SEPTEMBER 1975

CENTER FOR DISEASE CONTROL

NUTRITION SURVEILLANCE

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

PUBLIC HEALTH SERVICE

NUTRITION INDICES BY STATE

Data presented in Tables 1-3 represent children examined during the third quarter of 1975. They reflect initial visits to the health system and do not show either the results of nutrition intervention or the nutrition status of the general population.

Table 1 demonstrates that nutritional anemia, as measured by hemoglobin and hematocrit levels, continues to be a major nutritional problem. In Louisiana, about 20 percent of children screened had deficient hemoglobin or hematocrit values. Although some children had both determinations, most of the hemoglobin and hematocrit data are derived from different individuals.

A high percentage of children fall below the fifth percentile for height-for-age. Arizona continues to report the highest percent of children in the high risk category for retarded growth or "stunting." In weight-for-height the percentage with low values continues to be at about the expected five percent level, but the percentage with high values is significantly greater than the expected five percent, although generally lower this quarter than in previous quarters.

Table 2 shows that Blacks continue to have the highest prevalence of low hemoglobin and hematocrit values. Spanish American children have the highest percentage of low values in height-for-age. American Indians and Spanish Americans have the highest percentages of overweight values.

Table 3 presents the data by sex and age. The highest prevalence of anemia and the lowest prevalence both of stunting and overweight values are in the 6 to 9-year age group. These relationships have been previously noted. Their consistency suggests that children of this age, with relatively less retardation in linear growth, may have relatively more iron deficiency than children who are either younger or older. It is also possible that the lower limits of "normal" for hemoglobin and hematocrit are set too high at this age range.

The prevalence of excess weight-for-height is much greater in children of both sexes under age 2, and again in girls above age 12 which is consistent with previous quarters. Because the prevalence of high weight for a given height may be artificially increased by underestimating the actual length of infants, we are including in this Bulletin a report of a study of errors in weighing and measuring children.

Table 1

Nutrition Indices by State, July-September 1975
Persons Less than 18 Years of Age

State	Hemoglobin No. Exam.	Hemoglobin % Low	Hematocrit No. Exam.	Hematocrit % Low	Height For Age No. Exam.	Height For Age % Low	Weight For Age No. Exam.	Weight For Age % Low	Weight For Height No. Exam.	Weight For Height % Low	Weight For Height % High
Arizona	1,590	13.5	1,186	10.8	2,603	15.2	2,609	9.8	2,562	6.4	9.6
Kentucky	515	13.4	426	15.0	1,303	11.1	1,317	7.4	1,270	5.6	8.3
Louisiana	2,840	20.3	1,085	20.8	4,134	11.3	4,200	7.5	4,088	5.9	8.3
Tennessee	425	6.1	6,351	21.3	7,496	10.0	7,560	6.0	7,376	4.8	9.5
Washington	245	10.2	2,367	9.9	3,400	10.2	3,391	5.7	3,359	3.1	10.3
Total*	5,615	16.2	11,415	17.6	18,936	11.1	19,077	6.9	18,655	5.0	9.3

*Totals for Hgb. & Hct. include unknown sex.
Incomplete reporting for Kentucky.
Louisiana November data not included (not received).

Table 2

Nutrition Indices by Sex and Ethnic Group, July-September 1975
Persons Less than 18 Years of Age

