

INFORMATION TO USERS

This was produced from a copy of a document sent to us for microfilming. While the most advanced technological means to photograph and reproduce this document have been used, the quality is heavily dependent upon the quality of the material submitted.

The following explanation of techniques is provided to help you understand markings or notations which may appear on this reproduction.

1. The sign or "target" for pages apparently lacking from the document photographed is "Missing Page(s)". If it was possible to obtain the missing page(s) or section, they are spliced into the film along with adjacent pages. This may have necessitated cutting through an image and duplicating adjacent pages to assure you of complete continuity.
2. When an image on the film is obliterated with a round black mark it is an indication that the film inspector noticed either blurred copy because of movement during exposure, or duplicate copy. Unless we meant to delete copyrighted materials that should not have been filmed, you will find a good image of the page in the adjacent frame.
3. When a map, drawing or chart, etc., is part of the material being photographed the photographer has followed a definite method in "sectioning" the material. It is customary to begin filming at the upper left hand corner of a large sheet and to continue from left to right in equal sections with small overlaps. If necessary, sectioning is continued again—beginning below the first row and continuing on until complete.
4. For any illustrations that cannot be reproduced satisfactorily by xerography, photographic prints can be purchased at additional cost and tipped into your xerographic copy. Requests can be made to our Dissertations Customer Services Department.
5. Some pages in any document may have indistinct print. In all cases we have filmed the best available copy.

University
Microfilms
International

300 N. ZEEB ROAD, ANN ARBOR, MI 48106
18 BEDFORD ROW, LONDON WC1R 4EJ, ENGLAND

1315848

KAUTZ, LINDA LOUISE
ANTHROPOMETRIC MEASUREMENTS OF ANGLO AND
MEXICAN-AMERICAN CHILDREN INVOLVED IN THE
WOMEN, INFANTS, AND CHILDREN (WIC) SPECIAL
SUPPLEMENTAL FOOD PROGRAM.

THE UNIVERSITY OF ARIZONA, M.S., 1980

COPR. 1980 KAUTZ, LINDA LOUISE.

University
Microfilms
International

300 N. Zeeb Road, Ann Arbor, MI 48106

© 1980

LINDA LOUISE KAUTZ

All Rights Reserved

PLEASE NOTE:

In all cases this material has been filmed in the best possible way from the available copy. Problems encountered with this document have been identified here with a check mark .

1. Glossy photographs _____
2. Colored illustrations _____
3. Photographs with dark background _____
4. Illustrations are poor copy _____
5. Print shows through as there is text on both sides of page _____
6. Indistinct, broken or small print on several pages
7. Tightly bound copy with print lost in spine _____
8. Computer printout pages with indistinct print _____
9. Page(s) _____ lacking when material received, and not available from school or author
10. Page(s) _____ seem to be missing in numbering only as text follows
11. Poor carbon copy _____
12. Not original copy, several pages with blurred type _____
13. Appendix pages are poor copy _____
14. Original copy with light type _____
15. Curling and wrinkled pages _____
16. Other _____

ANTHROPOMETRIC MEASUREMENTS OF ANGLO AND MEXICAN-AMERICAN CHILDREN
INVOLVED IN THE WOMEN, INFANTS, AND CHILDREN (WIC)
SPECIAL SUPPLEMENTAL FOOD PROGRAM

by

Linda Louise Kautz

A Thesis Submitted to the Faculty of the
COMMITTEE ON NUTRITIONAL SCIENCES (GRADUATE)
In Partial Fulfillment of the Requirements
For the Degree of
MASTER OF SCIENCE
In the Graduate College
THE UNIVERSITY OF ARIZONA

1 9 8 0

© Copyright 1980 Linda Louise Kautz

STATEMENT BY AUTHOR

This thesis has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the library.

Brief quotations from this thesis are allowable without special permission, provided that accurate acknowledgement of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the copyright holder.

SIGNED: Linda Louise Kautz

APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

Garl G. Harrison
G. G. Harrison
Assistant Professor of
Nutrition and Food Science

July 29, 1980
Date

DEDICATION

I dedicate this thesis to my children, Andy and Becky Smith, and to my dear friend, Eric Bogatin. In many respects they have lived this experience just as I have by sharing the ups and downs that are involved in a project of this type. It is with great appreciation that I thank them for their loving support.

ACKNOWLEDGEMENTS

I would like to thank my advisor in this master's program, Dr. Gail Harrison, and also members of my committee for their advice and counsel, Dr. Charles Weber and Dr. Burris Duncan. A very special thanks is given to Dr. James Berry for his caring guidance and reassurance as I planned and began work on my master's degree.

In equipping me for my measurements, I thank Dr. Paul Pearson for advice on, the Arizona State Department of Health for plans for, and Roger Schroeder for construction of a measuring board, Dr. Walter Birkby for the loan of a pair of Lange[®] calipers, the Department of Family and Community Medicine for the purchase of a case of paper diapers and a box of alcohol swabs and the loan of a measuring board.

Thanks are especially due for staff of the WIC Program in allowing me to spend nine months involved with their clinics. Kathleen Johnson and Marilyn Majchrzak were important in helping to get me established within the clinics. Other people who were supportive as I worked with them through WIC were: Peggy Sloatman, Marian Wedding, Frances Gastelum, Norma Aguilar, Lupe Estrada, JoJo Juarez, Nellie Peregrina, Letty Ramos, Diana Lopez, Betty Anderson, Carolyn Black, Wanda Wong, Billie Celaya, Barb Knisley, Linda Hirschman, and Diane Champlin. It was their day-to-day input that was so essential for the success of this study.

Throughout planning and evaluation of this study, the advice

and guidance of Cole Thies in doing statistical analysis was invaluable. Thanks is also given to Kim Gehman for her help in coordination of various aspects of my degree work and for typing this thesis. Lisa Garner was responsible for the illustrative material involved.

Three friends are thanked for their consistent moral support throughout the years spent pursuing this master's degree. They are Rebecca Weinberg, Ida Williams, and Renee Silvey.

Finally, thanks to my parents, Mary Elda and Richard Kautz, for their vacations that were spent babysitting while I studied, hibernated in the library, and typed.

TABLE OF CONTENTS

	Page
LIST OF ILLUSTRATIONS	vii
LIST OF TABLES	viii
ABSTRACT	x
1. PURPOSE OF THE STUDY	1
2. BACKGROUND AND REVIEW OF LITERATURE	2
The Mexican-American Population	8
3. SUBJECTS AND METHODS	12
Development of a Study Design	12
The Study Population	14
Equipment	15
Measurements	16
Statistical Analysis	19
4. RESULTS	20
5. DISCUSSION	55
APPENDIX A: FORMS USED IN CLINICS	59
Subject's Consent Form in English	60
Subject's Consent Form in Spanish	61
Initial Questions	62
Data Sheet	63
APPENDIX B: PORTABLE MEASURING BOARD DIMENSIONS	64
REFERENCES	66

LIST OF ILLUSTRATIONS

Figure	Page
1. Length and Weight of Anglo Females	22
2. Head Circumference and Weight/Length of Anglo Females	23
3. Length and Weight of Mexican-American Females	24
4. Head Circumference and Weight/Length of Mexican-American Females	25
5. Length and Weight of Anglo Males	26
6. Head Circumference and Weight/Length of Anglo Males	27
7. Length and Weight of Mexican-American Males	28
8. Head Circumference and Weight/Length of Mexican-American Males	29
9. Upper Arm Length by Sex and Ethnic Group	36
10. Lower Arm Length by Sex and Ethnic Group	37
11. Middle Arm Circumference by Sex and Ethnic Group	38
12. Head Circumference by Sex and Ethnic Group	39
13. Chest Circumference by Sex and Ethnic Group	40
14. Thigh Circumference by Sex and Ethnic Group	41
15. Calf Circumference by Sex and Ethnic Group	42
16. Wrist Breadth by Sex and Ethnic Group	43
17. Tricep Skinfold Thickness by Sex and Ethnic Group	44
18. Subscapular Skinfold Thickness by Sex and Ethnic Group	45
19. Weight by Sex and Ethnic Group	46

LIST OF ILLUSTRATIONS--Continued

Figure	Page
20. Supine Length by Sex and Ethnic Group	47
21. Crown-Rump Length by Sex and Ethnic Group	48
22. Total Body Fat by Sex and Ethnic Group	49
23. Body Fat as Percent of Body Weight by Sex and Ethnic Group	50
24. Upper Limb Fat by Sex and Ethnic Group	51
25. Lower Limb Fat by Sex and Ethnic Group	52
26. Trunk Fat by Sex and Ethnic Group	53
27. Weight/Length by Sex and Ethnic Group	54

LIST OF TABLES

Table	Page
1. Anthropometric Data for Anglo Females	30
2. Anthropometric Data for Mexican-American Females	31
3. Anthropometric Data for Anglo Males	32
4. Anthropometric Data for Mexican-American Males	33
5. Overall Results of Two-Way Analysis of Variance	34
6. Sex, Ethnic, and Interaction Effects on Significant Variables of Two-Way Analysis of Variance	35

ABSTRACT

The body proportions of 95 Anglo and Mexican-American children aged 48-56 weeks in the Women, Infants, and Children (WIC) Special Supplemental Food Program were determined by use of multiple anthropometric measurements. Anglo or Mexican-American ethnicity was determined by statement of a parent or guardian that both parents of the subject were Anglo or Mexican-American. In the population studied, there were 20 Anglo females, 22 Mexican-American females, 25 Anglo males, and 28 Mexican-American males. Through use of a two-way analysis of variance of data, it was observed that males had larger head circumferences than females. Ethnic differences were several and collectively define the Mexican-American child as being greater in weight for length than the Anglo child with greater chest and thigh circumferences, subscapular skinfolds and estimated body fat.

CHAPTER 1

PURPOSE OF THE STUDY

The purpose of this study was to compare body proportions of Anglo and Mexican-American children and to see the extent to which the differences contribute to relative risk of being classified as overweight by standard criteria.

CHAPTER 2

BACKGROUND AND REVIEW OF LITERATURE

Although growth of children has been observed and recorded for several centuries, it has not been until recent years with the decline of the more pressing problems of decreasing infant and child mortality rates that growth has been used as a means of evaluating health (Lowrey, 1978). As Eveleth and Tanner (1976) state, "A child's growth rate reflects, better than any other single index, his state of health and nutrition; and often indeed his psychological situation also." They also go on to say that average values of heights and weights reflect the state of a nation's public health and the average nutritional status of its citizens, when appropriate allowance is made for differences in genetic potential.

The term "genetic background" refers to a person's race. And, races vary in many respects--amino acid excretion patterns, tooth morphology, frequency of different blood groups, as well as in body size and proportions (Garn, 1971). Human variability results from a number of forces that have been at work throughout human evolutionary history. Each population reflects the elements in the environment that have been shaping the population through time (Molnar, 1975). Trinkhaus (1978), in his study of the frequency of bilateral asymmetry in human cranial and postcranial non-metric traits, showed that asymmetry is common, suggesting that environmental stress, as well as geno-

type, is important in controlling even the expression of non-metric traits. Environmental forces included nutritional and climatic influences on growth and development, as well as biomechanical stress. Biomechanical remodeling of the skeleton in particular will influence expression of most non-metric traits directly or indirectly through changes in skeletal proportions.

Genetic and environmental factors, as well as interplay of the two, determine body size, shape, and proportion. Many studies have substantiated these factors as being significant influences in the shaping of differences from population to population, as well as within a population itself (Tanner, 1976).

In Meredith's (1978) observations, these factors are clearly exemplified. He demonstrated that secular increase in sitting height and lower limb height of black, white, and oriental populations has occurred during recent decades. Average lower limb height remains greater for black Americans than native Japanese, while average sitting height is greater for native Japanese than black Americans.

Spurgeon and co-workers (1978) have compiled data on black children living in West and Central Africa, North and South America, and the West Indies. They observed from 1974-1977 that United States black boys aged 6-11 years of Richland County, South Carolina were taller than black children studied since 1960 in Africa, South America, and the West Indies. The weights of these children varied with socioeconomic status, regardless of country, those from higher income groups being heavier. Also, a comparison of black and white children during

1974-1977 in Richland County concluded that in middle and late childhood, South Carolina black children are like their white peers in arm and calf girths and differ from them in having longer lower limbs, a lower index of calf girth to lower limb height, narrower hips, a lower index of hip width to lower limb height, a shorter body stem, and a higher index of lower limb height to sitting height. Again, one observes not only differences in populations but changes within a population due to environment.

In the Bogalusa Heart Study, black and white children aged 5-14 years were compared. It was found that black boys differed slightly from white boys in height and weight, but black girls were taller and heavier than white girls. The black children had longer upper arm lengths and smaller upper arm circumferences than white children (Foster et al., 1977).

In Bahia, Brazil a racially mixed population was studied. Anthropometric measurements showed that the mean upper segment/lower segment ratio decreased as the proportion of Negro admixture increased (Piedade, Oliveira, and Azevedo, 1977).

Fetal growth is usually evaluated by size of newborn infants. In two studies, one in the United States and one in England, Puerto Rican and Indian infants were found to be smaller in size than white and black ones. Discussion in both cases assumed nutritional status of the mother to be the limiting factor (Alvear and Brooks, 1978 and Johnston and Beller, 1976). Habicht and co-workers (1974) also noted the strong effect of environmental conditions as they studied pre-

school children. They concluded that differences in growth in pre-school children are more related to differences in social class than to ethnic factors alone. Herbert, Kidwell, and Chase (1979) agree with the above studies in concluding that environmental influences are strong in early life. In their work on inheritance and growth in mice, they found that environment had its greatest effect on an individual's size at early ages while genetic factors had greater affect as the individual's age increased.

When American-Japanese children have been compared with native Japanese children, the American counterparts were taller, heavier, and longer legged. Yet in a follow-up study with the same group in adulthood, the American group had shorter legs and were significantly heavier than the native Japanese (Greulich, 1976). And, in a study in Japan comparing body build from 1950 to 1975, it was observed that the Japanese people as a whole had become taller and heavier, possibly as a result of westernization after World War II (Kagawa, 1978). In these studies, the environmental influences have shown their affect not only as a population leaves its home country but also within the home country itself.

A final study that shows affect of environment was done in South America where the effect of hypoxia on human growth was observed in northern Chile. Conclusions were that altitude is associated with depression of growth with the exception of head length, but altitude could also affect body proportions such as head (breadth of face and depth of mandibles) and chest (anterior-posterior/transverse chest).

Yet, ethnicity had a greater effect on body proportions than size (Palomino, Mueller, and Schull, 1978).

Differences seen between populations in the size and shape of adults are due to differences in their gene pools, in their environments, and in interactions between these. Differences in size and shape among children of different populations have the same causes, but analysis is complicated by variation in rates of maturation. In some populations, children grow more quickly, reach puberty earlier, and stop growing at an earlier age (Tanner, 1976).

In order to be able to evaluate growth of children in different populations, Committee I of Commission III of the International Union of Nutritional Sciences recommended the formation of a committee to establish guidelines for development of growth standards in as many countries as possible. Each country's genetic and racial characteristics were to be defined and appropriately represented in the samples (Falkner, 1972).

There is controversy in discussion of growth standards, however. Some proponents feel that local standards are a necessity because international guidelines would probably set unreasonable growth goals in many third world countries where populations may have adapted to marginal food intakes by evolving smaller body size. Persons supporting the development of an international standard say the expense of developing local standards is too great. The financing that is available should be used to improve the situation in countries that have unstable nutritional conditions (Haas and Harrison, 1977).

Regardless of what standards may be employed in evaluating growth, investigators have come to recognize through their studies that in many instances race- and sex-specific standards are required before growth achievements can be properly evaluated (Eveleth, 1978 and Robson et al., 1975).

Garn and Clark (1976) express concern in their study of the American black that persons evaluating their growth be aware that blacks frequently are smaller than whites at birth but taller from 2-14 years, have advanced skeletal development, advanced dental development, a larger skeletal mass and bone density, and differences in hemoglobin concentration.

Wigg (1978) also emphasizes the need to be aware of population differences. In comparing the growth of Samoan children with European norms, the Samoans were larger at birth but by nine months were smaller. The author stressed a real need for population standards to be set so that the growth of Samoan children would not be evaluated incorrectly.

While there are situations where both ethnic and sex factors must be considered, some investigators have concluded that in certain measurements only sex-specific guidelines are necessary. Nellhaus (1968), in his study of head circumference of boys and girls from birth to 18 years of age, calculated from reports in world literature published since 1948, found no significant racial, national, or geographic differences in head circumference. Owen and Lubin (1973) state that although black children become taller than white children sometime

during the first two years of life separate growth charts based on race are unwarranted because the differences are not sufficiently large.

Thus far, genetic background, environmental forces, growth, and interactions of all three have been discussed in light of evaluation of the health of a population. With this background, let us look at the specific studies that have been done with Mexican-Americans.

The Mexican-American Population

In the United States there is a mixed cultural group speaking the Spanish language. Some components of this group are Puerto Ricans and Mexicans (Center for Disease Control, 1972).

The genetic background of Mexicans is defined by Manuel (1934) as containing two main elements, European (largely Spanish) and Indian. The mixture is by no means homogeneous throughout the population.

In the Ten State Nutrition Survey (Center for Disease Control, 1972) there were two small Spanish-speaking groups observed (Puerto Ricans in New York and Mexican-Americans in Texas), as well as white and black populations. Data from the survey revealed that for most nutrients a large number of infants and young children from all ethnic groups had intakes below dietary standards. This was particularly true for calories, iron, vitamin A, and vitamin C. For all nutrients except vitamin C, the 6- to 11-month infants appeared to have the most satisfactory dietary intakes.

It was also found in the survey population that there was an

excess of underweight and undersized children and adolescents in all population subgroups studied when compared to the Stuart-Meredith norms. The survey found that malnutrition was most common in blacks, less common in Spanish-Americans, and least common in white persons. And, generally there was an increase in prevalence of various indices of malnutrition as income decreased. Yet despite lower income levels, black children were taller than white children and more advanced in skeletal development, which indicate that genetic factors, as well as nutritional environmental factors, affect growth.

Manuel (1934) observed Mexican children in American schools of El Paso and Laredo, Texas. The children were classified according to skin pigmentation as light, medium, and dark as an index of the amount of Indian genetic heritage. Both boys and girls of darkest classification showed a tendency to be a little smaller than those of lighter color, except in depth of chest. The heights and weights of the Mexican children in the study corresponded closely to those reported from Mexico from Publications de la Secretaria de Educacion Publica de Mexico, 1930. In general, Mexican boys in American schools were a little lighter than their Mexican counterparts. Compared with the "American" children of the Baldwin-Wood tables of September, 1931, the boys aged six-to-fourteen and girls aged six-to-twelve in this study were about two inches shorter, age-for-age, and about four-to-seven pounds lighter. Manuel also observed from the measures that Mexican boys and girls appear to mature somewhat earlier than children of the Baldwin-Wood tables.

Duncan and co-workers (1979) found "male and female Spanish-surnamed children to weigh less, be shorter, and have smaller head circumferences than non-Spanish-surnamed children who lived in the same Denver neighborhoods." Because size of the children in these two populations living in lower and lower-middle class neighborhoods were closer to each other than to the sizes of children from middle and upper-middle socioeconomic classes, it would suggest that smaller size in this population was more a reflection of socioeconomic factors than ethnic factors. Meaney (1977) also concluded that socioeconomic factors are enormously important in size variation of school age Mexican-American children in Tucson, and these socioeconomic factors were often seen more distinctly as the size of the family increased. This would seem to indicate that the larger the size of the family the smaller the size of the children would be.

In a survey of infants from a low income population attending county health department clinics, Indian Health Service clinics or Women, Infants, and Children Special Supplemental Food Program (WIC) in the state of Arizona, Harrison and White (1980) observed that the Mexican-American infant, the high birthweight infant, and the American Indian infant were at relatively high risk of exceeding the 95th percentile of weight for length on the National Center for Health Statistics (NCHS) standards (NCHS, 1977) during the second year of life. It was this study that brought this writer to question what differences there might be between body build of Mexican-American children and Anglos that would perhaps help to explain the apparent state of overweight for

Arizona's Mexican-American children. Since there have been no previously reported studies directly comparing anthropometric measurements between these two populations, this needed to be a basic descriptive examination.

CHAPTER 3

SUBJECTS AND METHODS

Tucson, being located near the Mexican border in southern Arizona, has predominantly Mexican-American neighborhoods in pockets throughout the city. Anglos of similar socioeconomic levels live in areas adjacent to and frequently integrated into the Mexican-American communities. Thus, a comparative population is present. The challenge for this study was to locate an available source of children of both groups to measure.

