.0	212	9.73	1.27	9.63
1.25-1.75	1.5	222	11.03	1.40	10.99
1.75-2.25	2.0	215	12.25	1.54	12.13
2.25-2.75	2.5	206	13.44	1.83	13.15
2.75-3.25	3.0	205	14.28	1.67	14.06
3.25-3.75	3.5	176	15.68	2.01	15.48
3.75-4.25	4.0	180	16.96	2.54	16.56
4.25-4.75	4.5	160	17.94	2.79	17.69
4.75-5.25	4.9	58	18.78	4.17	17.88

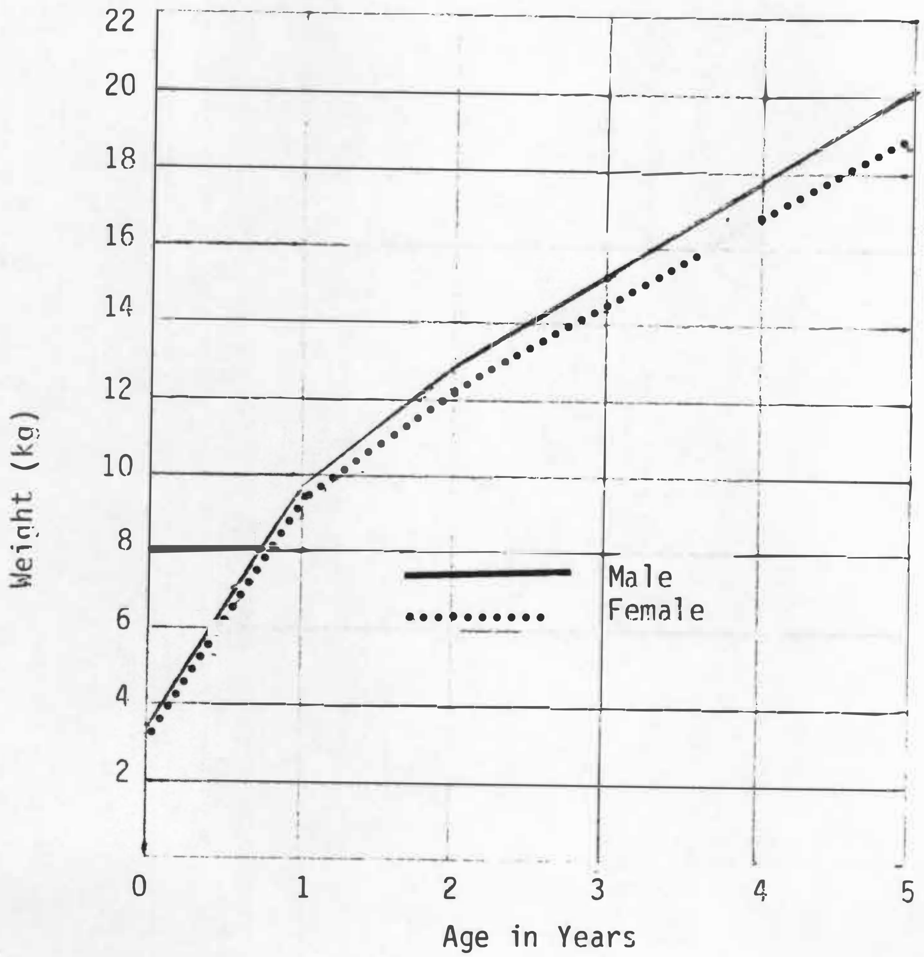

FIGURE 6. Mean Weights of Cherokee WIC Males and Females Ages 0-5

and female participants of the Murphy center are the lighest (except for males at 6 and 12 months) of the three groups (Table 14). Boys from Robbinsville tend to be heavier than boys from Cherokee, while girls from Robbinsville and girls from Cherokee alternate being heavier at different ages. The pattern set at birth of Robbinsville youths being the largest, Murphy the smallest, and Cherokee in between continues through age five.

The differences in weight by center seen in Table 14 was found to be real when tested by convariance analysis. The model used was:

Model weight = $b_0 + b_1$ (age) + b_2 (log age).

When the slopes were tested for homogeneity, F = 317.80 and P<.0001. Age and log age were significant factors contributing to the differences seen in weight between the centers.

Weight by Degree of Indian Inheritance: Sexes Combined. Individuals whose degree of Indian inheritance ranged between 0.26 and 0.51 and who were found to be slightly taller than other WIC participants were also heavier than their fellow participants for approximately the first two years of life (Table 8). Around two, however, individuals whose degree of Indian inheritance ranged from .76 to 1.00 completed their move up from having next to the lowest and the next to lowest weights to having the highest weights. They maintained the highest weights from two years through five years. At the same time, weights of WIC participants with 0 to 25 percent Indian blood were gradually falling relative to other WIC participants.

TABLE 14

MEAN WEIGHTS OF WIC CHILDREN BY AGE, SEX AND CENTER OF WIC SERVICE

	Males			Females		
	N	Mean	S.D.	N	Mean	S.D.
6 Months						
Cherokee	181	8.17	1.33	172	7.61	1.03
Murphy	5	8.67	1.15	2	7.54	0.72
Robbinsville	5	7.92	1.20	3	8.32	0.79
12 Months						
Cherokee	200	10.00	1.32	202	9.70	1.26
Murphy	11	9.20	1.65	5	9.27	0.93
Robbinsville	10	10.20	1.30	5	11.14	1.66
18 Months						
Cherokee	191	11.38	1.48	206	11.11	1.39
Murphy	16	10.92	1.34	9	9.45	0.92
Robbinsville	11	11.79	1.61	7	10.59	0.83
24 Months						
Cherokee	207	12.81	1.64	197	12.32	1.48
Murphy	14	11.87	1.58	11	10.62	1.10
Robbinsville	11	13.47	2.04	7	12.98	2.36
30 Months						
Cherokee	183	13.98	1.77	188	13.53	1.81
Murphy	17	13.33	1.14	8	11.78	1.72
Robbinsville	18	15.35	2.76	10	13.07	1.73
36 Months						
Cherokee	184	15.32	1.85	190	14.37	1.66
Murphy	17	14.07	1.40	9	12.60	1.26
Robbinsville	15	15.76	1.51	6	14.19	1.36
42 Months						
Cherokee	182	16.41	2.13	164	15.76	2.02
Murphy	20	15.78	1.57	7	14.14	1.69
Robbinsville	17	16.97	1.78	5	15.51	1.22
48 Months						
Cherokee	162	17.83	2.53	168	16.95	2.32
Murphy	18	16.59	1.76	6	14.04	0.87
Robbinsville	12	18.15	1.83	6	19.89	5.47
54 Months						
Cherokee	146	18.97	3.25	143	18.12	2.82
Murphy	13	17.74	1.87	9	15.10	0.84
Robbinsville	14	19.01	1.88	8	17.93	1.94

TABLE 14 (Continued)

	Males			Females		
	N	Mean	S.D.	N	Mean	S.D.
60 Months						
Cherokee	53	20.02	3.40	49	18.91	3.98
Murphy	8	18.95	1.83	6	15.80	1.04
Robbinsville	4	22.57	1.60	3	22.49	8.07

Weights of WIC participants with 51 to 75 percent Indian blood were gradually increasing relative to other WIC participants between the ages of two and five.

Comparison With Other Studies

Minneapolis Sample. Mean weights of Cherokee WIC children are compared with those of urban Native Americans living in Minneapolis and with participants of the HANES survey in Table 15. Both Cherokee boys and girls weighed the same as or less than their Minnesota counterparts for each age except 6 months. At the same time they weighed less than the HANES participants for each age except 36 months at which time Cherokee girls weighed more than HANES girls.

NCHS Sample. Percentiles of weight for age for Cherokee WIC children are described in Table 16 and are compared with those of the NCHS growth charts in Figures 7-10.

Cherokee children tend to be slightly heavier at each age than their NCHS counterparts. The greatest difference between the two groups appears in the ninety-fifth percentile where the Cherokees become much heavier.

Effects of Infant Feeding Patterns

The effects of infant feeding practices on statures and weights of WIC children are described in Table 17. The method of feeding used at birth or at the initial WIC visit was used to find these data. Unfortunately, the sample sizes were small and it was necessary to

TABLE 15

COMPARISON OF MEAN WEIGHTS FROM CHEROKEE WIC CHILDREN, MINNEAPOLIS URBAN NATIVE AMERICANS[1] AND THE HANES DATA[2] IN KILOGRAMS

Age	Cherokee			Minneapolis			Hanes		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
Males									
6 months	191	8.17	1.32	108	7.20	2.1			
12 months	221	9.97	1.34						
18 months	218	11.36	1.48	78	11.40	1.9			
24 months	232	12.78	1.67				77	12.74	1.60
30 months	218	14.04	1.87	55	14.60	2.0	157	13.69	1.77
36 months	216	15.25	1.83				147	14.61	1.54
42 months	219	16.34	2.09	57	16.40	4.3	146	15.48	1.76
48 months	192	17.74	2.45				152	16.85	2.24
54 months	173	18.88	3.08	39	19.10	2.7	162	17.67	2.10
60 months	65	20.05	3.23				135	18.55	2.50
Females									
6 months	177	7.61	1.02	135	7.0	1.9			
12 months	212	9.73	1.27						
18 months	222	11.03	1.40	89	11.0	1.5			
24 months	215	12.25	1.54				83	12.19	1.46
30 months	206	13.44	1.83	68	13.5	1.7	147	12.93	1.48
36 months	205	14.28	1.67				110	14.48	1.78
42 months	176	15.68	2.01	39	15.7	2.8	149	14.87	1.75
48 months	180	16.96	2.54				135	15.88	1.84
54 months	160	17.94	2.79	38	18.2	2.5	145	16.64	2.18
60 months	58	18.87	4.17				146	18.07	2.39

[1]Source: Johnston, Francis E. et al. (1978).

