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ABSTRACT

Three groups of children (urban black, urban white, rural white) from Middle Tennessee who live in an Appalachian-type environment were studied to assess their health and nutritional status. In addition, some attempt was made to relate aspects of physical status to intellectual adequacy as measured by the Stanford-Binet or the Wechsler Preschool and Primary Scale of Intelligence. The three target groups attended day care programs with a school lunch and snack program. A comparison group did not. Findings of interest were: (1) The general health status of children examined was not inferior on national norms. (2) There was a sufficiently high incidence of visual, auditory, and speech problems to warrant specific attention. (3) The composite specimen analysis technique was successfully used because it presented a precise picture of what a child ate rather than what he was served. (4) No particular meaning was found in correlations between various indices of skeletal age, height, weight, bone density and indices of learning ability. The study was designed and executed solely to provide descriptive information. Figures and tables of physiological data are provided. (WY)

COLLABORATIVE RESEARCH

REPORT

Health and Nutrition in Disadvantaged Children and Their Relationship With Intellectual Development

by

James Carter, Barbara Gilmer,
Roger Vanderzwaag and Katherene Massey

A Collaborative Research Study of the Demonstration and Research Center for Early Education at Peabody College and the Vanderbilt University School of Medicine, Division of Nutrition and Department of Pediatrics

George Peabody College for Teachers, Nashville, Tennessee 37203
Vanderbilt University School of Medicine, Nashville, Tennessee 37203

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Introduction

The study reported in these pages is largely a descriptive one, with special emphasis on the nutritional status of the children involved. In addition, some attempt has been made to relate the various aspects of physical status to intellectual adequacy as measured by the Stanford-Binet or the Wechsler Preschool and Primary Scale of Intelligence (WPPSI).

Although the sample represented in this study cannot be considered as necessarily representative of children from low-income homes, it does consist of black and white urban children, and rural white children from Middle Tennessee, who live in an Appalachian-type environment. Results on the three groups are reported separately. Since the body of published information based upon careful nutritional analyses of the status of such children is small, we believe the detailed report presented in the following pages may be useful to persons concerned with the nutritional aspects of the early development of children from low-income homes.

The Sample

For the school year 1968-69, 19 children were selected for attendance at the rural Early Training Center in Middle Tennessee. These children were examined at the end of the school year during the summer of 1969. For the school year 1969-70, an additional 19 children were selected for the rural center. These children at entry into the one-year program were aged 4 years 8 months to 5 years 7 months.

Nineteen children, 10 black and 9 white were selected for the urban Early Training Center. The children in the urban center were examined several weeks after the beginning of the school year. The urban center children were aged 3 years 8 months to 4 years 8 months at the beginning of the year.

The selection process can best be described as follows: Families were selected on the basis of low socioeconomic status. The social worker visited agencies in the community to inquire about the location of poverty areas and to identify poverty families. The poverty neighborhoods were explored by car. The Early Training Center social worker met with other social workers in the communities and invited their referrals. The criteria for subject selection were that the mother should be under 35 years of age; the target-age child should not be farther along in the family than the third child; in general, younger siblings should be present. The children from Nashville came from two housing projects in the East area.

The social worker also invited referrals from the Department of Public Welfare, the Health Department, and from local community centers. She also talked with elementary school principals and identified families having children in the free lunch program in the areas. Also house-to-house canvassing was employed. The possibility of their child's attending the preschool was presented to the families. It was also strongly stressed that we were only obtaining names and by no means was it definite that their child would be enrolled in the program.

Some referrals were made by neighbors living in the project areas. All families who appeared to fit the criteria were contacted regarding the program. In the urban situation half of the families selected were black.

In the urban center, the mothers' availability for participation one morning a week in a major intervention study was also an important consideration. The criteria of the mother's age and that the target-age child should not be further along in the family than the third child were relaxed in some instances.

All prospects were contacted and screened. Families meeting the above criteria and wishing to participate in the program were then registered. Transportation to and from the center was provided in every instance.

Twenty families constituting a comparison group were also selected. These were families who met the criteria but whom we had been unable to find at home on earlier visits. They were also families who had originally expressed reasons for not participating in the program such as anticipated moves or, in the case of the urban situation, the mothers' attempts to obtain employment or unwillingness to participate in the major intervention study. Some of the families in the comparison group were those who most closely met our criteria but did not meet all of them. The comparison children were not included in the health and nutrition study.

Socioeconomic Data

The typical family of the child selected for inclusion in the rural program in Middle Tennessee is likely to be one in which the natural father is present in the home. He is more than likely to be a skilled or semi-skilled laborer. Only a few of the fathers (3 of 38) were engaged in farm work. We are, therefore, dealing with a non-farming community as far as the majority of the population are concerned. The average annual income of the families in Fairview was well above the OEO Poverty Guidelines. Parent substitutes such as the grandparents, uncles and aunts, and stepfathers were more common in the rural community. The families tended to be slightly larger in the rural community and in several instances there was more than one family living under the same roof. About one third of the rural mothers had completed high school.

The typical family of a white child in the urban center is likely to be one in which the natural father is present in the home at least 50 percent of the time. He is usually an unskilled laborer or perhaps disabled. The average annual income is below the OEO Poverty Guidelines. Half of the mothers were on Welfare or Aid to Dependent Children Programs. There are fewer children in the family than in the rural group and the mother is likely to have gone further in school with 40 percent having completed high school.

The typical black family of the child enrolled in the urban center is likely to be one in which the natural father is not at home. If he is, he is usually employed in maintenance work, in the military service, or is a trainee in some OEO program designed to find jobs for the hard-core unemployed. The average annual family income is about the same as that for the urban white families and is well below the OEO Poverty Guidelines. At least 70 percent of the mothers are receiving Welfare, Aid to Dependent Children, or Social Security payments. The average number of children in the family was about the same as in the urban white families. Also fewer black mothers had completed high school than any other group.

The above socioeconomic data are summarized in the table below:

Table 1

	Urban Black	Urban White	Rural
Average annual income	$2,426	$2,389	$4,017
	Urban Black	Urban White	Rural White
Average age of mother	25.5 yrs.	27.9 yrs.	29.9 yrs.
Mothers work status	3 employed 1 WIN program 6 unemployed	1 WIN program 1 Training Program Welfare 8 unemployed	8 employed 27 unemployed 5 mothers absent
Average education of mother	9 yrs.	10 yrs.	9.5 yrs.
Mothers who completed high school	20%	40%	31%
Father present	20%	56%	74%
Average number of sibs in family	2.9	3.0	3.4

Priorities

An attempt was made to determine if the priorities of the Early Training Centers and those of the Division of Nutrition and the Department of Pediatrics at Vanderbilt coincided with those of the selected families.

The priorities of the Early Training Centers and Vanderbilt are listed below.

Early Training Centers

1. Intervention directed toward improving the educability of young children, with particular emphasis on intellectual and motivational factors.
2. Demonstration of techniques in early education.

3. Research and training in early education.

Vanderbilt--Division of Nutrition and Department of Pediatrics

1. Nutrition and health.

2. Child health.

3. Intervention to promote child health.

We determined the families' priorities by asking the mothers the following question: Which five of the following ten items do you consider most important in improving your living circumstances and making things better for you and your family? Place the numbers one through five in the space next to the items in order of their importance.

0. ______ More and better and different kinds of food.

1. ______ More income in the form of increased wages or larger Welfare and Social Security payments.

2. ______ Better house to live in, with the possibility of owning it some day.

3. ______ Indoor plumbing and toilets if you do not have them already.

4. ______ A babysitting service or day care center that would look after your children for reasonable prices. This would relieve you of this responsibility at least part of the day.

5. ______ An automobile.

6. ______ A television set or other household appliance that you need.

7. ______ Better schools for your children.

8. ______ Better medical care for you and your family, including doctors, public health nurses, and a hospital nearby.

9. ______ To be able to have a say-so in what the local government and politicians do such as taxes, roads, schools, etc.

The results can be summarized as follows. For the urban blacks, most important priorities were:

1. Housing
2. Food
3. Income

All of these items received approximately equal weighting and should be considered the top priorities for this population. Next in order were:

4. A babysitting service
5. Schools
6. Medical care

For the urban white group the following items were considered important:

1. Food
2. Income
3. Housing

The items in this top category were followed by:

4. Medical care
5. Schools

For rural center the most important items were:

1. Income
2. Housing
3. Medical care

This top category was followed by:

4. Schools
5. Indoor plumbing
6. A voice in government

It is interesting to note that food was not considered an important priority by the rural white, low-income families. This may be because nearly three-fourths of them had home gardens where they produced mainly fresh vegetables. Also their annual income was approximately $4000 as compared to $2400 in the urban center.

Sensory-Motor Characteristics

Visual Acuity

Most ophthalmologists agree that adequate screening for vision in school children should include at a minimum:

1. Screening for distance vision
2. Screening for near vision
3. An eye examination to detect muscle imbalance
4. An examination of the fundus of the eye
5. Eye refraction when indicated

Unless these examinations are done, it is not possible to say with absolute certainty that a given child has "normal" vision.

In this study, we were only able to screen for distance vision. The findings are nevertheless revealing in that 8 children out of a total of 57 in both the rural and urban centers had either: Unequal vision in the two eyes, or low visual acuity. In one instance, a child had both.

The test results for these children using the Snellen E Chart are given in Table 2.

Table 2

Visual Acuity

Name	Right eye	Left eye
Children with unequal vision		
AB	20/20-1	20/40±2
AC	20/25-2	20/40-2
AD	20/40-1	20/25-1
AE	20/25	20/40
AF	20/40	20/25-2
Children with low visual acuity		
AG	20/50-3	20/60-2
AH	20/60-3	20/60-2
Child with both unequal vision and low visual acuity		
AI	20/60-1	20/25-2

Normal vision for distance in children four to five years of age should be 20/40 or better. The overall percentage of children in the above series with a probable refractive error is 14. This is not at all unusual in white or black populations. Most studies of refraction in populations indicate that about 70 percent of all eyes are normal and that refractions close to emmetropia are more frequent than would be expected on a curve of normal distribution (McLaren, 1963).

Nevertheless, it should be pointed out that in any intervention program in early education, some account should be taken of the visual acuity of a child and corrective treatment prescribed in order for the child who is visually handicapped to profit from the intervention and learn.

Hearing Tests Results

Audiograms were performed on each of the children in the survey. Pure tone thresholds by air conduction were determined for each ear at octave frequencies from 250-8,000 Hz. For those children whose air conduction thresholds indicated the possibility of a conductive impairment, bone conduction thresholds were obtained.

Twenty-five children out of a total of 57 from both the rural and urban schools were found to have some degree of conductive hearing loss, evidenced by differences in air and bone conduction thresholds. Pure tone results in these children indicated some degree of middle ear impairment of medical significance, most probably due to a blocked Eustachian tube secondary to an upper respiratory infection, to acute or Chronic otitis media, or to a chronic serous otitis media.

Of these twenty-five children, only seven out of 15 percent were considered to have reduced hearing to a degree which might interfere with learning. This was determined as follows. Pure tone thresholds do not provide directly a value that can be regarded as representing the individual's communicative disability, since performance in social communication is related directly to hearing for speech rather than for pure tones. It is possible, however, to predict hearing for speech from pure tone thresholds by averaging the thresholds for pure tones across the range of speech frequencies. On this rationale, the Best Binaural Average (B.B.A.) was computed for each child as a single value representing his ability to hear spoken language. The B.B.A. is the average of his best pure tone thresholds from the two ears at 500, 1,000, and 2,000 Hz.

On the basis of experience with children of preschool and elementary school age, a B.B.A. range of 0-15 decibels (dB) can be regarded as normal. Children with B.B.A.'s of 15 dB's or greater can be expected to have some degree of difficulty in an aural communication situation.

Seven children in the above sample were found to have B.B.A.'s of 15 dB's or greater. The performance of these children might be influenced by reduced hearing, to the degree by which their B.B.A. exceeds 15 dB's. In addition, children whose B.B.A.'s are borderline (13 or 14 dB) might also have some degree of difficulty. It is surprising to find that 12 percent of the subjects in this study have reduced hearing to a degree which might interfere with learning. This should only emphasize the importance of routine screening for hearing loss in intervention programs in early childhood education.

Speech Pathology

Out of 19 children enrolled in the rural school during the year 1968-69, four were thought by the teachers to have a possible speech and language disorder. Their speech was largely unintelligible. On the other hand, they appeared to understand whatever the teacher and the other children said to them. These children would have been referred for a screening evaluation if an opportunity to do so had presented itself.