Development of a Study Design

Johnston (1980) reports that there are two aspects of descriptive research design which are especially important: 1) Careful description of the units of study and the population, and 2) Development of techniques of measurement which will generate appropriate data objectively.

The units of study that needed to be employed in looking at body proportions required not only the standard measurements of height, weight, and head circumference that are normally taken in well-baby clinics but also some fatfold measurements, circumference measurements of the limbs and chest, and linear measurements of the limbs.

The choice of population included Anglo and Mexican-American children. But, how could one find a source where there was a certain

age level of children that were of comparable socioeconomic states? Smith (1979) had reported that some Mexican-Americans generally did not seek out Anglo-type medical care but preferred to use their traditional healing techniques. A public health program that could offer this contact with both ethnic groups was the Special Supplemental Food Program for Women, Infants, and Children, hereafter referred to as the WIC Program.

The WIC Program, authorized by a September 26, 1972, amendment (Public Law 92-433:86 Stat 724) to the Child Nutrition Act of 1966 (42 U.S.C. 1786), provided cash grants to State Health Departments and approved local health clinics for the purpose of providing specified nutritious food supplements to pregnant and lactating women, infants, and children up to four years of age, who are at nutritional risk because of inadequate nutrition and inadequate income. The act included a provision for evaluation of medical data which could determine benefits of the program (Edozien, Switzer, and Houck, 1976).

Children seen in Pima County WIC Clinics have their hematocrit checked six months after they are entered on the Program or at one year of age. Many children in the Program are normal, healthy infants entered at birth because their mothers had been on the Program during pregnancy. Therefore, at their one year check-up they have a history of adequate nutrition because of supplemental foods that they and their mothers had. Mothers are also educated concerning good nutrition for their families. These clinics have a blend of several ethnic and racial groups attending them in the Tucson area and have a large enough popu-

lation involved that a survey of one year olds would be feasible.

Finally, it was necessary to develop techniques of measurement which would generate appropriate objective data. In this study, the investigator did the measuring herself in order to insure continuity. The only measurement equipment from the clinics was scales. Of particular interest was assessment of total body fat and that could be estimated from a formula that required: crown-rump length, circumference of the head and chest, upper and lower arm lengths, upper arm circumference, supine length, mid-thigh and calf circumferences, triceps and subscapular skinfolds (Dauncey, Gandy, and Gairdner, 1977). Also weight of the children would be recorded, as well as wrist breadth. All these measurements could be taken in WIC clinics when there were breaks in the flow of the usual routine. The whole measuring process could be completed in about fifteen minutes.

The Study Population

Children ranging in age from 48 weeks to 56 weeks and being followed in the WIC Program were measured when they came in for regular clinic appointments. This study included children from six Pima County WIC clinics: Theresa Lee, North, Congress, East, Columbia, and South. Children were recruited into the study if both parents identified themselves as Anglos or Mexican-Americans. Because WIC personnel are not permitted to ask ethnicity of participants, the ethnicity was discussed privately between parent or guardian and the investigator in the examination room. If the child was ineligible, measurements were still taken, but the data were not used in the study. This was done to avoid

problems that might arise concerning racial discrimination.

Upon entry into the study, a parent or guardian of the participant signed a consent form. This form was available in English or Spanish and was explained in the language in which it was written. Each consent form was also signed by a witness and this investigator. The consent forms are included in Appendix A.

Before a child was measured, three questions concerning his/her health were asked, and this information was attached to the data sheet. This was done to identify a child with a chronic problem that might affect body proportions. The list of health questions asked is included in Appendix A.

The child's name, birth date and ethnicity were recorded on the data sheet. The date of the examination was recorded, and the child was given an identification number. The child was measured and weighed. Upon completion of the measurements, specific observations about the child in the examining situation were noted. The observations included activity of the child while being measured and also any general comments about his/her growth that were volunteered by the parent. Also recorded was the name of the clinic where the child was seen. A copy of the data sheet is included in Appendix A.

Equipment

As it was discussed in the section entitled, "Development of Study Design," clinic scales were used. These scales were checked at each clinic visit by the use of two books that were previously weighed on an accurate balance. The scale was balanced at zero. Each book

was then weighed (the books varied from each other in weight by two pounds), and after each weighing, the scale was checked to see that it balanced at zero again.

A portable measuring board was constructed for use in this study and was taken to all the clinics. Plans for construction of this board are included in Appendix B.

Also included in equipment was a pair of Lange[®] calipers which read to 0.5 mm. and a fiberglass measuring tape that could be read in inches on one side and centimeters on the other. The investigator also carried a supply of paper diapers (weight - 69.2 gm. each) and individually packaged alcohol swabs (used for cleaning caliper tips, tape measure, and measuring board after each use). All clinics had sinks, soap, and paper towels available.

Measurements

When the subject entered the private room where he/she was to be measured, he/she was held in the lap of an adult (hereafter referred to as the parent). This was encouraged so the child would feel more secure. Measurements were taken as defined by Weiner and Lourie (1969). They will be described in the order that they were taken so the reader can visualize the flow of the examination. All limb measurements were taken on the left side of the body. In this first group of measurements, the fiberglass tape measure was used and the data recorded in centimeters.

Calf circumference was measured with the subject sitting on the parent's lap with his/her leg hanging freely. Maximum circumfer-

ence was measured horizontally.

Chest circumference was measured in expiration with the child's shirt removed and the tape horizontal around the subject's body and directly over the nipples. The subject's arms were relaxed at his/her sides.

Upper arm length was measured from the external superior border of the head of the radius to the inferior border of the acromion process. The length of this measurement was then divided by two and that amount was measured from the inferior border of the acromion process down and marked lightly on the back of the arm with a pen to show the mid-point of the upper arm.

Lower arm length was measured from the marked head of the radius to the tip of the lateral styloid.

Mid-arm circumference was measured with the tape directly over the middle upper arm mark horizontally around the arm with the arm relaxed.

At this point, the Lange[®] calipers were introduced, and the following three measurements were made with them to the nearest 0.5 mm. Wrist breadth was taken across the styloid processes oblique to the long axis of the arm with pressure to compress the tissues. Triceps skinfold was picked up at the back of the arm at the middle arm mark and directly in line with the point of the elbow or olecranon process. Measurement was read at two seconds after the full pressure of the caliper jaws was applied to the skinfold. Subscapular skinfold was picked up under the angle of the left scapula. The fold was vertical. Mea-

surement was read at two seconds after the full pressure of the caliper jaws was applied to the skinfold.

At this time, the subject was put on the measuring board with no clothing on except a diaper. The parent was instructed to hold the child's head in the Frankfort plane and to apply gentle traction to bring the top of his/her head into contact with the fixed headboard. The investigator held the child's feet, toes pointing directly upward, and also applying gentle traction, bringing the movable footboard to rest firmly against the child's heels. This measurement was recorded in centimeters as were the following three measurements.

If the child was calm, he/she had his/her head circumference measured as he/she reclined on the measuring board. Otherwise, he/she was measured while being held by the parent. Head circumference was measured around the maximum circumference of the head with the tape passing above (but not including) the brow ridges.

The child's diaper was now removed. Crown-rump length was measured with the subject lying on his/her back with his/her knees bent to a right angle. The parent was once again instructed to hold the child's head in the Frankfort plane and to apply gentle traction to bring contact with the fixed headboard. The investigator supported the subject's legs and brought the movable footboard to rest against his/her buttocks.

The thigh circumference was then measured while the child continued to lie on the measuring board. The tape was placed around the thigh horizontally with its top edge just under the gluteal fold.

The subject was now diapered in the paper diaper and was imme-

diately weighed while sitting on an infant scale. The weight was recorded in pounds and ounces and later converted to kilograms.

Statistical Analysis

Data from four individual subgroups were analyzed: Anglo females, Mexican-American females, Anglo males, and Mexican-American males. These divisions were made in order to be able to observe effects of sex trends, ethnicity, and interaction of the two. All the individual measurements were compared, as well as some indices calculated from the measurements. Calculated indices included weight for supine length and estimated body fat from the formula previously discussed (Dauncey, Gandy, and Gairdner, 1977).

Length, weight, head circumference, and weight for supine length were plotted for each of the four subgroups against NCHS growth grids (NCHS, 1977). Individual measurements and calculated indices were then analyzed by two-way analysis of variance (Neter and Wasserman, 1974).

CHAPTER 4

RESULTS

A total of 95 children were measured in this study. Of the total, 20 were Anglo females, 22 were Mexican-American females, 25 were Anglo males, and 28 were Mexican-American males. Figures 1 through 8 show length, weight, head circumference, and weight for supine length for each of these groups in relation to NCHS percentiles (NCHS, 1977).

Tables, 1, 2, 3, and 4, further outline the data in the four groups being studied. The first thirteen variables in these tables are from actual physical measurements. Total body fat, percent body weight as fat, upper limb fat, lower limb fat, and trunk fat are derived from the formula of Dauncey et al. (1977). Weight for length consists of the division of body weight in grams by height in centimeters and gives an impression of body density.

In Table 5 are the overall results of a two-way analysis of variance for all measures. Several measurements and indices have significance levels of .10 or less. These include: head circumference, chest circumference, thigh circumference, subscapular skinfold thickness, weight, total body fat, trunk fat, and weight for length. Table 6 then more fully describes the cause of the overall significance. Head circumference differs significantly by sex with a small amount of interaction with ethnicity. The rest of the overall significant dif-

ferences appear to be ethnically related. Of the ethnically significant variables, chest circumference shows some significant interaction. The data from Tables 1 through 4 have been plotted in graphs in Figures 9 through 27. In these Figures, individual values for the four groups are compared. Included in each of these graphs is the range, 25th percentile, 75th percentile, and median score.



Figure 1. Length and Weight of Anglo Females.

Girls: Birth to 36 Months-Physical Growth-NCHS Percentiles

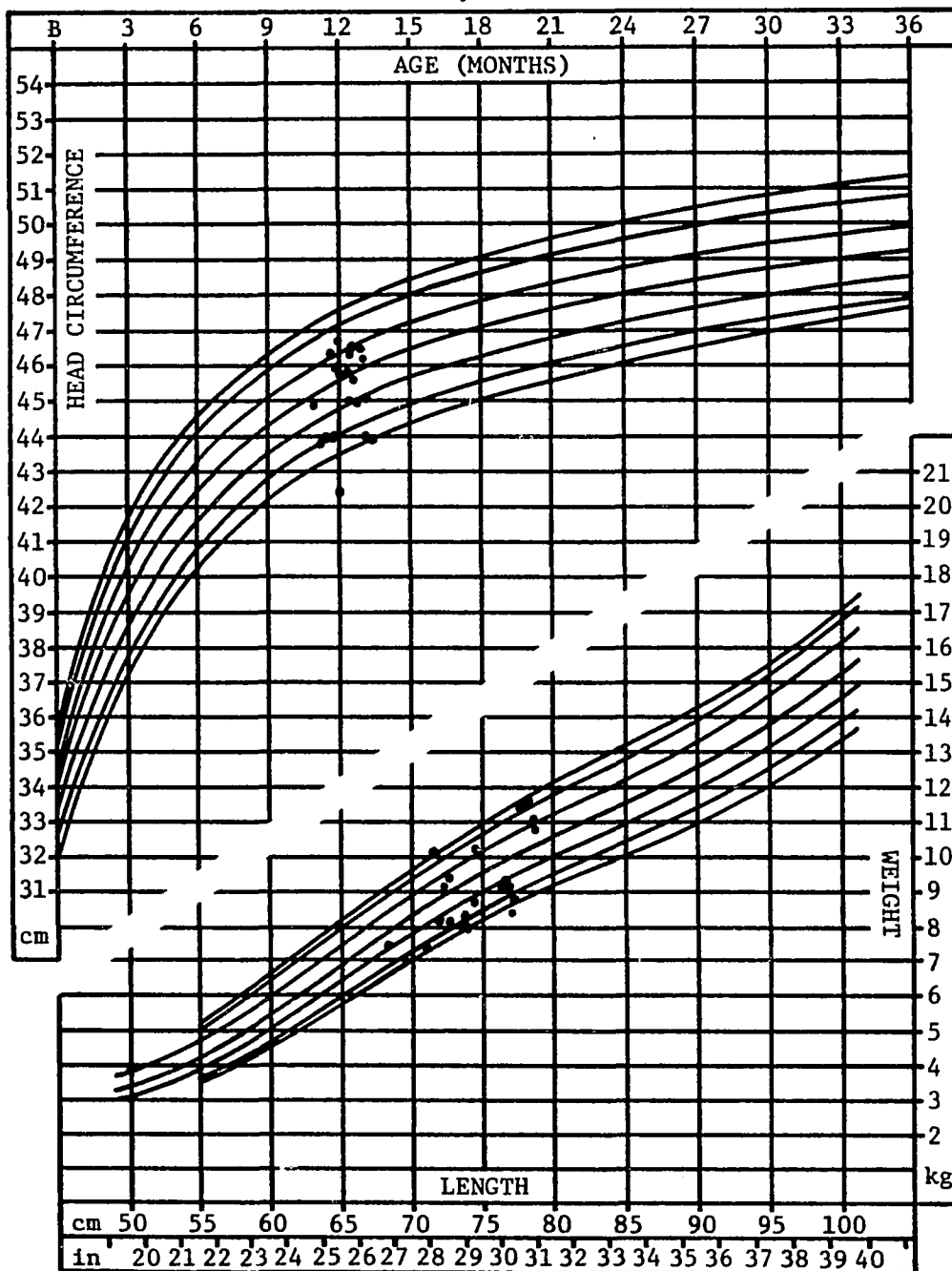


Figure 2. Head Circumference and Weight/Length of Anglo Females.

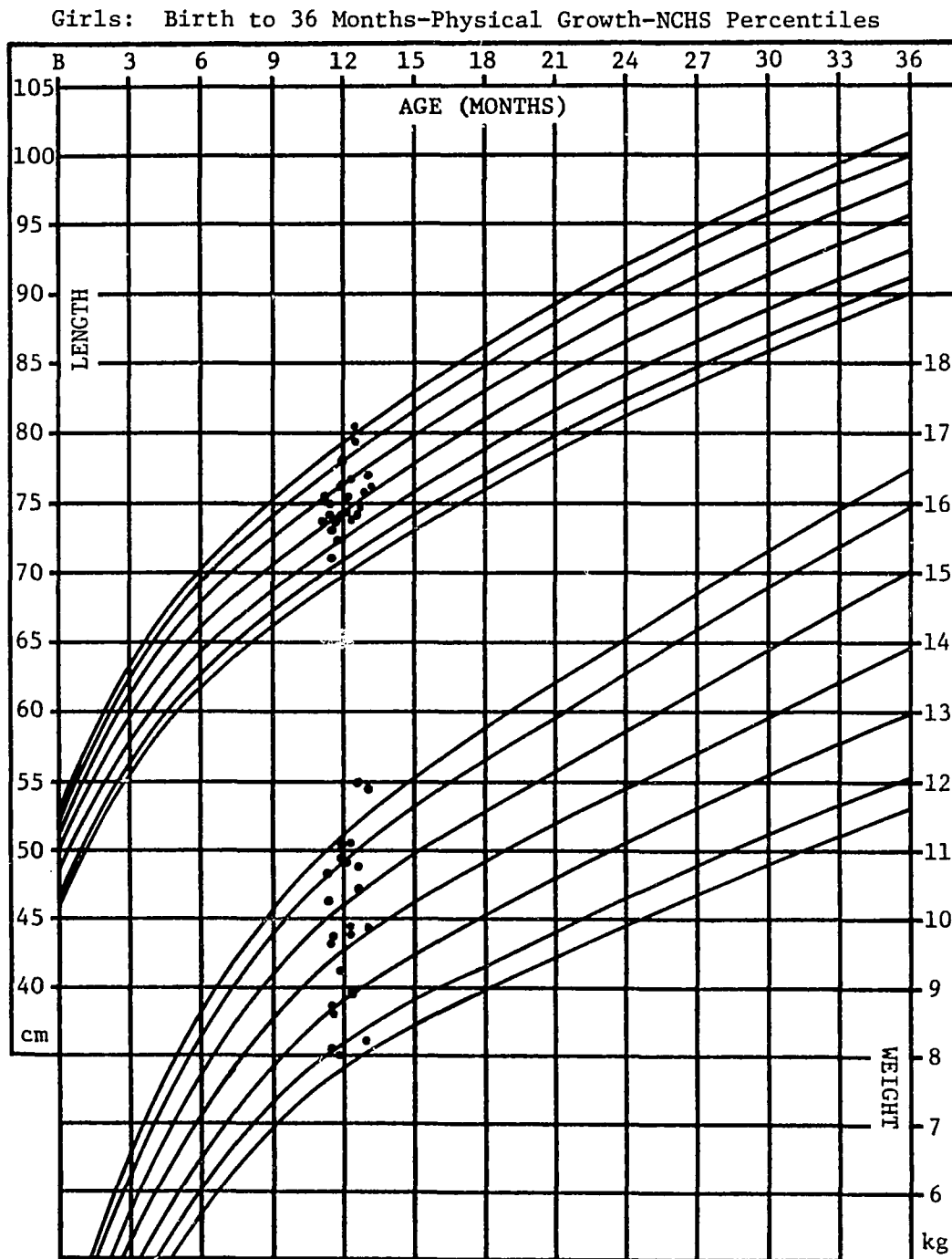


Figure 3. Length and Weight of Mexican American Females.

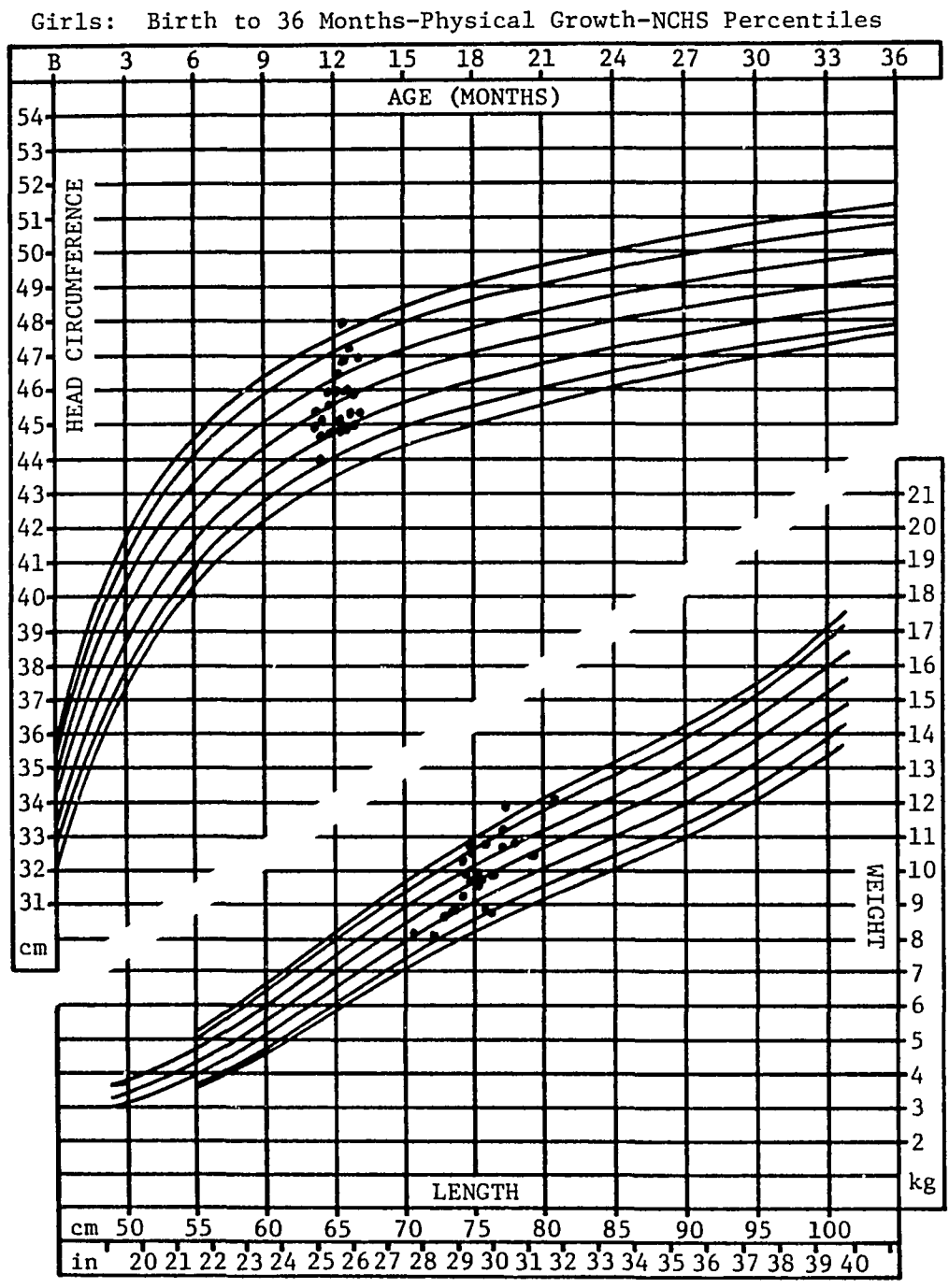


Figure 4. Head Circumference and Weight/Length of Mexican American Females.