Sex and Ethnic Group	Hemoglobin No. Exam.	Hemoglobin % Low	Hematocrit No. Exam.	Hematocrit % Low	Height For Age No. Exam.	Height For Age % Low	Weight For Age No. Exam.	Weight For Age % Low	Weight For Height No. Exam.	Weight For Height % Low	Weight For Height % High
Male											
Black	1,456	18.6	982	21.1	2,579	11.6	2,601	8.0	2,539	5.7	8.2
White	807	10.5	3,833	19.0	5,399	11.1	5,433	6.8	5,334	4.9	9.7
Sp. American	306	12.7	315	12.1	662	14.8	663	9.5	654	5.8	11.6
Am. Indian	158	16.5	195	11.3	412	12.4	410	7.8	406	5.9	12.3
Oriental	1	0.0	34	2.9	41	14.6	41	2.4	41	2.4	4.9
Other	29	31.0	31	19.4	72	16.7	72	16.7	71	9.9	7.0
Unknown	31	12.9	145	11.7	174	10.9	172	2.9	170	5.9	7.6
Total	2,788	15.6	5,535	18.4	9,339	11.6	9,392	7.3	9,215	5.3	9.4
Female											
Black	1,376	20.3	1,010	21.7	2,543	10.0	2,577	5.8	2,491	5.6	9.6
White	857	11.9	4,031	16.6	5,631	10.4	5,682	6.6	5,542	4.6	8.8
Sp. American	350	14.9	353	10.5	688	13.7	689	7.1	678	3.8	10.8
Am. Indian	174	14.9	214	10.7	443	11.5	442	5.4	439	3.4	12.1
Oriental	2	50.0	24	8.3	37	10.8	37	13.5	36	2.8	5.6
Other	26	42.3	51	17.6	79	13.9	81	6.2	79	6.3	10.1
Unknown	31	12.9	133	9.8	176	13.1	177	9.6	175	1.7	4.6
Total	2,816	16.9	5,816	16.7	9,597	10.6	9,685	6.5	9,440	4.7	9.2

Table 3

Nutrition Indices by Sex and Age, July-September 1975
Persons Less than 18 Years of Age

Sex and Age Group	Hemoglobin		Hematocrit		Height For Age		Weight For Age		Weight For Height		
	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	No. Exam.	% Low	% High
Male											
<1	239	11.1	603	9.6	2,861	13.6	2,901	9.0	2,784	6.3	11.0
1	388	12.6	812	9.9	1,047	14.3	1,063	7.2	1,041	6.5	14.4
2-5	353	15.5	2,246	19.5	2,679	10.8	2,686	5.1	2,666	4.0	9.5
6-9	495	19.2	872	31.2	1,142	6.9	1,137	5.5	1,136	5.7	5.7
10-12	316	18.7	436	21.3	683	10.4	679	9.3	677	5.0	6.1
13-17	447	15.0	566	13.8	927	10.9	926	9.7	911	4.5	6.3
Total	2,788	15.6	5,535	18.4	9,339	11.6	9,392	7.3	9,215	5.3	9.4
Female											
<1	271	12.2	590	9.5	2,862	12.4	2,899	6.6	2,770	4.5	12.1
1	384	18.0	864	9.8	1,077	16.0	1,091	8.3	1,069	5.7	13.4
2-5	397	16.3	2,299	16.7	2,753	10.2	2,777	5.5	2,746	3.6	7.2
6-9	461	19.1	898	28.4	1,163	5.2	1,163	4.9	1,160	6.5	5.2
10-12	319	16.0	551	19.4	763	7.9	767	6.8	754	7.4	5.6
13-17	484	18.4	614	14.0	979	9.7	988	8.3	941	3.3	9.9
Total	2,816	16.9	5,816	16.7	9,597	10.6	9,685	6.5	9,440	4.7	9.2

CRITERIA FOR IDENTIFYING INDIVIDUALS WITH LOW OR HIGH VALUES

1. Low Hemoglobin and Low Hematocrit: Hemoglobin or hematocrit below the level specified in the following table for appropriate age and sex.

Age	Hgb.	Hct.
6-23 months	10 grams	31%
2-5 years	11 grams	34%
6-14 years	12 grams	37%
15 or more years (females)	12 grams	37%
15 or more years (males)	13 grams	40%

2. Low Height for Age: Height for age less than the 5th percentile of a person of the same sex and age in the reference population.

3. Low Weight for Age: Weight for age less than the 5th percentile of a person of the same sex and age in the reference population.

4. Low Weight for Height: Weight for height less than the 5th percentile of a person of the same sex and height in the reference population.

5. High Weight for Height: Weight for height greater than the 95th percentile of a person of the same sex and height in the reference population.