During the school year 1969-70, arrangements were made for a screening evaluation of speech for those children in both the rural and urban preschools who appeared to have problems. Seven children were referred out of a total of 39 children in both schools. The reports of the speech screening are summarized on the following pages, together with results on one language screening device, the Peabody Picture Vocabulary Test (PPVT).

Urban White Group. Case of BA: Age at evaluation, 4-10. Patient exhibited a severe articulation disorder with fair stimulability for the defective sounds. His speech was largely unintelligible. Tongue strength and movement appeared adequate, but his lips were weak and more poorly controlled. His vocabulary comprehension as measured by the PPVT was greatly depressed at the 2 years 8 months age level. His expressive language output was limited in quantity and immature. Therapy was recommended on a twice weekly basis with emphasis on both articulation and language stimulation.

Case of BB: Age at evaluation, 4-4. Patient exhibited a moderately severe articulation disorder both in single word production and conversation. Intelligibility of his connected speech was poor. Examination of the oral structure and musculature revealed weak tongue and lip musculature. On the PPVT he received a vocabulary age of 4 years 9 months, which is generally adequate for his age level. Because of the moderately severe articulation disorder, therapy was recommended on a twice a week basis.

Rural Group. Case of BC: Age at evaluation, 601. This child's spontaneous speech was 100 percent intelligible to the examining clinician. A formal test of articulatory skill revealed a mild problem of misarticulation consisting primarily of difficulty producing the r sound and consonant blends containing r; the th sound and the v sound. Examination of the peripheral speech mechanism was essentially negative with reference to the articulation problem. Other clinical testing indicated functioning within broad normal limits in the area of receptive vocabulary. Speech therapy was not recommended. This child may correct her misarticulation patterns with maturity. However, it was felt that stimulation activities carried out in the classroom may be of help in improving the child's articulation. A list of some suggestions was sent to the classroom teacher.

Case of BD: Age at evaluation, 5-8. Patient exhibited a moderately severe problem of misarticulation, both in single words and in conversation. Intelligibility was generally poor. On examination of the oral musculature it was found that the child was capable of good control of tongue and lip movements, but he was not ordinarily using adequate movement. The PPVT was used for screening verbal adequacy. His performance yielded a mental age of 3 years 8 months, with a quotient of 63, indicating a decided deficit in receptive vocabulary. Because of the moderately severe articulation disorder and the depression in receptive language, diagnostic therapy was recommended for the patient.

Case of BE: Age at evaluation, 6-0. Examination revealed an articulation disorder of moderate severity characterized by distortions, substitutions, and omissions of several consonant sounds. Examination of the peripheral speech mechanism indicated adequate strength and range of movement for normal speech production. Patient's vocabulary comprehension as measured by the PPVT was considerably below expectancy with an age equivalent of 3 years 9 months, and a vocabulary quotient of 65. The patient's expressive language, however, appeared grammatically adequate. A therapeutic program of articulation training and language stimulation was recommended.

Case of BF: Age at evaluation, 5-6. Analysis of the patient's articulation revealed a moderately severe problem both in single word production and conversation. Examination of the oral structures revealed weak tongue musculature. Manifestations of a tongue thrust swallowing pattern were noted. On the PPVT the patient received a vocabulary age of 4 years 9 months, indicating a nine month delay in this area. Because of the moderately severe articulation disorder, speech therapy was recommended on a twice a week basis.

Case of BA: Age at evaluation, 5-6. Receptive language was assessed by means of the PPVT which revealed a vocabulary age equivalent of 5 years 1 month, with a vocabulary quotient of 87. The patient's expressive language throughout the evaluation appeared at age level. His articulation analysis revealed a mild articulation disorder characterized by substitution of f for voiceless th; b for v, a frontal lisp for the s and z; d substitution for voiced th, and some difficulty with r blends; fl blends; and sl blends. It was not felt that speech therapy was indicated at this time, but rather that the teacher and parent might be able to work with the child on the few defective sounds he has in order to encourage correct sound production. A suggested outline was sent to the classroom teacher.

The overall percentage of the children enrolled in the rural center for the year 1968-69 who were considered by the teachers to have a speech disorder and possibly impaired language development was 21 percent. In the subsequent year, 1969-70, the overall percentage of children in both the rural and the urban centers demonstrated to have speech and language vocabulary problems was 19 percent. The children in the 1969-70 group were evaluated by a trained speech clinician and a speech pathologist.

It is interesting to note that the majority of the children with speech problems came from the rural center. There were only two children with speech and language problems from Nashville. Also, no black children to the recollection of the teachers have ever been referred for speech and language evaluation. The reasons for this apparent racial difference and difference between urban and rural white families are not apparent. The differences appeared to be consistent, however, even though the numbers of children are small.

Shaw and Schoggen (1969) have pointed out the importance of language development to the way in which children learn. Verbal stimulation on the part of the mother is a prerequisite to normal or enhanced cognitive development. If the mother and the siblings have articulation disorders, then the target-child will most certainly develop one. Speech disorders should be taken into consideration in evaluating the performance of children on oral tests of ability and achievement. Therapy to correct such disorders should be included as an appropriate part of the individualized curriculum in early education programs. The major importance of language in general school adequacy goes without saying. The educational program of these schools has included enhanced language development as one of its most important goals. Since it makes a major contribution to the general purpose of socialization for competence--or enhancing the adequacy of young children for meeting the demands of school and broader life.

Nutrition

School Feeding Program

At both the rural and the urban centers, the children were served a snack and a lunch. The snack was given upon arrival at the center and the lunch was given later on. in the urban center, which opened each day at 8:30, children who appeared to have had no, or an inadequate breakfast, were given a light breakfast.

December Menu

	Monday	Tuesday	Wednesday	Thursday	Friday
First Week	chili saltine crackers carrott & celery sticks fruit cocktail milk (2)	chicken noodle soup egg salad sandwich potato chips apple cobbler milk (3)	baked ham sweet potatoes green beans hot biscuits jello - cherry milk (4)	macaroni & cheese cole slaw whole wheat bread white cake - chocolate icing milk (5)	fish sticks whipped potatoes mixed vegetables butterscotch pudding milk (6)
	biscuit & jelly milk	graham cracker orange juice(Hi-C)	fig newton milk	cinnamon toast hot chocolate	peanut butter & crackers grape juice (Hi-C)
Second Week	eggs(scrambled or creamed) sausage french fries hot biscuit banana milk (9)	vegetable soup corned beef sandwich pickles fruited jello milk (10)	meat loaf baked potato broccoli corn bread raspberry sherbet milk (11)	white beans deviled eggs cole salw corn bread peach cobbler milk (12)	tuna noodle cassarole green peas cottage cheese on pear french bread cookie, milk (13)
	cereal milk	buttered toast apple juice	cookie milk	vanilla wafer milk	orange milk
Third Week	"sloppy joes" fritoes carrot sticks peach half milk (16)	chicken & stars soup cheese sandwich chocolate cake - white icing milk (17)	beef stew corn bread tossed salad apple sauce cookie milk (18)	turnip greens w/ham whipped potatoes cooked carrots corn bread banana pudding milk (19)	hot dogs potato salad pickles lime sherbet milk milk
	biscuit honey	ritz crackers orange juice	cinnamon toast hot chocolate	sugar cookie hawaiian punch	apple milk

The Composite Specimen Analysis

In order to obtain some idea of the nutrients consumed by the average five to six year old in the rural center and by the average four to five year old in the campus center, we asked the teachers to select approximately ten students on whom we could collect composite food samples of both the snack and the lunch. We asked the teachers to select students whom they considered to be "poor eaters," "average eaters," and "big eaters." Approximately three students were selected for each group.

Composite samples were collected and prepared for each child on a typical school day according to the methods outlined in the I.C.N.N.D. Manual for Nutrition Surveys (1963). These samples were sent to the Wisconsin Alumni Research Foundation (W.A.R.F.) Institute, Inc., for analysis. The methods used by W.A.R.F. are given in the appendix.

Fluoride analysis was also determined by W.A.R.F. on water samples collected from several homes in the rural community and in Nashville. These results will be reported later in conjunction with the dental findings.

The results of the dietary composites collected in the rural and the urban centers are given in the tables on the following pages.

Table 3'A

DIETARY COMPOSITES - RURAL CENTER

Name	I.D.		Wt. of Sam.	Cal.	Pro. gm.	CHO gm.	A I.U.	B Caro. mg.	K. mg.	Mg. mg.	Na. mg.	Fe. mg.	Zn. mg.	Ca. mg.	P. mg.
CA	3-10	*	749.2	506	21.7	53.2	502.0	7.42	1648	77.9	1221	1.933	2.772	449.5	449.5
CB	3-15	**	533.2	481	19.2	49.6	282.6	1.97	1226	53.3	1034	3.274	2.186	266.6	271.9
CD	3-01	**	680.4	645	35.4	70.8	605.6	0.14	1701	70.8	1109	2.232	3.334	408.2	523.9
CE	3-13	*	468.0	328	15.0	44.9	379.1	0.14	983	39.3	356	1.535	5.101	332.3	294.8
CF	3-09	***	916.0	747	31.1	76.9	458.0	0.28	2382	79.7	2143	3.005	3.023	320.6	375.6
CG	3-05	*	709.0	819	29.8	80.8	390.0	0.21	1560	64.5	1510	2.205	3.687	425.4	411.2
CH	3-06	***	679.4	577	21.3	62.5	366.9	0.27	1834	70.7	944	3.193	4.620	434.8	455.2
CJ	3-19	**	628.3	396	13.8	65.3	314.2	0.63	1319	31.4	955	1.621	1.131	201.1	233.7
CJ	3-12	***	724.2	737	29.0	68.8	579.4	0.44	1955	63.0	891	2.375	3.186	434.5	593.8
CK	3-14	*	768.4	760	27.7	99.9	845.2	0.31	2075	66.9	1352	2.390	2.613	384.2	630.1
	Average		685.6	600	25.4	67.3	472.3	1.18	1668	61.8	1152	2.376	3.165	365.7	424.0
STD.	Deviation		124.7	169	7.5	16.3	169.0	2.26	420	15.9	466	.614	1.142	83.2	133.9
STD.	Error		39.4	53	2.4	5.2	53.4	.71	133	5.03	147	.194	.361	26.3	42.4
	Minimum		468.0	328	13.8	44.9	282.6	.14	983	31.4	356	1.535	1.131	201.1	233.7
			916.0	819	35.4	99.9	845.2	7.42	2382	79.7	2143	3.274	5.101	449.5	630.1

* Poor eater ** Average eater *** Big eater

Table 3B .

DIETARY COMPOSITES - URBAN CENTER

Name	I.D.		Wt. of sample	Cal.	Pro. gm.	CHO gm.	Rib. mg.	B-6 mg.	B-12 mcg.	NIA mg.	Folic Acid mg.	Ascor. Acid mg.	THI. mg.	E mg.
CL		*	561.6	785	15.2	133	.388	.379	.466	3.55	23.6	90.0	.295	1.48
CM	2-07	*	410.3	612	16.6	65.2	.602	.328	1.04	3.55	9.08	23.2	.216	1.55
CN	1-05	**	723.8	849	25.6	121	.687	.357	1.23	3.63	10.8	80.8	.303	.984
CO	2-02	**	761.1	716	25.4	65.1	.827	.488	1.54	4.14	6.24	24.7	.482	1.24
CP	2-08	*	352.9	487	16.7	43.0	.588	.215	1.06	1.35	4.17	5.56	.221	1.85
CQ	1-07	*	318.5	223	10.8	22.0	.417	.169	1.38	1.16	2.56	1.88	.166	.433
CR	2-03	**	720.5	791	24.1	79.8	.704	.557	1.27	5.94	5.69	23.5	.302	1.52
CS	1-02	***	1002.0	1022	37.7	104	.942	.655	1.40	4.29	34.2	105	.625	2.74
CT	2-01	*	628.0	711	25.4	103	.618	.393	.728	5.70	10.2	76.9	.393	1.45
	Average		608.7	688	21.9	81.8	.641	.393	1.124	3.701	11.9	47.9	.334	1.47
	STD Deviation		222.3	229	8.03	36.6	.177	.155	.344	1.643	10.7	39.7	.145	.626
	STD Error		74.1	76	2.68	12.2	.059	.052	.115	.548	3.6	13.2	.048	.209
	Minimum		318.5	223	10.8	22.0	.388	.169	.466	1.160	2.56	1.88	.166	.433
	Maximum		1002.0	1022	37.7	133.0	.942	.655	1.540	5.940	35.2	105.	.625	2.74

* Poor eater ** Average eater *** Big eater

This represents to our knowledge the first time information has been obtained by analysis of food composites on average nutrient intakes of preschool children in a day care situation. It should be noted, however, that this day care situation is not typical.