Boys: Birth to 36 Months-Physical Growth-NCHS Percentiles

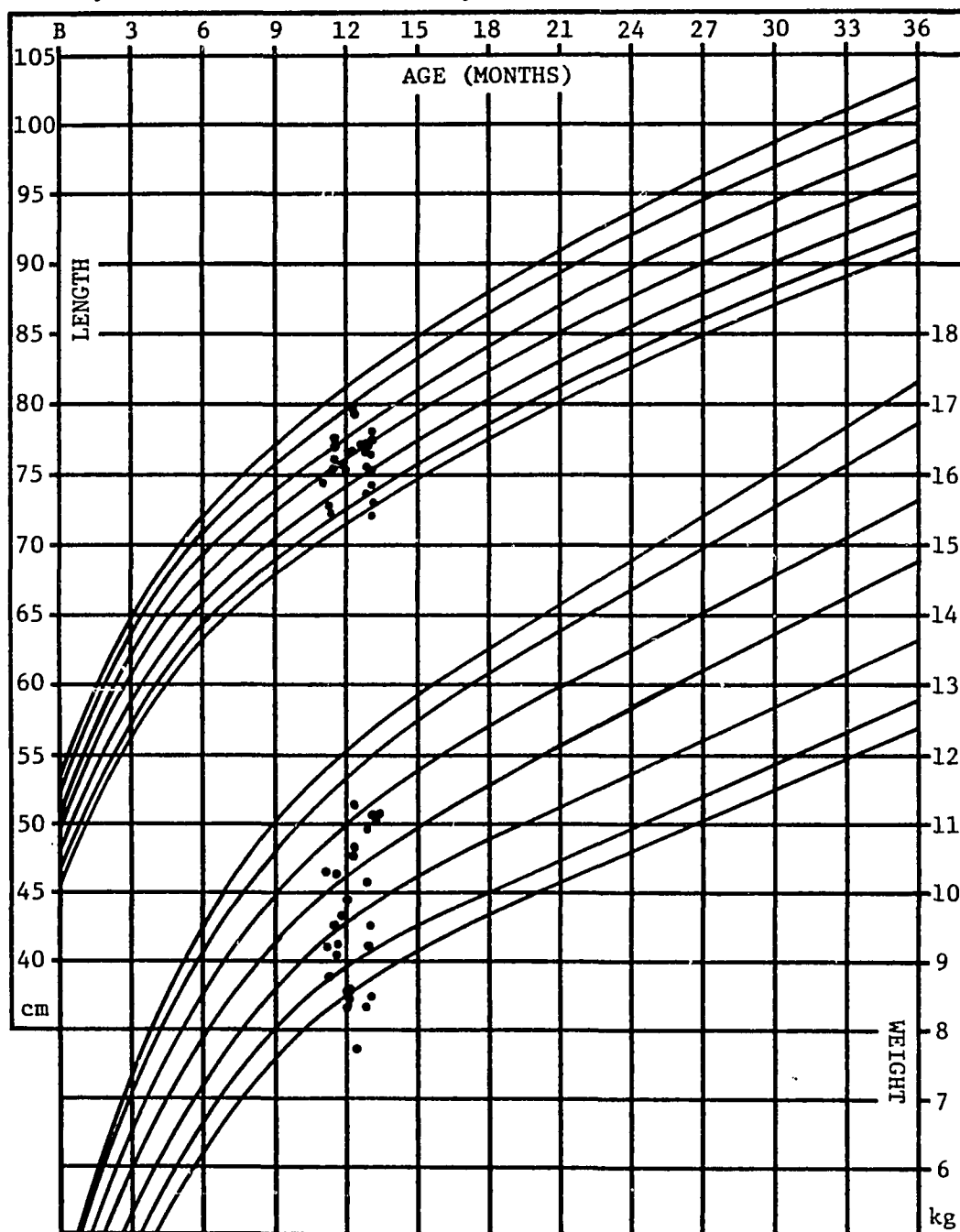


Figure 5. Length and Weight of Anglo Males.

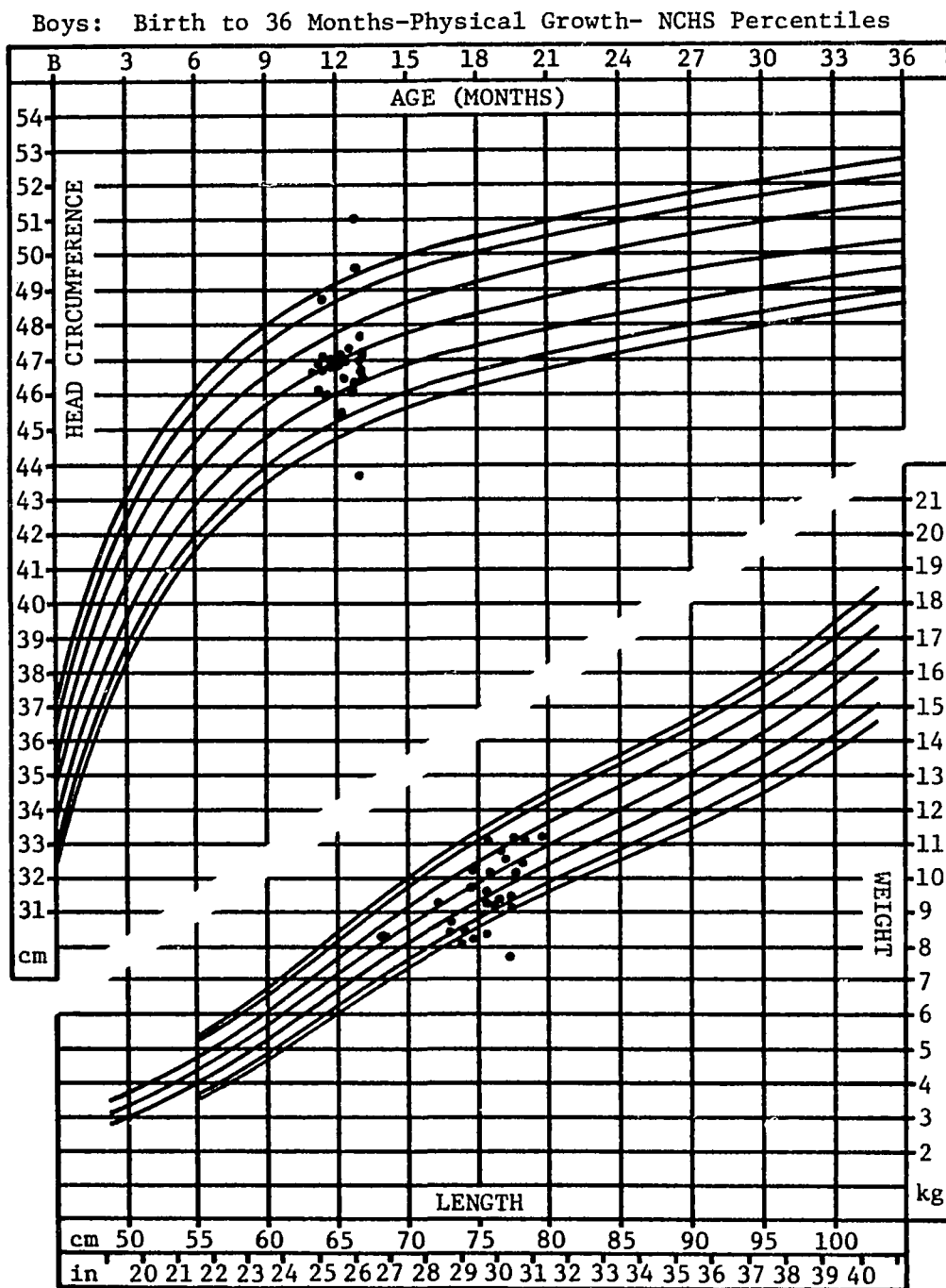


Figure 6. Head Circumference and Weight/Length of Anglo Males.

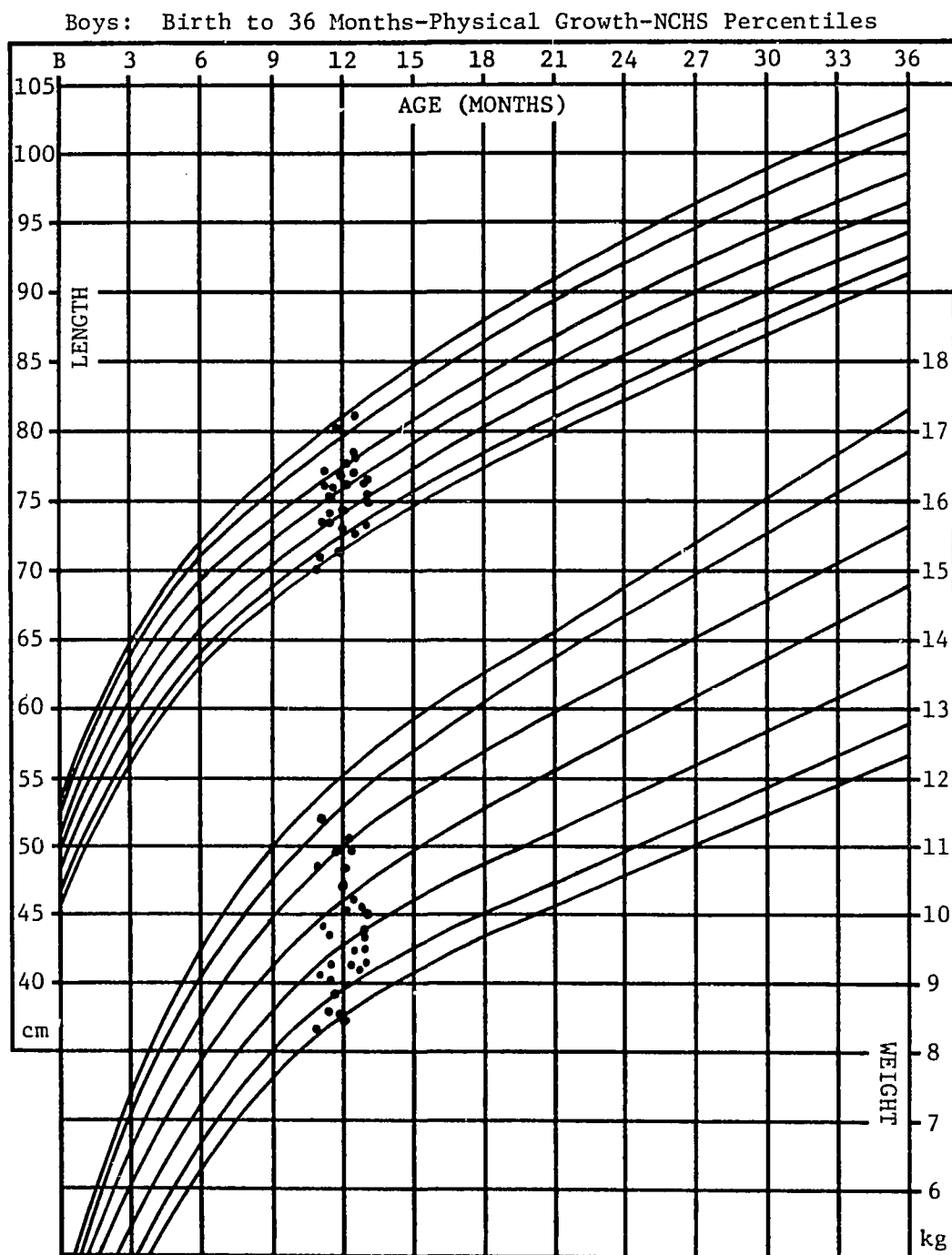


Figure 7. Length and Weight of Mexican American Males.

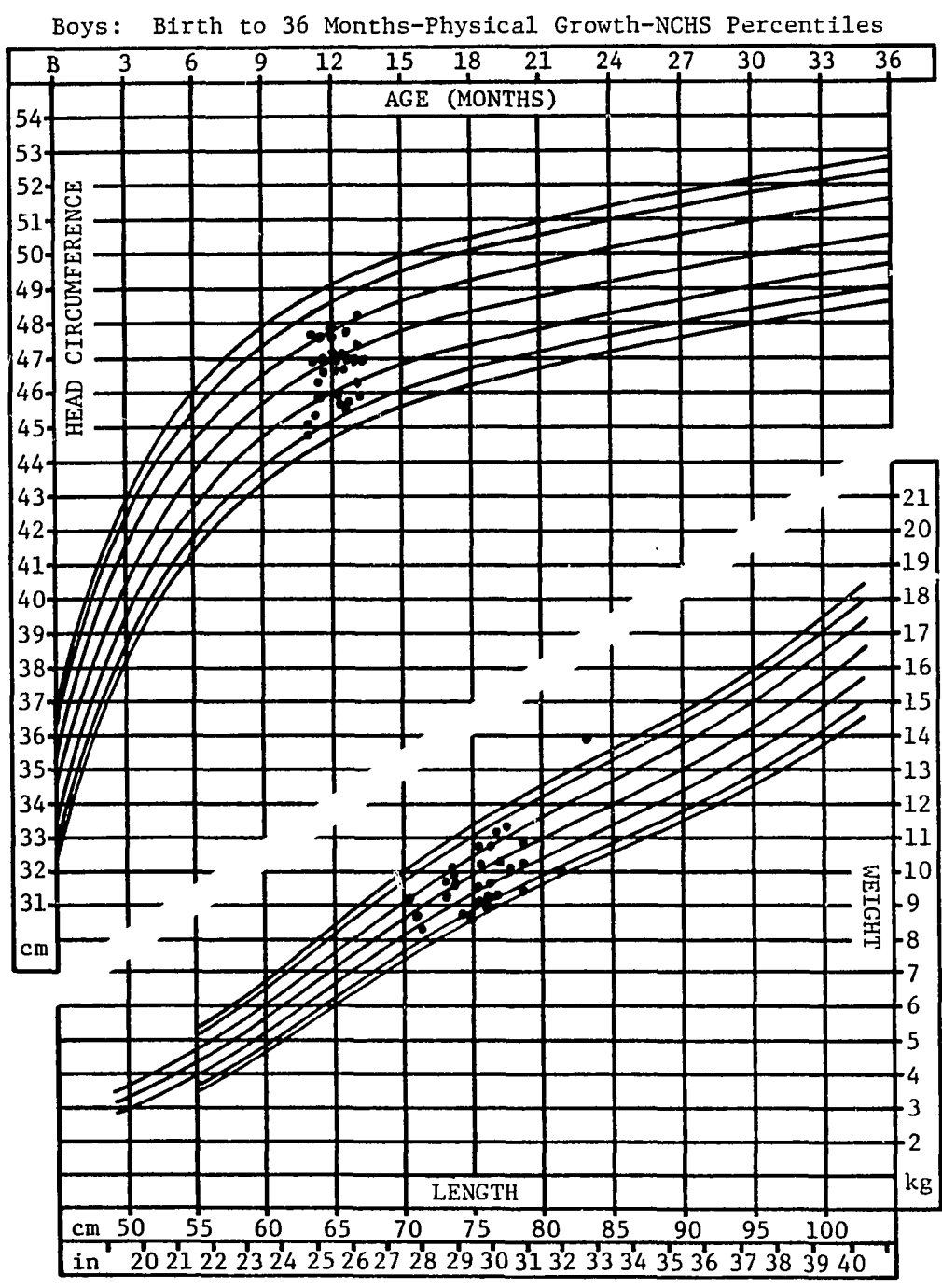


Figure 8. Head Circumference and Weight/Length of Mexican American Males.

Table 1. Anthropometric Data for Anglo Females

Variable	Mean	S.D.	Minimum	25% Level	Median	75% Level	Maximum	Number of Cases
Upper arm length*	14.71	0.73	13.20	14.00	15.00	15.20	15.80	20
Lower arm length*	10.63	0.93	8.50	10.00	10.65	11.30	12.00	20
Middle arm circumference*	15.30	1.14	13.60	14.30	15.30	16.00	17.10	20
Head circumference*	45.20	1.19	42.40	44.00	45.30	46.30	46.70	20
Chest circumference*	46.59	2.15	43.20	44.55	46.65	48.30	49.80	20
Thigh circumference*	27.39	2.65	23.20	25.05	27.40	29.90	32.00	20
Calf circumference*	18.71	1.65	16.30	17.40	18.35	20.05	21.70	20
Wrist Breadth**	29.95	3.25	23.50	29.00	30.00	32.00	37.50	20
Tricep skinfold thickness**	7.63	1.77	5.00	6.50	7.25	8.25	12.00	20
Subscapular skinfold thickness**	6.95	1.28	5.00	6.00	6.50	8.00	9.50	20
Weight***	9.18	1.14	7.53	8.21	9.13	10.05	11.47	20
Supine length*	74.70	2.86	68.70	72.35	74.60	77.10	78.90	20
Crown-rump length*	47.98	1.55	45.40	46.55	48.10	49.30	51.00	20
Total body fat****	1715.79	454.31	1026.43	1366.65	1627.80	1981.77	2645.13	20
Body fat as percent of body weight	18.77	4.66	11.26	15.69	17.77	23.19	26.32	20
Upper limb fat****	219.17	76.32	110.56	159.68	207.65	249.29	416.00	20
Lower limb fat****	345.46	111.64	187.44	266.06	333.43	400.81	632.52	20
Trunk fat****	777.18	215.46	454.83	632.77	715.50	956.91	1212.54	20
Weight for length*****	12.28	1.27	10.65	11.20	11.86	13.35	14.82	20

*centimeter
 **millimeter
 ***kilogram
 ****gram
 *****gram/centimeter

Table 2. Anthropometric Data for Mexican-American Females

Variable	Mean	S.D.	Minimum	25% Level	Median	75% Level	Maximum	Number of Cases
Upper arm length*	15.20	0.58	14.20	15.00	15.20	15.60	16.20	22
Lower arm length*	10.77	0.60	9.30	10.50	11.00	11.30	11.70	22
Middle arm circumference*	16.09	1.13	13.50	15.40	16.10	16.90	17.90	22
Head circumference*	45.91	1.00	44.00	45.20	45.80	46.80	48.00	22
Chest circumference*	49.35	2.87	44.80	47.00	49.85	50.80	57.40	22
Thigh circumference*	28.96	2.65	24.70	26.60	29.25	31.40	32.60	22
Calf circumference*	19.58	1.62	16.20	18.50	19.50	20.80	23.30	22
Wrist Breadth**	30.68	2.26	25.00	29.50	31.00	32.00	34.00	22
Tricep skinfold thickness**	8.43	0.98	6.50	8.00	8.50	9.00	10.00	22
Subscapular skinfold thickness**	8.82	1.60	6.00	7.50	9.00	10.00	12.00	22
Weight***	10.00	1.15	8.01	8.94	9.93	10.84	12.00	22
Supine length*	75.37	2.11	71.30	74.00	74.90	76.20	80.20	22
Crown-rump length*	48.61	1.78	45.40	47.70	48.45	49.20	53.40	22
Total body fat****	2289.92	541.07	1191.88	1825.74	2407.08	2669.25	3357.18	22
Body fat as percent of body weight	22.69	3.69	14.73	20.20	23.46	24.92	30.72	22
Upper limb fat****	270.71	55.41	142.76	231.00	279.84	306.88	349.83	22
Lower limb fat****	421.74	97.72	233.46	366.38	421.23	467.67	617.29	22
Trunk fat****	1159.46	347.04	571.87	815.39	1213.22	1367.03	2008.92	22
Weight for length*****	13.25	1.28	11.09	12.08	13.20	14.34	15.54	22