Reference Population: Smoothed distribution of percentiles of the following populations:

Age	Reference Population Data
Birth - 24 months	Fels Research Institute Growth Study
25 - 59 months	Preschool Nutrition Survey
60 -143 months	National Health Examination Survey, Cycle II
144 -215 months	National Health Examination Survey, Cycle III

Note: Growth percentiles represent heights and weights which have been standardized for sex and age, and sex and height (for weight for height). Therefore height and weight comparisons may be made between groups of individuals using percentiles without being concerned about the age and sex distributions of groups being compared. However, comparisons of height and weight among groups with persons of diverse ethnic origins should be made with care because of possible genetic differences in growth potential. Differences observed between groups may be due to differences in nutritional status of the individuals or in possible differences in the ethnic makeup of the groups.

SOURCES OF ERROR IN WEIGHING AND MEASURING CHILDREN

Background

Nutrition surveillance utilizes available clinic information to specify populations at risk for nutritional problems. Small differences in height and weight between groups of people may indicate significant nutritional differences. These differences may be obscured if the measurements are not made with accuracy or precision.

Since the inception of the surveillance activity in 1973, certain observations cast doubt on the accuracy of some anthropometric data.

1. Some of the reported data contain improbable groupings of heights and weights for age and weight-for-height when compared to the expected standard. This may result from inaccurate measurements, recording errors, or both. The problem is geographically widespread and seems greater in the measurements of children less than 2 than of older children.

2. State Health Department personnel report that inadequate weighing and measuring equipment and incorrect technique are common in clinic settings, including some of those participating in nutrition surveillance.

A study was designed by the Bureau of Training, CDC to provide information on the frequency and causes of inaccurate measurements.

The State of Washington was selected as the study site because of its broad diversity of clinics and programs which submit data to the surveillance system. The Washington State Department of Social and Health Services and CDC conducted the study during May 1975.

Methodology

Two teams, each consisting of one CDC and one State health department person gathered the data. The 74 local clinics participating in the surveillance system were stratified according to "urban" or "rural" location, and 10 urban and 10 rural clinics were randomly selected. At each participating clinic, an attempt was made to take height/length and weight measurements on 10 children less than 2 years of age and 10 children 2-5 years of age. A total of 304 children were included in the survey, 152 in each age group.

The study had three components:

1. Techniques and equipment used to weigh and measure children were observed.

2. Repeat measurements of height (or length) and weight of children were taken to quantify the degree to which both equipment and human factors contribute to measurement inaccuracy.

3. Clinic measurers and their supervisors were interviewed to identify other factors that contribute to measurement inaccuracy.

The equipment consisted of the weighing and measuring devices ordinarily used in the clinics, "reference" weighing and measuring devices supplied by the study teams, and standard weights and measures for calibrating the scales and measuring devices.

Study teams measured children less than 2 years recumbent, and children 2-5 years old were measured standing. All children were weighed wearing only underclothing.

Findings

The reference teams' results differed considerably from the heights, weights, and lengths obtained by clinic personnel.

The most significant problem is that clinic measurers tend to measure children less than 2 years old too short (Table 1). Since accurate weights are generally obtained, clinics tend to report an artificially high percent of children as being stocky and overweight. This excess is most apparent in the more than 90th centile range of weight-for-length. According to the weights and measures obtained by clinic personnel using their own equipment, 21% of the survey population less than 2 years old belonged in this category, in contrast to an "expected" 10% and the teams' finding of 12% (Figure 1).

Clinic measurers also tend to measure standing children too tall (Table 1).

Although some clinics obtained more accurate measurements than did others, errors are widespread geographically and occur in both urban and rural areas.

There are multiple causes of measurement inaccuracy. These may be described as equipment-related, skills and/or knowledge-related, and motivation-related.

