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ABSTRACT

As part of a national study of the nutrition of preschool children, data were collected on 201 Apache children, 1 to 6 years of age, living on an Indian reservation in Arizona. This report reviews procedures and clinical findings, and gives an analysis of growth data including skeletal maturation, nutrient intakes and clinical biochemical data. In the study, home interviews were conducted and children were also examined clinically. The high level of voluntary participation of families reflected great interest in the health status of their children. Limited socioeconomic information was obtained on the participant families but, generally, living conditions were at the poverty or near-poverty level. It is noted that 36 of the children were enrolled in Head Start and received a portion of their food intake there. The pattern of insufficient or inadequate dietary intakes, growth underachievement and biochemical evidence of nutritional risk seen for Apache children was similar to that of children living in poverty in Mississippi. (NH)

Nutrition Survey of White Mountain Apache Preschool Children

by

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In the early fall of 1968, we anticipated that our field team would be in southwestern U.S. in the spring of 1969 involved in studies with preschool children in our national sample.[1] Other studies with selected population groups[2-5] had been completed earlier and we wished to acquire additional current information on some segment of the North American Indian preschool population. During the first three weeks of April, 1969, we evaluated nutritional status of children between one and six years old who were members of the White Mountain Apache Tribe in Arizona and who lived on the Fort Apache Reservation.

A general review of procedures, clinical findings, analysis of growth data including skeletal maturation, nutrient intakes and clinical biochemical data follows. More information on food habits and dietary intakes is currently being summarized. Similarly, analysis of dental findings will be completed later.

PROCEDURES AND METHODS

Sample

Based on information from the Indian Health Service (IHS), a sample of some 200 children representing approximately 15 percent of the preschool children on the reservation was selected for study based on logistic considerations and the availability of funds, personnel and time. It was known that nearly all five-year old children on the Reservation were enrolled in a Head Start program, so they were listed according to general area of residence (Cibecue, East Fork or Whiteriver) on the Reservation. Within these three areas, the average family size (based on numbers of children in family) was approximately equal. Accordingly, names of Head Start children were randomly selected from the list with chances for inclusion being proportionate to the contribution of each area to the total list of Head Start children. Half of the children so selected were to be included in the study:

if there were other children between one and six years old in a selectee's family, one or two were designated by the interviewer for inclusion in the study. Initially, it was agreed that we should study no more than two children per family but as the study progressed, three children were studied in some families. The other half of the children selected from the list were not included in the study nor were any of their siblings: rather, their dwelling unit was identified and the interviewers were to select the nearest dwelling unit with preschool children. This was done in order to allow inclusion of preschool youngsters from those families which did not have a child enrolled in Head Start. A more sophisticated sampling scheme could have been devised but could not have been tested and applied in the time available.

Interview

Home dietary interviews were conducted by five Indian Health Service nutritionists, one from the Phoenix area, the others from other locations in the U.S.[6] Forms and procedures being used in home interviews in our national project were modified to fit the needs of the interviewers and local customs. Each interviewer was accompanied by an Apache woman who could speak both Apache and English. Two interviewers and a supervisor employed full-time in our program worked with the team of Indian Health Service nutritionists to code diet records.

Medical

The children and families were transported to clinic sites for physical examination. Two nurses employed full-time in our survey program reviewed children's medical histories with the assistance of bilingual Apache women. The nurses weighed the children to the nearest 25 gm, using

standard double beam scales which was calibrated each day with known weights. Heights were measured to the nearest centimeter with children standing shoeless with back against a vertical surface and a right-angle level brought to the crown of the head. Frontal-occipital circumference of the head was measured to the nearest centimeter with a steel tape. Thoracic fatfold measurements were made at the left costal margin at the anterior axillary line with Harpenden calipers: successive measurements which agreed within one millimeter were accepted. With bilingual Apache women assisting, three pediatricians from Columbus (The Ohio State University) and one from Denver (University of Colorado) examined the children.