*centimeter
 **millimeter
 ***kilogram
 ****gram
 *****gram/centimeter

Table 3. Anthropometric Data for Anglo Males

Variable	Mean	S.D.	Minimum	25% Level	Median	75% Level	Maximum	Number of Cases
Upper arm length*	15.33	0.77	14.00	14.75	15.40	15.80	17.40	25
Lower arm length*	10.97	0.77	9.70	10.40	11.00	11.40	13.20	25
Middle arm circumference*	15.48	0.96	14.00	14.90	15.30	16.10	17.40	25
Head circumference*	47.01	1.36	43.80	46.40	47.00	47.20	51.20	25
Chest circumference*	47.79	2.42	43.50	45.95	47.80	49.10	53.20	25
Thigh circumference*	26.23	2.24	20.60	24.90	26.00	27.30	31.00	25
Calf circumference*	19.05	1.45	15.90	17.70	19.30	20.10	21.20	25
Wrist Breadth**	31.38	1.80	28.00	30.25	32.00	32.75	35.00	25
Tricep skinfold thickness**	8.12	2.10	5.00	6.50	7.00	9.75	13.00	25
Subscapular skinfold thickness**	7.21	1.91	4.00	6.00	6.50	8.25	11.50	25
Weight***	9.63	1.06	7.64	8.65	9.48	10.58	11.26	25
Supine Length*	75.78	1.81	72.20	74.40	75.90	77.00	79.50	25
Crown-rump length*	49.28	1.77	46.50	47.90	49.10	50.70	52.35	25
Total body fat****	1904.05	685.44	830.44	1400.97	1689.64	2365.38	3416.20	25
Body fat as percent of body weight	19.48	5.75	10.87	15.10	19.28	23.89	34.79	25
Upper limb fat****	252.85	101.82	124.02	178.02	210.38	343.76	484.70	25
Lower limb fat****	862.77	341.91	294.03	633.56	786.57	1079.75	1728.16	25
Trunk fat****	12.69	1.24	9.92	11.80	12.78	13.81	14.75	25
Weight for length*****								

*centimeter
 **millimeter
 ***kilogram
 ****gram
 *****gram/centimeter

Table 4. Anthropometric Data for Mexican-American Males

Variable	Mean	S.D.	Minimum	25% Level	Median	75% Level	Maximum	Number of Cases†
Upper arm length*	15.01	1.12	12.00	14.70	15.05	15.60	17.20	28
Lower arm length*	11.07	0.85	9.60	10.40	11.00	11.65	13.00	28
Middle arm circumference*	15.66	1.23	14.00	14.60	15.75	16.65	18.40	28
Head circumference*	46.64	0.84	44.90	46.00	46.80	47.10	48.00	28
Chest circumference*	48.76	2.41	45.00	47.45	48.25	50.10	57.20	28
Thigh circumference*	27.80	2.60	22.70	26.20	27.50	29.90	33.80	27
Calf circumference*	18.90	1.35	16.40	18.10	18.80	19.65	22.40	28
Wrist Breadth**	30.82	1.87	27.50	29.50	31.25	32.00	35.00	28
Tricep skinfold thickness**	7.88	1.72	5.50	6.50	7.25	9.00	11.00	28
Subscapular skinfold thickness**	8.09	2.21	5.00	6.50	7.50	9.25	13.00	28
Weight***	9.90	1.12	8.31	9.19	9.75	10.35	13.93	28
Supine length*	75.66	2.84	70.10	73.75	75.65	76.95	83.20	28
Crown-rump length*	48.53	1.89	44.80	47.33	48.35	49.80	53.70	28
Total body fat****	2029.28	813.25	1009.69	1482.05	1748.39	2400.49	4370.00	27
Body fat as percent of body weight	20.16	6.39	11.47	15.68	17.82	23.26	33.09	27
Upper limb fat****	242.89	88.54	123.38	182.01	216.98	277.14	470.99	28
Lower limb fat****	374.22	137.68	175.77	274.28	348.10	456.75	746.06	27
Trunk fat****	1018.79	451.06	500.45	707.03	865.97	1203.57	2421.46	28
Weight for length*****	13.07	1.17	11.46	12.15	12.93	13.69	16.74	28

*centimeter
 **millimeter
 ***kilogram
 ****gram
 *****gram/centimeter

†Due to an error in measurement of one thigh circumference, Number of Cases will vary in some instances.

Table 5. Overall Results of Two-Way Analysis of Variance

Variable	Overall F (Significance of F)
Upper arm length	0.67 (n.s.)
Lower arm length	2.16 (n.s.)
Middle arm circumference	2.10 (n.s.)
Head circumference	14.81 (p<.001)
Chest circumference	6.12 (p<.005)
Thigh circumference	6.70 (p<.005)
Calf circumference	0.67 (n.s.)
Wrist breadth	1.26 (n.s.)
Tricep skinfold thickness	0.21 (n.s.)
Subscapular skinfold thickness	6.36 (p<.005)
Weight	2.80 (p<.10)
Supine length	0.99 (n.s.)
Crown-rump length	1.32 (n.s.)
Total body fat	2.97 (p<.10)
Body fat as percent of body weight	2.27 (n.s.)
Upper limb fat	0.50 (n.s.)
Lower limb fat	0.93 (n.s.)
Trunk fat	6.05 (p<.005)
Weight for length	3.49 (p<.05)

Table 6. Sex, Ethnic, and Interaction Effects on Significant Variables of Two-Way Analysis of Variance

Variable	Sex F (Significance of F)	Ethnicity F (Significance of F)	Interaction F (Significance of F)
Head circumference	29.38 (p<.001)	0.21 (n.s.)	5.56 (p<.05)
Chest circumference	0.26 (n.s.)	11.97 (p=.001)	3.05 (p<.10)
Thigh circumference	5.05 (p<.05)	8.29 (p=.005)	0.01 (n.s.)
Subscapular Skinfold Thickness	0.47 (n.s.)	12.26 (p=.001)	1.71 (n.s.)
Weight	0.47 (n.s.)	5.12 (p<.05)	1.38 (n.s.)
Total body fat	0.12 (n.s.)	5.81 (p<.05)	2.73 (n.s.)
Trunk fat	0.17 (n.s.)	11.91 (p=.001)	2.20 (n.s.)
Weight for length	0.23 (n.s.)	6.76 (p<.05)	1.17 (n.s.)

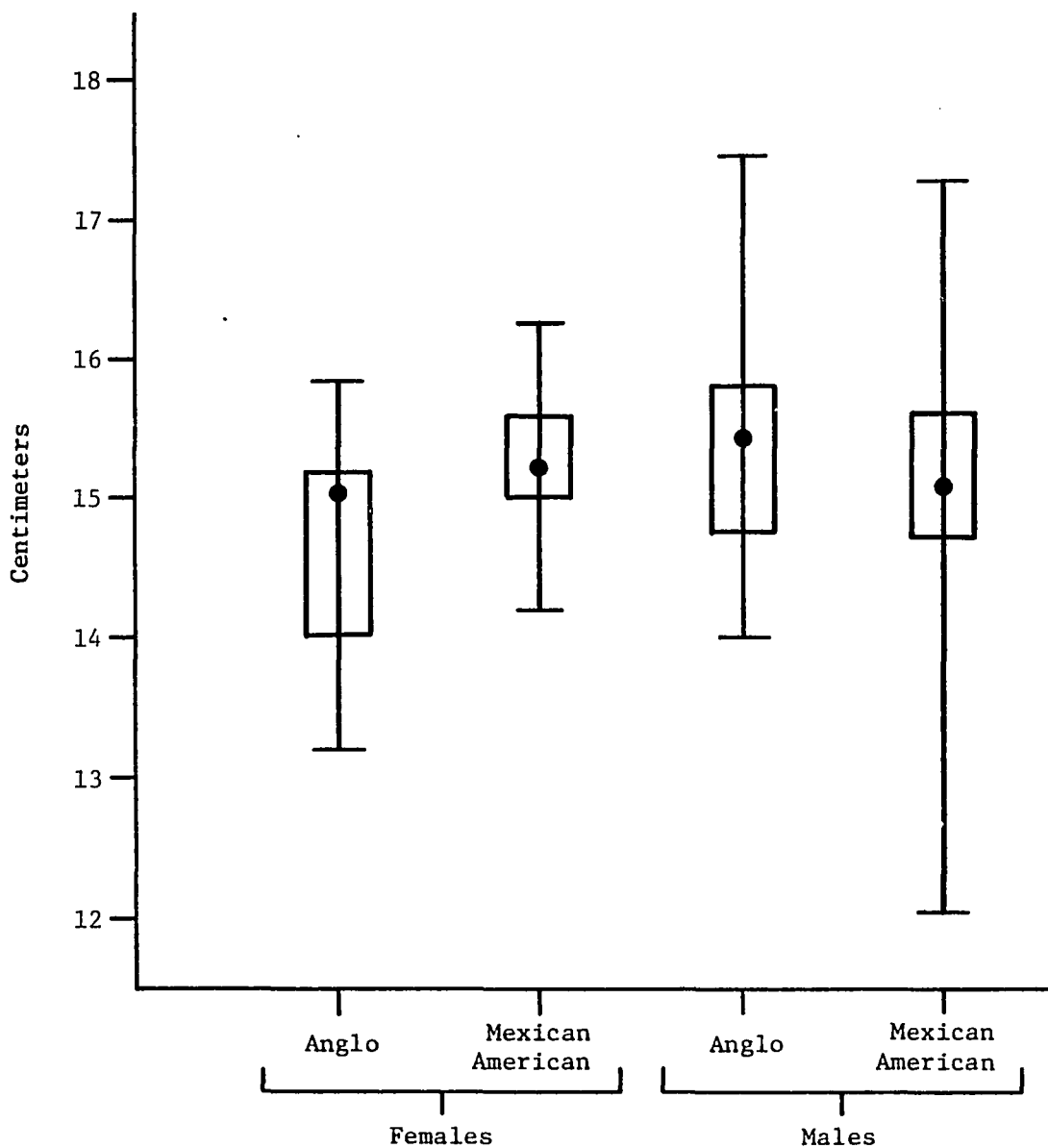


Figure 9. Upper Arm Length by Sex and Ethnic Group.

F (Significance of F):	Overall	0.67	(n.s.)
	Sex	1.30	(n.s.)
	Ethnicity	0.05	(n.s.)
	Interaction	5.41	(p<.05)

Graph values: range, median, 25th and 75th percentiles.

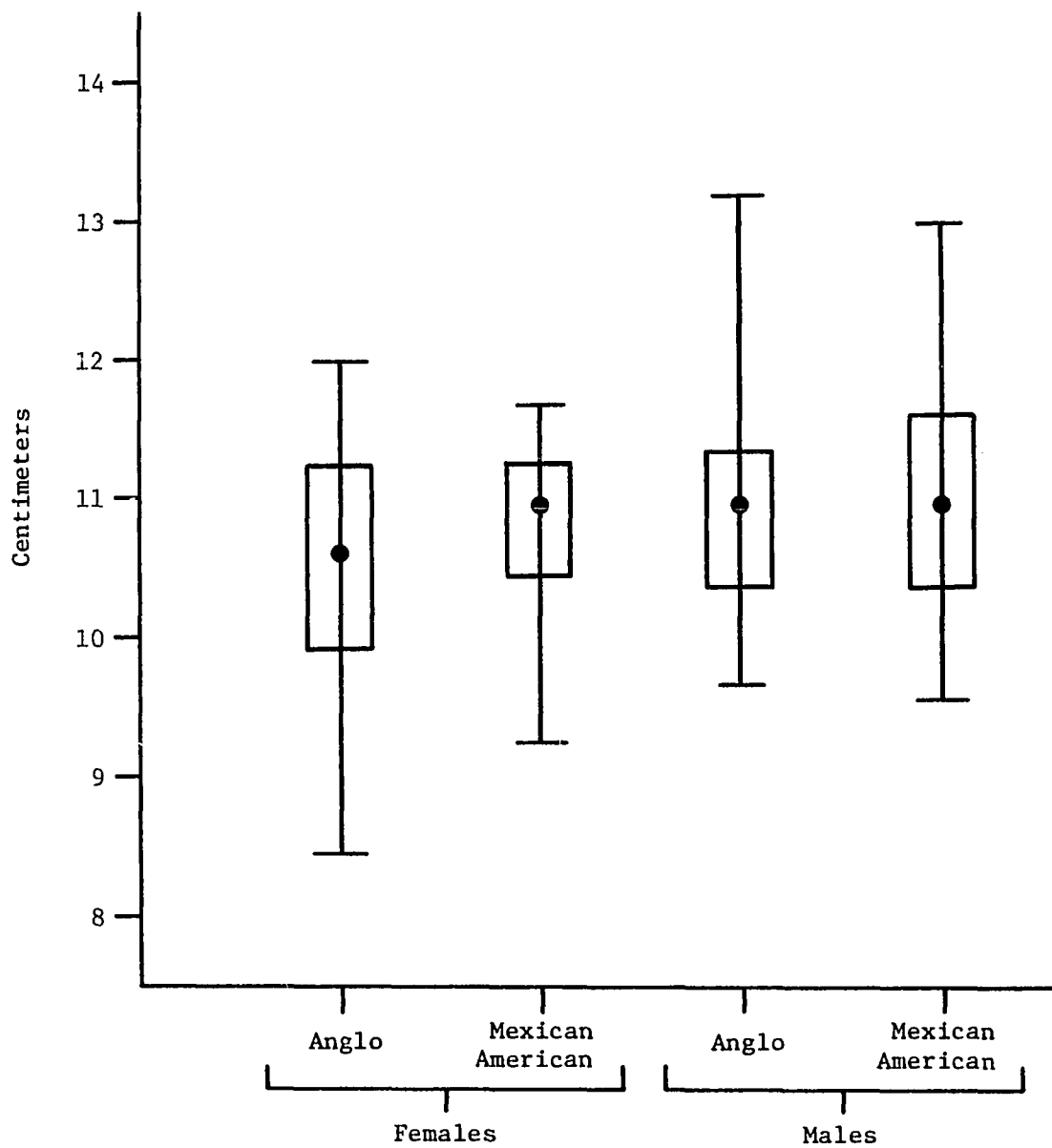


Figure 10. Lower Arm Length by Sex and Ethnic Group.

F (Significance of F):	Overall	2.16	(n.s.)
	Sex	3.77	(p<.10)
	Ethnicity	0.53	(n.s.)
	Interaction	0.02	(n.s.)

Graph values: range, median, 25th and 75th percentiles.

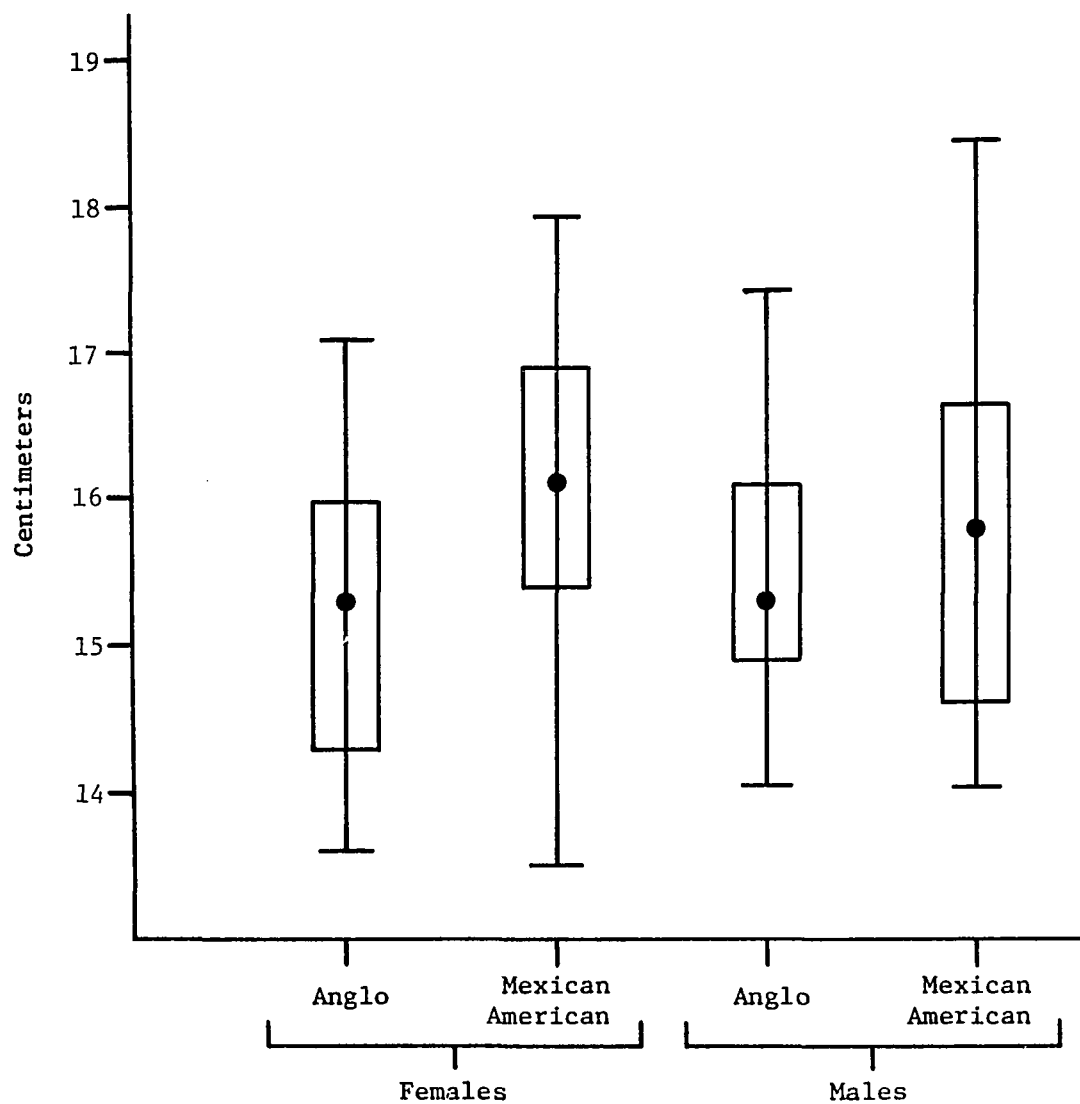


Figure 11. Middle Arm Circumference by Sex and Ethnic Group.

F (Significance of F):	Overall	2.10	(n.s.)
	Sex	0.36	(n.s.)
	Ethnicity	3.85	(p<.10)
	Interaction	1.66	(n.s.)

Graph values: range, median, 25th and 75th percentiles.

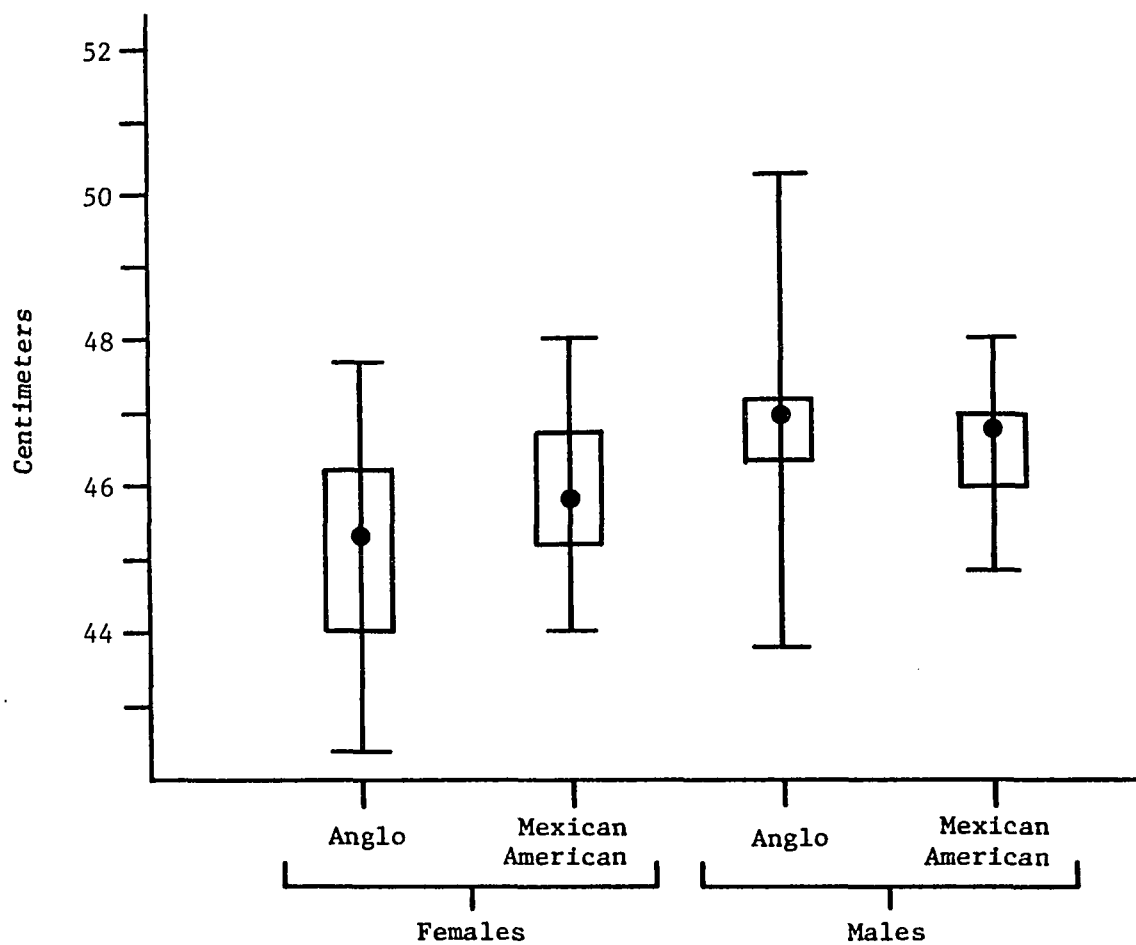


Figure 12. Head Circumference by Sex and Ethnic Group.