[2]Source: Hamill, Peter V. et al. (1977).

TABLE 16

SAMPLE SIZE, MEAN, STANDARD DEVIATION AND THE 5TH, 25TH, 50TH, 75TH and 95TH PERCENTILES BY AGE AND SEX FOR WEIGHT (IN KILOGRAMS) OF WIC CHILDREN

Age in Years	N	Mean	Std. Dev.	Percentiles 5th	25th	50th	75th	95th	Low	High
Males										
0.2	33	5.45	1.05	3.57	4.71	5.44	6.09	7.57	3.43	7.77
0.5	191	8.18	1.32	6.01	7.51	8.25	8.85	10.04	2.41	13.32
0.7	33	8.73	1.50	5.95	8.05	8.85	9.30	12.09	5.56	13.83
1.0	222	9.97	1.34	7.71	9.07	9.98	10.82	12.35	5.61	13.83
1.5	218	11.36	1.48	8.95	10.51	11.34	12.24	14.06	7.46	7.46
2.0	232	12.78	1.67	10.18	11.79	12.70	13.83	15.65	8.16	7.92
2.5	218	14.04	1.87	11.63	12.93	13.72	14.97	16.92	9.53	24.94
3.0	216	15.25	1.83	12.67	14.06	14.97	16.33	18.40	10.20	21.55
3.5	219	16.34	2.09	13.61	14.97	16.22	17.46	20.41	10.89	24.83
4.0	192	17.74	2.45	14.51	16.22	17.41	18.82	21.93	11.11	29.03
4.5	173	18.08	3.08	15.39	17.24	18.37	19.96	25.37	12.13	35.15
4.9	65	20.05	3.23	16.17	17.92	19.73	21.38	28.60	11.34	29.82
Females										
0.2	41	5.32	1.01	3.45	4.62	5.24	6.06	6.99	2.41	7.00
0.5	177	7.62	1.01	6.24	7.03	7.54	8.24	9.10	3.49	11.20
0.7	39	8.16	1.03	6.24	7.60	8.08	8.85	9.89	5.90	10.43
1.0	212	9.73	1.27	7.71	8.86	9.63	10.43	11.94	6.18	14.40
1.5	222	11.03	1.40	8.94	10.01	10.99	11.79	13.35	7.85	17.92
2.0	215	12.25	1.54	10.08	11.34	12.13	13.15	14.79	8.76	21.43
2.5	206	13.44	1.83	10.89	12.25	13.15	14.51	16.30	9.47	23.59
3.0	205	14.28	1.67	11.86	13.15	14.06	15.15	17.24	8.68	19.96
3.5	176	15.68	2.01	12.79	14.43	15.48	16.73	18.67	11.57	26.54
4.0	180	16.95	2.54	13.74	15.42	16.56	17.92	21.83	12.47	29.03
4.5	160	17.94	2.79	14.51	15.88	17.69	19.26	22.91	13.38	32.43
4.9	58	18.78	4.17	14.49	16.33	17.88	19.50	31.58	13.83	35.15

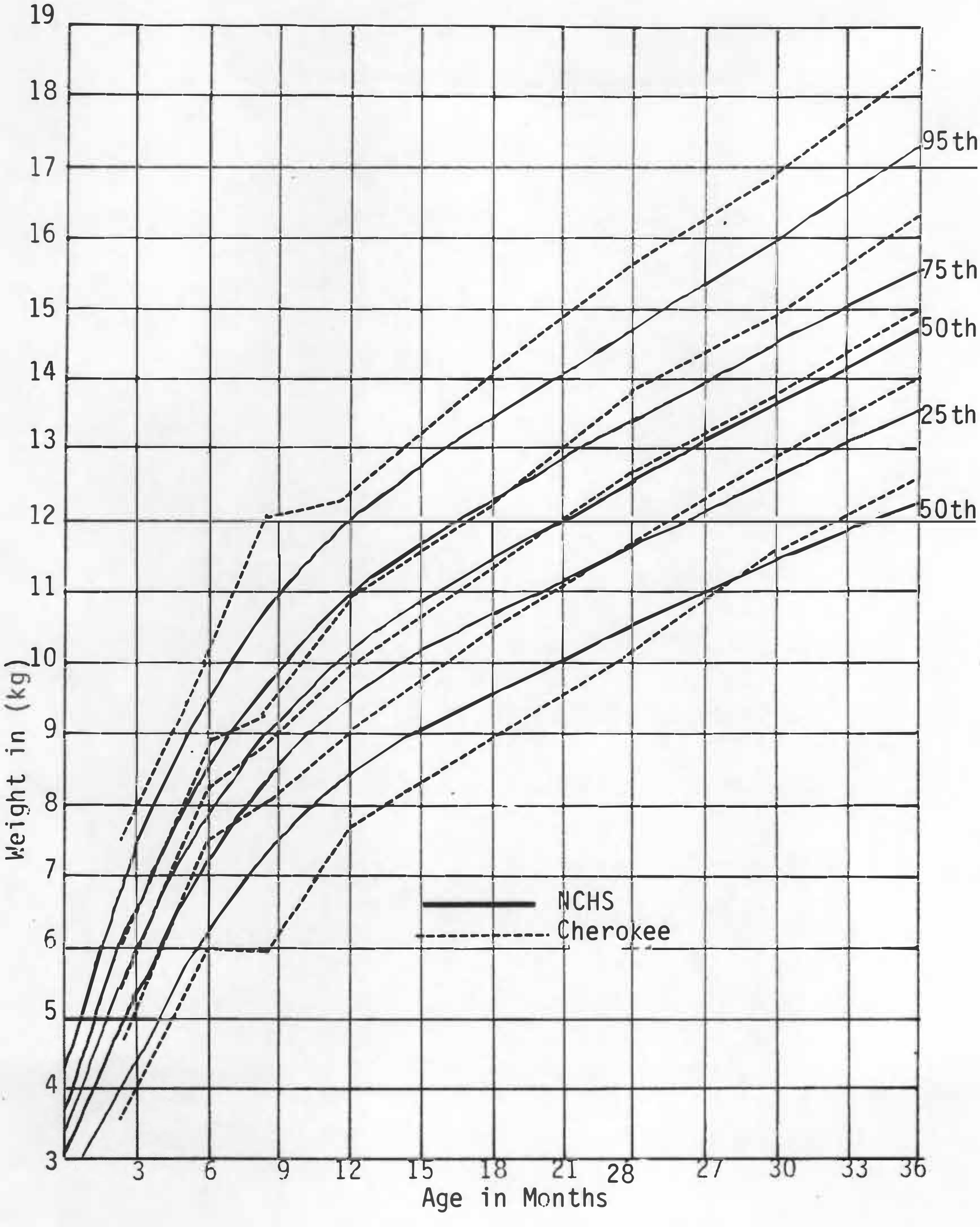

FIGURE 7. Comparison of the 5th, 25th, 50th, 75th and 95th Percentiles of Weight for Age of WIC Boys Ages 0-3 Years to Growth Curves of the National Center for Health Statistics (Fels)