Laboratory

Determinations of hemoglobins and hematocrits and qualitative tests for urine glucose and protein were completed by our laboratory technician working in field clinics. Blood plasma, erythrocytes and urine specimens were promptly frozen for shipment to Columbus where the remainder of the laboratory determinations were completed (plasma iron, iron binding capacity, vitamin A, ascorbic acid, total protein, albumin, cholesterol and urea nitrogen; urinary creatinine, urea nitrogen, iodine, thiamine and riboflavin). With the exception of vitamin A determinations, laboratory procedures and other methods have been described in an earlier publication.[4] A fluorometric method[7] was used for determinations of plasma vitamin A level.

RESULTS

Sample

A total of 201 preschool children from 125 families were included in the entire sample. No families with eligible preschool children were known to have declined to take part in the study although participation was

entirely on a volunteer basis.

Although 201 children were interviewed at home, only 164 youngsters, from 97 families, were examined in clinics. Half the children were nearly equally distributed in the age intervals of 12-23, 24-35 and 48-59 months. The other children were equally divided in two other age intervals, i.e., 36-47 and 60-71 months. The remainder of this report will deal with the information pertaining to the 164 children, (88 boys and 76 girls), who were seen in the clinics. Of these 164 children, 74 lived in Cibecue, 48 lived in Whiteriver, 21 in East Fork, 12 in Seven-Mile Settlement and 9 in Canyon Day. Average elevation was 5000 feet above sea level.

Interview

Limited socioeconomic information was obtained on families included in the study. The principal occupations of the families were in forestry, farming (livestock grazing) and tourism. The average parent had completed the ninth grade, was 30 years old and had between 1 and 13 liveborn children with an average of six. About one-half of the fathers (or mothers in families where there were no fathers) were stated to be employed, with about equal numbers listed as skilled craftsmen, semi-skilled workers or laborers; the remainder were unemployed. Almost all the families lived in one family dwelling units, two-thirds of which were rated[8] poor or very poor. Families were relatively large with three-fourths including six or more persons, with the majority living in dwelling units with four or less small rooms. Only one-third had indoor toilets. Eighty-five percent of families used community piped water, 11 percent obtained water from spring, stream or lake and the remainder from wells, cisterns or unknown sources. Only three families had telephones. Some 40 percent either owned or had use of an automobile or a truck for personal transportation. An equivalent proportion had an icebox

or refrigerator and a television. More than half had radios and most had a stove (electric, gas, oil or solid fuel).

It was reported that only four children were receiving vitamin supplements at the time of study. Therefore, frequency distributions of intakes (Table 1) reflect essentially dietary sources of various nutrients. In general, as the children grew older, they appeared to consume progressively better diets, i.e., more adequate levels of calories and of essential nutrients. In Table 2, average intakes of calories and of several nutrients are summarized and the percentage of youngsters considered to have low intakes are also given. A significant proportion of Fort Apache preschool children were receiving insufficient calories, calcium, ascorbic acid, vitamin A, riboflavin and iron to meet requirements.

Medical

Of 584 liveborn children in the 97 families interviewed in the clinic, 88 (15%) had died: 61 died during the first year of life and altogether 69 died during the first five years of life. Therefore, at the time our survey was in progress, each family had an average of five living children. Eighty-five percent of children in the study population were born in Whiteriver Indian Hospital: mean birth weight of boys was 3.22 kg and that of girls was 3.02 kg. Ten percent of the study children delivered in the hospital weighed less than 2500 gm at birth.

A majority of the children had been hospitalized at least once. Forty-five children between 12 and 35 months of age had 114 hospitalizations or an average of 2-1/2 per child. Older children between 36 and 71 months of age had 234 hospitalizations or an average of two for each child. Approximately one-third of the hospitalizations were for a primary disgnosis of pneumonia; one-third were primarily for gastroenteritis and the remainder

for a variety of other reasons, frequently multiple.