F (Significance of F):	Overall	14.81	(p=0)
	Sex	29.38	(p=0)
	Ethnicity	0.21	(n.s.)
	Interaction	5.56	(p<.05)

Graph values: range, median, 25th and 75th percentiles.

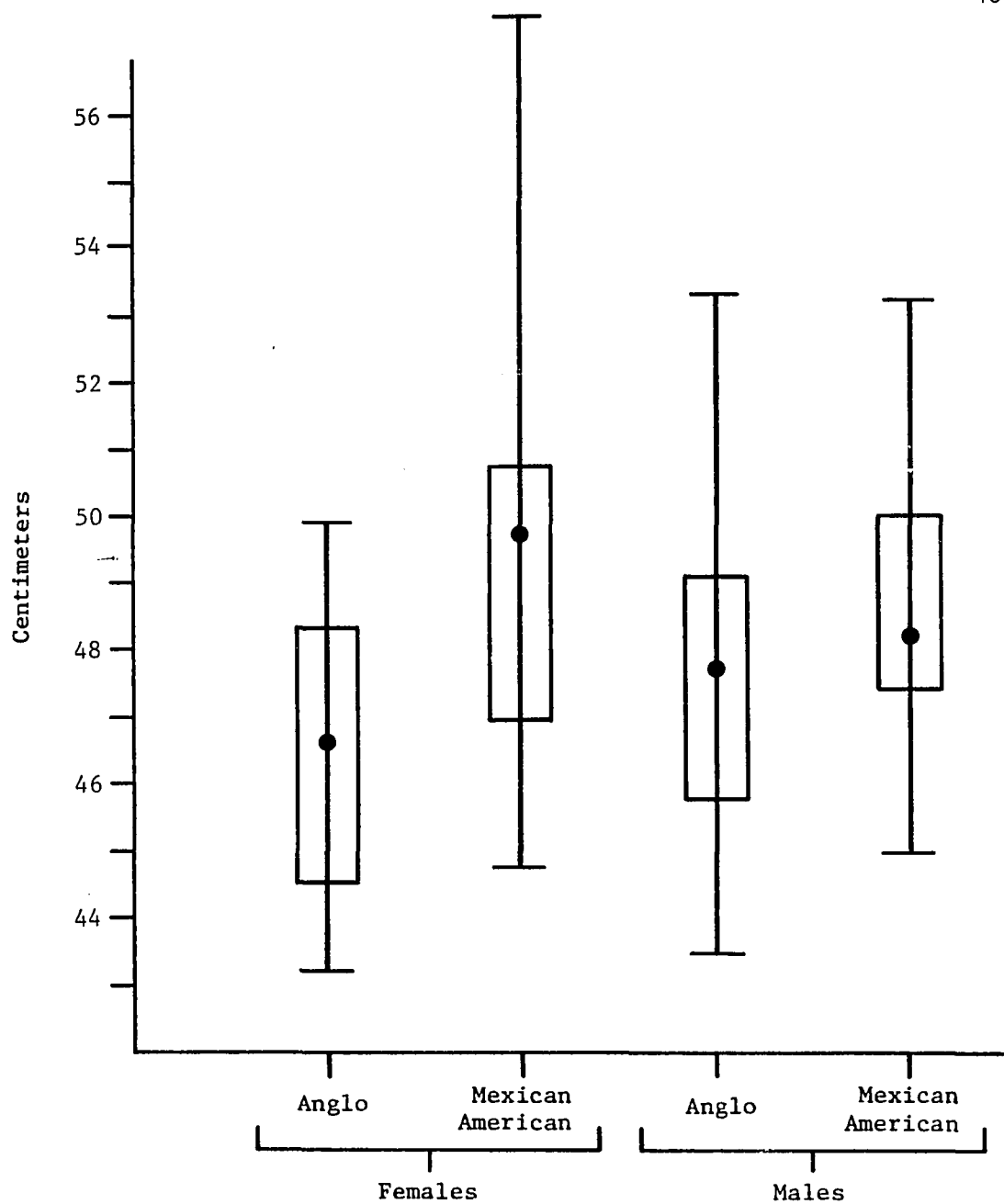


Figure 13. Chest Circumference by Sex and Ethnic Group.

F (Significance of F):	Overall	6.12	($p < .005$)
	Sex	0.26	(n.s.)
	Ethnicity	11.97	($p = .001$)
	Interaction	3.05	($p < .10$)

Graph values: range, median, 25th and 75th percentiles.

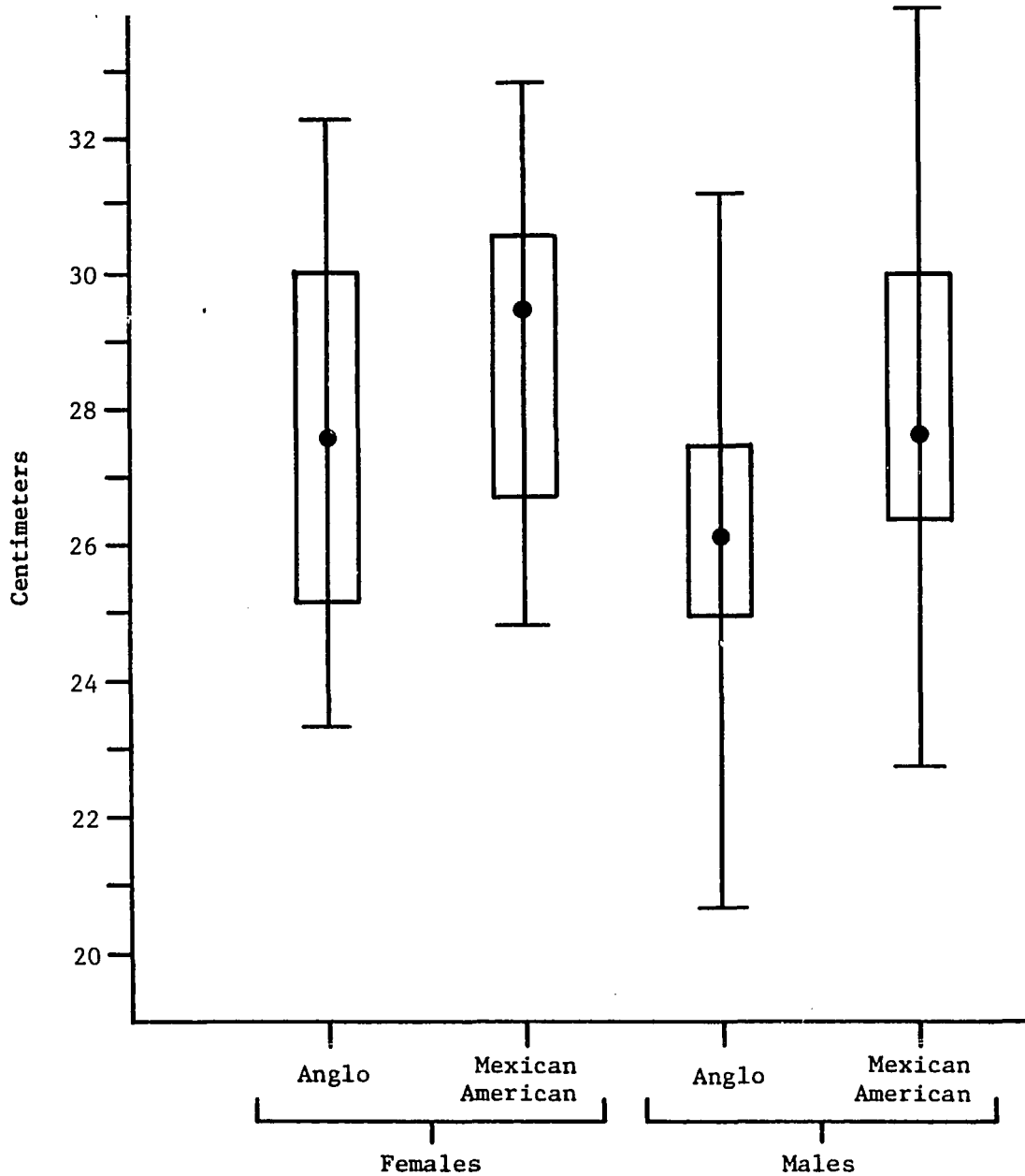


Figure 14. Thigh Circumference by Sex and Ethnic Group.

F (Significance of F):	Overall	6.70	(p<.005)
	Sex	5.05	(p<.05)
	Ethnicity	8.29	(p=.005)
	Interaction	0.01	(n.s.)

Graph values: range, median, 25th and 75th percentiles.

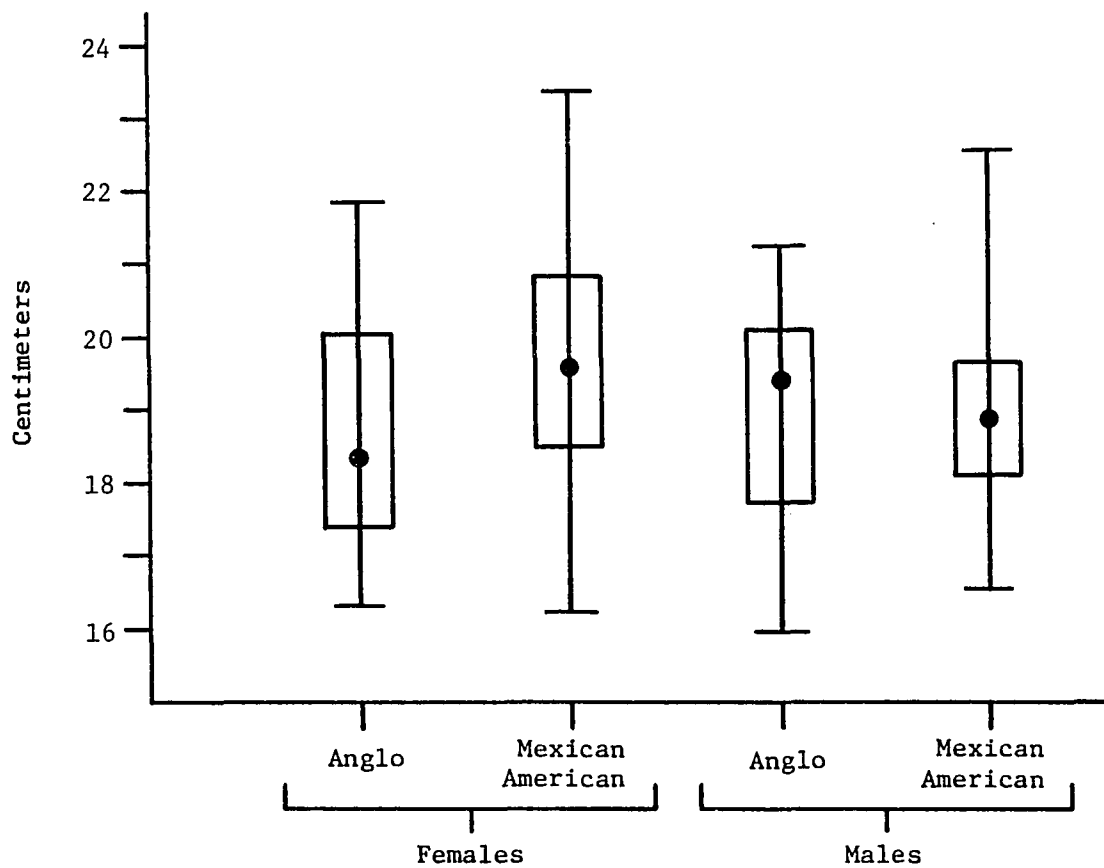


Figure 15. Calf Circumference by Sex and Ethnic Group.

F (Significance of F):	Overall	0.67	(n.s.)
	Sex	0.40	(n.s.)
	Ethnicity	0.95	(n.s.)
	Interaction	2.76	(p=.10)

Graph values: range, median, 25th and 75th percentiles.

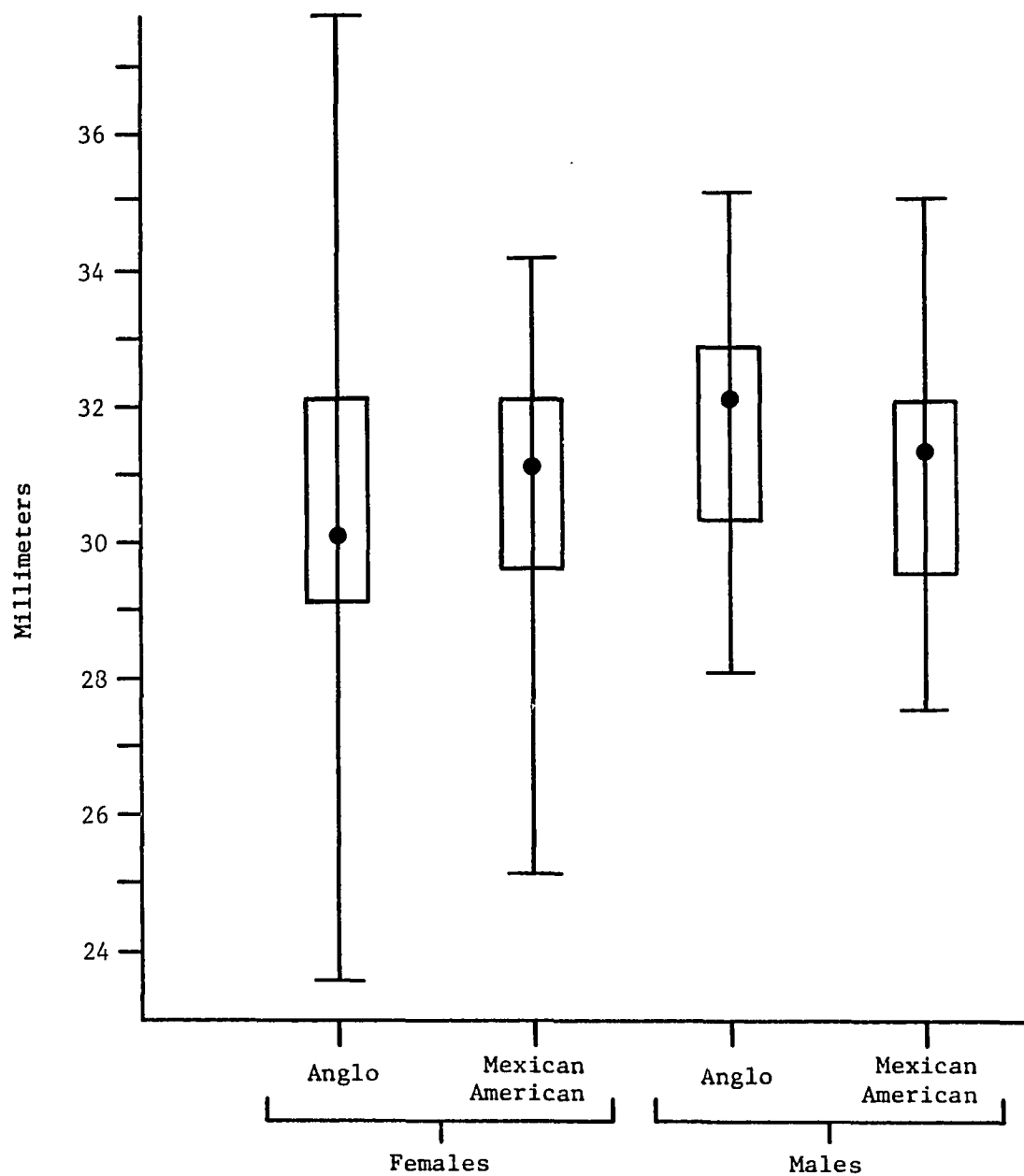


Figure 16. Wrist Breadth by Sex and Ethnic Group.

F (Significance of F):	Overall	1.26	(n.s.)
	Sex	2.51	(n.s.)
	Ethnicity	0.00	(n.s.)
	Interaction	1.84	(n.s.)

Graph values: range, median, 25th and 75th percentiles.

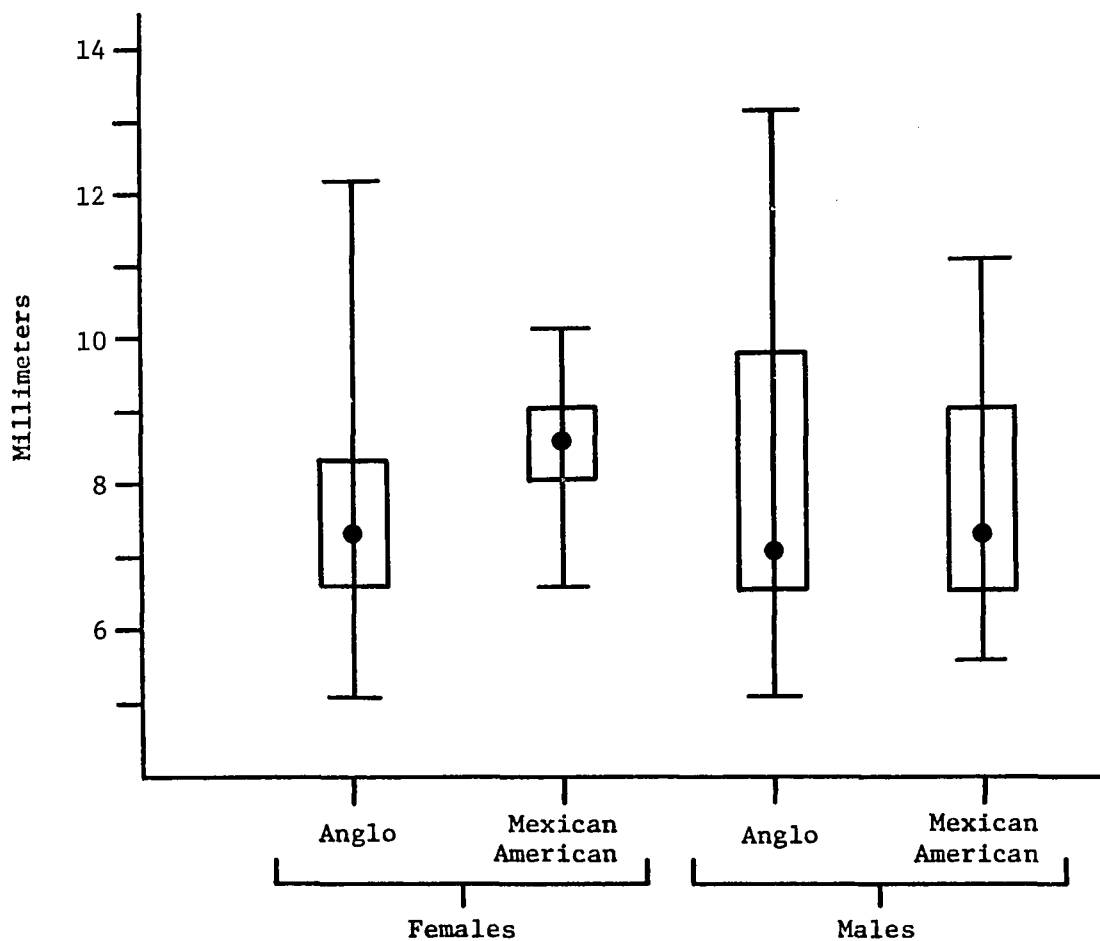


Figure 17. Tricep Skinfold Thickness by Sex and Ethnic Group.