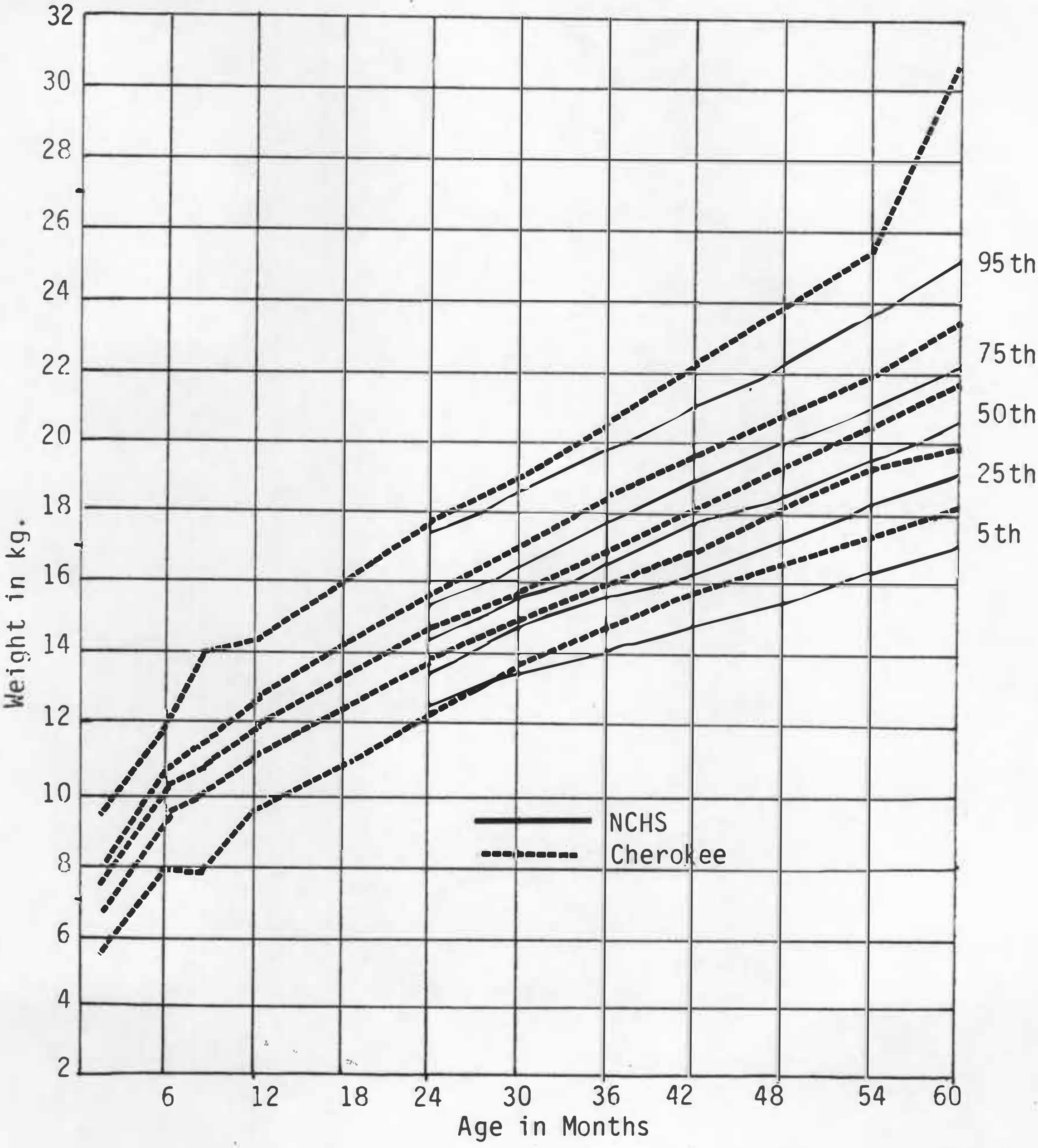

FIGURE 8. Comparison of the 5th, 25th, 50th, 75th and 95th Percentiles of Weight for Age of WIC Boys Ages 0-5 Years to Growth Curves of the National Center for Health Statistics (HANES)

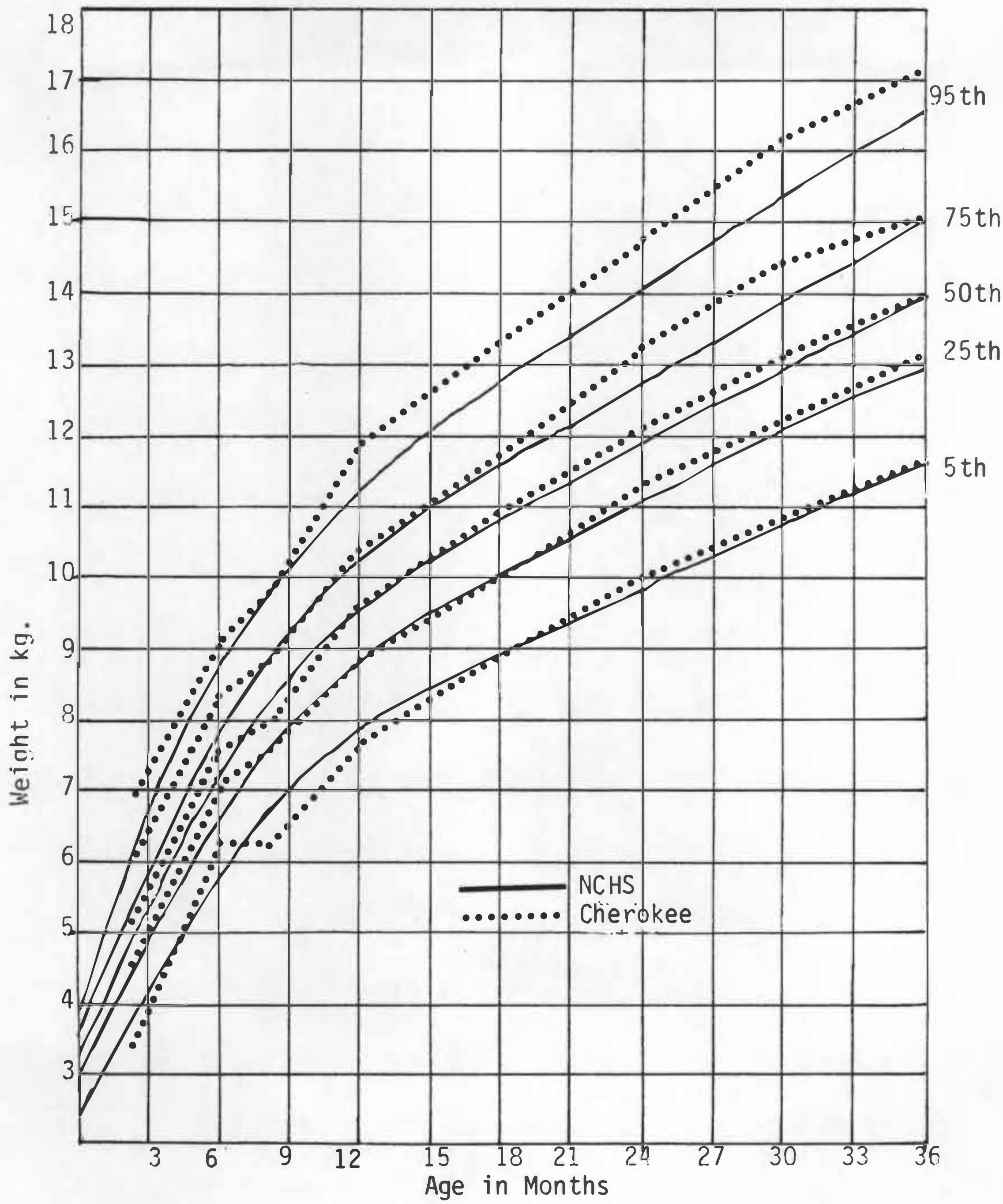

FIGURE 9. Comparison of the 5th, 25th, 50th, 75th and 95th Percentiles of Weight for Age of WIC Girls Ages 0-3 Years to Growth Curves of the National Center for Health Statistics (Fels)

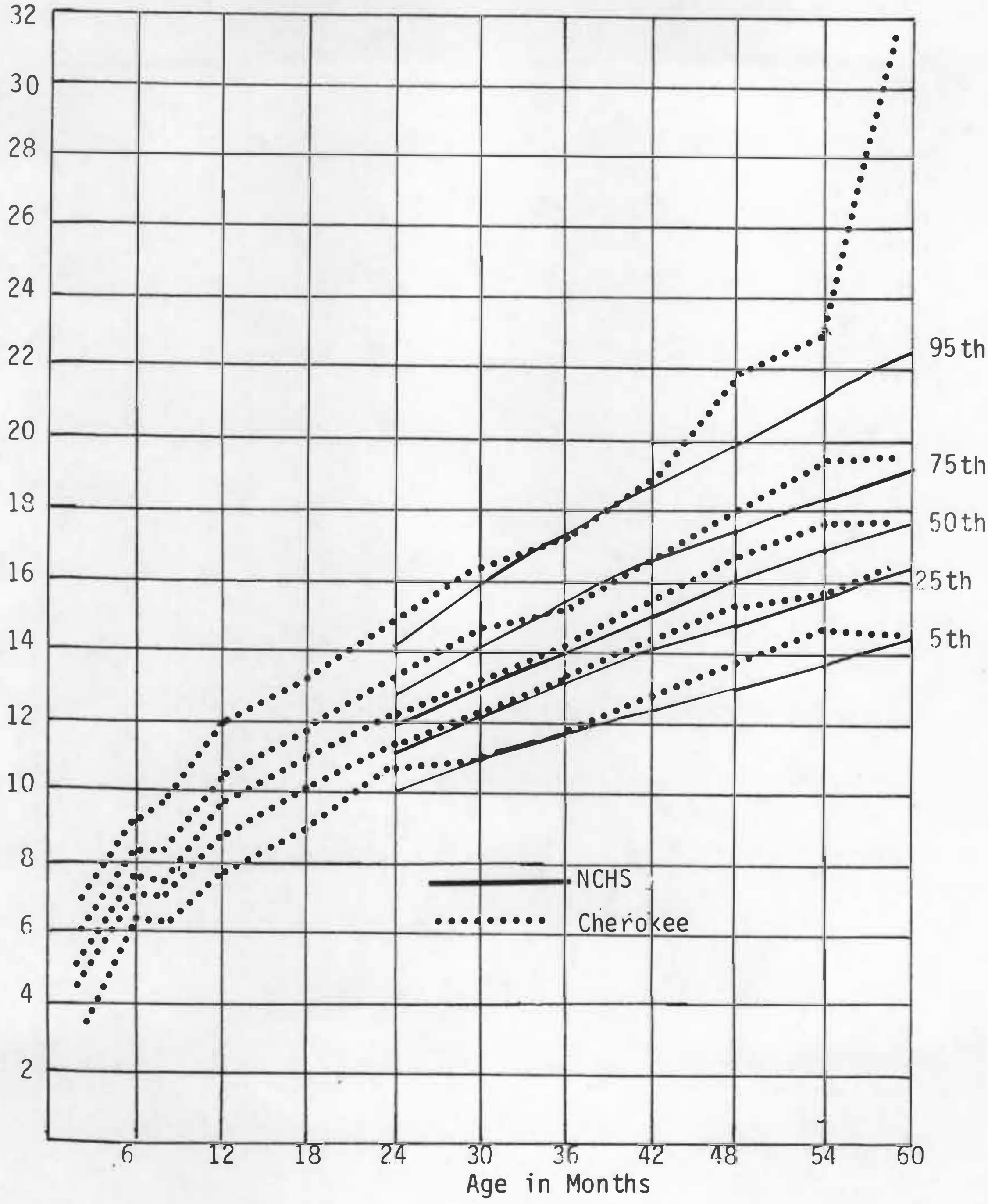

FIGURE 10. Comparison of the 5th, 25th, 50th, 75th and 95th Percentiles of Weight for Age of WIC Girls Ages 0-5 Years to Growth Curves of the National Center for Health Statistics (HANES)