As has been pointed out by Bettelheim (1970), "food can be used to nurture the mind." It is fair to say that this is the case in the Early Training Center feeding program. The meals are well prepared and appetizing. The teachers (one for every five students) sit down at the same table and eat and converse with the children, thereby creating a pleasant atmosphere where interaction between student and teacher can take place. Food for the mind and food for the body then become psychologically one and the same. This atmosphere does not prevail in the typical school lunch situation in most day care centers and public schools.

It can also be seen from the tables that the subjective impressions of the teachers as to which children were poor, average, and big eaters were reasonably accurate. This probably reflects the close association between teacher and child at snack and lunch time and the fact that she knows on a day to day basis what each child is eating.

The average nutrient intakes, therefore, do not tell the whole story of the benefits to be derived from a well-run school feeding program with good food and with a continuation of the learning process during meal time. The staff and teachers can be proud of this aspect of their program.

Estimated Home Consumption of Nutrients

A modified seven day recall dietary history was obtained from each mother by an experienced dietitian. The mother was not asked to keep a daily record but instead was asked to estimate the kinds and amounts of food consumed by her child on a typical day for every day in the week. These amounts were recorded as daily or weekly servings of a particular food. The nutrient content of these foods was determined by referring to previously published values in the U. S. Department of Agriculture's Handbook Number 8.

As mentioned earlier, food was not an important priority for the families in the rural community. Home gardens were in evidence in 75-80 percent of the homes. These families grew mostly corn, tomatoes, greens, cucumbers, potatoes, peas and beans, carrots, turnips, peppers, squash, okra, and radishes. In addition, incomes were slightly above the poverty level according to OEO guidelines.

The average daily consumption of nutrients estimated by the recall method is given in Table 4.

Table 4

Daily Consumption of Nutrients

	Urban Black	Urban White	Rural White	National Nutrition Survey Reference Standard*
CAL.	1534.0	1709.0	1932.0	1255-1590
PRO. (gm)	47.2	54.4	59.9	23-29.1
CA. (mg)	609.0	710.0	759.0	450
FE (mg)	6.4	7.5	8.5	10
A (IU)	3666.0	4419.0	4155.0	2000
C (MG)	30.2	36.2	41.3	30
THI. (mg)	.62	.74	.88	.50-.64
RIB. (mg)	1.1	1.3	1.4	.69-.88
NIA. (mg)	8.9	9.7	11.1	8.3-10.5

* The ranges are given for recommended dietary intakes for healthy four to six year old children.

As can be seen from the above recall data, the estimated daily intakes of nutrients by black and white children in urban Nashville, and by white children in the rural community are well above the reference standards.

These data cannot be added to the average daily nutrient intakes determined by analysis of composites of the school snack and lunch because they are not comparable.

Past Medical History

There was no attempt in this study by means of a questionnaire or interview to obtain medical histories on the children examined.

Nevertheless, we did obtain locally available medical records from the Health Department, private physicians, and hospital records. This was done for the purpose of verifying birth weights and for obtaining previously recorded measurements of height and/or weight. In looking over these records, we could not help noticing that some of the children had previous illnesses which might have some bearing on their ability to learn in a preschool situation. Some glaring examples follow.

Case of D.A.:--This child had an aspiration pneumonia shortly after birth. It was also noted at the time of delivery that he had a single umbilical artery. (This malformation is frequently associated with other congenital defects.) There was a tuberculosis contact in the family from both the mother and grandmother and the child as an infant received B.C.G. The child's mother was 19 years old and she was murdered a few years after he was born. D.A. apparently witnessed this tragic event on the front porch. A few months before the mother was shot, the child had begun to have convulsive seizures and was started on therapy with phencbarbital. He also had a history of pneumonia at one time, asthma associated with upper respiratory infections, and at least three bouts of otitis media (ear infections).

Case of D.B.:--This child had a history of having taken iron all of his life for a suspicious anemia.

Case of D.C.:--This child at one time had a heart murmur which was thought to be functional. D.C. was also definitely anemic with a hemoglobin of 7 grams.

Case of D.D.:--This child was hospitalized at the age of 1 year for having ingested Warfarin (rat poison). She was also diagnosed at this time, as having iron deficiency anemia. She was hospitalized again at the age of 19 months with meningitis.

Case of E.E.:--This child had a history of having been resuscitated for nearly twenty minutes following delivery. Her reflexes were considered sluggish. There was a possibility that she may have suffered brain damage during such a severe period of anoxia.

Case of D.F.:--This child was diagnosed as having the respiratory distress syndrome or hyaline membrane disease shortly after birth.

Case of D.G.:--This child had congenital heart disease with frequent bouts of heart failure. She had also had corrective open heart surgery. The post-operative diagnosis was atrial septal defect, i.e., ostium primum with a cleft mitral valve. She was malnourished prior to surgery and the malnutrition secondary to her heart lesion may have interfered with brain growth.

Case of D.H.:--This child was diagnosed as having chronic otitis media (ear infection).

Case of D.I.:--This child was hospitalized at age 11 months for pneumonia and iron deficiency anemia.

Case of D.J.:--This child was hospitalized at age 15 months for observation because of a head injury. A hematoma was present in the occipital area.

The above illnesses may or may not represent an unusual amount of pathology for a group of 57 four to six year old children. We do not think that should be our primary consideration. Rather we should be concerned with the fact that a large number of these children do have medical histories clearly relevant to their general adequacy. A summary of these past medical histories, which we came upon almost by accident, does serve to point out, however, that information of this kind should be obtained on every preschool child before he is enrolled in an early education training center.

Physical Studies

Every child enrolled in the urban and rural centers had a complete physical examination. The children were examined once during the school year. The results of this examination are given in Table 5. The numbers and percentages in each group who were positive for a given physical finding are recorded.

Table 5

Results of Physical Examinations

		Urban Black N=10	Urban White N=9	Rural White N=38	Total N=57
1. Dyspigmentation of hair	no.	0	5	27	32
	%		55.56	71.05	56.14
2. Hair easily plucked	no.	2	3	16	21
	%	20.00	33.33	42.11	36.84

Table 5 (continued)

		Urban Black n=10	Urban White n=9	Rural n=38	Total n=57
3. Abnormal texture or loss of curl	No. %	0	0	0	0
4. Ringworm of scalp	No. %	0	0	1 2.63	1 1.75
5. Confunctival injection bilateral	No. %	4 40.00	5 55.56	10 26.32	19 33.33
6. Xerosis	No. %	0	0	0	0
7. Bitot's Spots	No. %	0	0	0	0
8. Angular lesions	No. %	0	0	0	0
9. Angular scars	No. %	0	0	0	0
10. Cheilosis	No. %	3 30.00	1 11.11	9 23.68	13 22.81
11. Filiform papillary atrophy	No. %	1 10.00	4 44.44	7 18.42	12 21.05
12. Fungiform, papillary hypertrophy or hyperemia	No. %	3 30.00	1 11.11	9 23.68	13 22.81
13. Geographic tongue	No. %	1 10.00	1 11.11	0	2 3.51
14. Fissures	No. %	1 10.00	3 33.33	3 7.89	7 12.28
15. Glossitis	No. %	0	0	0	0
16. Nasolabial seborrhea	No. %	0	0	1 2.63	1 1.75

Table 5 (continued)

		Urban Black n=10	Urban White n=9	Rural n=38	Total n=57
17. Parotids visibly enlarged	No. %	0	0	0	0
18. Size of thyroid gland Palpable thyroid	No. %	2 20.00	4 44.44	22 57.89	28 49.12
Visible head normal	No. %	0	0	0	0
Visible head extended	No. %	8 80.00	5 55.56	16 42.11	29 50.88
Goiter WHO II	No. %	0	0	0	0
Goiter WHO III	No. %	0	0	0	0
Goiter WHO IV	No. %	0	0	0	0
19. Pallor at nail beds	No. %	10 100.00	2 22.22	6 15.79	18 31.58
20. Spooned nails	No. %	0	0	0	0
21. Ridged nails	No. %	0	0	0	0
22. Follicular hyperkeratosis, arms	No. %	0	0	0	0
23. Follicular, hyperkeratosis, back	No. %	0	0	0	0
24. Dry or scaling skin (xerosis)	No. %	7 70.00	0	5 13.16	12 21.05
25. Hyperpigmentation, face and hands	No. %	1 10.00	0	0	1 1.75

Table 5 (continued)

		Urban Black n=10	Urban White n=9	Rural n=38	Total n=57
26. Thickened pressure points	No. %	2 20.00	0	1 2.63	3 5.26
27. Ringworm of skin	No. %	0	0	2 5.26	2 3.57
28. Pot belly	No. %	5 50.00	2 22.22	5 13.16	12 21.05
29. Hepatomegaly	No. %	2 20.00	1 11.11	8 21.05	11 19.30
30. Umbilical hernia	No. %	4 40.00	0	0	4 7.02
31. Pretibial edema, bilateral	No. %	2 20.00	5 55.56	11 28.95	18 31.58
32. Beading of ribs	No. %	0	0	1 2.63	1 1.75
33. Bowed legs	No. %	0	0	0	0
34. Epiphyseal enlargement, wrists	No. %	0	0	1 2.63	1 1.75
35. Bossing of skull	No. %	4 40.00	2 22.22	6 15.79	12 21.05
36. Winged scapula	No. %	2 20.00	1 11.11	4 10.53	7 12.28
37. General impression skinny	No. %	2 20.00	3 33.33	8 21.05	13 22.81
fat	No. %	0	0	2 5.26	2 3.51
neither	No. %	8 80.00	6 66.67	28 73.68	42 73.68
38. Strabismus	No. %	1 10.00	0	3 7.89	4 7.01

		Urban Black n=10	Urban White n=9	Rural n=38	Total n=57
39. Condition of ears normal drums	No. %	9 90.00	7 77.78	38 100.00	54 94.74
Acute otitis media	No. %	0	0	0	0
Serous otitis media	No. %	1 10.00	2 22.22	0	3 5.26
Chronic draining ear	No. %	0	0	0	0
40. Condition of tonsils Normal tonsils	No. %	4 40.00	3 33.33	19 50.00	26 45.61
Hypertrophy without infection	No. %	6 60.00	6 66.67	19 50.00	31 54.39
Tonsillitis	No. %	0	0	0	0
41. Cervical Adenopathy Anterior	No. %	1 10.00	0	3 7.89	4 7.02
Posterior	No. %	2 20.00	5 55.56	4 10.53	11 19.30
Both	No. %	5 50.00	1 11.11	13 34.21	19 33.33
Neither (none)	No. %	2 20.00	3 33.33	18 47.37	23 40.35
42. Lungs clear to auscultation Yes	No. %	10 100.00	7 77.78	38 100.00	55 96.49
No	No. %	0	2 22.22	0	2 3.51
Not Known	No. %	0	0	0	0
43. Auscultation of Heart Normal	No. %	8 80.00	6 66.67	28 73.68	42 73.68
Functional murmur	No. %	2 20.00	1 11.11	10 26.32	13 22.81
Congenital organic heart disease	No. %	0	2 22.22	0	2 3.51
Rheumatic organic heart Diesease	No. %	0	0	0	0

Table 5 (continued)

		Urban Black n=10	Urban White n=9	Rural n-38	Total n=57
44. Abdomen Normal to palpation	No. %	10 100.00	8 88.89	37 97.37	55 96.49
Splenomegaly	No. %	0	1 11.11	1 2.63	2 3.51
Palpable mass	No. %	0	0	0	0
45. Femoral Pulses Palpated					
Normal	No. %	10 100.00	8 88.89	35 92.11	53 92.98
Weak and/or delayed	No. %	0	1 11.11	1 2.63	2 3.51
Not known	No. %	0	0	2 5.26	2 3.51
46. Inquinal adenopathy	No. %	8 80.00	6 66.67	27** 75.00	41 74.55
47. Indirect inguinal adenopathy	No. %	0	0	0**	0
			**two children unknown		
48. Genitalia Normal	No. %	9 90.00	9 100.00	30 78.95	48 84.21
Malformations	No. %	1* 10.00	0	2 5.26	3 5.26
Not known	No. %	0	0	6 15.79	6 10.53
			*Phimosis		
49. Testes Both descended	No. %	5 100.00	4 100.00	19 95.00	28 96.55
One descended only	No. %*	0	0 5.00	1 3.45	1
Neither descended	No. %*	0	0	0	0
Not known	No. %*	0	0	0	0
Not applicable (female)	No. %*	5 50.00	5 55.56	18 47.37	28 49.12

*percentage of males only.