F (Significance of F):	Overall	0.21	(n.s.)
	Sex	0.03	(n.s.)
	Ethnicity	0.39	(n.s.)
	Interaction	2.22	(n.s.)

Graph values: range, median, 25th and 75th percentiles.

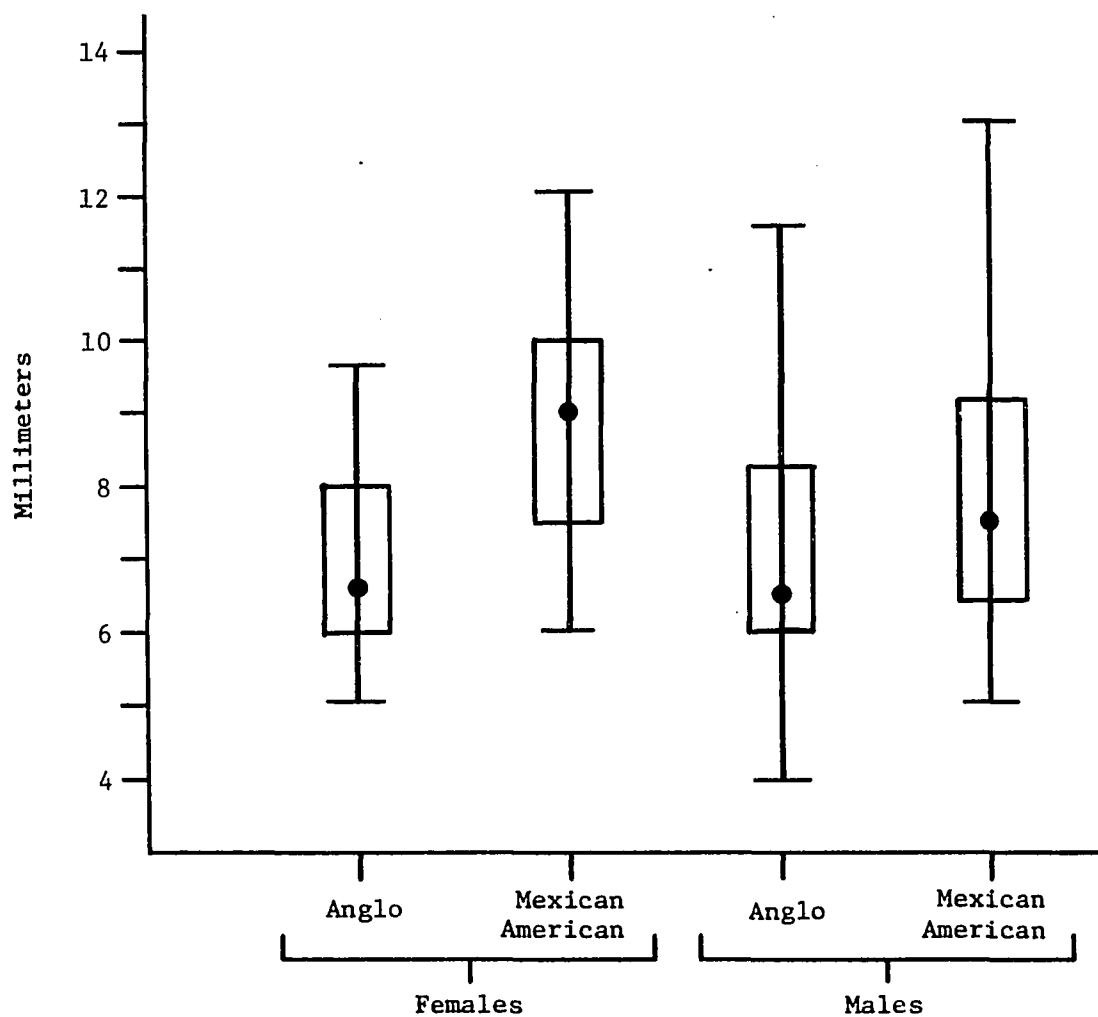


Figure 18. Subscapular Skinfold Thickness by Sex and Ethnic Group.

F (Significance of F): Overall 6.36 (p<.005)
 Sex 0.47 (n.s.)
 Ethnicity 12.26 (p=.001)
 Interaction 1.71 (n.s.)

Graph values: range, median, 25th and 75th percentiles.

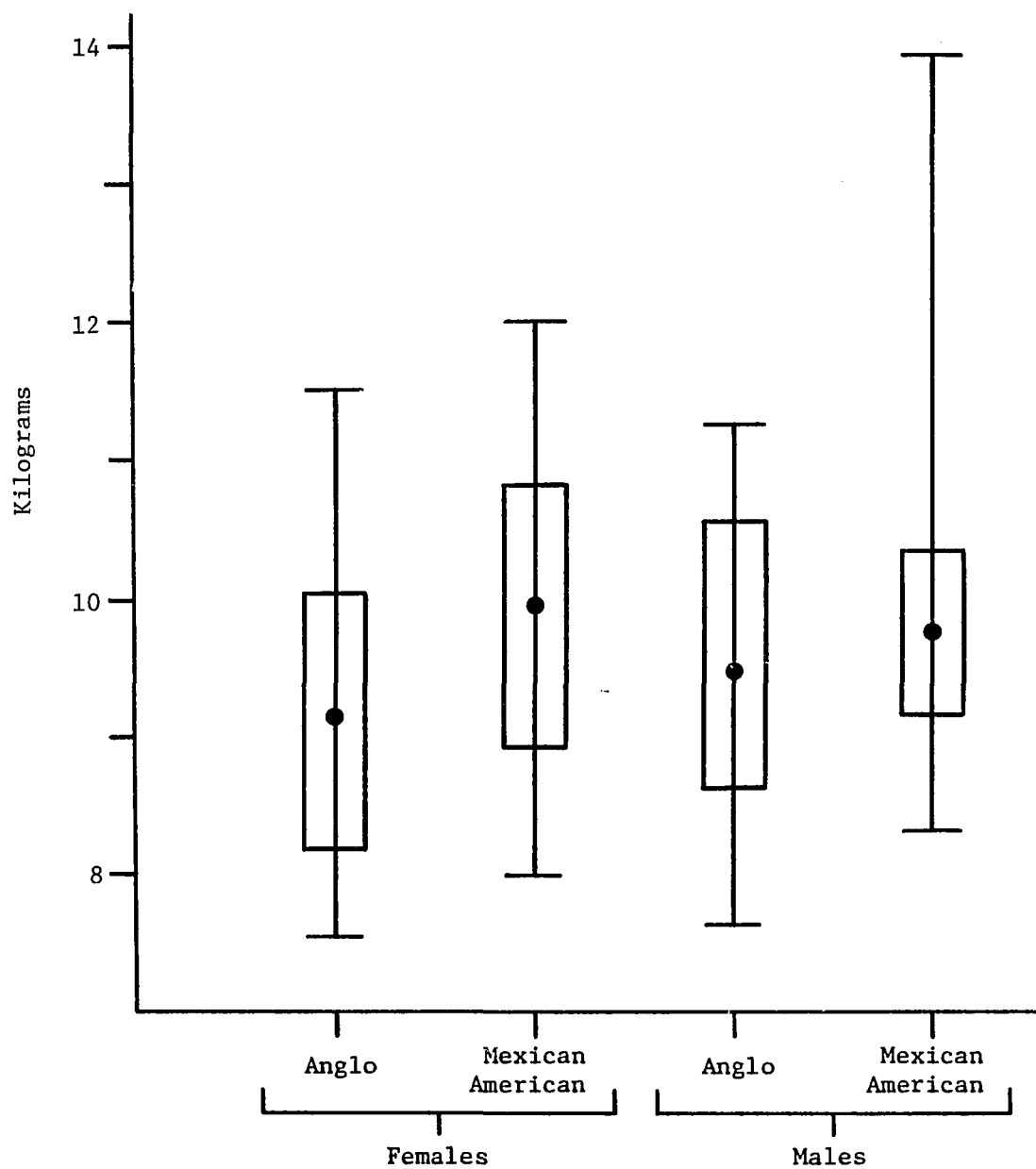


Figure 19. Weight by Sex and Ethnic Group.

F (Significance of F):	Overall	2.80 (p<.10)
	Sex	0.47 (n.s.)
	Ethnicity	5.12 (p<.05)
	Interaction	1.38 (n.s.)

Graph values: range, median, 25th and 75th percentiles.

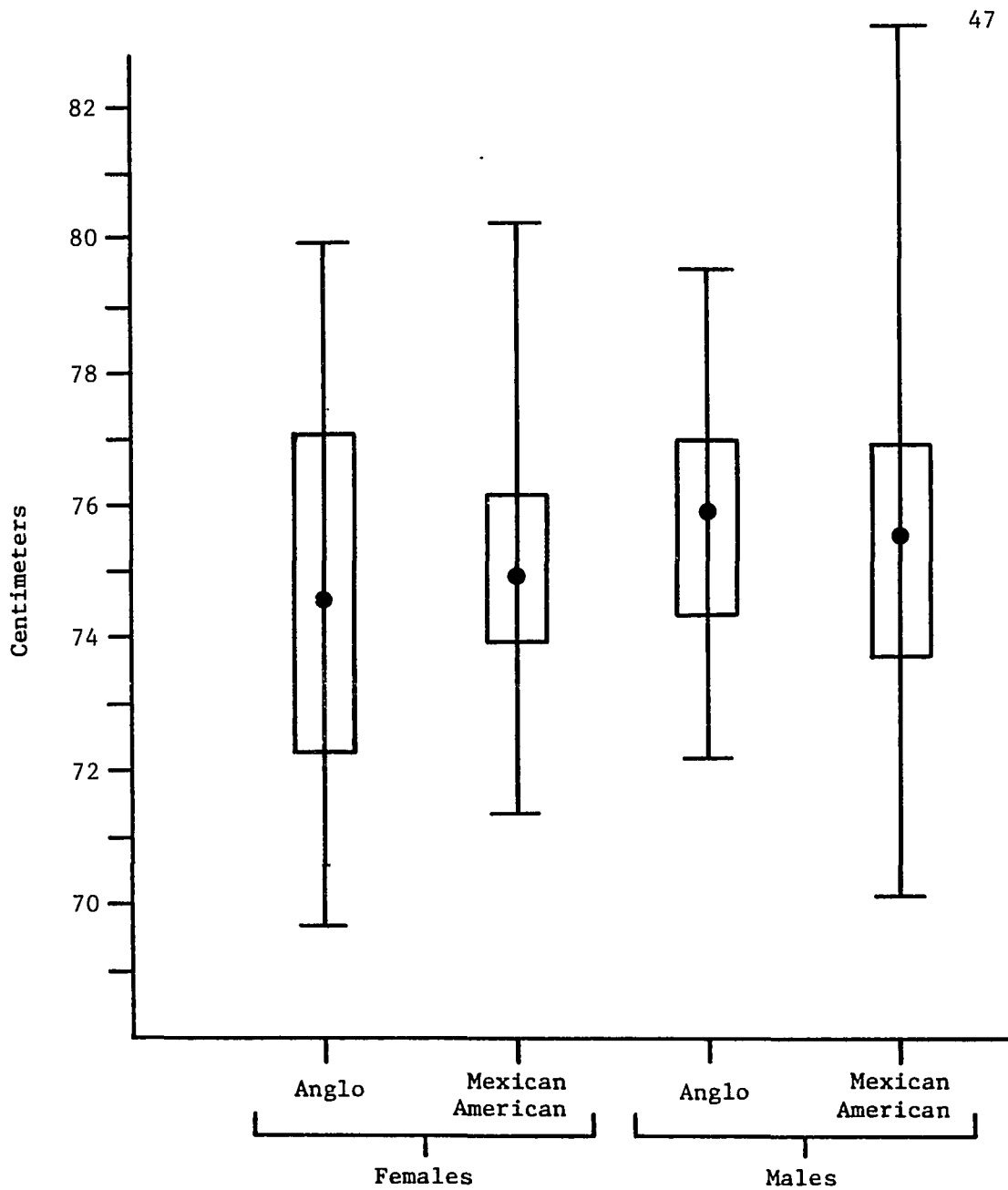


Figure 20. Supine Length by Sex and Ethnic Group.

F (Significance of F):	Overall	0.99	(n.s.)
	Sex	1.76	(n.s.)
	Ethnicity	0.22	(n.s.)
	Interaction	0.62	(n.s.)

Graph values: range, median, 25th and 75th percentiles.

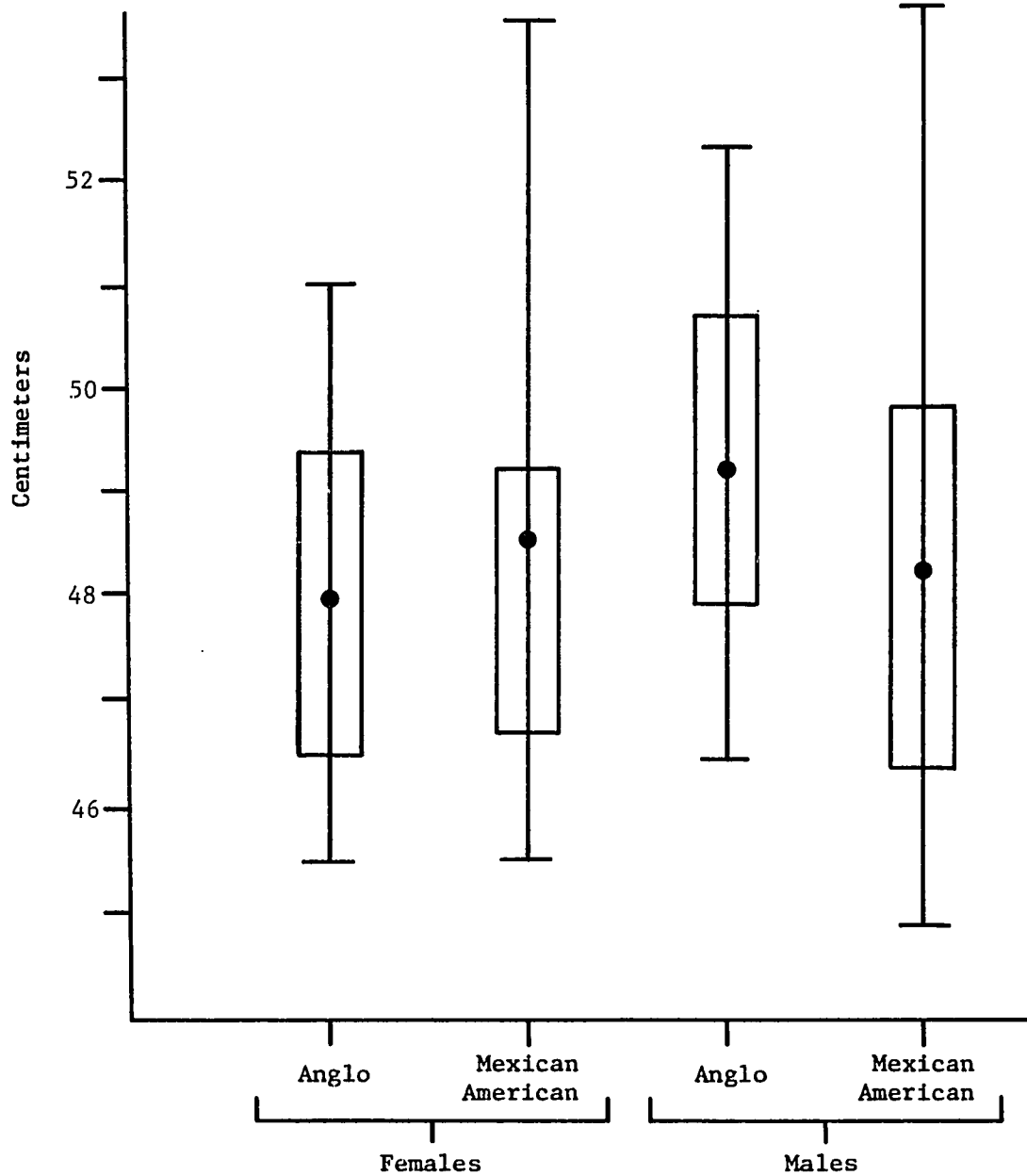


Figure 21. Crown-Rump Length by Sex and Ethnic Group.

F (Significance of F):	Overall	1.32	(n.s.)
	Sex	2.49	(n.s.)
	Ethnicity	0.15	(n.s.)
	Interaction	3.54	(p<.10)

Graph values: range, median, 25th and 75th percentiles.

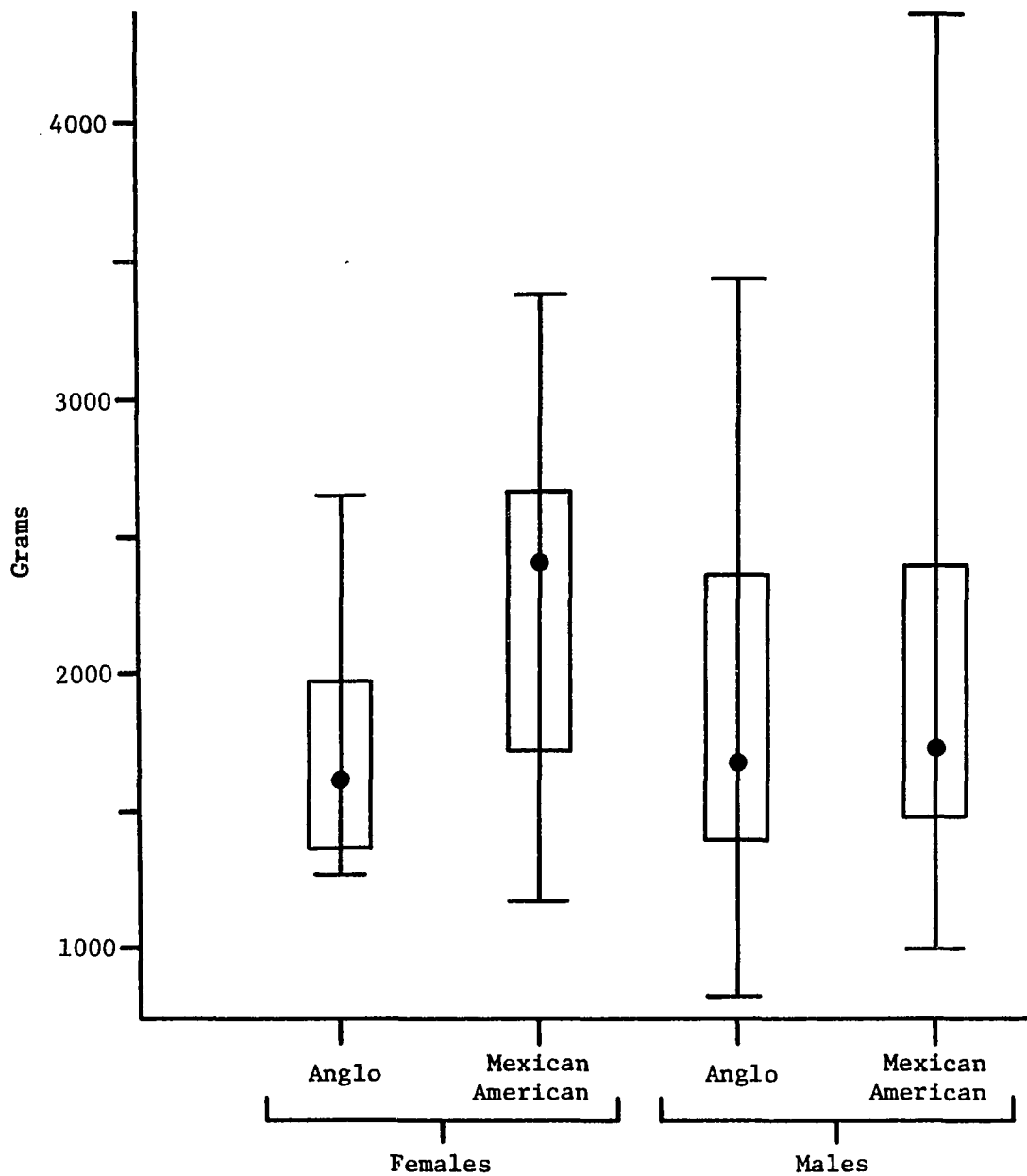


Figure 22. Total Body Fat by Sex and Ethnic Group.