Approximately one-fourth of the children had experienced measles and a similar proportion reportedly had experienced varicella. Three-fourths or more of children we examined had been sucessfully vaccinated for smallpox and had received immunizations for diphtheria, tetanus and pertussis. Virtually all those children presumed suceptible to rubeola had received measles vaccine.

Virtually all the children examined had significant dental disease but only half were examined by the pedodontist and analysis of data pertaining to those children will be completed later.

One-third of the children were believed to have normal physical examinations if dental findings were excluded. Other than growth under-achievement, clinical findings which might be considered indicative of nutritional disorders, were bowed legs (2), obesity (6), hepatomegaly (1), hair dyspigmentation (1), and pallor (2). Several children showed evidence of recent acute respiratory infections and six had otitis media. Several children had impetigo, one had a questionable atrial septal defect and another had an anal fistula.

Heights and weights of the children are shown in Figures 1a and 1b. Some 38 percent of height measurements were below the 10th percentile of the reference chart while three percent were above the 90th percentile. Of weight measurements, 18 percent were below the 10th percentile and 7 percent were above the 90th percentile of the reference chart. Bone ages[10] of 65 children between 24 and 71 months old are compared with chronological ages in Figure 2. Measurements of frontal-occipital head circumference (FOC) and throacic fatfold thickness are shown in Table 3.

Laboratory

Frequency distributions of certain biochemical determinations are shown in Table 4 and average values of these and other determinations are summarized in Table 5 where estimates of the proportions of abnormal values are also given. Plasma iron values (Table 4) paralleled the hemoglobin concentrations with some rather low values characteristic early and very few low values noted during the fifth year of life. With increasing age, fewer children had low levels of vitamin A and vitamin C in plasma, which reflected a decreasing proportion of the population with low intakes of these vitamins. Four children taking multi-vitamin supplements had levels of vitamin C in plasma exceeding 1.4 mg/100 ml. Only one of the vitamin-supplemented children had a urine specimen available for examination and thiamine and riboflavin levels were well above median values of unsupplemented children.

COMMENT

It was evident to us that the Health Committee of the Tribal Council, with whom we met in planning stages of the study, accurately reflected the interest of the community-at-large in the desire to learn more about nutritional and health status of their preschool children. We were therefore pleased but not surprised at the high level of participation of families in the study. Some families had to travel considerable distances in order to bring children to the clinics so we were similarly pleased that 80 percent of children interviewed in the home were also examined clinically.

Although no attempts were made to determine income of families included in the study, the fact that 60 percent had received surplus commodities indicated that the majority were living in conditions of poverty or near-poverty. Housing and sanitary conditions were generally rather poor. Because

distances between home and hospital were often considerable and because communication by telephone was usually not possible, it seemed likely that many families found it difficult at times to make the best use of the medical services available at Whiteriver Indian Hospital.

Statistics from birth certificates showed that in calendar years 1964, 1965, 1966 and 1967, median birth weights for Apache children (boys and girls) born in Whiteriver Indian Hospital were 3.15, 3.19, 3.07 and 3.09 kilograms, respectively[9]. In the 117 hospital-born children (boys and girls) included in our study, median birth weight was 3.13 kg. Date of birth and birth weight of each study child who was born in the hospital was verified and the overall incidence of low birth weight (< 2500 gm) was 8 percent, similar to the average in the U.S. It should be remembered that on the average, these were fifth-born children in relatively large families and birth weights of those who were first- or second-born or ninth- or tenth-born were less than those of children who were fifth- or sixth-born.

There was an excess of children who were short for age at time of our study with 38 percent below the tenth percentile of the reference chart.[9] In the Mississippi study[4] 24 percent of 503 children had heights below the 10th percentile. We have completed preliminary analysis of height and weight data on 1136 children in our national survey[1] and find 20 percent of heights are below the 10th percentile of the reference chart. Excluding those children who had birth weights below 2500 gm. (or unknown birth weight), nearly 17 percent of heights in the national survey were below the tenth percentile. If Apache children with low (< 2500 gm) or unknown birth weights are excluded from the population, then heights of 30 percent of these children fall below the tenth percentile of the reference chart.