Significance testing of the height/length and weight data obtained by the clinic measurers and the team members, each using both their own and the other's equipment, identifies equipment as the principle contributor to inaccurate measurements. The difference between clinic and team measurers using the clinics' equipment to measure the length of children <2 years old is highly significant ($p < .01$), while the difference when using the teams' reference equipment is not significant (NS). In 10 of the 20 clinics, personnel were measuring children less than 2 years of age with equipment not specifically designed for that purpose. The clinic equipment, when tested with standard measures, was found on the average to measure a 24" rod with a 5/16" variation in urban clinics and a 9/16" variation in rural clinics. Similarly a 60" rod was measured with a 12/16" variation (on the average) in both urban and rural clinics. The general tendency was to measure both the 24" and 60" standards too short.

Technique errors were less significant contributors to measurement inaccuracies. Only a few were observed with any great frequency, but they were observed to be widely distributed geographically. Only 17 of 152 children <2 years old and 40 of 152 children 2-5 years old were weighed and measured without errors in technique (Table 2). The most common technique errors were that young children were not properly stretched for measuring (33 of 152 times) and the Frankfort plane* was not verticle (33 of 152 times) at the time the measurement was made. These situations are primarily the result of clinic measurers having to measure young children unassisted (61 of 152 times), and of unmanageable children (45 of 152 times).

Recording errors also contributed significantly to inaccuracy. The measurer recorded a value different from that seen on the scale by the team in 15% of all measurements of length of young children (in contrast to 5% of weights being misrecorded). These errors resulted primarily from misreading the scale, interruptions before the value could be recorded, and transposition of digits.

The occurrence of errors is heavily influenced by motivation. Staff must be motivated if correct techniques, once learned, are completely and consistently utilized. Motivation can be enhanced by regular feedback to the clinic measurers on measurement accuracy, showing them that the data provided to the State are used for clinical management and surveillance, providing supervisory discussions regarding techniques and problems, and sharing with the staff the outcomes of patient referrals.

Summing Up

This study provides information both on the kinds and sources of measurement errors and the magnitude of those errors. In the next few months the Center for Disease Control will make specific recommendations relative to equipment-related sources of error, and recommend techniques for improving motivation and technical skills of those who are responsible for weighing and measuring.

Sources of error can be found and changed in anthropometry. Unfortunately the other traditional methods of nutrition assessment — dietary histories, clinical examinations, and laboratory tests — may have greater errors which are less easily detected or improved.

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*The usual "plane of sight" and the Frankfort plane are approximately equivalent.