TABLE 17

EFFECTS OF INFANT FEEDING PATTERNS ON STATURES AND WEIGHTS OF WIC CHILDREN: SEXES COMBINED

Age and Infant Feeding Pattern	Stature in Centimeters			Weight in Kilograms		
	N	Mean	S.D.	N	Mean	S.D.
3 Months						
Breast and bottle	6	58.21	2.56	6	6.11	0.70
Breast fed	11	58.68	3.58	11	5.64	0.86
Bottle fed	10	56.00	2.90	10	5.15	0.88
6 Months						
Breast and bottle	63	65.76	3.34	63	7.65	1.19
Breast fed	43	65.88	2.68	43	7.82	0.99
Bottle fed	74	66.75	4.09	74	7.99	1.36
12 Months						
Breast and bottle	44	73.73	3.38	46	9.64	1.10
Breast fed	44	73.62	3.28	44	9.42	0.96
Bottle fed	50	74.67	3.26	53	10.15	1.49
18 Months						
Breast and bottle	40	79.91	3.66	40	11.05	1.67
Breast fed	35	79.49	2.97	35	11.04	1.04
Bottle fed	45	80.70	3.25	45	11.31	1.14
24 Months						
Breast and bottle	29	83.76	3.01	29	11.76	1.61
Breast fed	33	84.38	3.08	32	12.00	1.16
Bottle fed	34	85.24	3.20	34	12.63	1.38
30 Months						
Breast and bottle	19	88.63	2.73	19	13.25	1.96
Breast fed	29	88.53	3.50	29	13.16	1.25
Bottle fed	27	89.71	3.18	27	13.50	1.49
36 Months						
Breast and bottle	15	93.13	3.83	15	14.42	1.94
Breast fed	26	94.15	4.24	26	14.44	1.38
Bottle fed	17	92.53	3.38	17	14.33	1.85

TABLE 17 (Continued)

Age and Infant Feeding Pattern	Stature in Centimeters N	Mean	S.D.	Weight in Kilograms N	Mean	S.D.
42 Months						
Breast and bottle	5	93.98	3.36	5	13.79	2.17
Breast fed	13	97.69	2.97	13	15.63	1.18
Bottle fed	8	95.41	3.42	8	15.66	1.48
48 Months						
Breast and bottle	2	100.65	4.04	2	17.07	2.33
Breast fed	8	102.23	2.12	8	17.03	0.83
Bottle fed	2	100.33	3.59	2	15.99	0.16

combine the sexes when calculating this table. Nevertheless, there is a trend present where bottle fed infants, the shortest and lightest weight infants at 3 months, become the heaviest and tallest ones from 6 months through 30 months after which time the pattern disappears.

The supplementation of breast milk with formula or juice at an early age of life may be a factor involved in the high mean weight achieved by breast and bottle fed infants at three months. This high weight gain may suggest that it is not necessary to supplement the breast milk. But it is also likely that formula fed infants are also receiving juice supplements early without displaying a similar rapid gain in weight. The long term effects of this early supplementation remains inconclusive.

Longitudinal Results for Weight

Table 18 depicts weight gained for six month periods from birth through five years of age. From birth, there is a steady decrease in the amount gained during the previous six month period. This pattern ends at around 30 months for boys and 36 months for girls. After this time, both sexes occassionally gain more in a six month period than they did in the previous six month period.

When the means for growth at each six month period are totaled, the sum for males equals 21.04 kilograms and the sum for females equal 20.22 kilograms. When added to mean birth weights, new figures are larger than the means for distance in weight attained at five years. The differences are .99 kilograms for males and 1.44 kilograms for females.

TABLE 18

WEIGHT GAIN OF WIC CHILDREN BY SIX MONTH PERIODS IN KILOGRAMS

	Male			Female		
	N	Mean	S.D.	N	Mean	S.D.
Birth-6 months	24	4.90	0.89	18	4.11	0.66
6 months-12 months	5	2.30	0.90	6	2.50	0.91
12 months-18 months	11	1.56	0.83	8	2.16	1.69
18 months-24 months	22	1.47	0.73	24	1.25	0.69
24 months-30 months	21	1.08	0.56	27	0.88	1.07
30 months-36 months	19	1.51	0.54	25	0.82	0.77
36 months-42 months	21	0.86	0.53	18	1.29	0.72
42 months-48 months	19	1.16	0.64	17	0.94	0.48
48 months-54 months	16	1.60	1.77	18	1.34	1.08
54 months-60 months	3	1.17	0.59	2	1.36	2.25

CHAPTER VI

ANALYSIS OF WEIGHT FOR HEIGHT

Distance Results

Weight for Height by Sex. Table 19 describes the means, standard deviations and medians of weight for height for Cherokee WIC males and females. From 49 to 61 centimeters females weigh more than males at each interval. Between 64 and 86 centimeters the sexes appears to alternate weighing the most at each interval. After 89 centimeters, males weigh more than females at each interval except at 114-116 centimeters where the high standard deviation suggests that there may be a problem with the data.

Weight for Height by Sex and Degree of Indian Inheritance. There does not appear to be a strong link between degree of Indian inheritance and weight for height in Cherokee WIC children (Table 20). There is a pattern, however, for individuals whose degree of Indian inheritance falls between 0 and 25 percent to have relatively lower weights for height than individuals in the other groups.

Comparisons With Other Studies

The Cherokee WIC data are compared with the NCHS growth charts for weight for height in Figures 11 and 12. Cherokee median weights for height are larger than the national average from 55 centimeters to 100 centimeters. The difference between the two samples is most pronounced at the 90th percentile.

TABLE 19

WEIGHT (IN KILOGRAMS) BY STATURE (IN CENTIMETERS) OF WIC CHILDREN

Stature in Centimeters	Weight in Kilograms: Males N	Mean	S.D.	Median	Females N	Mean	S.D.	Median
49-51	2	3.13	0.38	3.13	6	3.84	0.71	3.93
54-56	11	4.83	0.74	4.99	11	4.94	1.09	4.76
59-61	10	6.10	1.17	6.11	22	6.27	0.62	6.27
64-66	27	7.65	0.65	7.66	36	7.26	0.65	7.35
69-71	45	8.63	0.87	8.73	30	8.68	0.94	8.54
74-76	48	9.97	0.98	10.07	54	9.85	0.88	9.81
79-81	63	11.31	1.02	11.34	73	11.04	1.21	10.89
84-86	60	12.39	1.05	12.25	65	12.62	1.16	12.70
89-91	72	13.89	1.13	13.89	69	13.77	1.47	13.61
94-96	65	15.41	1.16	15.20	62	15.39	1.38	15.19
99-101	118	16.80	1.51	16.57	118	16.48	1.42	16.33
104-106	83	18.79	2.45	18.37	60	17.75	2.05	17.69
109-111	36	21.98	4.20	20.53	21	20.57	3.27	19.62
114-116	3	21.96	3.01	22.23	8	25.46	6.99	24.04