Table 5 (continued)

		Urban Black n=10	Urban White n=9	Rural n=38	Total n=57
50. Gait					
Normal	No.	9	9	37	54
	%	90.00	100.00	97.37	94.74
Abnormal	No.	1	0	0	1
	%	10.00			1.75
Not known	No.	0	0	1	2
	%			2.63	3.51
51. Posture					
Normal	No.	6	8	23	37
	%	60.00	88.89	60.53	64.91
Stooped	No.	2	0	12	14
	%	20.00		31.58	24.56
Increased Lordosis	No.	2	1	3	6
	%	20.00	11.11	7.89	10.53
Scoliosis	No.				
	%	0	0	0	0
Not known	No.				
	%	0	0	0	0
52. Muscle Tone					
Spasticity	No.				
	%	0	0	0	0
Hypotonia	No.			1	1
	%	0	0	2.63	1.75
Myotonia	No.	10	9	37	56
	%	100.00	100.00	97.37	98.25
Not known	No.				
	%	0	0	0	0
53. Emotional					
Apathetic	No.			2	2
	%			5.26	3.51
Irritable	No.				
	%				
Frightened	No.	4	2	11	17
	%	40.00	20.00	28.95	29.82
Other	No.		1	1	2
	%		11.11	2.63	3.51
Normal	No.	6	6	24	36
	%	60.00	66.67	63.16	63.16

In general, these children were considered to have physical findings within normal limits. The majority of the positive findings were of a non-specific nature. Some of these findings are listed below.

1. There was evidence of iron deficiency with filiform papillary atrophy of the tongue in 21 percent and pallor of the nail beds in 32 percent.
2. Umbilical hernia, as to be expected, was found only in the black children with a prevalence of 40 percent.
3. The pretibial edema which was recorded was slight in every instance and an extreme amount of pressure had to be exerted.
4. One child was noted to have beading of the ribs, and another child was noted to have epiphyseal enlargement of the wrists. These are probably signs of old rickets.
5. There was no evidence of goiter or thyroid enlargement in any of these children.
6. The majority of children were considered to have normal body-build.
7. A few (3) of the children were diagnosed as having chronic serious otitis media.
8. Two children were thought to have congenital heart disease. One child as noted above had previous heart surgery for an atrial septal defect. The other was also suspected of having an atrial septal defect.
9. One child had an undescended testicle on repeated examinations.

The majority of the children were cooperative during the examination and in only one instance, which was corroborated by her history, was a child thought to have a severe emotional disturbance. This particular child was emotionally upset during the examination. Her performance in the classroom over a six months period indicated that she was non-communicative. She refused to say a single work or enter into conversation with the teacher and the other students at her table.

Examination of these children, therefore, by routine inspection and using the conventional instruments found in a doctor's office, i.e. stethoscope, otoscope, etc. would be expected to yield minimal findings. Only by obtaining past medical histories, visual acuity, audiometry, anthropometric measurements, and blood and urine tests would we be able to pick up significant medical problems which might interfere with the learning process.

Anthropometric Measures

All of the children in this study were weighed. In addition, the measurements given below were recorded. The units in which the measurements were recorded are given in parentheses.

Height (cm); Chest Circumference (cm); Head Circumference (cm); Skin Fold Thickness in the Sub-scapular Area (mm); Skin Fold Thickness in the Triceps Area (mm); Arm Circumference (cm); Mother's Height (cm)

In addition, the child's birth weight was recorded from the mother's history and verified from local hospital records when they were available.

Muscle circumference was calculated, using the formula developed by Jelliffe, from values recorded for arm circumference and skinfold thickness in the triceps area.

The adjusted heights and adjusted weights were also calculated. They represent the difference between the child's actual height and weight, and the expected height and weight for the appropriate sex and chronological age, according to the means recorded in the Iowa growth charts.

Height age and weight age were also determined by using the child's actual height and weight and referring back to the Iowa growth chart to determine the mean age for these measurements.

The data on actual height and weight, expected height and weight, adjusted height and weight, and height age and weight age are given for each of the children in this study in the table below.

Table 6

Height and Weight Indices

Sex	Age	Ht.	Exp.Ht.	Adj.Ht.	Ht.Age	Wt.	Exp.Wt.	Adj. Wt.	Wt.Age
				Urban Black					
M	51	103.0	105.1	- 2.1	47	14.6	17.6	- 3.0	27
F	53	112.5	105.3	+ 7.2	66	16.9	17.6	- .7	49
F	50	111.0	103.7	+ 7.3	64	15.1	17.1	- 2.0	39
F	50	103.1	103.7	- .6	49	17.0	17.1	- .1	50
M	54	105.5	106.7	- 1.2	52	17.6	18.1	- .5	51
M	52	104.0	105.6	- 1.6	49	18.2	17.8	+ .4	55
F	48	95.5	102.5	- 7.0	36	13.3	16.7	- 3.4	30
M	53	111.1	106.2	+ 4.9	62	14.9	17.9	- 3.0	34
F	55	111.3	106.4	+ 4.9	64	18.5	17.9	+ .6	59
M	50	94.7	104.5	- 9.8	34	14.7	17.4	- 2.7	32
				Urban White					
M	53	113.0	106.2	+ 6.8	66	14.8	17.9	- 3.1	33
M	55	112.5	107.3	+ 5.2	65	17.0	18.3	- 1.3	48
F	58	111.0	108.0	+ 3.0	64	18.7	18.4	+ .3	60
M	48	105.2	103.4	+ 1.8	51	19.2	17.1	+ 2.1	61
M	51	93.5	105.1	-11.6	32	14.1	17.6	- 3.5	23
F	54	97.5	105.9	- 8.4	39	14.0	17.7	- 3.7	33
F	50	95.0	103.7	- 8.7	35	11.9	17.1	- 5.2	22
F	51	99.5	104.2	- 4.7	43	15.2	17.2	- 2.0	39
F	51	96.5	104.2	- 7.7	38	13.0	17.2	- 4.2	27

Table 6 (continued)

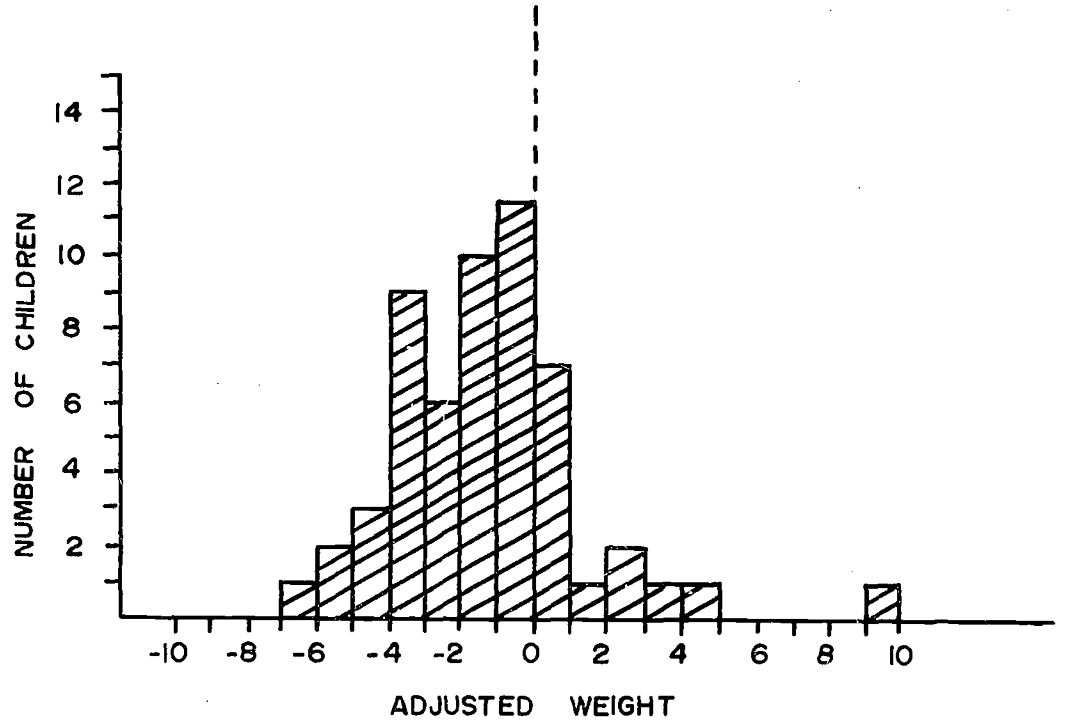
Rural

Sex	Age	Ht.	Exp.Ht.	Adj.Ht.	Ht.Age	Wt.	Exp.Wt.	Adj.Wt.	Wt.Age
M	73	115.3	116.5	- 1.2	71	20.2	21.1	- .9	67
F	78	112.5	118.1	- 5.6	66	17.6	21.4	- 3.8	53
M	71	119.2	115.5	+ 3.7	79	20.3	20.8	- .5	68
M	79	120.2	119.4	+ .8	81	22.1	22.1	0.0	79
M	79	115.5	119.4	- 3.9	71	20.2	22.1	- 1.9	67
M	80	118.8	119.9	- 1.1	78	25.1	22.2	+ 2.9	94
F	76	112.2	117.2	- 5.0	66	19.1	21.1	- 2.0	63
M	73	114.2	116.5	- 2.3	68	15.4	21.1	- 5.7	38
M	70	117.7	115.1	+ 2.6	75	24.5	20.6	+ 3.9	91
F	76	103.0	117.2	-14.2	49	15.0	21.1	- 6.1	38
F	79	125.2	118.6	+ 6.6	96	25.8	21.6	+ 4.2	113
M	70	112.7	115.1	- 2.4	65	21.5	20.6	+ .9	76
M	75	110.3	117.5	- 7.2	61	18.0	21.4	- 3.4	54
F	71	107.9	114.8	- 6.9	58	17.7	20.3	- 2.6	54
F	79	108.9	118.6	- 9.7	60	16.7	21.6	- 4.9	48
F	79	114.7	118.6	- 3.9	71	19.6	21.6	- 2.0	66
F	72	113.1	115.3	- 2.2	68	20.1	20.5	- .4	70
M	71	115.6	115.5	+ .1	71	20.4	20.8	- .4	69
F	76	110.8	117.2	- 6.4	63	17.9	21.1	- 3.2	55
F	60	102.5	109.1	- 6.6	48	16.0	18.7	- 2.7	44
M	64	110.7	112.0	- 1.3	61	19.4	19.7	- .3	62
F	70	112.0	114.3	- 2.3	66	19.7	20.2	- .5	67
F	68	107.0	113.3	- 6.3	56	17.4	19.9	- 2.5	52
M	61	110.5	110.5	0.0	61	18.3	19.2	- .9	55
F	62	114.0	110.2	+ 3.8	69	19.0	19.0	0.0	62
F	68	113.0	113.3	- .3	67	19.2	19.9	- .7	63
M	68	117.0	114.1	+ 2.9	74	21.6	20.3	+ 1.3	76
M	62	107.5	111.0	- 3.5	55	17.9	19.4	- 1.5	53
F	68	115.1	113.3	+ 1.8	72	19.4	19.9	- .5	65
F	65	107.0	111.7	- 4.7	56	16.3	19.5	- 3.2	46
F	67	109.5	112.8	- 3.3	61	18.2	19.8	- 1.6	57
M	63	109.0	111.5	- 2.5	58	18.7	19.5	- .8	58
M	69	121.0	114.6	+ 6.4	83	29.9	20.5	+ 9.4	112
M	62	102.5	111.0	- 8.5	47	15.0	19.4	- 4.4	35
M	67	106.5	113.6	- 7.1	54	16.2	20.2	- 4.0	43
M	61	106.6	110.5	- 4.9	52	17.7	19.2	- 1.5	52
F	66	108.0	112.3	- 4.3	58	18.1	19.6	- 1.5	56
F	68	113.0	114.1	- 1.1	67	21.1	20.3	+ .8	70

Since the numbers in each group were small, the actual plotting of the recorded heights and weights on the Iowa growth charts was not revealing. (There were too few points to show graphically whether or not there was significant growth retardation in the respective groups). Instead, we grouped all of the children together and looked at their adjusted weights and adjusted heights and how they cluster about the Iowa mean. This is shown graphically in Figure 1.

These graphs show that the histograms for both weight and height are skewed to the left. One is therefore justified in the conclusion that, on the selection criteria for inclusion in this program, the children selected on the average tend to be shorter and weigh less than the children upon which the Iowa norms were established. It is generally assumed that the children who were the basis for the Iowa study came from middle and upper income families and had reached their maximum potential as far as growth in stature is concerned. The DARCEE children all came from lower class homes.

The data on skin fold thickness in the triceps area are shown in the next three figures. (See following pages) The standards used for skin fold thickness in the triceps area are those of Tanner, as reported by Jelliffe (1966), and were recorded on British subjects. These are the only figures available for this age group, but skin fold thickness data recorded on older children show comparable values for British and Americans.