F (Significance of F):	Overall	2.97	(p<.10)
	Sex	0.12	(n.s.)
	Ethnicity	5.81	(p<.05)
	Interaction	2.73	(n.s.)

Graph values: range, median, 25th and 75th percentiles.

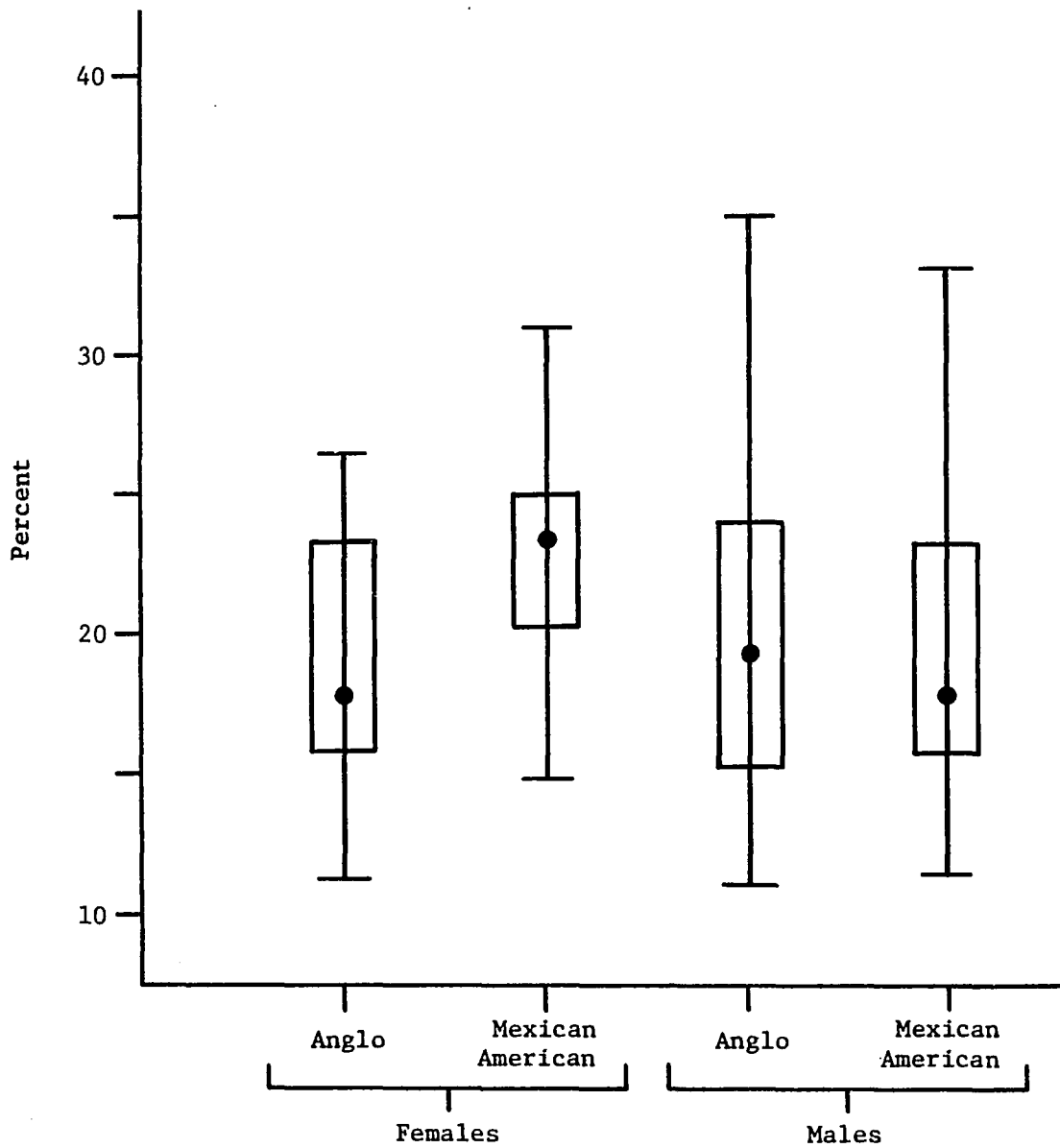


Figure 23. Body Fat as Percent of Body Weight by Sex and Ethnic Group.

F (Significance of F): Overall 2.27 (n.s.)
 Sex 0.79 (n.s.)
 Ethnicity 3.74 (p<.10)
 Interaction 2.14 (n.s.)

Graph values: range, median, 25th and 75th percentiles.

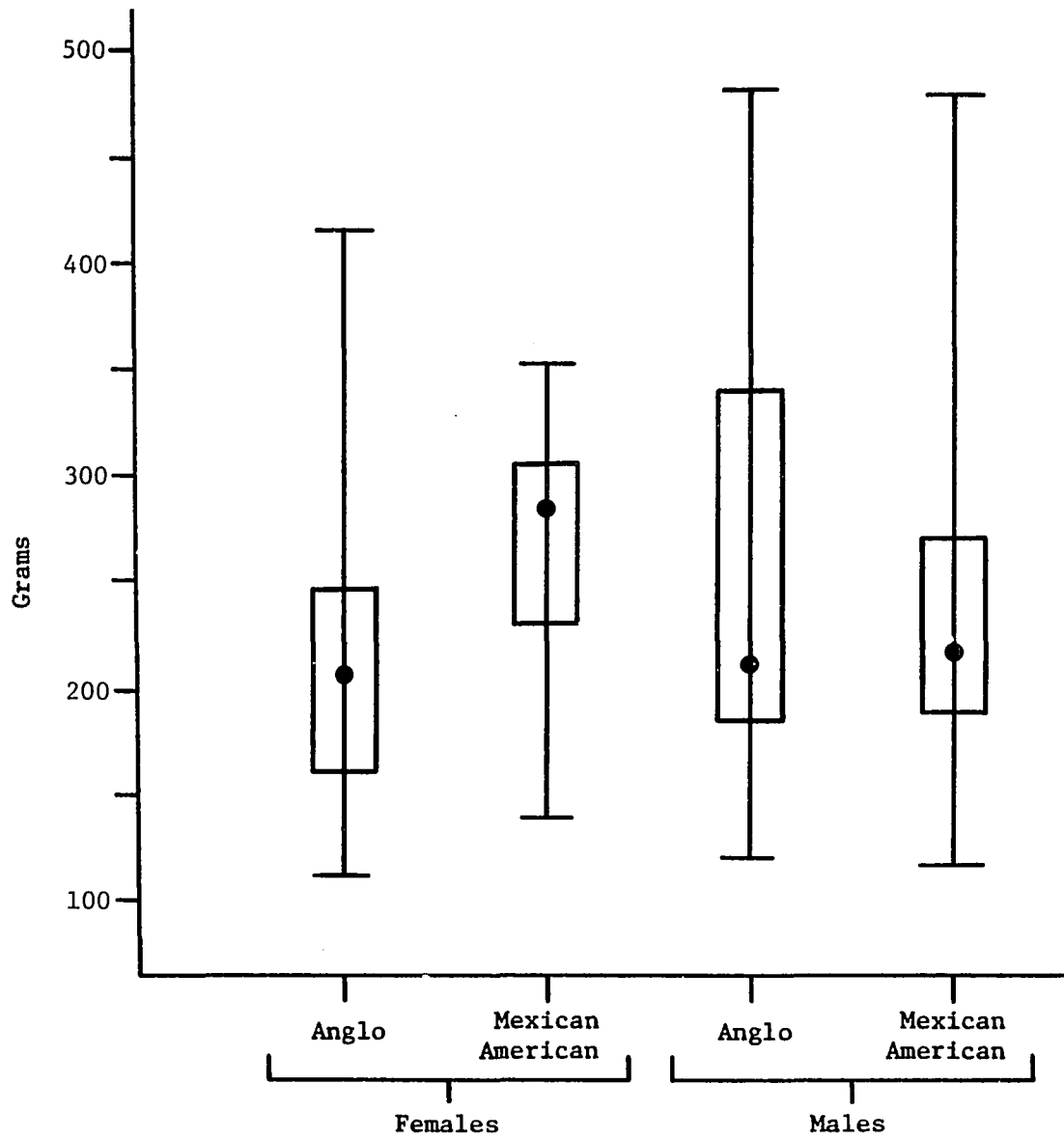


Figure 24. Upper Limb Fat by Sex and Ethnic Group.

F (Significance of F):	Overall	0.50	(n.s.)
	Sex	0.01	(n.s.)
	Ethnicity	0.99	(n.s.)
	Interaction	3.15	(p<.10)

Graph values: range, median, 25th and 75th percentiles.

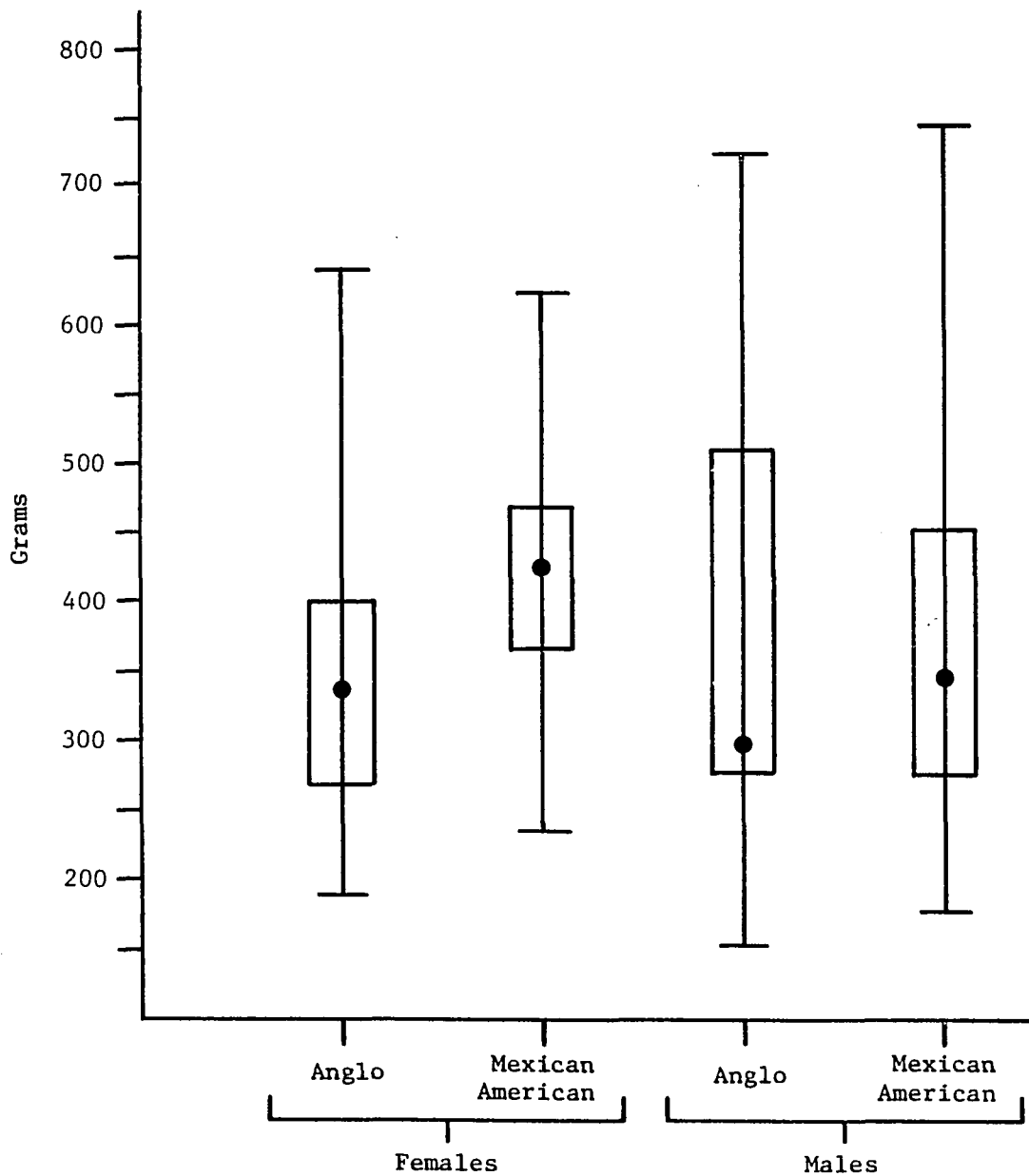


Figure 25. Lower Limb Fat by Sex and Ethnic Group.

F (Significance of F):	Overall	0.93	(n.s.)
	Sex	0.18	(n.s.)
	Ethnicity	1.68	(n.s.)
	Interaction	2.01	(n.s.)

Graph values: range, median, 25th and 75th percentiles.

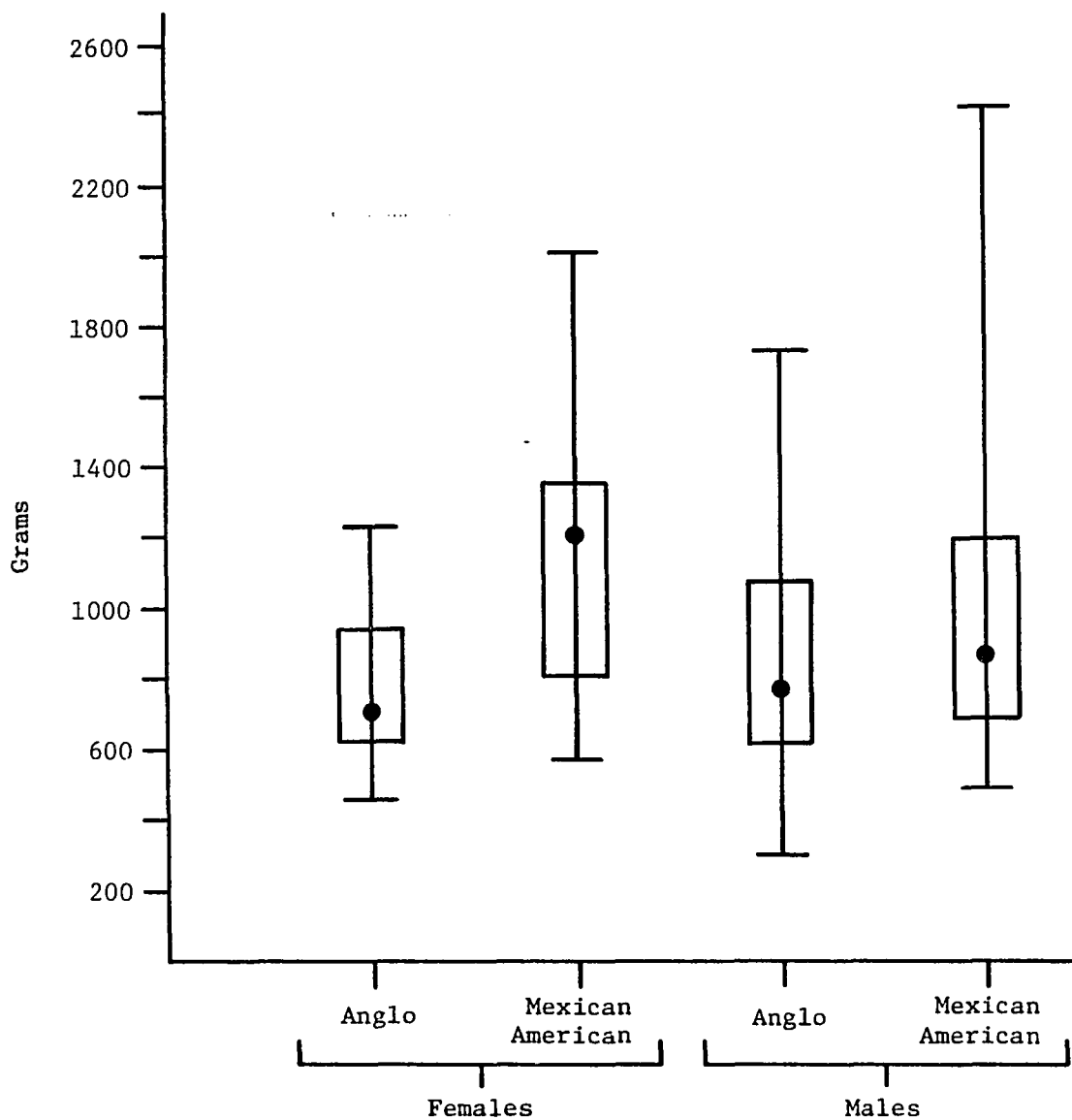


Figure 26. Trunk Fat by Sex and Ethnic Group.

F (Significance of F):	Overall	6.05	($p < .005$)
	Sex	0.17	(n.s.)
	Ethnicity	11.91	($p = .001$)
	Interaction	2.20	(n.s.)

Graph values: range, median; 25th and 75th percentiles.

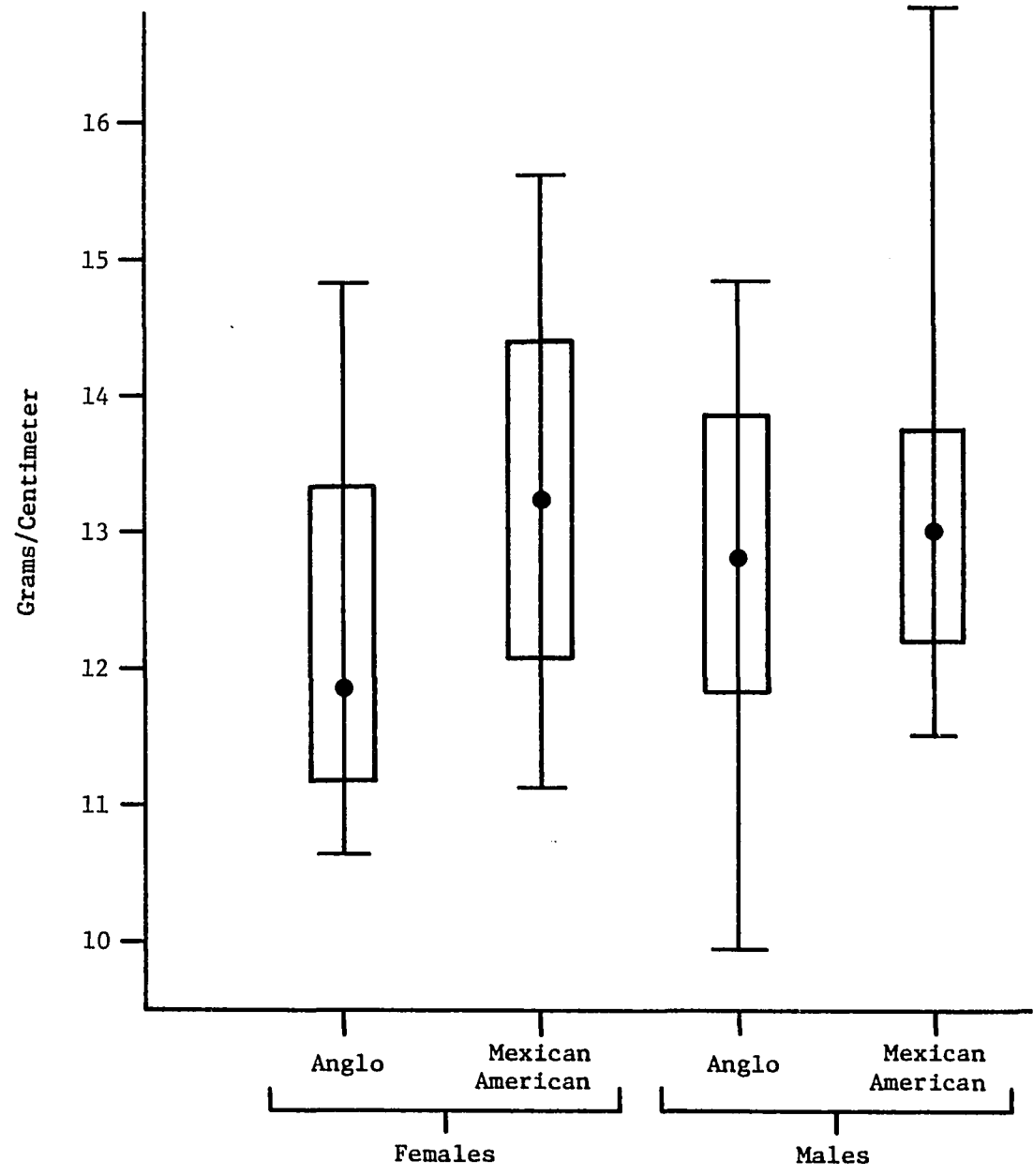


Figure 27. Weight/Length by Sex and Ethnic Group.