To view heights and weights of Apache children from a different

perspective, we have compared them with those of 159 low-income Negro children living in rural Mississippi and of 440 children examined in the first 13 primary sample units (15% of expected total sample) of our national study. Standard scores $\left(\left(\frac{x - \bar{x}}{S.D.}\right) 10 + 50 = \text{Standard Score}\right)$ [13] for heights and weights were derived from the combined data of the three populations. Percentages of children in each of the three populations with standard scores above 63 or below 37 are given in Table 6.

It is evident that Apache children we studied were appreciably shorter than Negroes in rural Mississippi and also shorter than children we studied in other areas of U.S. Mothers of Apache children were also short: heights of 85 Apache women were measured in the clinics and the average was 157 cm. or approximately 8 cm. shorter than the average U.S. woman with preschool children. Kraus[14] measured heights and weights of White Mountain Apache children in 1954: average heights of boys and of girls and average weights of girls were similar to those reported here while weights of boys studied in 1954 were considerably less than those reported here (Figure 3).

It was of interest that although these Apache preschool children were short for age there was no significant delay in skeletal maturation (Figure 2), a finding in contrast to that reported in other preschool children recently studied in Texas (Mexican-American), New Mexico and Arizona (Navajo) in the National Nutrition Survey.[15] It is obvious that relative contributions of diet and of heredity to body build and growth patterns of Indian children cannot be defined. It is believed[14] that Apache and Navajo come from same biologic stock so one might anticipate similarities in body build and growth patterns of those living in Southwestern U.S. Nevertheless, overall improvement in diet of these

Apache children might be expected to result in relatively greater increase in body weight whereas similar changes in diets of Navajo might result in relatively greater increase in height.

The average frontal-occipital head circumference values (boys and girls) were slightly below average values of either boys or girls as summarized by Nellhaus[16]. He could find no significant racial, natural or geographic differences in head circumferences. Any additional comments concerning the values of the Apache children seem unwarranted.

Thoracic fatfold thickness of Apache children reflected their relative excess of weight-for-height (see Fig. 3a and 3b) when compared with other children in the U.S.[17] To the authors knowledge, there are no data reported on thoracic fatfold measurements in preschool children. We elected to use this site in our project on preschool children because we found it to be relatively much easier to measure than triceps, subscapular or other standard sites.

Those items in limited supply for some Apache children, i.e., calories, calcium, ascorbic acid, iron, vitamin A and riboflavin were with the exception of the latter two, those also in limited supply for some Mississippi preschool children[4].

Of 43 five-year old children examined in the clinics, 36 were currently enrolled in Head Start normally during the week received an estimated one-third of total food intake at Head Start. During a portion of the time our survey was in progress on the reservation, school was recessed for spring vacation so only five children were actually eating at Head Start during the survey. Nevertheless, it seemed reasonable to suggest that some of the apparent age-related changes in dietary intakes (Table 1) and in biochemical indices (Table 4) may have reflected overall

improvements in diets because of participation of children in Head Start program.

It appeared that the proportion of Apache children with low levels of hemoglobin in blood or of iron, vitamin A, vitamin C in plasma and of riboflavin in urine was similar to that of low-income children in Mississippi [4] and was two or three times more than the proportion of children in the national study [17] with low values. In our laboratory assessment, acceptable values are for the most part based on the criteria agreed upon for the National Nutrition Survey.[18] A hemoglobin value of 11 gm/100 ml has been accepted as a lower limit for children beyond the age of two years and it may be appropriate to extend that figure to children between one and two years of age.[19]

CONCLUSION

Apache children, one to six years of age, living on an Indian Reservation in Arizona had mean intakes of calories, calcium, vitamin A, vitamin C and vitamin B_2 substantially below those that were considered sufficient to meet needs. Protein intake was quantitatively acceptable but was often of poor quality and in many instances may have been utilized to some extent to meet energy needs. The majority of Apache children were ingesting insufficient iron to meet current needs and to create iron stores. Average growth in height was significantly retarded although skeletal maturation was not delayed. About one-fifth of the Apache children demonstrated low levels of hemoglobin in blood or of iron, vitamin A, vitamin C in plasma.