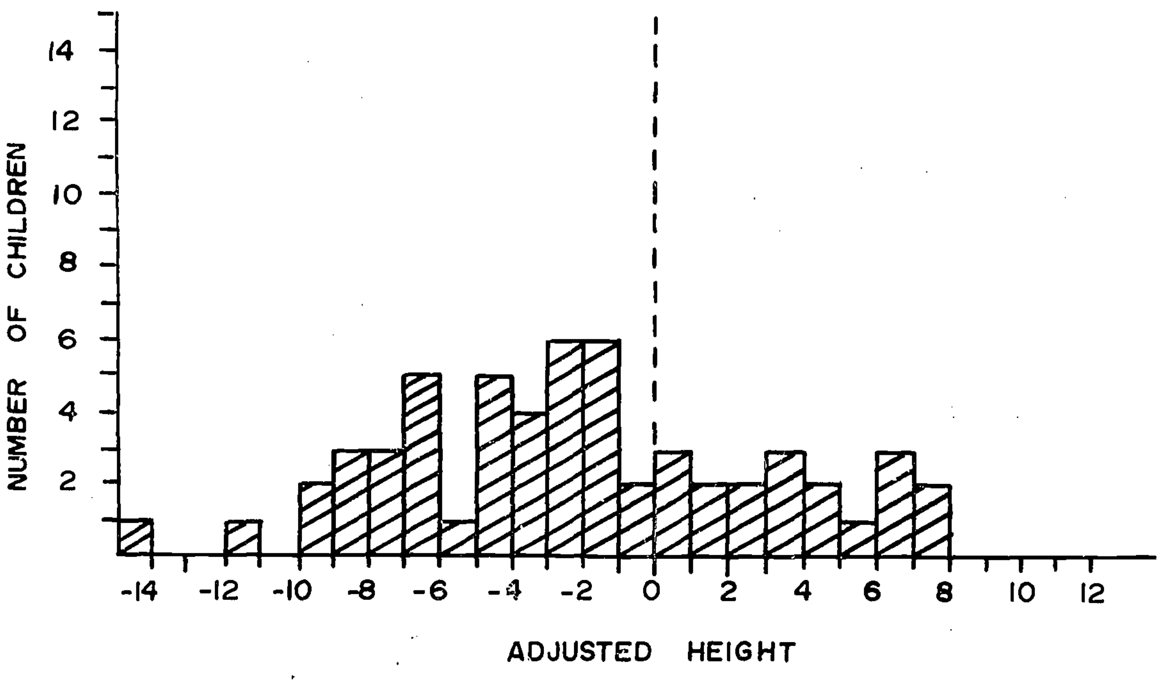


FIGURE 1: HEIGHT AND WEIGHT DISTRIBUTIONS IN RELATION TO THE IOWA MEANS.

	Boys	Girls	Total
Below Standard	16	18	34
Below 90% Standard	16	17	33
Below 80% Standard	12	13	25
Below 70% Standard	10	7	17
Below 60% Standard	6	2	8

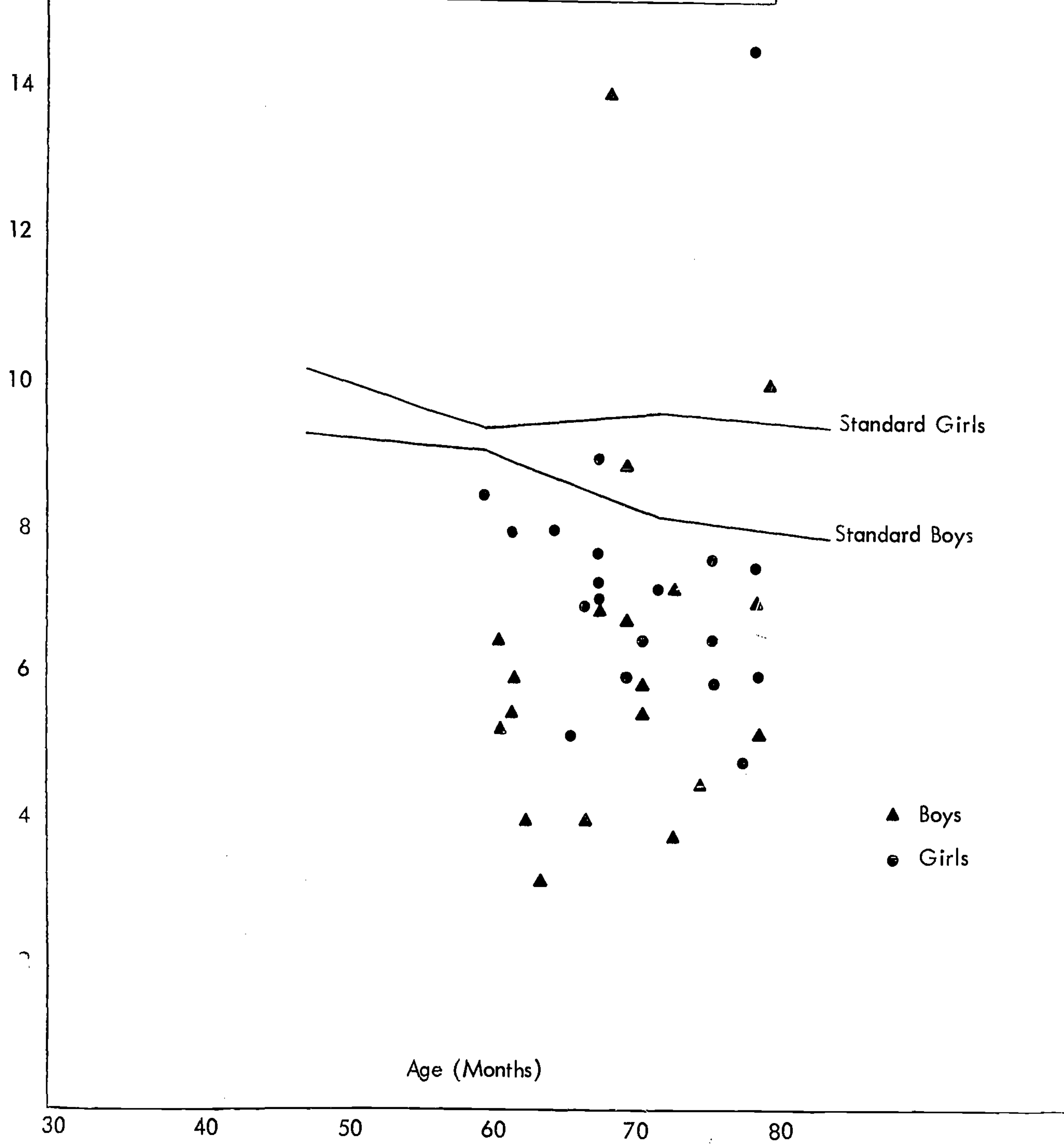
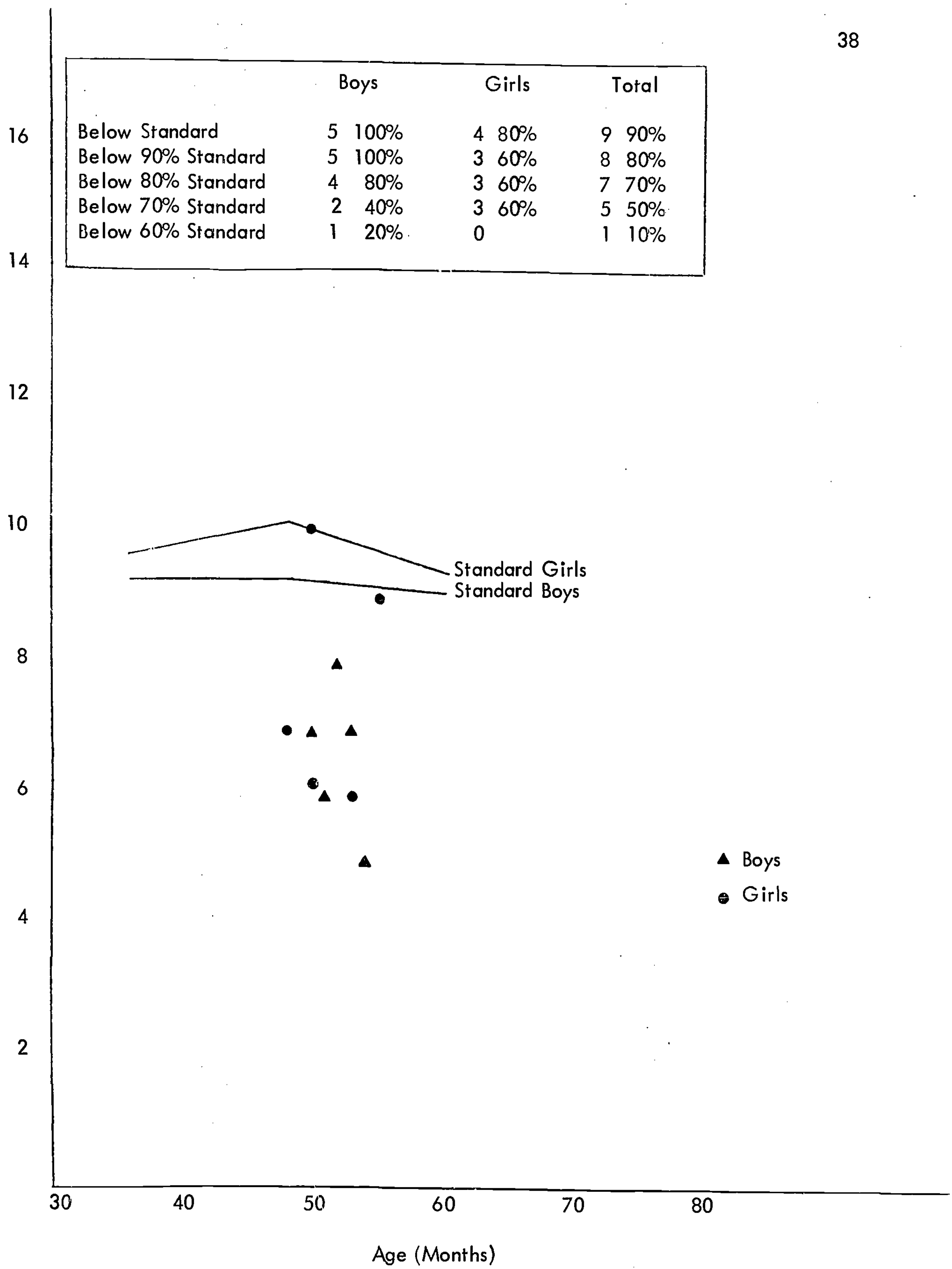


Figure 2 Triceps Skinfold Thickness With Rural Children



	Boys		Girls		Total	
Below Standard	5	100%	4	80%	9	90%
Below 90% Standard	5	100%	3	60%	8	80%
Below 80% Standard	4	80%	3	60%	7	70%
Below 70% Standard	2	40%	3	60%	5	50%
Below 60% Standard	1	20%	0		1	10%

Figure 3 Triceps Skinfold Thickness With Urban Blacks

	Boys		Girls		Total	
Below Standard	4	100%	4	80%	8	89%
Below 90% Standard	3	75%	3	60%	6	67%
Below 80% Standard	2	50%	3	60%	5	56%
Below 70% Standard	1	25%	2	40%	3	33%
Below 60% Standard	1	25%	0		1	11%