F (Significance of F):	Overall	3.49	(p<.05)
	Sex	0.23	(n.s.)
	Ethnicity	6.76	(p<.05)
	Interaction	1.17	(n.s.)

Graph values: range, median, 25th and 75th percentiles.

CHAPTER 5

DISCUSSION

Figures 1 through 8 show data from this study plotted against national growth curves. Among the Anglo females, one child had a head circumference, height, and weight less than the 5th percentile. Her data sheet reveals that her mother was also very small. Neither the other Anglo females who weighed less than the 5th percentile, nor the subject in that group who was at less than the 5th percentile in weight for length, had outstanding health problems or irregularities.

Among Mexican-American females, there were no subjects below the 5th percentile of weight for age, height for age, or weight for length. There were, however, two subjects above the 95th percentile for weight, one for length, and one for head circumference. The Mexican-American female with the largest head circumference had no major medical problems or other outlying measurement values. One child with height over the 95th percentile in that group was also high in weight but was between the 90th and 95th percentile in weight for length. The other Mexican-American female who was greater than the 95th percentile in weight was also at that level in weight for length. On her data sheet there is a quote from the child's mother, "Es muy gorda," ("She is very fat.").

Among the Anglo males, there were outliers in both directions

concerning head circumferences. The subject with the head circumference well above the 95th percentile was being followed by his personal physician for a large head. The child who was below the 5th percentile in head circumference was proportionally smaller with regard to weight, length, and weight for length. His parent volunteered that he was a "very allergic child." Another subject with weight and weight for length at less than the 5th percentile but height at the 50th percentile had recently been ill with vomiting and diarrhea for a couple of days.

For males, as well as females, the Mexican-American children were heavier. The one Mexican-American male above the 95th percentile in weight was also above it in height. In recalling his mother pushing him in his stroller into the examining room, this writer recalls this child as appearing very large for his age. His mother stated that occasionally he "had diarrhea when he ate too much."

Thus, in reviewing the four groups within the total population, the vast majority of subjects were clustered between the 5th and 95th percentiles of the NCHS norms.

In reviewing the two-way analysis of variance and then looking at the graphs comparing sex, ethnic group, and interaction, it is apparent that there are some outstanding trends. First, the data indicates in Figure 12 that males have larger head circumferences than females, regardless of ethnic background. This agrees with the work of Nellhaus (1968) discussed earlier.

Ethnic differences are apparent in several of the parameters. Chest circumference, thigh circumference, subscapular skinfold thick-

ness, trunk fat, and weight for length are all greater for Mexican-Americans than for Anglos (see Figures 13, 14, 18, 26, and 27). Two borderline significance levels show Mexican-Americans to have a tendency to have greater weight and total body fat (see Figures 19 and 22).

Significant interaction indicates that a significant portion of the relationship seen is due to the combined effects of the two variables. With regard to head circumference, it would appear that interaction describes the fact that although males, when grouped together, have a median head circumference that is significantly greater than for females, this difference is seen only in the Anglo, not in the Mexican-American children. With chest circumference, interaction appears to describe that there is a greater difference in median chest circumference between Anglo and Mexican-American females than between Anglo and Mexican-American males. Yet in both instances, the Mexican-American has a larger chest circumference than the Anglo.

In summary, the one year old Mexican-American children tend to be heavier for length than Anglo children and to have greater amounts of fat distributed around the trunk. Thus, one has a description of this population in terms of anthropometry.

Some interesting questions still remain. Could these findings be reproduced in a larger population or in a population at a different age level? Do the differences here continue to maturity? And, if this is truly an ethnic difference, what environmental and genetic forces caused this difference and why?

Whether ethnic-specific growth charts are indicated for the

Mexican-American population is yet to be seen. Meanwhile, it is important that persons involved in health care of Mexican-Americans be aware that ethnic differences in body proportions and body fat content and fat distribution should be considered when looking at the total picture of the individual's health status.

APPENDIX A
FORMS USED IN CLINICS

SUBJECT'S CONSENT

Title: ANTHROPOMETRIC MEASUREMENTS OF ANGLO AND MEXICAN-AMERICAN CHILDREN INVOLVED IN THE WIC PROGRAM.

I understand that I am being asked to allow some simple measurements to be made on my child, _____.

These measurements will consist of length, weight, crown-rump length, head circumference, mid-arm, thigh, calf, and chest circumference, upper and lower arm length, and the thickness of several folds of skin, as well as wrist breadth. There is no pain or discomfort associated with any of these measurements, and there are no complications of the measurements.

I understand that these measurements will be taken at this appointment only.

I realize that there will be no direct benefit to my child. At some time in the future, a revision of growth charts may be made according to ethnic growth patterns. The participation of my child in this study may help to make these growth charts possible.

If I decide to have my child participate in this study, my name and that of my child will be kept confidential at all times. No charges will be made for this study.

I understand that in the event of physical injury resulting from the measurements that financial compensation is not available for wages, time lost, medical care, or hospitalization. I understand that the investigator will provide more information upon my request.

The nature, demands, risks, and the benefits of the project have been explained to my witness and me. I understand what my participation involves. Furthermore, I understand that I am free to ask questions and to withdraw from the project at any time without affecting my medical care.

I also understand that this consent form will be filed in an area designated by the Human Subjects Committee with access restricted to the principal investigator or authorized representative of the particular department.

Signature of Parent or Legally Authorized Representative Date

Witness Date

I have carefully explained to the subject the nature of the above project. I hereby certify that to the best of my knowledge, the subject signing this consent form understands clearly the nature, demands, benefits, and risks involved in participating in this study. A medical problem, language problem, or educational barrier has not precluded a clear understanding of his/her involvement in this project.

Investigator's Signature Date

CONSENTIMIENTO PERSONAL

Título: MEDICIONES ANTROPOMETRICAS DE NIÑOS ANGLOS Y
MEJICO-AMERICANOS EN EL PROGRAMA WIC

Entiendo que me piden una autorización para que a mi niño (a) _____
_____ le sean tomadas algunas mediciones.

Las mediciones consistirán de lo siguiente: estatura; peso; largo, de la coronilla a las asentaderas; contorno de la cabeza, del brazo, del muslo, de la pantorrilla y del pecho; largo del brazo y del antebrazo; grosor de varios pliegues de la piel y amplitud de la muñeca. Estas mediciones no producen dolor, ni incomodidad, ni complicación alguna.

Entiendo que las mediciones serán tomadas en esta cita únicamente.

Reconozco que mi hijo (a) no recibirá ningún beneficio directo de este estudio. Así mismo reconozco que nuestra participación podría facilitar la revisión que se haga en el futuro a las gráficas de crecimiento, teniendo en cuenta los modelos étnicos de desarrollo físico humano.

Si decido participar en este estudio, se me garantiza que tanto mi nombre como el de mi hijo (a) se mantendrán siempre en secreto. No tengo que pagar para participar.

Entiendo que en caso de que mi hijo (a) sufriera alguna lesión como resultado de las mediciones, no recibiré compensación monetaria por salario o tiempo perdido, ni atención médica, ni hospitalización. La persona que está a cargo de este estudio me dará mayor información cuando yo se la solicite.

A mi testigo y a mí nos explicaron en qué consiste el estudio, lo que debo hacer cuando participe en éste, los riesgos que tiene y los beneficios que proporcionará. Entiendo bien en que consiste mi participación. Además sé que puedo hacer preguntas cuando lo crea necesario y que puedo retirarme del proyecto cuando quiera, sin que por ello se afecte en ninguna forma la atención médica que nos es debida a mí y a mi hijo (a).

Entiendo que este formulario de consentimiento personal será guardado en un sitio determinado por el Comité de Asuntos Humanos y que sólo podrán usarlo el investigador principal del proyecto o los representantes del departamento respectivo.

Firma del padre, de la madre o de su representante legalmente autorizado.

Fecha

Firma del testigo

Fecha

Certifico que les he explicado cuidadosamente a los firmantes la naturaleza de este proyecto. Certifico también que, según mi leal saber y entender, los firmantes de este documento entienden claramente la naturaleza del estudio, conocen los requerimientos de éste y saben qué beneficios y riesgos ofrece. Certifico que los firmantes no tienen ningún impedimento físico, o relativo a su idioma o al nivel de su educación que les haya impedido la comprensión clara del carácter de este estudio y de su participación en él.

Firma del investigador

Fecha

INITIAL QUESTIONS

1. Does the child have a chronic disease? If so, what?
2. Has the child ever been hospitalized for a week or more?
3. Has the child had chronic diarrhea?

DATA SHEET

Child 1 — —

Name _____

Date of examination $\frac{\quad}{4}$ / $\frac{\quad}{6}$ / $\frac{\quad}{8}$ (mo.) (day) (yr.) Date of birth $\frac{\quad}{10}$ / $\frac{\quad}{12}$ / $\frac{\quad}{14}$ (mo.) (day) (yr.)Age $\frac{\quad}{16}$ (wks.) Sex 1 - Female
2 - Male
18Ethnicity 1 - Anglo Ethnicity 1 - Anglo
(Mother) 2 - Mexican-American (Father) 2 - Mexican-American
19 20Body Measurements

Arm lengths:

Upper arm $\frac{\quad}{21}$ cm.Lower arm $\frac{\quad}{25}$ cm.

Circumferences:

MAC (mid-upper arm) $\frac{\quad}{29}$ cm.FOC (head) $\frac{\quad}{33}$ cm.Chest $\frac{\quad}{37}$ cm.Thigh $\frac{\quad}{41}$ cm.Calf $\frac{\quad}{35}$ cm.

Widths:

Wrist breadth $\frac{\quad}{49}$ mm.

Fatfolds:

Triceps $\frac{\quad}{53}$ mm.Subscapular $\frac{\quad}{57}$ mm.

Weight:

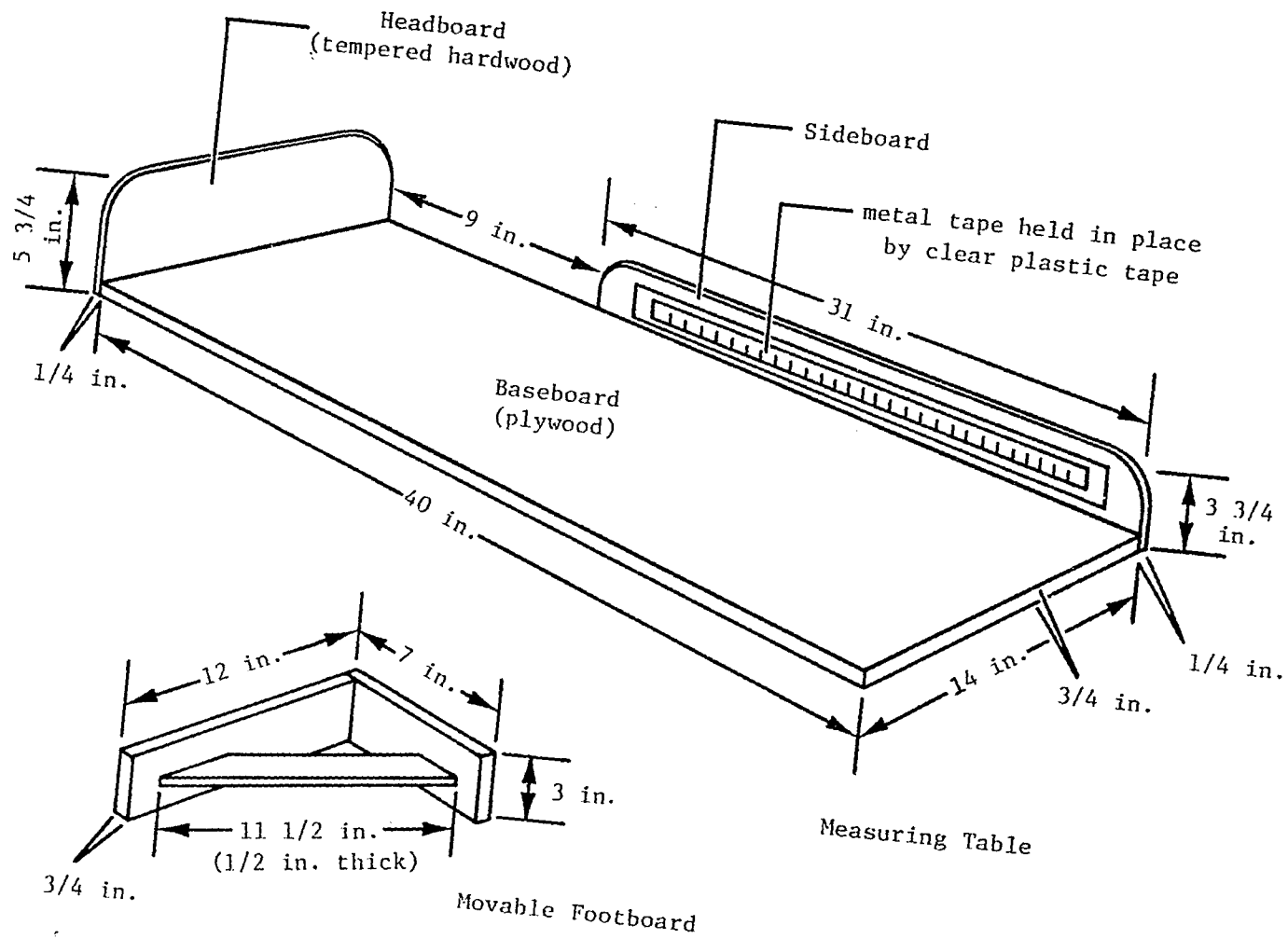
 $\frac{\quad}{61}$ kg. (. . . . lb. oz.)

Lengths:

Supine (crown-heel) $\frac{\quad}{65}$ cm.Crown-rump $\frac{\quad}{69}$ cm.

APPENDIX B

PORTABLE MEASURING BOARD DIMENSIONS



PORTABLE MEASURING BOARD DIMENSIONS

APPENDIX B

REFERENCES

- Alvear, J. and O. G. Brooke. Fetal growth in different racial groups. Arch. Dis. Child. 53: 27-32, 1978.
- Center for Disease Control. Ten State Nutrition Survey, 1968-1970. DHEW Publication No. (HSM) 72-8130. Atlanta: U.S. Dept. of Health, Education, and Welfare, 1972.
- Dauncey, M. J., Gillian Gandy, and Douglas Gairdner. Assessment of total body fat in infancy from skinfold thickness measurements. Arch. Dis. Child. 52: 223-227, 1977.
- Duncan, Burris, Ann N. Smith, and Franklin W. Briese. A comparison of growth: Spanish-surnamed with non-Spanish-surnamed children. Am. J. Public Health 69(9): 903-907, 1979.
- Edozien, Joseph C., Boyd R. Switzer, and Ann Houck. Medical Evaluation of the Special Supplemental Food Program for Women, Infants, and Children (WIC). Chapel Hill, N. C.: Dept. of Nutrition - School of Public Health, 1976.
- Eveleth, Phyllis B. Differences between populations in body shape of children and adolescents. Am. J. Phys. Anthropol. 49: 373-382, 1978.
- Eveleth, Phyllis B., and J. M. Tanner. Worldwide Variation in Human Growth. Cambridge: Cambridge University Press, 1976.
- Falkner, Frank. The creation of growth standards: a committee report. Am. J. Clin. Nutr. 25: 218-220, 1972.
- Foster, Theda A., Antonie W. Voors, Larry S. Webber, Ralph R. Frerichs, and Gerald S. Berenson. Anthropometric and maturation measurements of children, ages 5 to 14 years, in a biracial community - the Bogalusa Heart Study. Am. J. Clin. Nutr. 30: 582-591, 1977.
- Garn, Stanley M. Human Races. Springfield, Ill.: Charles C. Thomas, 1971.
- Garn, Stanley M., and Diane C. Clark. Problems in the nutritional assessment of black individuals. Am. J. Public Health 66(3): 262-267, 1976.

- Greulich, William Walter. Some secular changes in the growth of American-born and native Japanese children. *Am. J. Phys. Anthropol.* 45: 553-568, 1976.
- Haas, Jere D., and Gail Grigsby Harrison. Nutritional anthropology and biological adaptation. *Ann. Rev. Anthropol.* 6: 69-101, 1977.
- Habicht, Jean-Pierre, Reynaldo Martorell, Charles Yarbrough, Robert M. Malina, and Robert E. Klein. Height and weight standards for preschool children. *Lancet* 1: 611-615, 1974.
- Harrison, Gail Grigsby, and Morissa White. Overweight in Arizona infants: relation to birthweight and ethnic group. In L. S. Greene and F. E. Johnston, eds.: *Social and Biological Predictors of Nutritional Status, Physical Growth, and Behavioral Development*. New York: Academic Press, 1980.
- Herbert, J. G., J. F. Kidwell, and H. B. Chase. The inheritance of growth and form in the mouse. IV. Changes in the variance components of weight, tail length, and tail width during growth. *Growth* 43: 36-46, 1979.
- Johnston, Francis E. Research design and sample selection in studies of growth and development. In Francis E. Johnston, A. F. Roche, and C. Susanne, eds.: *Human Physical Growth and Maturation*. New York: Plenum Press, 1980.
- Johnston, Francis E., and Anne Beller. Anthropometric evaluation of the body composition of black, white, and Puerto Rican newborns. *Am. J. Clin. Nutr.* 29: 61-65, 1976.
- Kagawa, Yasuo. Impact of westernization on the nutrition of Japanese: changes in physique, cancer, longevity, and centenarians. *Prev. Med.* 7: 205-217, 1978.
- Lowrey, George H. *Growth and Development of Children*. Chicago: Yearbook Medical Publishers, 1978.
- Manuel, H. T. Physical measurements of Mexican children in American schools. *Child. Develop.* 5: 237-252, 1934.
- Meaney, Francis John. Factors influencing the physical growth of Tucson school-children. Tucson: University of Arizona Doctoral Thesis, 1977.
- Meredith, Howard V. Secular change in sitting height and lower limb height of children, youths, and young adults of Afro-Black, European, and Japanese ancestry. *Growth* 42: 37-41, 1978.

- Molnar, Stephen. Races, Types, and Ethnic Groups. Englewood Cliffs, N. J.: Prentice-Hall, 1975.
- National Center for Health Statistics. NCHS Growth Curves for Children, Birth-18 years, United States. DHEW Publication No. (PHS) 78-1650. Hyattsville, Md.: NCHS, 1977.
- Nellhaus, Gerhard. Head circumference from birth to 18 years. Peds. 41(1): 106-114, 1968.
- Neter, John, and William Wasserman. Applied Linear Statistical Models. Homewood, Ill.: Richard D. Irwin, 1974.
- Owen, George M., and A. Harold Lubin. Anthropometric differences between black and white preschool children. Am. J. Dis. Child. 126: 168-169, 1973.
- Palomino, Hernan, William H. Mueller, and William J. Schull. Altitude, heredity, and body proportions in northern Chile. Am. J. Phys. Anthropol. 50: 39-50, 1978.
- Piedade, Maria, M. S. Oliveira, and Eliane S. Azevedo. Racial differences in anthropometric traits in school children of Bahia, Brazil. Am. J. Phys. Anthropol. 46: 471-476, 1977.
- Robson, J. R. K., F. A. Larkin, J. H. Bursick, and K. P. Perri. Growth standards for infants and children: a cross-sectional study. Peds. 56(6): 1014-1020, 1975.
- Smith, Linda Kautz. Mexican-American views of Anglo medical and dietetic practices. J. Am. Diet. Assn. 74(4): 463-464, 1979.
- Spurgeon, John H., E. Matilda Meredith, and Howard V. Meredith. Body size and form of children of predominantly Black ancestry living in West and Central Africa, North and South America, and the West Indies. Ann. Hum. Biol. 5(3): 229-246, 1978.
- Tanner, J. M. Population differences in body size, shape, and growth rate. Arch. Dis. Child. 51: 1-2, 1976.
- Trinkhaus, Erik. Bilateral asymmetry of human skeletal non-metric traits. Am. J. Phys. Anthropol. 49: 315-318, 1978.
- Weiner, J. S., and J. A. Lourie. Human Biology. Philadelphia: F. A. Davis Company, 1969.
- Wigg, N. R. The anthropometry of western Samoan preschool children. N. Z. Med. J. 87: 172-176, 1978.