PRESCHOOL CHILD FEEDING, HEALTH AND NUTRITIONAL STATUS IN GUALACEO, ECUADOR

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SUMMARY

Anthropologic, survey, dietary recall and anthropometric techniques were used to study the correlates of nutritional status of preschool children under five years of age in Gualaceo Ecuador. A widespread stunting was found among the children. Nutritional status was worst among infants comprised between 12 and 23 months old but it improved between April and August, thus suggesting seasonality changes of nutritional status.

The correlates of nutritional status (expressed as Z score of weight-for-age) were dietary diversity, birth-spacing, fertility, migration, household income, material goods owned, and parental education. A regression model with these variables predicted 63°/o of the variability in weight-for-age. The prediction of height-for-age was similar, but only predicted 43°/o of the variability in height-for-age. Correlates of dietary diversity, birth-spacing, fertility, and migration were child age, maternal age and arm circumference, parental education, use of birth control, household food expenditure, material goods owned, and the raising of animals. Parental education was a correlate of dietary diversity, fertility and migration. Parental education was related to change in weight-for-age in the longitudinal subset.

Pre-harvest time and a pathway of illness leading to decreased dietary diversity and to decreased nutritional status in April, were suggested as important to preschool child nutritional status. Hot-cold ideology —resulting in food withdrawal during illness and restriction of high-protein and high-calorie foods— appears to be an important mechanism determining preschool child nutritional status. Breast-feeding, sanitary, higienic, birth control, and drinking (alcohol) practices were suggested as areas that could be improved, in order to improve preschool child nutritional status. Communication between parents and western health care providers was also suggested as an area for improvement.

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INTRODUCTION

Preschool children are at high risk of undernutrition, morbidity and mortality in developing countries due to rapid growth and considering that this is a period of chemical maturation, including immunologic maturation (1-3). Furthermore, undernutrition, morbidity and mortality are inter-related (4-6).

Many factors are known to be associated with each of these outcomes: age, sex, some feeding and health practices, and some maternal and community variables. All, however, are culture-specific in their relative importance. Pelto wrote (7):

> "The extent to which economic factors, household characteristics, the individual's beliefs, goals, desires, and values, and psycho-biological characteristics affect decisions about infant feeding is amenable to empirical investigation. Since the relative importance of these characteristics is likely to be different in different environments, future research must be cross-cultural and must be carried out in different regions and cultural conditions. This does not mean that research on infant feeding has to be undertaken in every community on the face of the earth before we can have a better understanding of the contemporary situation. But it does mean that we must be careful not to assume that the picture is the same in all urban centers of the industrialized world, or that we can easily extrapolate findings from a rural Asian community to a plantation in Guatemala."

The conceptual hypothesis of this paper is that *culture-specific* feeding and health practices are important factors in determining preschool child nutritional status (PCNS), (8, 9). It is proposed that these practices can be better identified and measured by a multi-disciplinary methodology utilizing ethnography, survey research techniques, anthropometry, and dietary recall methods from nutritional sciences.

The conceptual framework of this communication reflects a research approach that anthropologists would call "cultural ecology" (7,10). That is, that both the environment and culture are seen as contributors to foods, diet and nutritional status. A nutritionist might call this framework a nutritional ecosystem (11). With this general framework, variables that are associated with PCNS will be organized into categories of household, mother and child. This is for illustration purposes only, because, clearly, these variables overlap categories in places.

Understanding the mechanism involved in determining PCNS is essential for intervention to improve PCNS. For example, a recent review of preschool feeding intervention programs by Beaton and Ghassemi (12) shows that in six- to 24-months-old children, the critical period of weaning and introduction of complementary foods, show no improvement in growth from intervention of supplementary feeding. The authors conclude that this is due to cultural variation in maternal beliefs and attitudes resulting in culturally-distinct feeding practices, and that the intervention must, therefore, be culturally-tailored.

Freedman (13) notes that, whatever the cause of a nutritional problem, the solution will almost always require modification of a cultural habit,

and that the nutritional anthropologist (or anthropologic nutritionist) can suggest an intervention that will be met with the least resistance.

Thus, lack of understanding of cultural variations may be the principal reason for many unsuccessful interventions (10, 12-15).