TABLE 20

COMPARISON OF WEIGHT (IN KILOGRAMS) BY STATURE (IN CENTIMETERS) AND DEGREE OF INDIAN INHERITANCE IN WIC CHILDREN

Stature and Degree of Inheritance	Weight					
	Males			Females		
	N	Mean	S.D.	N	Mean	S.D.
74-76 cms						
0.00-0.25	4	10.12	0.67	4	9.97	1.59
0.26-0.50	2	10.31	0.06	3	10.69	0.68
0.51-0.75	4	9.82	1.11	8	9.72	0.70
0.76-1.00	7	9.91	0.50	8	9.78	0.73
79-81 cms.						
0.00-0.25	5	11.32	1.04	7	10.40	0.81
0.26-0.50	6	11.63	1.04	5	11.22	0.91
0.51-0.75	2	11.26	0.52	7	11.58	0.54
0.76-1.00	12	11.55	0.87	7	11.63	1.17
84-86 cms.						
0.00-0.25	8	12.32	0.69	6	12.33	0.88
0.26-0.50	8	12.72	1.24	5	12.92	0.46
0.51-0.75	4	11.28	0.67	9	11.91	0.99
0.76-1.00	6	12.56	0.21	6	13.93	0.99
89-91 cms.						
0.00-0.25	5	13.09	0.80	9	13.71	1.01
0.26-0.50	4	13.86	0.46	7	14.47	0.90
0.51-0.75	7	13.49	1.29	2	14.46	0.40
0.76-1.00	6	13.92	1.08	9	13.66	1.20
94-96 cms.						
0.00-0.25	6	15.05	0.73	9	14.35	0.82
0.26-0.50	4	16.84	2.24	6	15.04	1.15
0.51-0.75	2	16.50	0.88	3	15.19	0.82
0.76-1.00	5	15.28	1.01	9	15.94	2.03
99-101 cms.						
0.00-0.25	5	16.40	0.22	13	15.79	0.81
0.26-0.50	9	17.99	1.45	6	16.34	1.21
0.51-0.75	3	17.54	0.79	11	16.88	1.03
0.76-1.00	7	17.46	2.44	9	17.73	0.90

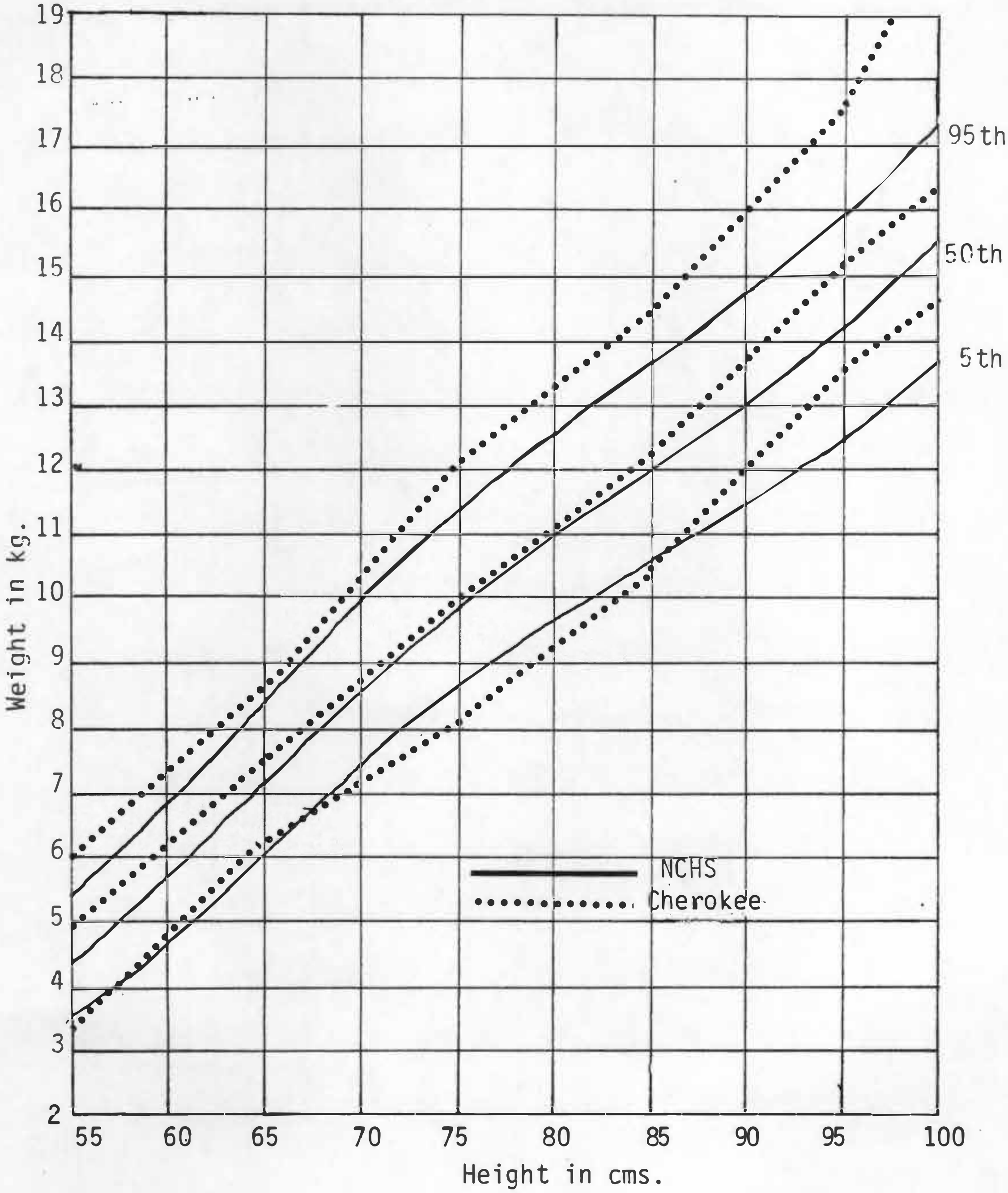

FIGURE 11. Comparison of the 5th, 50th and 95th Percentiles of WIC Males and of the National Center for Health Statistics: Weight for Height

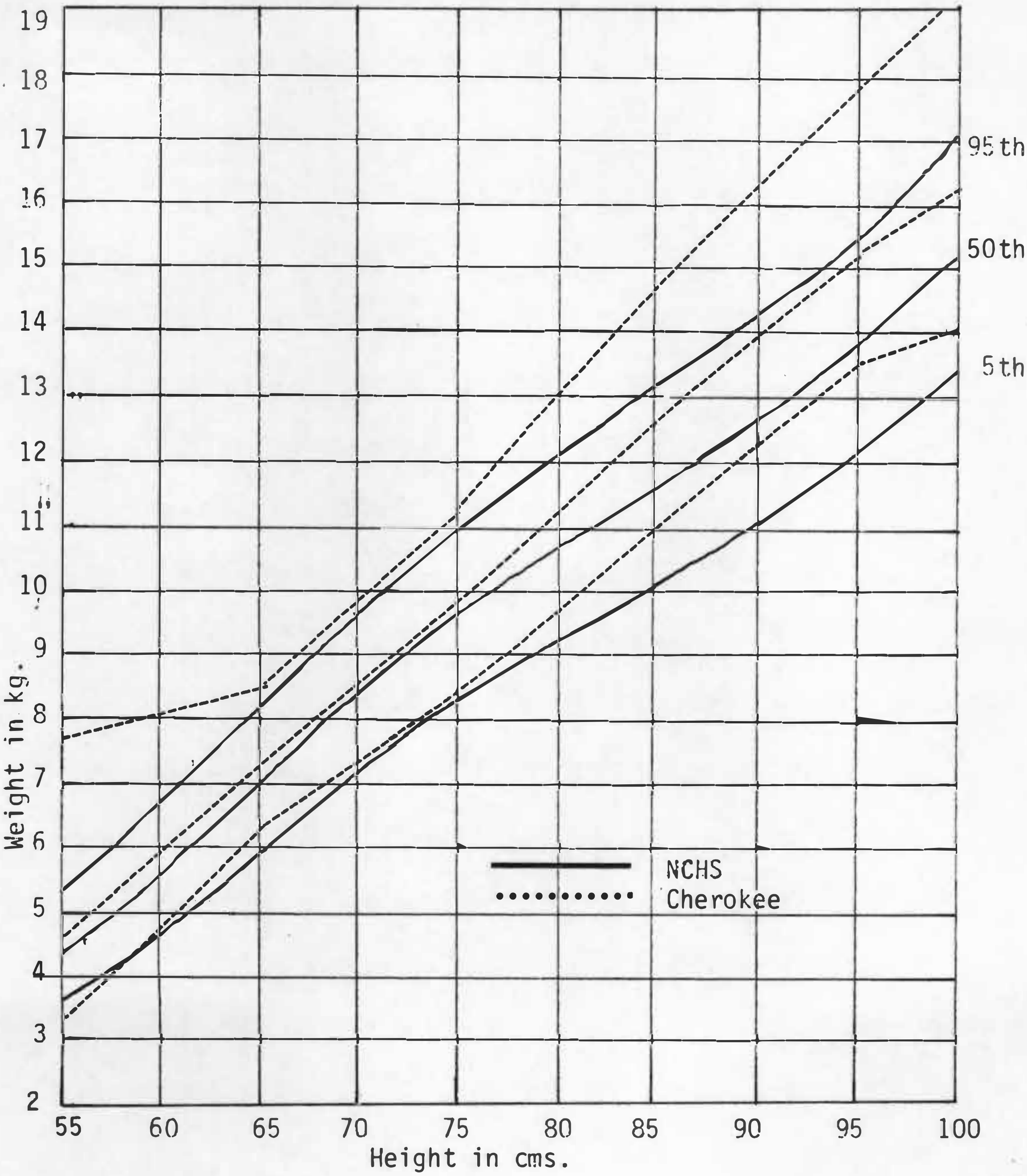

FIGURE 12. Comparison of the 5th, 50th and 95th Percentiles of Weight for Stature of Cherokee WIC Females and of the National Center for Health Statistics: Weight for Height

CHAPTER VII

ANALYSIS OF HEMATOCRITS

Variations Within WIC Sample

Hematocrits by Age and Sex. Means hematocrits of WIC children are arranged by age and sex in Table 21. From birth through two years of age, females tend to have hematocrits equal to or less than those of their male counterparts. From two years to five years, the trend reverses itself and females have hematocrits greater than or equal to those of their male counterparts. The differences between the mean hematocrits for each sex at each age is small. In fact, a third of the time, the mean hematocrit for one sex equalled that of the other sex.