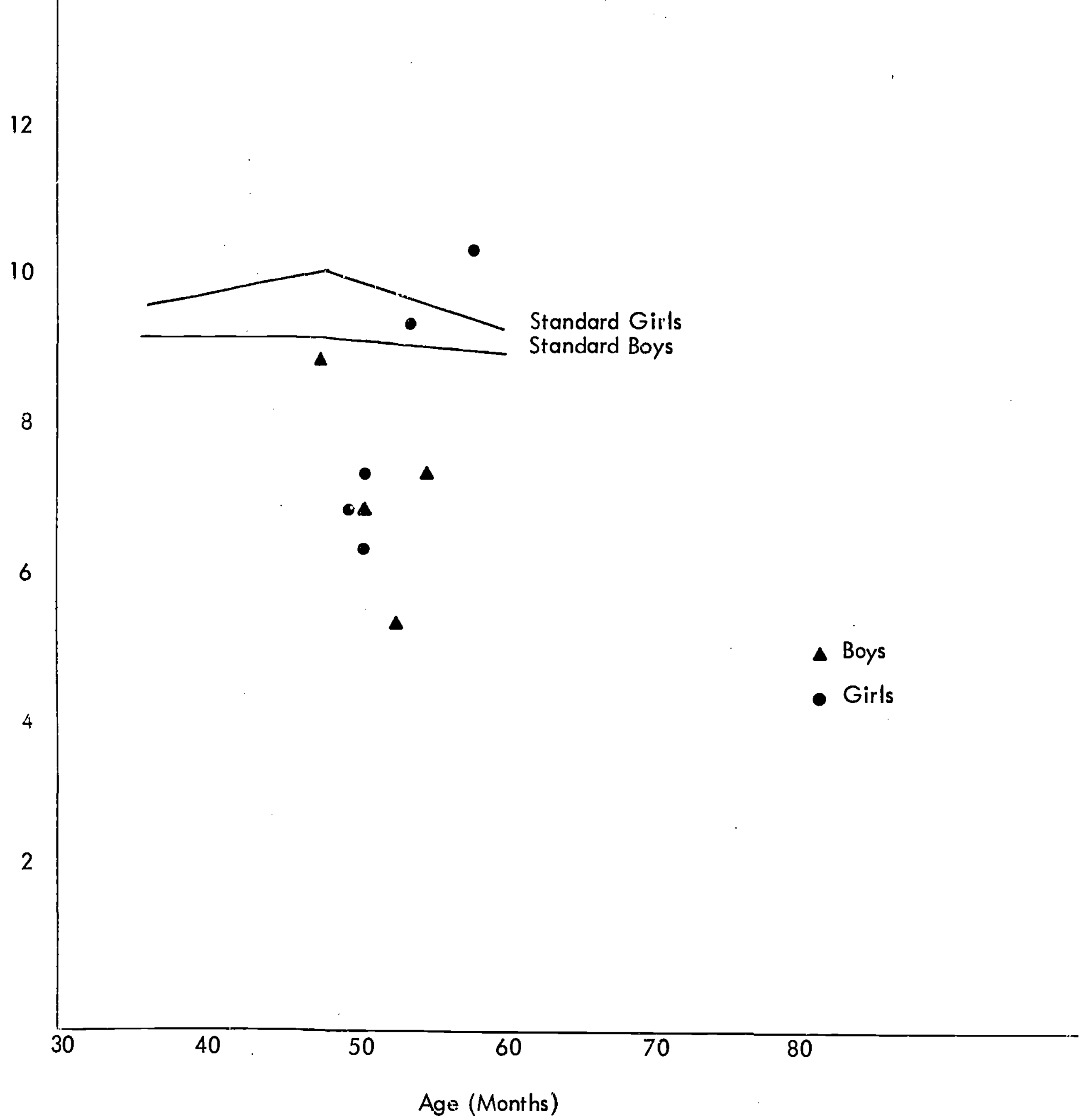


Figure 4 Triceps Skinfold Thickness With Urban Whites

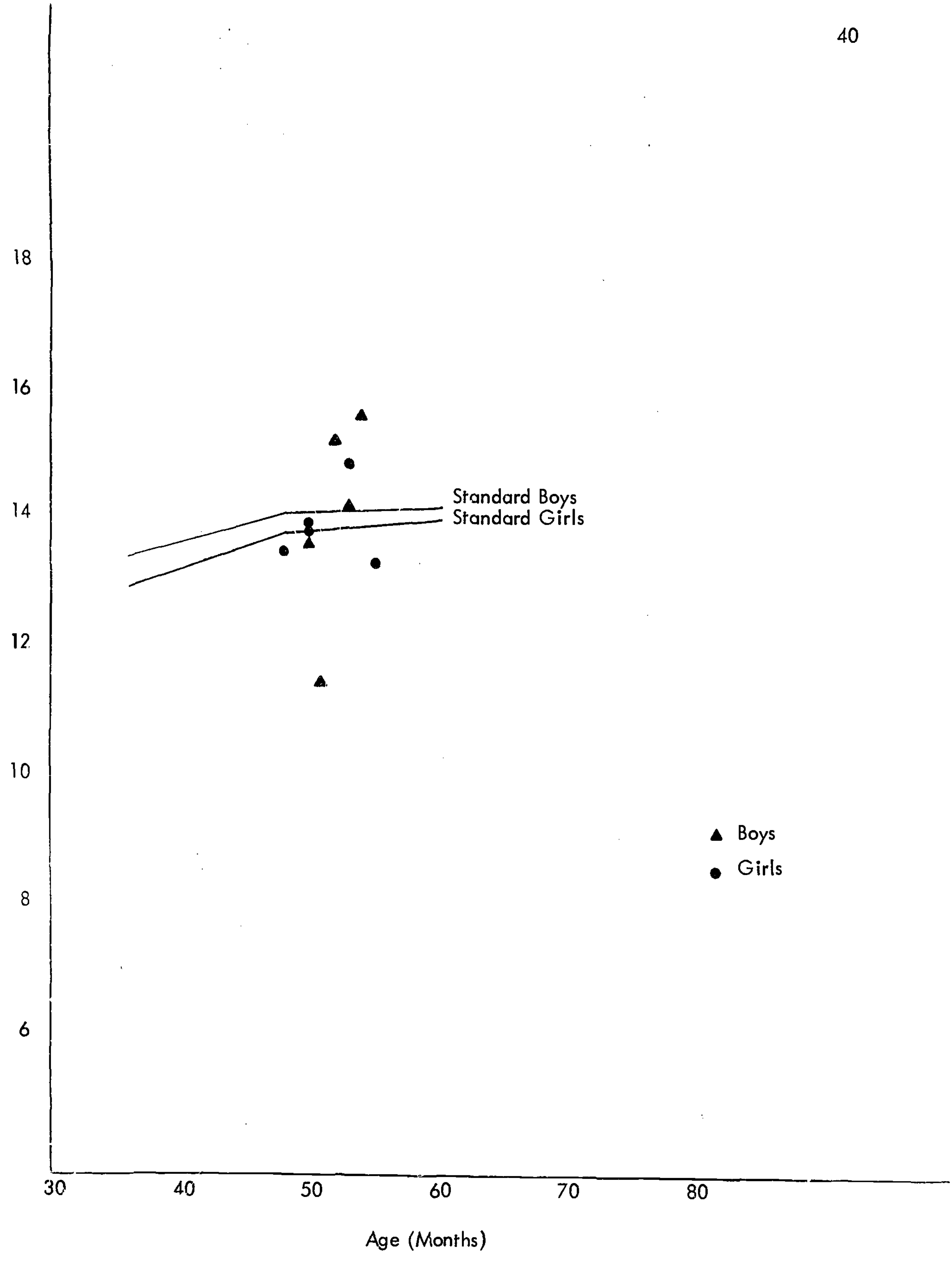


Figure 5 Midarm Muscle Circumference W:'' Urban Blacks

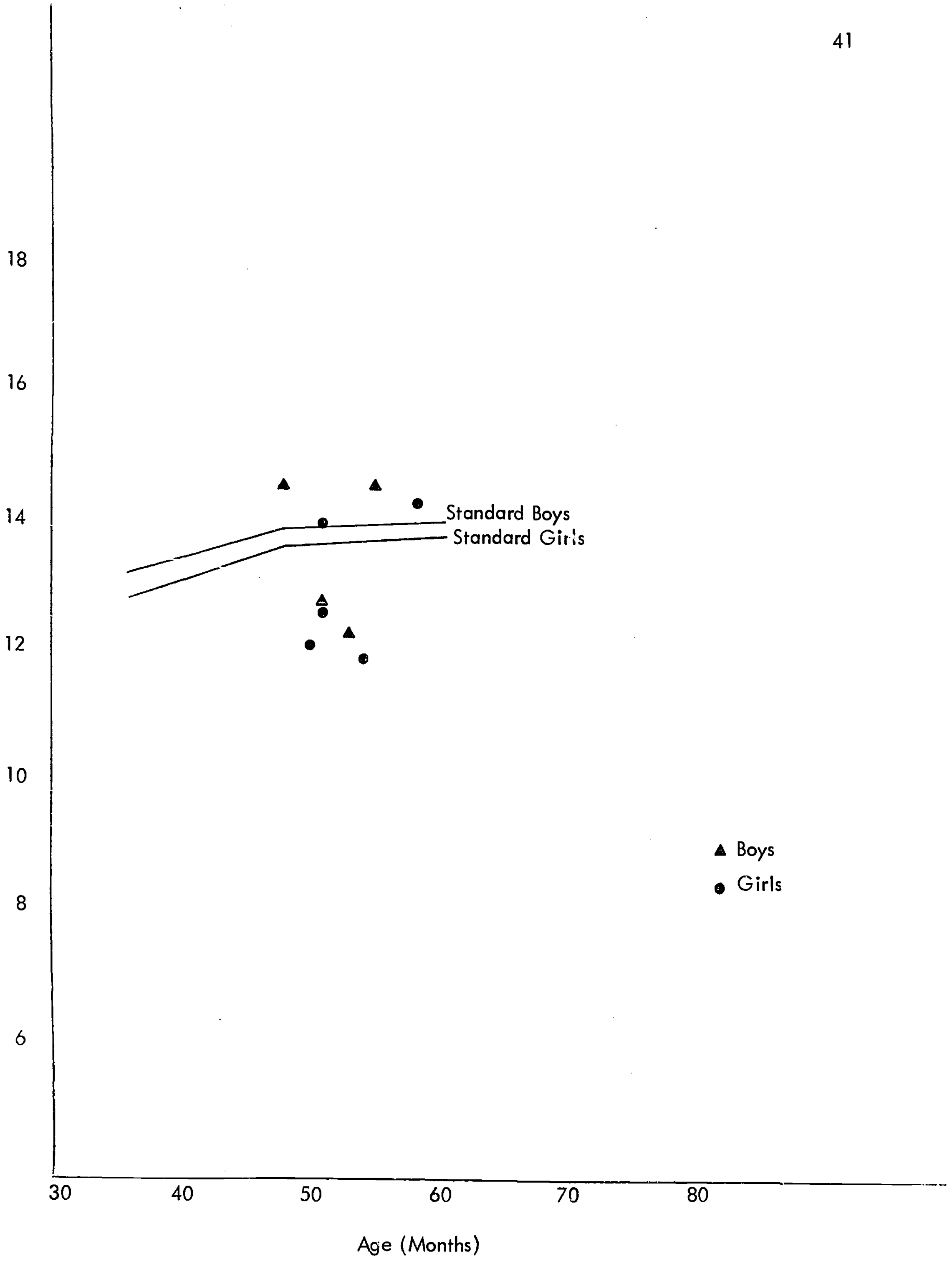


Figure 6 Midarm Muscle Circumference With Urban Whites

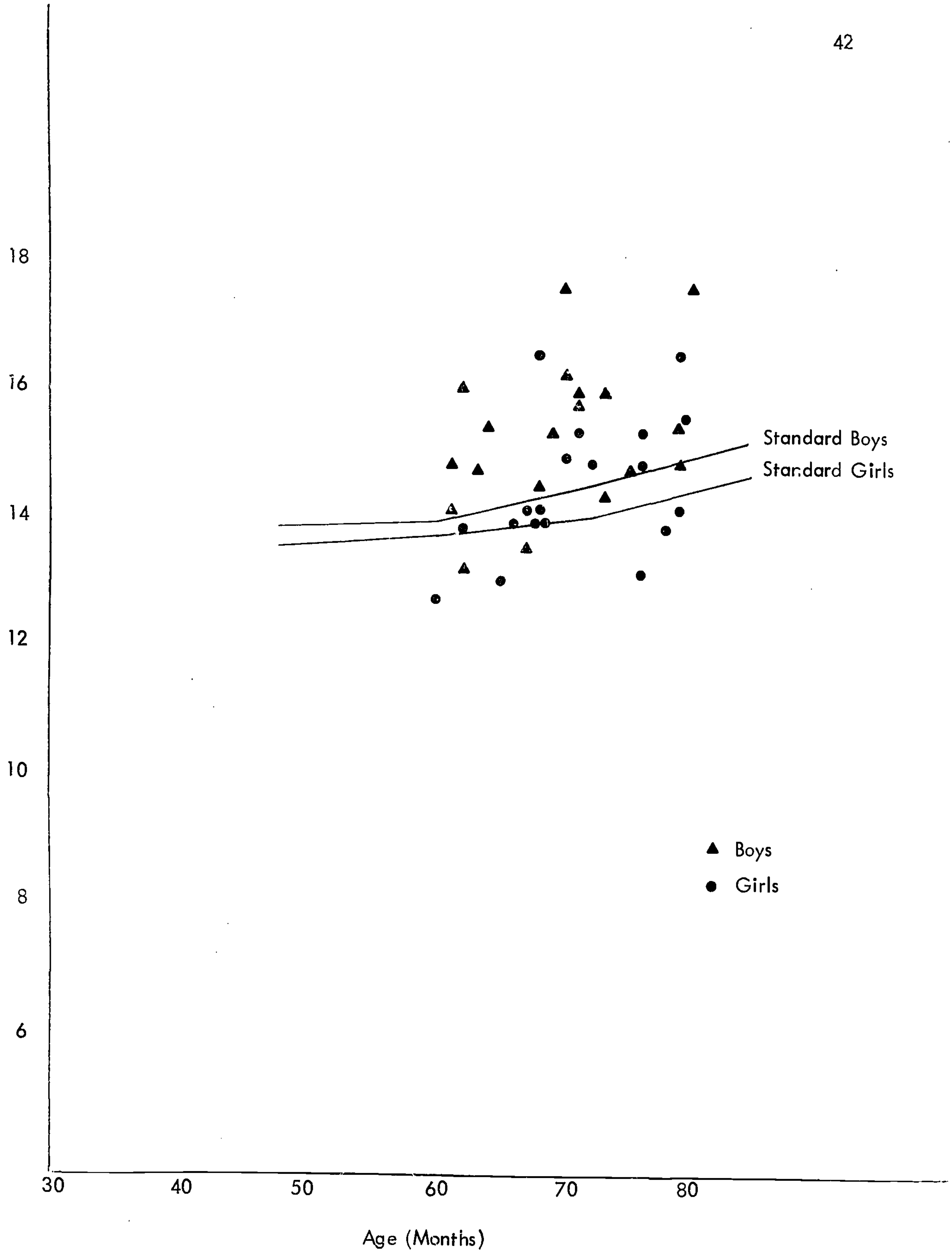


Figure 7 Midarm Muscle Circumference With Rural Whites

As can be seen in all three figures, the amounts of subcutaneous fat recorded in the triceps area are considerably less than the standard. This is true for urban black, urban white and the rural children. On the other hand, the calculated values for mid-arm muscle circumference which are shown in the next three figures, compared to standards prepared by Jelliffee (1966), show that nearly all of the children in the DARCEE study have normal muscular development. The reasons for the decreased amounts of subcutaneous fat are unexplained. The recall dietary data suggest that caloric intakes on the average are more than adequate.

Radiographic Studies of Skeletal Maturation and Bone Density

X-rays of the left hand were recorded on nearly all of the children in the program. The films were sent to Mr. Charles Colbert of the Fels Research Institute, Yellow Springs, Ohio, for study of selected bones.

These films were matched on age, sex, and race with those of a sample of children from the Fels (Ohio) longitudinal study population and with children from a day care center in the inner city of Springfield, Ohio. The skeletal ages and the relative weights and sizes of the bones in the Tennessee and Ohio sample populations were determined from the radiographs. These three measurements were examined for significant differences by grouping them according to chronological age, race, sex, bone site, and geographic location, and combinations of these factors.

From each radiograph, a trained observer assessed the skeletal maturity of each hand-wrist. This was done using the method of Greulich and Pyle (1959). Also, using a Joyce-Loebl microdensitometer/LINC-8 computer system, rectangular zones of the x-rays were scanned. These zones included the images of the diaphyses and epiphyses of middle phalanges II and III. At the conclusion of a scan, the computer calculated a bone index proportional to the (wet) weight of the bone plus the (wet) weight of the soft tissue. To adjust (normalize) the bone index for possible variations in kilovoltage between films, each bone index was divided by the numerical value of the absorption coefficient of a reference wedge which had been radiographed in the same field. Bone density was determined from these x-rays in a microscopic sense, i.e., bone weight bone volume within the periosteal envelope.

The findings of the Tennessee samples were compared with the middle class Fels longitudinal study population, and with the inner city children from Springfield, Ohio. Tennessee bones were about 16 percent heavier than the Ohio ones. In both the Tennessee and Ohio samples the bones of black children were about 16 percent heavier than those of white children. In addition, they were about 9 percent larger than those of white children. The bone densities of Tennessee children, both black and white, were about 10 percent greater than those of the Ohio children. In addition, the bone densities of black children in both locations are about 5.5 percent greater than those of white children.

The skeletal ages of the children in both locations were comparable. Low-income children in Tennessee, therefore, do not show retarded bone age when compared to the middle income Ohio children who make-up the Fels longitudinal study of population.

The reasons for the heavier and denser bones in the Tennessee sample are as yet unexplained. The Tennessee sample may have a higher calcium intake. Or the higher bone density might be due to nutritional, ethnic, or environmental characteristics, to trace elements, or to some combination of these factors. The possible presence of a trace element in the bones of Tennessee residents is being investigated. In addition, the higher intake of meat, and meat products, in the Tennessee sample might also explain the difference. This is also being investigated (Barzel, 1970).

Dental Findings

Dental examinations were performed on all of the children in the program. X-rays were not obtained, however.

The numbers and percentages of individuals with normal teeth, teeth with active caries, and teeth with active caries plus one or more teeth needing extraction are given in Table 7. The data are broken down for the entire urban group and the entire rural group.

The proportion of children with all existing teeth normal is twice as great in the urban group as in the rural group (.10 P .< 05).

Also, the percentages of individuals with a given number of teeth with active caries, with caries involving the pulp and where extraction is indicated, and with caries where the dental crown has been completely broken down, are given for urban and rural in Table 7.

Table 7

Dental Findings

		Urban	Rural
Number of teeth with active caries or caries involving pulp, in which extraction is indicated, or with crown completely broken down by caries.	0	11 (57.9%)	11 (28.9%)
	1	3 (15.7%)	4 (10.5%)
	2	1 (5.3%)	2 (5.3%)
	3	2 (10.5%)	1 (2.6%)
	4	1 (5.3%)	6 (15.7%)
	5	1 (5.3%)	2 (5.3%)
	6		3 (7.9%)
	7		1 (2.6%)
	8		1 (2.6%)
	9		1 (2.6%)
	10		1 (2.6%)
	11		2 (5.3%)
	12		1 (2.6%)
	13		
	14		1 (2.6%)
	15		
	16		
	17		
	18		
	19		1 (2.6%)

These data show that dental caries of all degrees of severity was more of a problem in the children in the rural group than it was in those in the urban group in Nashville.

Eleven children of 37 at the rural center on examination by the dentist, were thought to have diffuse or localized marginal redness of the gums; seven children out of 38 at the rural center were thought to have diffuse of localized marginal swelling of the gums. None of the children in the urban group had marginal redness or swelling of the gums.

In an attempt to explain the higher incidence of dental caries in the rural group, water samples were collected from selected homes and analyzed for fluoride content. The analysis were done by the Wisconsin Alumni Research Foundation. The results were as follows: Sixteen water samples were collected in rural community. Six had spring water as the source of their drinking water; three had water provided by the nearby city and seven had well water which in all but one instance came from deep wells. The fluoride content in each and every one of these specimens was reported as "less than 0.05 ppm." This amount is negligible.