The pattern of dietary intakes, growth underachievement and biochemical evidence of nutritional risk of the Apache children was similar

to that of children living in poverty in Mississippi.[4] Because in both areas the population was essentially rural in character, it will be of interest to compare findings in these preschool children with those in low income urban areas.

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Legends

Figure 1a. Heights and weights of girls compared with 10th, 50th, and 90th percentiles from Stuart's data[9].

Figure 1b. Heights and weights of boys compared with 10th, 50th, and 90th percentiles from Stuart's data[9].

Figure 2 Bone age versus chronological age.

Figure 3a. Average heights and weights of girls shown on Iowa Growth Chart. Values of 1954[14] shown as x's and those of current study as o's.

Figure 3b. Average heights and weights of boys shown on Iowa Growth Chart. Values of 1954[14] shown as x's and those of current study as o's.

TABLE 1

Percentage Distribution of Daily Intakes

Calories (Kcal/kg)	Less than 40	40-49	50-59	60-69	70-79	80-89	90-99	100-109	110-119	120 and above	N	Mean
12-23 mos.	0	14	0	23	14	18	9	4	14	4	22	85
24-59 mos.	3	11	10	17	19	13	15	4	4	4	95	76
60-71 mos.	8	0	13	23	25	10	8	4	0	5	39	73

Protein (gm/kg)	Less than 1.0	1.0-1.4	1.5-1.9	2.0-2.4	2.5-2.9	3.0-3.4	3.5-3.9	4.0-4.4	4.5-4.9	5.0 and above	N	Mean
12-23 mos.	9	5	9	18	18	9	23	0	5	5	22	2.8
24-59 mos.	1	8	15	21	25	15	9	2	3	0	95	2.5
60-71 mos.	3	3	18	26	23	13	8	3	3	3	39	2.6

Calcium (mg)	Less than 100	100-199	200-299	300-399	400-499	500-599	600-699	700-799	800-899	900 and above	N	Mean
12-23 mos.	4	9	13	4	4	13	22	9	4	17	23	609
24-59 mos.	4	22	14	14	17	6	7	6	2	7	98	412
60-71 mos.	5	14	9	9	7	21	12	12	7	4	43	492

Vitamin A (I.U./kg)	Less than 50	50-99	100-149	150-199	200-249	250-299	300-349	350-399	400-449	450 and above	N	Mean
12-23 mos.	9	9	23	18	9	9	5	5	0	14	22	182
24-59 mos.	31	26	15	10	11	3	0	0	0	4	95	125
60-71 mos.	23	28	18	13	10	8	3	0	0	0	39	122

Ascorbic Acid (mg)	Less than 15	15-29	30-44	45-59	60-74	75-89	90-104	105-119	120-134	135 and above	N	Mean
12-23 mos.	43	22	9	4	9	9	0	0	0	4	23	33
24-59 mos.	41	15	15	10	7	2	3	1	2	3	98	40
60-71 mos.	26	21	14	9	9	14	0	2	0	5	43	48

TABLE 2

Mean Daily Intakes of
Apache Children 12-71 months old

	Calories (Kcal/kg)	Protein (gm/kg)	Calcium (mg)	Vit. A (I.U./kg)	Vit. C (mg)	Vit. B_1 (mg/1000 Kcal)	Vit. B_2 (mg/1000 Kcal)	Iron (mg)
Mean	77	2.6	440	132	41	0.6	0.8	7
% low	41	3	41	16	36	3	10	63
Low Intakes	< 75* < 60	< 1.2	< 250	< 35	< 15	< 0.3	< 0.4	< 8

* < 75 for children 12-23 months: < 60 for children 24 months and older.