Hematocrits by Age, Sex and Center of WIC Serice. When mean hematocrits for the Cherokee WIC sample are arranged by center of WIC service, males and females from the Cherokee center tend to have lower hematocrits than the others (Table 22). Around 3 years of age, however, Cherokee hematocrits increase relative to the other groups. Murphy males and Robbinsville females have the highest hematocrits.

Hematocrits by Age and Degree of Indian Inheritance: Sexes Combined. There does not appear to be an association between the degree of Indian inheritance and hematocrits in WIC children (Table 23).

TABLE 21

MEAN HEMATOCRITS BY AGE AND SEX OF WIC CHILDREN

Age and Sample Size		Hematocrit		
Age in Years	Midpoint	Number	Mean	S.D.
		Males		
.13- .38	.2	29	34.9	7.29
.38- .63	.5	175	34.6	2.35
.63- .75	.7	23	35.2	3.15
.75-1.25	1.0	205	34.9	2.28
1.25-1.75	1.5	195	35.4	2.42
1.75-2.25	2.0	219	35.2	2.56
2.25-2.75	2.5	199	35.5	2.35
2.75-3.25	3.0	197	35.7	2.11
3.25-3.75	3.5	199	36.1	2.15
3.75-4.25	4.0	177	36.1	2.28
4.25-4.75	4.5	162	36.6	2.43
4.75-5.25	4.9	61	36.8	2.53
		Females		
.13- .38	.2	37	34.9	7.51
.38- .63	.5	158	34.3	2.50
.63- .75	.7	27	34.7	2.74
.75-1.25	1.0	193	34.9	2.38
1.25-1.75	1.5	208	35.4	2.52
1.75-2.25	2.0	202	35.3	2.70
2.25-2.75	2.5	200	35.5	2.28
2.75-3.25	3.0	190	36.0	2.36
3.25-3.75	3.5	170	36.2	2.19
3.75-4.25	4.0	167	36.2	2.16
4.25-4.75	4.5	148	36.9	2.54
4.75-5.25	4.9	55	37.1	3.40

TABLE 22

MEAN HEMATOCRITS BY AGE, SEX AND CENTER OF WIC SERVICE

	Males			Females		
	N	Mean	S.D.	N	Mean	S.D.
6 Months						
Cherokee	167	34.5	2.20	156	34.3	2.52
Murphy	4	36.3	3.10	1	34.0	0.00
Robbinsville	4	38.0	4.90	1	34.0	0.00
12 Months						
Cherokee	188	34.8	2.25	185	34.9	2.30
Murphy	9	36.2	2.59	3	35.0	3.61
Robbinsville	8	35.0	2.56	5	37.2	3.92
18 Months						
Cherokee	177	35.3	2.38	196	35.3	2.50
Murphy	12	36.9	2.87	8	35.4	2.26
Robbinsville	6	35.5	1.87	4	37.0	4.08
24 Months						
Cherokee	200	35.1	2.53	188	35.1	2.46
Murphy	12	36.4	3.06	8	37.8	3.88
Robbinsville	7	35.9	2.12	6	38.5	4.97
30 Months						
Cherokee	173	35.4	2.29	186	35.4	2.15
Murphy	16	36.2	2.71	8	36.0	2.73
Robbinsville	10	36.0	2.67	6	38.2	4.02
36 Months						
Cherokee	174	35.7	2.02	178	35.9	2.33
Murphy	17	36.0	2.85	8	36.5	2.67
Robbinsville	6	35.5	2.59	4	38.0	2.83
42 Months						
Cherokee	172	36.0	1.97	161	36.2	2.19
Murphy	20	37.8	2.86	6	35.2	1.94
Robbinsville	7	34.0	0.58	3	37.3	2.52
48 Months						
Cherokee	156	36.1	2.24	159	36.2	2.13
Murphy	15	36.6	2.23	6	37.0	2.53
Robbinsville	6	34.8	3.19	2	39.0	1.41
54 Months						
Cherokee	139	36.6	2.48	134	36.9	2.60
Murphy	13	35.8	1.91	8	36.9	2.36
Robbinsville	10	36.6	2.46	6	38.2	2.13

TABLE 22 (Continued)

	Mean			Females		
	N	Mean	S.D.	N	Mean	S.D.
60 Months						
Cherokee	49	36.7	2.43	49	37.1	3.54
Murphy	9	36.3	2.78	5	37.0	2.35
Robbinsville	3	38.7	3.51	1	37.0	0.00

TABLE 23

MEAN HEMATOCRITS BY AGE AND DEGREE OF INDIAN INHERITANCE OF WIC CHILDREN (SEXES COMBINED)

Age and Degree of Indian Inheritance	Number	Hematocrits Mean	S.D.
6 Months			
0.00-0.25	29	34.4	1.86
0.25-0.50	30	33.8	2.20
0.51-0.75	24	35.3	2.35
0.76-1.00	25	34.8	2.43
12 Months			
0.00-0.25	33	35.0	2.43
0.26-0.50	38	34.2	2.53
0.51-0.75	28	34.7	2.29
0.76-1.00	39	35.3	2.61
18 Months			
0.00-0.25	38	34.9	2.15
0.26-0.50	40	35.0	2.95
0.51-0.75	30	35.7	2.03
0.76-1.00	42	35.3	2.54
24 Months			
0.00-0.25	40	34.4	3.04
0.26-0.50	41	35.1	2.41
0.51-0.75	32	35.3	2.08
0.76-1.00	44	35.4	2.28
30 Months			
0.00-0.25	38	35.6	2.46
0.26-0.50	40	35.0	2.32
0.51-0.75	32	35.2	2.05
0.76-1.00	41	35.4	2.02
36 Months			
0.00-0.25	35	35.6	2.57
0.26-0.50	40	35.8	2.52
0.51-0.75	29	36.2	2.23
0.76-1.00	42	35.7	1.93
42 Months			
0.00-0.25	28	35.6	2.13
0.26-0.50	25	36.6	1.63
0.51-0.75	23	36.6	1.92
0.76-1.00	34	36.1	1.98

TABLE 23 (Continued)

Age and Degree of Indian Inheritance	Number	Hematocrits Mean	S.D.
48 Months			
0.00-0.25	24	35.8	1.77
0.26-0.50	22	36.3	2.60
0.51-0.75	13	36.7	2.29
0.76-1.00	22	37.4	2.30
54 Months			
0.00-0.25	16	37.1	2.60
0.26-0.50	11	37.3	3.58
0.51-0.75	9	38.1	2.03
0.76-1.00	15	37.6	2.47

Comparison With Other Studies

When hematocrits of the Cherokee WIC children are matched with those of Minnesota urban Native Americans, the Cherokees have hematocrits greater than or equal to the Minnesotans at each age (Table 24). But when compared to "average normal" standards in a hematology textbook (Miale 1977:426) the Cherokee had lower scores at each age. The scores were higher, however, than "minimal normal" ones also described.

TABLE 24

MEAN HEMATOCRITS OF CHEROKEE WIC CHILDREN COMPARED TO HEMATOCRITS OF MINNEAPOLIS URBAN NATIVE AMERICAN CHILDREN[1]

Age and Sample	Males			Females		
	N	Mean	S.D.	N	Mean	S.D.
6 months						
Cherokee	167	34.5	2.2	156	34.3	2.5
Minneapolis	53	33.0	3.4	68	33.6	3.4
18 months						
Cherokee	177	35.3	2.4	196	35.3	2.5
Minneapolis	44	33.6	3.0	54	33.9	3.8
30 months						
Cherokee	173	35.4	2.3	186	35.4	2.2
Minneapolis	31	35.4	2.5	31	34.4	2.7
42 months						
Cherokee	172	36.0	2.0	161	36.2	2.2
Minneapolis	42	35.6	2.6	28	35.6	2.9
54 months						
Cherokee	139	36.6	2.5	134	36.9	2.6
Minneapolis	28	34.7	2.0	28	35.1	2.3

[1]Source: Johnston, Francis E. et al. 1978.

CHAPTER VIII

CONCLUSIONS AND IMPLICATIONS

Discussion and Summary

Height, weight and hematocrit measurements of 921 Cherokee children participating in the WIC program between 1976 and 1982 were studied. Both distance and velocity data for height and weight were presented. Comparisons were made between means for heights, weights and hematocrits of the Cherokee Indians, the urban Indians from Minneapolis and the national averages. Also internal comparisons of the WIC sample were made by age, sex, center of WIC service, degree of Indian inheritance and year of birth of the WIC participants.

Cherokee boys and girls in this sample were found to be longer at birth than boys and girls in a predominantly White New York City sample. After birth, mean heights of Cherokee males tended to be slightly less than the national averages presented in the NCHS growth charts and variable when compared with mean heights of urban Native Americans from Minnesota. Mean heights of Cherokee girls were about equal to the national average in the first year of their life but then became less through the fifth year. From 6 to 54 months, Cherokee females were shorter than their Minnesota counterparts.