The objective of the study detailed in this paper was to identify culture-specific feeding and health factors associated with preschool child nutritional status in one community of Ecuador (Gualaceo, Azuay), using a combined methodology drawn from ethnography, survey research techniques, anthropometry, and dietary recall. Secondary objectives were to identify the relative importance of identified factors and the mechanisms responsible for their association.

MATERIALS AND METHODS

This study was designed within the context of a larger project, "The Sex Ratio in Ecuador: Cultural Management and Cultural Change", designed and implemented by Dr. Lauris McKee. Gualaceo was the community selected to represent southern Ecuador and, presumably, a high sex-mortality ratio (number of girls dying per number of boys) as was seen in provincial census data from 1974.

Gualaceo is located at 2,200 meters above sea level, an altitude not believed to affect growth (16), and it had an estimated population for 1983, of 5,700 persons (17). It is the county seat of the county of Gualaceo, with a mean annual temperature of 17°C, and a mean annual rainfall of 670 mm. The seasons are not marked, but generally, more rain falls between October and April. Staple crops are corn, beans, sugar cane and fruit. Pigs and chickens are the main animals raised for food.

Gualaceo is a craft community, with hand shoe-making the primary occupation and the most economically-rewarding. Twenty years earlier there was still a great deal of subsistence agriculture being practiced in Gualaceo (18, 19). But mining and hydro-electric power plant construction have changed Gualaceo from subsistence agriculture to a cash economy. In 1984, only 14% of the households grew a crop (this study, research 1983-1984).

With these changes have come fewer extended family households and less adherence to traditional practices. Nevertheless, 20 years is, historically, a short time. Thus, there is a blend of traditional and modern ideas relevant to PCNS.

Combining needs of the two studies, 100 households were randomly selected for survey, anthropometry and dietary recall from which the first 12 households were selected for ethnographic study with both a male and female child aged 12 to 60 months (ten households), or a child less than 12 months (two households, one male and one female).

Families that participated in ethnographic study were compensated with 800 Sucres (U.S.$ 10.00); this was an incentive for most of them. One family refused to cooperate and one was a migrant-working family which was logistically impossible to study.

Households selected for ethnographic study were visited for 30 hours, or 15 hours where there was only an infant, from September 1983 to July 1984. Visits were roughly scheduled so as not to change the household

routine activities. Generally, the observer sat where the children and/or mother were located, accompaying them to do laundry at the river, harvest corn in the field, etc. Questions were asked as they arose from observed behavior, or as seemed appropriate. The observer tried to respond ambiguously to maternal questions about preschool child health and nutritional status until after the ethnography and survey studies were complete, so as not to bias maternal responses. The observer was careful to observe as many meals as possible but did not partake. Topics covered in the ethnographic study included beliefs and practices concerning child development, diet, sex differences, pregnancy, delivery and post-partum treatment of the neonate, family structure, economic information, health and illness and socialization.

Questions relating to preschool child feeding, health and nutritional status, and maternal beliefs and attitudes were added to the survey questionnaire, as suggested by ethnographic visitation.

The survey and anthropometry were performed from April to August 1984. Dr. McKee's pretested survey questionnaire was conducted first by personal interview, followed (at the same visit) by this study's questionnaire (pretested after including questions elicited by ethnographic study) and anthropometry performed by standard procedures (arm circumference of mothers and weight and height or length for children). Weight was measured on a CMS hanging scale in duplicate to the nearest 100 g, and height/length was measured in duplicate to the nearest millimeter on a wooden length board with a moveable head/foot piece. Children under 24 months were measured horizontally (i.e. length). Arm circumference was measured with a Singer flexible fiberglass tape measure in duplicate to the nearest 0.1 cm. The same assistant (R.W.D.) was used for all measures. One hundred households with 146 children were studied, and repeat anthropometric measures were done in August on the first 22 children, to see if anthropometry had changed notably with season.

The combined ethnographic and survey methodology has many advantages. The ethnography, the description and analysis of a particular group of people (20), provides in-depth exploration into cultural practices that affect PCNS, and the survey tests, the resulting hypotheses on a randomly-selected group. Variables selected before the ethnography (or usually, before arriving at the study site) may not include a vital component to that time and place. The ethnography, thus, suggests new hypotheses and prioritizes old ones. Furthermore, the ethnography suggests culturally-appropriate ways of asking questions. A trained observer from another culture has a unique opportunity to be *more* objective than a member of the culture can be. Such a methodology has the additional advantage over traditional survey methodology of providing clues about mechanisms for the associations discovered.