TABLE 3

Average values for head circumference (FOC) and thoracic fatfold thicknesses (FAT) for White Mountain Apache boys and girls together*

Age (mos.)	Children (no.)	FOC (cm.)	FAT (mm.)
12-17	10	45.5	5.9
18-23	9	47.1	6.1
24-29	11	47.5	5.3
30-35	14	48.6	5.2
36-41	27	48.4	4.8
42-47	21	48.4	5.2
48-53	9	49.1	4.6
54-59	14	49.4	4.7
60-65	14	51.4	3.9
66-71	25	50.2	4.9

*All measurements were made by two nurses.

TABLE 4

Percentage Distribution of Biochemical Values

Hemoglobin (gm/100 ml)	Less than 10	10.0-10.4	10.5-10.9	11.0-11.4	11.5-11.9	12.0-12.4	12.5-12.9	13.0-13.4	13.5-13.9	14.0- and above	N	Mean
12-23 mos.	24	19	10	10	5	10	14	9	0	0	21	10.8
24-59 mos.	6	2	7	1	1	17	13	23	13	15	82	12.6
60-71 mos.	0	0	0	0	0	6	18	16	25	34	32	13.7

Plasma Iron (ug/100 ml)	Less than 20	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100 and above	N	Mean
12-23 mos.	23	41	5	9	5	5	0	0	0	15	22	37
24-59 mos.	10	11	6	9	17	11	9	11	5	12	94	63
60-71 mos.	0	5	0	7	12	19	14	19	7	17	42	79

Vitamin A (ug/100 ml)	Less than 10	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90 and above	N	Mean
12-23 mos.	0	10	50	20	10	10	0	0	0	0	10	33
24-59 mos.	2	17	40	17	12	8	3	0	0	1	65	32
60-71	0	10	16	19	26	19	10	3	0	0	31	41

Ascorbic Acid (mg/100 ml)	Less than 0.1	0.1-0.2	0.3-0.4	0.5-0.6	0.7-0.8	0.9-1.0	1.1-1.2	1.3-1.4	1.5-1.6	1.7 and above	N	Mean
12-23 mos.	9	30	4	13	17	4	13	9	0	0	23	0.6
24-59 mos.	6	13	9	17	19	17	10	8	0	2	90	0.8
60-71 mos.	2	5	2	10	14	19	24	10	12	2	42	1.0

Albumin (gm/100 ml)	Less than 2.5	2.5-2.9	3.0-3.4	3.5-3.9	4.0-4.4	4.5-4.9	5.0 and above	N	Mean
12-23 mos.	0	0	0	71	29	0	0	21	3.9
24-59 mos.	1	0	2	30	59	8	0	88	4.0
60-71 mos.	0	0	0	43	48	7	2	42	4.0

TABLE 5

Average Biochemical Values

	BLOOD	PLASMA				URINE		
	Hgb (gm/100 ml)	Fe (ug/100 ml)	Albumin (gm/100 ml)	Vit. A (ug/100 ml)	Vit. C (mg/100 ml)	Vit. B_1 (ug/gm creatinine)	Vit. B_2 (ug/gm creatinine)	Iodine (ug/gm creatinine)
Mean	12.7	64	4.0	33	0.8	1575*	1375*	725*
% low	17	26	3	16	19	0	5	0
Low Values	< 11	< 40	< 3.5	< 20	< 0.3	< 175	< 500	< 100

*Median Values

TABLE 6

Distributions of Height and Weight Standard Scores (S.S.) of Three Population Groups

	S.S. ≤ 37	S.S. ≥ 63
	Heights	
White Mountain Apache	20	5
Rural Mississippi Negro	10	11
U.S. National	6	12
	Weights	
White Mountain Apache	7	10
Rural Mississippi Negro	7	9
U.S. National	9	8