Table 1

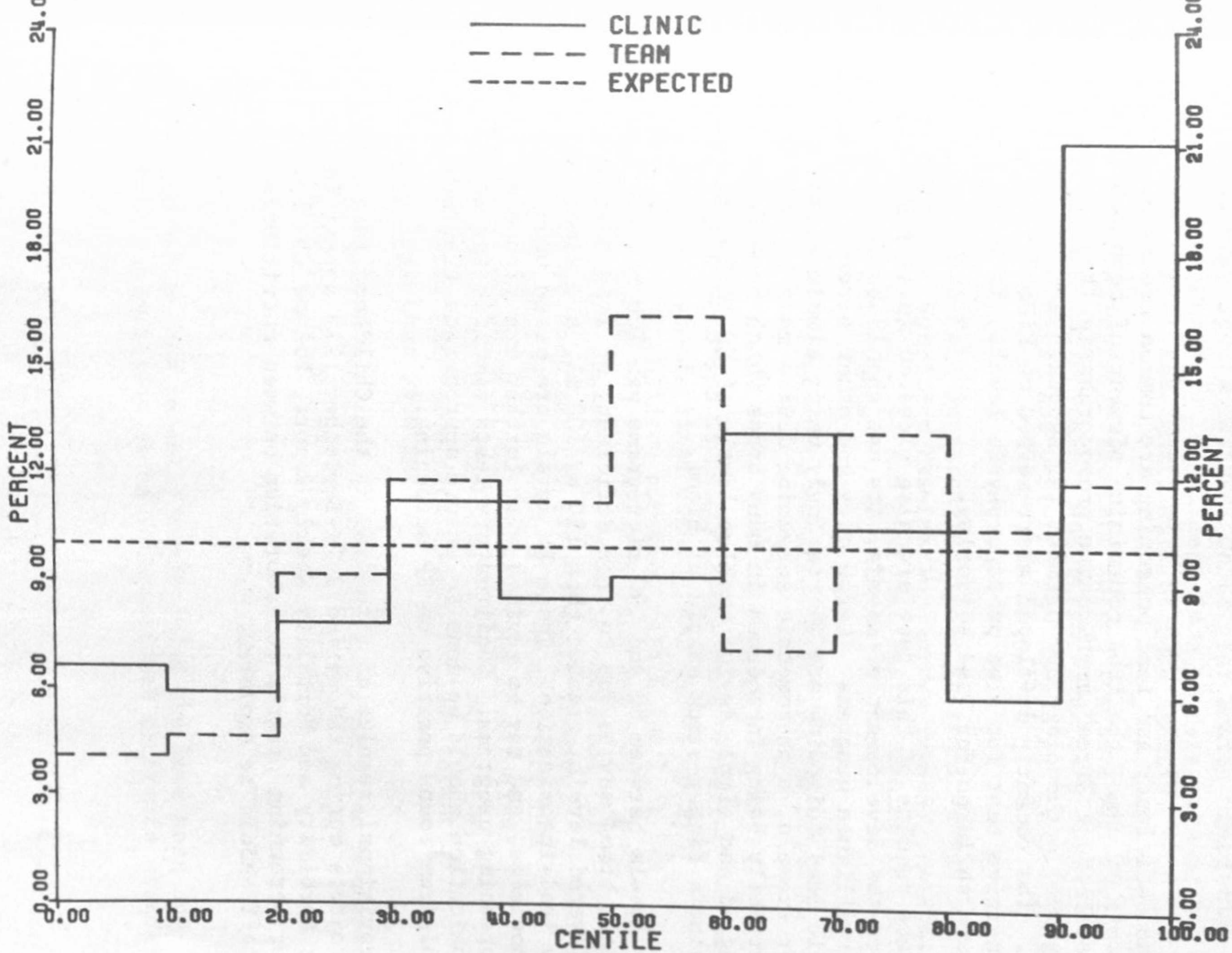
Frequency and Percent of Differences in Height and Weight
Measurements of Children 0-5 Years Old by Study Teams Using
CDC Equipment versus Clinic Staff Using Clinic Equipment

Measurement Difference	Age					
	<2 Yrs. Total		2-5 Yrs. Total		0-5 Yrs. Total	
	Length	Weight	Height	Weight	Height	Weight
Same Height (±1/8") or Weight (±4oz.)	27(17.8%)	98(64.5%)	52(34.2%)	85(55.9%)	79(26.0%)	183(60.2%)
Shorter (>1/8") or Lighter (>4oz.) by Clinic Staff	74(48.7%)	30(19.7%)	34(22.4%)	33(21.7%)	108(35.5%)	63(20.7%)
Longer (>1/8") or Heavier (>4oz.) by Clinic Staff	51(33.5%)	24(15.8%)	66(43.3%)	34(22.4%)	117(38.5%)	58(19.1%)
No. Subjects	152(100.0%)	152(100.0%)	152(100.0%)	152(100.0%)	304(100.0%)	304(100.0%)

Frequency of Technique Errors by Clinic Staff
Weighing and Measuring Children 0-5 Years Old

Item	Frequency and Percent	
	<2 Yrs.	2-5 Yrs.
Number error-free	17(11.2%)	40(26.3%)
Number in which errors observed	135(88.8%)	112(73.7%)
Specific weighing errors		
Excessive movement	47(14.5%)	21(10.1%)
Clothing left on	21(16.5%)	39(18.9%)
Specific measuring errors		
No assistance	61(18.8%)	-
Excessive movement	45(13.8%)	11(15.3%)
Not stretched or positioned correctly	33(10.1%)	61(29.6%)
Improper Frankfort plane	33(10.1%)	46(22.3%)
Headboard not placed against child's head	27(8.3%)	-
Child measured standing (<2) or recumbent (>2)	25(7.7%)	5(2.4%)
Measured with cap or shoes	12(3.7%)	12(5.8%)
Other	21(6.5%)	22(10.6%)
Total Errors	325(100.0%)	206(100.0%)
Average Errors/Child	2.1%	1.4%