In contrast, the city water in Nashville is fluoridated. Three specimens were obtained from the housing projects where the children lived. The fluoride concentration ranged from 0.93 to 1.10 ppm. These amounts are in the effective range for the prevention of dental caries.

In addition, we looked at the Calcium/Phosphorus ratio in the diet, both from the seven day recall data and from the analysis of the school snack and lunch composites. There were very few individuals with Ca/P ratios below 0.5.

The majority had ratios between .5 and 1.0. There was no relationship between the number of teeth with active dental caries and the Ca/P ratio. Although one cannot rule out genetic factor completely, it would appear that the reduced incidence of dental caries in the urban group is probably due to water fluoridation.

Biochemical Determinations

Blood specimens were collected from nearly all of the children in both the rural and urban preschools. Hemoglobin and selected nutritional biochemical determinations were performed. Standard methods were used and have been previously described by our laboratory in connection with other nutrition surveys (Carter *et al.*, 1970). These methods are similar to those employed on the I.C.N.N.D. Nutrition Surveys and have been published in their manuals.

The results have been evaluated using the guidelines published by the Nutrition Program of the Center for Disease Control to decide when the level of a given nutrient is acceptable, less than acceptable, low, or deficient. The percentages of acceptable, low, and deficient biochemical values for the three groups in the DARCEE program are given in the table below.

Table 8

Percentages of Acceptable, Low and Deficient Biochemical Values

		Hgb.	Fe.	Vit. A.	Vit. C	S. Fol.	TK and TTP Effect
Urban	Acceptable	90	80	50	100	70	90
	Low	10		30	0	30	10
	Deficient	0	20	20	0	0	
Urban	Acceptable	78	87	34	100	89	100
	Low	11	13	22	0	11	0
	Deficient	11		44	0	0	92
Rural	Acceptable	100	97	47	100	89	8
	Low	0	3	31	0	8	
	Deficient	0		22	0	3	

Table 8 indicates that the few children who had low or deficient levels of hemoglobin were all in the urban group. There were also higher percentages of individuals with low serum irons (systemic iron deficiency) in the urban group. In both the case of low and deficient levels of hemoglobin and serum iron, black and white children appear to be equally affected.

There were substantial amounts of vitamin A deficiency in all three groups. Twenty percent in urban black, 44 percent in rural white, and 33 percent in the rural groups. None of the children in any of the groups, however, had low or deficient levels of vitamin C.

There were some low serum folate levels, but only three of the subjects were considered deficient and they were from the rural center. A few of the subjects in the urban black group and in rural center shown to be Thiamin deficient as manifested by a low level of the enzyme transketolase together with a greater than 15 percent rise after stimulation with Thiamin pyrophosphate.

It is interesting to note that there is more anemia and systemic iron deficiency in the urban group than in the rural groups. This parallels the median annual family incomes already mentioned.

Fewer of these children have less than acceptable levels of the above nutrients in blood than did a comparable group of children included and examined in the sample selected for the National Nutrition Survey. We believe that the school feeding program is the reason the children in the less than $4000 income group show relatively adequate biochemical nutritional parameters. The average child from a low-income family does not have the benefit of a well-prepared snack and lunch in a day care preschool program. As mentioned earlier in this report, the way in which the lunch itself is served is as important as the nutrient content of the food. On both counts the school feeding program appears to be an excellent one.

Examination for Ova and Parasites

A scotch tape swab and a stool examination were performed on as many of the children in the program as possible. The swab was done for the detection of pinworm ova and the stool examination for the detection of ova of other intestinal roundworms and for the detection of intestinal protozoa. Direct examination of fecal smears and concentration techniques (Faust & Russell, 1964) were used.

The results of the scotch tape swabs and stool examinations are presented in the table below for the groups in the sample.

Table 9

Incidence of Ova and Parasites

Urban Black		
Number	Stool	Scotch Tape Swab
1	?	Pinworm ova seen (loaded)
2	?	Pinworm ova seen
3	?	-------------------
4.	?	-------------------
5.	Ascaris ova	-------------------
6.	----------	-------------------
7.	E. coli cyst	-------------------
8.	----------	-------------------
9.	?	-------------------
10.	E. nana and Giardia	Pinworm ova seen

Table 9 (continued)

Urban White

Number	Stool	Scotch Tape Swab
1.	Ascaris ova	Pinworm ova seen (loaded)
2.	?	--------------------
3.	Trichuris ova	Pinworm ova seen
4.	?	Pinworm ova seen (loaded)
5.	E. coli cyst, Giardia cyst	Pinworm ova seen
6.	?	--------------------
7.	------------	Pinworm ova seen (loaded)
8.	------------	--------------------
9.	------------	--------------------

Rural

Number	Stool	Scotch Tape Swab
1.	------------	--------------------
2.	------------	--------------------
3.	------------	Pinworm ova seen
4.	------------	Pinworm ova seen
5.	------------	Pinworm ova seen
6.	------------	Pinworm ova seen
7.	?	?
8.	------------	Pinworm ova seen
9.	------------	Pinworm ova seen
10.	------------	Pinworm ova seen (loaded)
11.	?	--------------------
12.	E. coli cyst	Pinworm ova seen
13.	E. coli cyst	--------------------
14.	------------	Pinworm ova seen
15.	?	Pinworm ova seen
16.	?	--------------------
17.	------------	Pinworm ova seen (loaded)
18.	------------	Pinworm ova seen (loaded)
19.	------------	Pinworm ova seen

It is to be noted that several of the children in the urban group had Ascaris and Trichuris ova and Giardia cysts in their stools. This was unexpected since presumably all of these children were living in two housing projects in Nashville. Indoor plumbing and sanitary facilities are available. Furthermore, the majority of these children were born and reared in urban Nashville. This does not exclude the possibility of their becoming infected while visiting relatives who live in a rural environment without adequate sanitary facilities. None of the rural children were infected with Ascaris, Trichuris, or pathogenic protozoa.

Nearly half the children in the urban group were infected with pinworms. About 70 percent of the rural children were so infected. We do not know whether or not they had anal itching of a significant degree.