In a study of Cherokee teenagers, both males and females were found to be similar in height to their White counterparts surveyed in the HES sample used to create the NCHS growth charts and similar in height to urban Native Americans from Minneapolis except after the age of 15 when Cherokee males continued to increase their means for height relative to the Minneapolis ones (Thompkins 1980:44, 48).

When mean birth weights of the Cherokee WIC boys and girls were matched with those of 25 other Native American groups, about one-half of the tribes had lower birth weights than did the Cherokee. Cherokee mean birth weights were, however, much closer to the means for the tribes with the highest birth weight than the tribe with the lowest. Cherokee birth weights were higher than those of a New York City sample of Whites. Weights of Cherokee boys and girls were higher, especially those which fell in the 95th percentile, than weights presented in the NCHS growth chart for ages birth through five. The mean weights of Minnesota Native Americans were greater than or at least equal to those of the Cherokees.

Cherokee teenagers between the ages of 13 and 17 had greater mean weights at each age than did their Black and White counterparts in an NCHS study and were generally heavier than teenagers from Minneapolis (Thompkins 1980:44- 45, 55-58).

Mean hematocrits of the WIC children were greater than or equal to those of the Minnesota sample but less than average for the nation.

Several patterns emerged when the Cherokee data were analyzed for age, sex, center of WIC service, degree of Indian inheritance, and year of child's birth. One of the clearest patterns to appear was the differences between the centers.

Participants of the Robbinsville clinic were the tallest and heaviest of the sample. Females from this clinic had the highest hematocrits. Participants of the Murphy clinic tended to be the shortest and least heavy and males there had the highest hematocrits. Participants of the Cherokee clinic usually fell in between those from Robbinsville and Murphy for heights and weights but had the lowest hematocrits of the three groups.

There was an association between degree of Indian inheritance and weight. Age was a factor in the association between weight and degree of Indian inheritance as it was in other associations in the physical growth of these children. After two years of age, participants with the highest degrees of Indian inheritance (76-100 percent) weighed the most and participants with the smallest degrees of Indian inheritance (0-25 percent) weighed the least. Before two years of age, an increase in Indian inheritance was associated with a decrease in weight for age.

A study of Cherokee teenagers, ages 13-16, showed a tendency for height to decrease as the degree of Indian inheritance increased (Tompkins 1980:33).

An increase in weight with an increase in the degree of Indian inheritance was found for Cherokee teenage males from ages 13 through 16, after which time there was a decrease in weight associated with an increase in the degree of Indian inheritance. Cherokee females, ages 13 and 14, also showed an increase in weight with an increase in the degree of Indian inheritance. The association between weight and degree of Indian inheritance was less straightforward for Cherokee females between the ages of 15 and 17 (Tompkins 1980:37-42).

During the first six months of life, several patterns are laid down which are not continued. Bottle fed babies, for example, the heaviest babies from 12 months to 30 months are the lightest at six months. One explanation for this finding might be that breast fed children are more content and have had their oral gratification fulfilled. At around three months, girls are taller than boys, the only such occurrence from birth through five years of age. Cherokee girls are as tall as their NCHS counterparts for the first year of life but not later. Males tend to weigh less per unit of height than females and have higher hematocrits for the first year of life, patterns which are not continued.

Birth weights of Cherokee children do not appear to have changed from 1966 to 1982. Girls born from 1978 to 1982 tend to be taller and have higher hematocrits than girls born between 1972 and 1978. Weight for age of these WIC girls has not changed over time. Boys born from 1978 to 1982 are shorter, heavier, and have lower hematocrits than boys born earlier. The Cherokee WIC program has apparently been more succesful with girls than boys.

Implication for WIC Program

Height. 1. Use of the NCHS growth charts may suggest that more children are short for age than is actually the case, especially girls. New guidelines for acceptable heights for age need to be drawn so that the staff can spot those children who are outside the norm for Cherokee.

2. The data suggests that if the boys and girls make regular visits to WIC they will be taller (Table 25, Appendix D).

<u>Weight.</u> 1. As many Cherokee children will be overweight on the NCHS charts it may be necessary to create a different criteria for determining obesity.

2. As children with higher degrees of Indian inheritance tend to become the heaviest of the participants, the WIC staff may want to work with these children and their families. As this pattern emerges around two years of age, and should be controlled at this time, it is hoped that the WIC program will be spared federal cutbacks.

3. As an increase in weight is associated with an increase in the number of visits to WIC (Table 26, Appendix D) it appears that the children are, in fact, receiving the food. It may be necessary, however, to provide increased nutrition education and physical education opportunities with the supplemental food to prevent increases in weight in cases where it is not desired.

4. As women under 20 and over 30 tend to have babies with lower than average birth weights (for Cherokees) the WIC staff should continue to concentrate on them.

<u>Hematocrits.</u> 1. As hematocrits of the WIC children are less than normal, the program's presence is indeed justified.

2. As male hematocrits have been decreasing with an increase in visits to WIC (Table 27, Appendix D) while girls have not, the WIC staff should work with the boys.

Infant Feeding. 1. While bottle feeding does lead to greatly increased weight in the early years of life, its effects do not appear to last past three years. This might be a topic for future research.

2. As more than two thirds of WIC women breast feed their child to some extent, a percentage much higher than the national average, the Cherokee WIC program can consider its efforts in this regard a success.

Suggestions for Future Research

1. Evaluate these same children in a few years to see if patterns of growth by center, and degree of Indian inheritance, and number of visits to WIC continue to exist.

2. Evaluate these same individual children in 40 or 50 years and analyze the growth patterns of the children who became diabetics and those who did not.

3. Analyze differences in energy expenditure within the WIC sample.

4. Analyze differences in body shape within the WIC sample as it has been suggested that adult diabetics have different body proportions than non-diabetics.

5. Analyze velocity growth by degrees of Indian inheritance.

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APPENDICES

APPENDIX A

CHEROKEE WIC PROGRAM CERTIFICATION RECORD

CHEROKEE WIC PROGRAM
CERTIFICATION RECORD

Name ______________________ I.D. Number ______________________ CATEGORY: Pregnant ☐

Address ______________________ Date of Birth ______________________ Trimester of Pregnancy ___1___2___3

______________________ SEX: ☐ Male ☐ Female Expected/Actual Delivery Date ________

Phone Number ______________________ Ethnic Group: (circle) W.B. Am Ind. O. Last Delivery Date ________

Parent's Name ______________________ Prepregnancy Weight __________ lbs.

County of Residence ______________________ No. in Household ______________________ Postpartum ☐ Breast-Feeding ☐

No. Now on WIC ______________________ Infant ☐ Child ☐

Information Recorded by (Name) ______________________ Date ______________________

		Initial	PP	6 mo.	6 mo.	6 mo.	6 mo.	6 mo.	6 mo.	6 mo.	6 mo.
Date of Initial Visit:											
	Date Certified:										
	Professional Position										
Height											
Weight											
Hematocrit Anemia	34% or less										
Hemoglobin	11 G or less										
Abnormal Wt. Pattern	◄ 10% ideal wt or ► 20% ideal wt										
Low Birth Weight	◄ 2500 G or ◄ 5 lbs										
Unacceptable gain	► 3 lb 1st ► 7 lb / month trimester month										
High Risk	◄ 18 yr old ► 35 yr old										
Unacceptable weight gain or (Excessive weight gain)	◄ 10th percentile or ► 90th percentile										
Unacceptable growth for length or height	◄ 10th percentile ► 90th										
Inadequate diet											
Previous low birth weight infant											
Miscarriage											
Prematurity											
Still Birth											
Abrupto Placenta											
Multiple Fetus											
Toxemia											
Chronic cond. - Diabetes, GI, Renal, Heart, etc.											
Alcohol, Tobacco Abuse											
Mental Retardation or infant of alcoholic, mentally retarded, drug addicted mother											
Infant of a breast-feeding mother at nutritional risk or Breast-feeding mother of an infant at risk											
Infant of WIC mother											
Inborn error of metabolism											
Regression in nutritional status											
Other											

PRIORITY (Circle appropriate number) I, II, III, IV, V, VI

CERTIFIED INELIGIBLE BECAUSE:

WRITTEN NOTICE GIVEN BY: TITLE:

DATE TERMINATED WHY:

SIGNATURE: TITLE:

APPENDIX B

VOLUNTEER'S INFORMED CONSENT

VOLUNTEER'S INFORMED CONSENT

This project is designed to gather information on infant feeding patterns and child growth among the participants in the Cherokee WIC program. Those participating in this project will have their WIC and possibly their medical records examined. Information on age, sex, height, weight, hematocrit or hemoglobin levels, outcomes of previous pregnancies and breast and bottle feeding practices, if recorded, will be taken from the WIC records. Additionally, history of family illnesses, especially diabetes, degree of Cherokee blood, and information on birth order, maternal birth weight and length, length of pregnancy and number of children will be taken from the medical records.

The records will be identified by a code only and the key to the code will be kept at the Cherokee WIC office. You are asked to let your records be examined for this project, with the understanding that your participation is entirely voluntary. To indicate your consent, you are asked to read and sign this statement, a copy of which will be given to you.