Of 146 children in 100 households, descriptive data were complete on 144 children, and anthropometric data, on 142 children. Thus, 142 children were used for analytic purposes. The responses "I don't know" and "sometimes" were treated as missing values in analysis.

A variable, consentual union, was created from the maternal civil status variable because ethnographic experience suggested that the parents being together was more important than formal marriage. Thus, "married"

and "free union" responses became "yes", and "single", "separated" and "divorced" became "no".

A square root transformation of the household income variable was created because income values were skewed upwards. This transformed variable was used in multivariate analyses.

As both father's and mother's education have previously been found important to PCNS, parental education (the sum of years of mother's and father's education) was used to describe educational level. Paternal education was used as given by maternal recall, even when parents were not in union.

The dietary diversity variable was created by summing every different food item consumed in the previous 24 hours, taken from the 24-hour dietary recall. Breast-feeding was treated as one food item. Only children older than 12 months were considered.

Per cent of the fiftieth percentile of the WHO standard (21) was calculated for weight-for-age, height-for-age and weight-for-height. Z scores were calculated also according to the WHO standards (22) using the median and one standard deviation above or below the median where Z = (x – median)/standard deviation. These reference data were taken from the National Center for Health Statistics data (NCHS), (23). The calculations were accomplished using the IBM mainframe facilities at Cornell University.

Z scores for weight-for-age and height-for-age were used as the dependent variable in order to control for the variability in growth by age and sex. Using a Z score requires the assumption that the growth pattern is similar for all children. Z scores were chosen rather than per cents of a standard value or percentiles because they are easier to interpret and because this is a standard analytic procedure (24). Weight-for-age and height-for-age were chosen because they were found to be the most powerful measures from the available literature (25,26). Furthermore, weight-for-age gives a picture of the composite effect of nutritional wasting and stunting – the primary concern for this paper – and height-for-age reflects stunting, which is particularly prevalent in this area of the world (16,25).

RESULTS

Demographic Characteristics

Mean household size was five ± two persons. Eighty-nine per cent of the mothers were married, and 79% were living with their husbands, at least on occassion (n = 98). Twenty per cent of households had experienced a previous preschool child death (n = 94). Women reported that their husbands drank regularly in 14% of households (n= 98).

Mothers were 28 ± seven years old at the time of the interview: median age was 27 years (n= 97). The youngest mother was 13 and the oldest 45. Mothers had had 3.1 ± 2.0 children; the median was three children. Values ranged from zero to 12. The mean space between births was 29.7 ± 16.2 months (including still births and miscarriages): the median was 26 months. The shortest birth space was 11 months: seven

women had children more than seven years apart: these were excluded from the mean. The mean per cent of standard arm circumference was 100 (27); the range was 79 to 117°/o (n = 96). Nine per cent of women were pregnant at the time of the survey: 46°/o had used birth control.

Mean paternal education was nine ± five years; the median was six years (n = 93). Mean maternal education was seven ± four years; the median was six years (n = 97).

Mean paternal income was 2,810 ± 4,590 sucres/week (US$31.00); the median was 2000 sucres/week (n = 89). Mean household income was 3,760 ± 5,196 sucres/week (US$42.00), and the median was 2,300 sucres/week (n = 94).

Forty-eight per cent of fathers were employed making handmade shoes, 21°/o as civil servants and 12°/o as drivers (bus, taxi, etc.); no woman considered her partner unemployed. Forty-two per cent of mothers considered themselves housewives, 17°/o made hand-made shoes, 15°/o were civil servants, and 12°/o worked in other crafts. Twenty-one per cent of mothers worked away from their children. Fourteen per cent of households grew a crop and 18°/o raised at least one animal.

Feeding Practices

Children are breast-fed for about 10 months (mean age of weaning, 10 ± seven months, n = 109); the median was 10. Bottle-feeding was generally introduced within the first six months (80°/o, 10 children were zero to six months old). Children began eating complementary food at a mean of five ± four months (n = 128). Complementary foods were eaten regularly at a mean of 11 ± seven months (n = 111). "Hot" foods (e.g. pork, beans, hen, chocolate, guinea pig) were introduced at a mean of 16 ± 10 months (n = 97).