Relationships Among Variables

Epidemiological data gathered by Birch, et. al., in Aberdeen, Scotland (1970) and by Cravioto, et. al., in a village in rural Mexico (Cravioto et. al.) show a correlation between the mother's nutritional status as determined by her height (stature) and her infant's birth weight and subsequent growth and development. In the Aberdeen study there was also a correlation between the mother's height and the child's height at seven years of age and his performance on various achievement tests which were administered after entrance to school.

In the table on the next page we attempted to correlate the mother's height with the child's birth weight, adjusted weight, and adjusted height. This is done for all three groups.

Table 10

Relationships With Mother's Height

Mother's Height	Total (all groups)	Urban Black	Urban White	Rural
Birth Weight	.436**	.491	.475	.344*
Adjusted Weight	.505***	.802	.541	.473**
Adjusted Height	.304*	.350	.647*	.337*

* $P < .05$ ** $P < .01$ *** $P < .001$

We can conclude from these data that in the case of the children in this study, there was a correlation between the mother's height and her child's birth weight, adjusted weight, and adjusted height. There was no correlation between either the mother's height, or the child's birth weight, or adjusted weight, or adjusted height, and the Binet IQ score.

In the following tables, attempts were made to correlate the parameters listed below with other variables.

Table 11

Intelligence Test Scores

Group	Urban Black	Urban White	Rural White	Rural White	Total Sample
No. (varies slightly in some cases)	10	7	19	18	54
Mean	76.1	95.3	90.7	87.7	
Standard Deviation	13.0	16.7	14.7	9.2	
Correlations with other variables					
Skeletal Age	.56	- .75	.43	.46	.26
Height (unadjusted)	.36	.20	- .12	.44	.18
Weight (unadjusted)	.35	- .02	- .02	.48	.17
Muscle Circumference	- .03	.30	- .21	.27	.07
Birth Weight	- .11	.21	.07	.50	.07
Bone Density	- .04	.66	- .43	.29	- .13
Height (adjusted)	.30	.27	- .19	.50	.02
Weight (adjusted)	.33	- .07	- .06	.53	.07
Skinfold	.36	- .67	- .06	.41	.04
Skeletal Age-Chron Age	.57	- .69	.36	.46	.11

Table 12

Skeletal Age

Group	Urban Black	Urban White	Rural White 1968	Rural White 1969	Total Sample
No. (varies slightly in some cases)	10	7	19	18	54
Mean	52.8	45.9	68.7	53.6	
Standard Deviation	10.5	5.3	9.0	8.8	
Correlations with other variables					
Height (unadjusted)	.65	.30	.54	.6-	.68
Weight (unadjusted)	.80	.61	.67	.34	.61
Muscle Circumference	.19	.47	.50	.16	.56
Birth Weight	.32	- .42	.49	.38	.42
IQ Scores	.56	- .75	.43	.46	.26
Bone Density	- .16	- .87	- .10	.04	.05
Height (adjusted)	.56	.26	.45	.54	.19
Weight (adjusted)	.71	.64	.61	.33	.36
Skinfold	.30	.82	.52	.40	.26
Skeletal Age-Chron Age	.99	.80	.92	.94	.58

Table 13

Bone Density

Group	Urban Black	Urban White	Rural White 1968	Rural White 1969	Total Sample
No. (varies slightly in some cases)	10	7	19	18	54
Mean	.200	.190	.201	.197	
Standard Deviation	.018	.012	.197	.016	
Correlations with other variables					
Skeletal Age	- .16	- .87	- .10	.04	.05
Height (unadjusted)	- .52	- .23	.19	.45	.12
Weight (unadjusted)	- .01	- .66	.15	.64	.26
Muscle Circumference	.18	- .68	.36	.25	.26
Birth Weight	- .24	.09	.07	.05	.05
IQ Scores	- .04	.66	- .43	.29	- .13
Height (adjusted)	- .67	- .14	.29	.48	.07
Weight (adjusted)	- .16	- .61	.20	.65	.22
Skinfold	- .31	- .93	- .15	.45	- .03
Skeletal Age-Chron Age	- .22	- .57	.07	- .02	- .01

Table 14

Skinfold Thickness

Group	Urban Black	Urban White	Rural White 1968	Rural White 1969	Total Sample
No. (varies slightly in some cases)	10	7	19	18	54
Mean	7.2	7.8	6.9	6.8	
Standard Deviation	1.5	1.6	2.4	2.4	
Correlations with other variables					
Skeletal Age	.30	.82	.52	.40	.26
Height (unadjusted)	-.01	.12	.53	.49	.19
Weight (unadjusted)	.31	.60	.74	.64	.46
Muscle Circumference	-.16	.42	.57	.00	.13
Birth Weight	.55	-.04	.49	.16	.28
IQ Scores	.36	-.67	-.06	.41	.04
Bone Density	-.31	-.93	-.15	.45	-.03
Height (adjusted)	.04	.05	.53	.52	.37
Weight (adjusted)	.46	.61	.76	.61	.62
Skeletal Age-Chron Age	.39	.67	.44	.35	.38

Table 15

Muscle Circumference

Group	Urban Black	Urban White	Rural White 1968	Rural White 1969	Total Sample
No. (varies slightly in some cases)	10	7	19	18	54
Mean	13.9	13.3	15.5	14.5	
Standard Deviation	1.2	1.1	1.1	1.0	
Correlations with other variables					
Skeletal Age	.19	.47	.50	.16	.56
Height (unadjusted)	.24	.52	.69	.49	.68
Weight (unadjusted)	.50	.86	.88	.54	.78
Birth Weight	- .32	.39	.32	.22	.34
IQ Scores	- .03	.30	- .21	.27	.07
Bone Density	.18	- .68	.36	.25	.26
Height (adjusted)	.19	.54	.73	.43	.31
Weight (adjusted)	.56	.85	.87	.58	.63
Skinfold	- .16	.42	.57	.00	.13
Skeletal Age-Chron Age	.15	.40	.60	.07	.16

Table 16

Birth Weight

Group	Urban Black	Urban White	Rural White 1968	Rural White 1969	Total Sample
No. (varies slightly in some cases)	10	7	19	18	54
Mean	6.7	5.9	7.2	7.0	
Standard Deviation	1.1	1.1	1.4	.9	
Correlations with other variables					
Skeletal Age	.32	- .32	.49	.38	.42
Height (unadjusted)	.01	.17	.27	.22	.34
Weight (unadjusted)	.36	.44	.49	.22	.47
Muscle Circumference	- .32	.39	.32	.23	.34
IQ Scores	- .11	.21	.07	.50	.07
Bone Density	- .24	.09	.07	.05	.05
Height (adjusted)	.03	.23	.33	.30	.21
Weight (adjusted)	.40	.36	.54	.29	.45
Skinfold	.55	- .04	.49	.16	.28
Skeletal Age-Chron Age	.39	- .13	.52	.46	.32

The IQ scores (Table 11) for example, are not correlated with any other anthropometric measurement with the exception of skeletal age where it may be possibly correlated within groups, although the urban whites' pattern of correlation seems almost opposed to that of the rural whites. With the small sample, the parsi various interpretation is that simply of sample fluctuation.

Skeletal age, on the other hand, is correlated with height, weight, muscle circumference, and skin fold thickness (Table 12). In the latter case, it is mostly correlated within groups. It is not correlated with bone density.

Bone density (Table 13) is not correlated with any of the other variables.

Skin fold thickness (Table 14) as would be expected, is correlated with weight. It is also correlated with skeletal age within groups. There is also possibly a slight correlation between skin fold thickness and birth weight.

Muscle circumference (Table 15) is correlated with skeletal age, height, and weight. There is also possibly a slight correlation between muscle circumference and birth weight.

Birth weight (Table 16) is slightly correlated with the child's height, his muscle circumference, and his skin fold thickness. There is no correlation between birth weight and the Binet IQ score.

What these data appear to mean is that in the low-income families selected for inclusion in the program, there was evidence of an inter-generational effect as far as selected anthropometric measurements are concerned. The data gathered in Scotland and in Mexico suggest that socioeconomic factors are more likely responsible for these relationships than is heredity. There is no evidence, however, unlike the Aberdeen study (Birch et. al., 1970), that the performance on the IQ test was related to any of these growth parameters, with the possible exception of skeletal age.

Previous attempts by Sandstead, et. al., (1968) to correlate biochemical, nutritional determinations with scores on the IQ test were unsuccessful. No attempt was made, therefore, to find a relationship between any particular biochemical test and the IQ score in the children in this study.

On the correlational data, the most attention should probably be given to the two samples, which represent a relatively homogenous group of Appalachian type whites, largely of Anglo-Saxon extraction. The most interesting of the findings in this respect is probably that of the correlation between the mother's height and birth weight, or adjusted weight, or the adjusted height of the children in the sample.

We were not surprised that we failed to turn up anything of particular meaning in correlations between the intelligence test scores of the children, and the various indices of skeletal age, height, weight, bone density, and so on. The number of cases was small and only one index of intellectual ability was used. Perhaps with a larger number of cases and increasingly refined techniques of assessment, such relationships might emerge.

A Final Word

As the introduction points out this study has been largely a descriptive one. To the limited extent, however, that we can generalize from our small sample, some interesting findings have appeared. The reader should remember that the urban findings are based upon only 10 blacks and 9 whites. The rural findings, for the most part, are based upon 38 white children, and consequently are somewhat more stable.

Certain findings are perhaps of particular interest. (1) Although these were many problems uncovered, the general health status of the children examined was not markedly inferior.Some of the adequacy of the nutritional status may be related to the school feeding program; the other indices would be largely independent of the sort of intervention that has been promoted at these Early Training Centers.

The sensory test, visual and auditory, and the speech test suggest a sufficiently high incidence, however, of children with problems in these respective areas as to need specific attention.

The nutritional data is probably most impressive in terms of its thorough-going nature. The great value of the composite specimen analysis, which to the best of our knowledge has not been used before for young children in day care centers, is that one receives a precise picture of what the child actually eats, not of what he is served but which may go back to the kitchen. Information of this sort provides a clear-cut guide for intervention programs in nutrition in any day care center in two ways--the balance of nutrients needed and also the need for such food preparation and eating conditions as will encourage the children to consume an adequate amount of the food served.

We would like to close however with a reminder to the reader that our primary concern in the health and nutritional status of young children should not be because of any real or hypothesized relationships with such indices of learning ability as intelligence test scores or even achievement test. As far as cognitive development is concerned it should be apparent that the input, association, and output of information depends on intact sense, normal brain function, and normal speech and motor performance. It is clear from this study that some of the children tested were not hearing well, were not seeing well, had disorders, and had medical histories which indicated they had had illnesses which might have resulted in sensory or brain damage. Needless to say, these problems should be discovered before a successful individualized intervention program can be planned. Children entering day care programs and other extended intervention program, should have a complete medical examination. They should have no less than what has been done for the children in this study. This implies a closer coordination between those rendering health care and those responsible for remedial educational programs.

Much of what we hear at the current time about improving the quality of life is centered on improving the environment. No one would deny that the environment in the United States of America in 1970 sorely needs attention. On the other hand, the healthy human organism is at least equally important for improving the quality of life. Adequate nutrition and adequate health care are sorely needed in many situations, as it is with the children studied in this report. The quality of life can hardly be made better until we have improved the quality of the organisms who must live this life.

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APPENDIX

Methods of Analysis

Protein:	A.O.A.C., 15 (1965) 10th Ed.
Moisture:	A.O.A.C., 327 (1965) 10th Ed.
Ash:	A.O.A.C., 328 (1965) 10th Ed.
Ether extract:	A.O.A.C., 331 (1965) 10th Ed.
Fiber:	A.O.A.C., 332 (1965) 10th Ed.
Carbohydrates:	By difference
Calories:	Bomb calorimeter
Riboflavin:	A.O.A.C., 773 (1965) 10th Ed.
Vitamin B-6	Atkins, Schultz, Williams and Frey, Inc. and Eng. Chem., Anal. Ed., 15, 141 (1943) (S. carlbergensis)
Vitamin B-12:	U.S.P. XVII, 864 (1965)
Niacin:	A.O.A.C., 771 (1965) 10th Ed.
Folic acid:	A.O.A.C., 830 (1955) 10th Ed.
Fluoride:	A.O.A.C., 260 (1965) 10th Ed.
Ascorbic acid:	J. Biol. Chem., 147, 399 (1943)
Thiamine:	A.O.A.C., 758 (1965) 10th Ed.
Vitamin E:	Acta Chemica Scandinavica, 11, 34-43 (1957)
Elemental:	Jour. of the A.O.A.C., Vol. 51, No. 5, 1968, 11. 1003-1010.