1. I agree to participate in this project, which is designed to gather information on infant feeding patterns and child growth among the participants in the Cherokee WIC program. I understand that there are no risks or benefits associated with my participation.

2. I have been given, in my opinion, an adequate explanation of the nature of the project and procedures to be followed. I understand that any questions which may arise will be answered fully and promptly.

3. I understand that I have the right to withdraw my consent and to discontinue participation in this project at any time without penalty.

4. I understand that my identity will remain confidential regarding the information obtained from me.

Date______________________________1982

Participant's name____

Signature of participant or guardian______________________________

Researcher: Patti Driscoll
1506 Holston River Road
Knoxville, TN 37914
615-525-6478

Local Contact
Cherokee WIC Office
P. O. Box 666
Cherokee, NC 28719
704- 497-7297

APPENDIX C

DATA FROM WIC RECORDS

Data from Cherokee WIC Records on Tape OU3235

From Scan Sheet One: Numbers indicate input numbers on Tape OU3235

Name
64 Center C=Cherokee, R=Robbinsville, M=Murphy
118 Degree of Indian Inheritance A=none, B=.01 - .25, C=.26 - .5, D=.51 - .75, E=.76 - 1.0

Sex
111 M=male, F=female.

Maternal Diabetes
128-129 1=Maturity onset diabetes, 2=gestational, 3-pre-diabetic, 4-juvenile.

Identification Number
53-57 Birth

Special Codes
121-124 Family code
125 Subject code 1=oldest child, 2=next oldest child
126 Page number

Mother's Data
151-155 0=no, 1=yes blank=no information
Birth date of mother in decimal years
166-170 Mother's prepregnancy weight
171-175 Mother's height
176 Alcohol abuse by mother
177 Tobacco abuse by mother
178 Drug abuse by mother
179 Maternal hypertension
180 Maternal renal disease
181 Toxemia
182 Family history of diabetes
183 Prematurity

Child's data
186 Breast/bottle fed 1=B&B, 2=complete breast, 3=complete bottle at birth or initial visit.
192 Twin
193 Foster or adopted child

194 Mother on WIC, 0=never, 1=during this pregnancy, 2=mother on WIC after this pregnancy while child on WIC, 3=mother on WIC prior to but not during this pregnancy, 4=mother on WIC after the child is off WIC
195 Otitis media
196 Serious illness while on WIC (child)
198 Allergies
199 Social problems
200 Siezures
201-205 Date of 6 month visit in decimal years
206-210 Date of 1 year visit in decimal years
211-215 Date of 1-1/2 year visit in decimal years
216-220 Date of 2 year visit in decimal years
221-225 Date of 2-1/2 year visit in decimal years
226-230 Date of 3 year visit in decimal years
231-235 Date of 3-1/2 year visit in decimal years
236-240 Date of 4 year visit in decimal years
241-245 Date of 4-1/2 year visit in decimal years
246-250 Date of 5 year visit in decimal years
251-255 Length at 6 month visit in cm
256-260 Length at 1 year visit in cm
261-265 Length at 1-1/2 year visit in cm
266-270 Length at 2 year visit in cm

From Scan Sheet Two

151-155 Length at 2-1/2 year visit in cm
156-160 Length at 3 year visit in cm
161-165 Length at 3-1/2 year visit in cm
166-170 Length at 4 year visit in cm
171-175 Length at 4-1/2 year visit in cm
176-180 Length at 5 year visit in cm

181-185 Weight at 6 month visit in kg
186-190 Weight at 1 year visit in kg
191-195 Weight at 1-1/2 year visit in kg
196-200 Weight at 2 year visit in kg
201-205 Weight at 2-1/2 year visit in kg
206-210 Weight at 3 year visit in kg
211-215 Weight at 3-1/2 year visit in kg
216-220 Weight at 4 year visit in kg
221-225 Weight at 4-1/2 year visit in kg
226-230 Weight at 5 year visit in kg

231-232 Hematocrit anemia in percent at 6 month visit
233-234 Hematocrit anemia in percent at 1 year visit
235-236 Hematocrit anemia in percent at 1-1/2 year visit
237-238 Hematocrit anemia in percent at 2 year visit
239-240 Hematocrit anemia in percent at 2-1/2 year visit

241-242	Hematocrit anemia in percent at 3 year visit
243-244	Hematocrit anemia in percent at 3-1/2 year visit
245-246	Hematocrit anemia in percent at 4 year visit
247-248	Hematocrit anemia in percent at 4-1/2 year visit
249-250	Hematocrit anemia in percent at 5 year visit
251-255	Birth weight of child
256-260	Length at birth of child

APPENDIX D

PHYSICAL GROWTH BY NUMBER OF VISITS TO WIC CLINICS

TABLE 25

MEAN HEIGHTS OF WIC CHILDREN BY AGE, SEX AND NUMBER OF VISITS TO WIC CLINICS (IN CENTIMETERS)

	Male			Female		
	N	Mean	S.D.	N	Mean	S.D.
24 Months						
1-5 visits	64	85.25	3.24	61	84.12	3.82
6-10 visits	166	85.48	3.62	145	84.62	3.32
30 Months						
1-5 visits	50	91.26	4.24	50	88.50	3.95
6-10 visits	168	89.28	4.30	151	88.48	3.60
36 Months						
1-5 visits	45	93.25	4.63	38	91.68	5.15
6-10 visits	165	94.10	3.76	166	92.55	3.75
42 Months						
1-5 visits	68	97.77	5.03	41	95.45	3.91
6-10 visits	148	97.65	4.11	135	96.72	4.01
48 Months						
1-5 visits	63	101.56	4.85	52	100.04	6.57
6-10 visits	124	102.01	4.32	126	100.60	3.92
54 Months						
1-5 visits	72	104.31	4.15	55	103.34	5.60
6-10 visits	99	105.49	4.25	104	104.61	4.66
60 Months						
1-5 visits	27	108.28	4.93	23	106.16	5.21
6-10 visits	39	108.70	5.32	35	106.55	4.51

TABLE 26

MEAN WEIGHTS OF WIC CHILDREN BY AGE, SEX AND NUMBER OF VISITS TO WIC CLINICS (IN KILOGRAMS)

	Male			Female		
	N	Mean	S.D.	N	Mean	S.D.
24 Months						
1-5 visits	66	12.76	1.62	62	12.04	1.49
6-10 visits	166	12.79	1.70	153	12.34	1.56
30 Months						
1-5 visits	48	14.53	2.25	50	13.41	2.13
6-10 visits	170	13.90	1.73	156	13.45	1.73
36 Months						
1-5 visits	49	15.07	1.56	39	13.95	2.26
6-10 visits	167	15.31	1.90	166	14.36	1.49
42 Months						
1-5 visits	67	16.17	2.11	42	15.09	1.96
6-10 visits	152	16.41	2.09	134	15.87	1.99
48 Months						
1-5 visits	67	17.24	2.02	54	17.08	3.14
6-10 visits	125	18.00	2.62	126	16.90	2.26
54 Months						
1-5 visits	74	18.19	2.22	55	17.70	2.72
6-10 visits	99	19.40	3.52	105	18.06	2.83
60 Months						
1-5 visits	27	19.69	2.93	23	18.71	4.73
6-10 visits	38	20.30	3.44	35	18.82	3.84

TABLE 27

MEAN HEMATOCRITS OF WIC CHILDREN BY AGE, SEX AND NUMBER OF VISITS TO WIC CLINICS

	Male			Female		
	N	Mean	S.D.	N	Mean	S.D.
24 Months						
1-5 visits	62	35.2	2.28	61	35.6	3.33
6-10 visits	157	35.1	2.67	141	35.2	2.39
30 Months						
1-5 visits	40	35.7	2.73	48	35.2	2.39
6-10 visits	159	35.3	2.25	152	35.5	2.25
36 Months						
1-5 visits	42	36.2	2.07	31	35.9	2.17
6-10 visits	155	35.6	2.10	159	36.0	2.40
42 Months						
1-5 visits	60	36.3	2.61	42	36.1	2.24
6-10 visits	139	36.0	1.92	128	36.3	2.18
48 Months						
1-5 visits	58	36.5	2.44	47	35.3	2.09
6-10 visits	119	35.9	2.17	120	36.6	2.07
54 Months						
1-5 visits	68	36.5	2.35	49	36.0	2.23
6-10 visits	94	36.6	2.50	99	37.4	2.57
60 Months						
1-5 visits	26	37.2	2.51	22	36.9	4.54
6-10 visits	35	36.4	2.52	33	37.3	2.42

VITA

Patricia Anne Driscoll was born on July 24, 1952 in Albuquerque, New Mexico. She attended Leilehua High School in Wahiawa, Hawaii and graduated from Woodson High School in Fairfax, Virginia in June 1970.

At the University of Virginia she earned a Bachelor of Science degree in Elementary Education in June 1974. Following graduation she joined the Peace Corps. She worked for two years as an elementary school teacher on Yap, Micronesia.

In the spring of 1978 she enrolled in the graduate school of The University of Tennessee Knoxville. She received a Master of Arts degree with a major in Anthropology in December 1982. Upon completion of her thesis, she will move to Swaziland, Africa.

Patricia Anne Driscoll is married to David James Styles. They have one child, Meghan Christine, born June 26, 1981.