FIGURE 1. PERCENTAGE DISTRIBUTION OF CHILDREN <2 YEARS OF AGE BY WT/HT CENTILES: CLINIC PERSONNEL & EQUIPMENT VS TEAM PERSONNEL & EQUIPMENT



SIMPLIFIED SCREENING FOR IRON DEFICIENCY AND LEAD POISONING BY THE FREE ERYTHROCYTE PROTOPORPHYRIN DETERMINATION

Iron deficiency and lead poisoning are common causes of imparied synthesis of heme, the iron containing pigment of hemoglobin, with resultant elevation of "free" erythrocyte protoporphyrin (EP), a heme precursor. Improved methodology now permits the accurate and rapid determination of EP. The recently developed micro-method of Piomelli, a quick, simple, and sensitive test for zinc protoporphyrin levels, is being used to screen young children for lead poisoning.

Since results of this test are also elevated in iron deficiency, even before the development of anemia, its use should be considered in nutritional surveillance programs. Large city and other screening programs for pediatric lead poisoning are increasingly using simple screening tests for EP. For example, a photometric screening device made by Bell Laboratories is currently being introduced in many areas which have Federal grants. This rugged and simple device enables levels of EP to be determined rapidly using a finger-stick sample of blood.

EP levels between 60 and 190 micrograms per 100 milliliters (ug/100 ml) whole blood may be due to iron deficiency or lead poisoning. Extremely elevated levels, greater than 190 ug/100 ml, are almost exclusively caused by lead intoxication. These EP levels are based upon presently available knowledge, and may be revised with further experience with this method in screening programs. Confirmatory tests specific for anemia and lead intoxication should be done to ensure appropriate treatment and follow-up of children found positive on EP screening.

Provisional results of screening in the Childhood Lead Poisoning Control projects during the period July-September 1975 appear in the March 6 issue of Morbidity and Mortality Weekly Report, Volume 25, No. 9. Opportunities for screening program collaboration between nutritionists and lead program staff should be explored.

HEIGHT AND WEIGHT CHARTS

Height and weight charts, based on reference population data recommended by a special committee of the National Academy of Sciences (NAS) in 1974[1], are being developed jointly by the National Center for Health Statistics and the Center for Disease Control. Final decisions on data sets to be utilized and actual layouts of the charts will be made shortly.

Separate charts will be available in the near future for boys and girls for plotting height-for-age (0-18 years), weight-for-age (0-18 years), weight-for-height (0-10 for girls and 0-11-1/2 for boys), and head circumference (0-3 years).

Data sets being utilized are Fels Research Institute (birth-3 years) and a combination of Health and Nutrition Examination Survey (HANES), National Health Examination Survey (Cycle II), and National Health Examination Survey (Cycle III), for ages 2-18 years.

The ideal characteristics of reference population data are described as follows:[1]

> "Reference data should be based on measurements made by well-trained personnel using standardized methods and should apply to a probability sample of children observed within the last 15 years. Data on at least 200 children of each sex should be available for each year of age from age 2 to 18 years and for at least 200 children of each sex for each 3-month interval during the first year and for each 6-month interval during the second year of life. Cross sectional rather than longitudinal observations on groups of children are desirable. During the first two years of life, reference data should exclude infants with birth weights less than 2500 gm."

The National Center for Health Statistics will publish a detailed monograph describing the properties of these populations in the near future.

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A joint WHO and FAO committee has recently recommended the data sets comprising the NAS reference population as an international reference standard.

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[1]Food and Nutrition Board: Comparison of Body Weights and Lengths or Heights of Groups of Children. Washington, National Research Council-National Academy of Sciences, 1974.