Dietary diversity scores (children 12 months or older) ranged from two to 16 (mean = seven ± three, n = 118). The mean number of servings of breads and cereals per day was three ± two (four recommended), (28), two ± two of milk and milk products (two recommended), one ± one of meat (two recommended) and two ± two of fruit and vegetables (four recommended, n = 118).

Health

Twenty-nine per cent of children were ill at the time of the survey (n = 133); they had been ill for a mean of eight ± 11 days (n = 30). Seventy-three per cent were attended by a private physician when ill (n = 143), and 52°/o of children that had begun eating food, were not fed when ill (n = 134). Forty-four per cent of children with teeth had dental caries (n = 118). Four percent of them had geophagia. On the average, all were given a purgative every 10 ± nine months (n = 69).

Nutritional Status

The mean height-for-age was −1.45 ± 1.2 SD, weight-for-age was −0.90 ± 1.0 SD, and weight-for-height was 0.04 ± 0.7 SD (Table 1). When examined by age, the 12-24-month period is the lowest for all three

TABLE 1

ANTHROPOMETRY BY AGE AND SEX
PER CENT OF STANDARD* AND Z SCORE**
GUALACEO, ECUADOR

	Male and female Mean ± SD	
Measure and age (mo)	% (N)	Z (N)
Weight-for-age		
0-11	93 ± 11 (24)	-0.63 ± 0.9 (24)
12-23	86 ± 11 (28)	-1.33 ± 1.1 (28)
24-35	93 ± 11 (34)	-0.75 ± 1.0 (34)
36-47	91 ± 10 (26)	-0.80 ± 0.9 (26)
48-59	90 ± 12 (30)	-0.97 ± 1.0 (30)
0-59	91 ± 11 (142)	-0.90 ± 1.0 (142)
Weight-for-age		
0-11	97 ± 4 (24)	-0.90 ± 0.9 (24)
12-23	93 ± 4 (28)	-1.94 ± 1.2 (28)
24-35	95 ± 5 (34)	-1.27 ± 1.3 (34)
36-47	94 ± 5 (26)	-1.63 ± 1.3 (26)
48-59	94 ± 5 (30)	-1.50 ± 1.1 (30)
0-59	94 ± 5 (142)	-1.45 ± 1.2 (142)
Weight-for-age		
0-11	102 ± 9 (24)	0.12 ± 0.8 (24)
12-23	98 ± 7 (28)	-0.24 ± 0.8 (28)
24-35	102 ± 8 (34)	-0.08 ± 0.7 (34)
36-47	104 ± 6 (26)	0.29 ± 0.5 (26)
48-59	100 ± 7 (30)	-0.03 ± 0.7 (30)
0-59	101 ± 7 (142)	0.04 ± 0.7 (142)

* (21)
** (22)

measures, whereas the first year is the highest. There were no sex differences found in anthropometric measures, and the values were normally distributed. As Table 2 shows, the weight-for-age of children in the longitudinal subset improved between April and August. This group was significantly lower in April and August than the survey group as a whole, which was measured between April and August ($t = -2.1$ and -2.2, $p < 0.05$). Children who decreased in weight-for-age differed from those that did not only in parental education ($t = 2.12$, $p < 0.05$).

The severely undernourished (< 80% weight-for-age) were compared to the rest of the group for various parameters. Undernourished children were from households with lower income, parental education, food expenditures, and fewer material goods. Their mothers had more children,

TABLE 2

ANTHROPOMETRY OF CHILDREN IN THE LONGITUDINAL SUBSET, PER CENT OF STANDARD AND Z SCORE VALUES GUALACEO, ECUADOR

Measure	First measure (April) Mean ± SD (N)	Second measure (August) Mean ± SD (N)
% weight-for-age	87 ± 8 (22)*,+	89 ± 8 (20)
% weight-for-age	92 ± 4 (20)	92 ± 5 (20)
% weight-for-height	101 ± 5 (20)	102 ± 5 (20)
Z weight-for-age	- 1.3 ± 0.8 (22)**,++	- 1.1 ± 0.8 (20)
Z weight-for-age	- 2.1 ± 1.1 (20)	- 2.0 ± 1.2 (20)
Z weight-for-height	0.0 ± 0.6 (20)	0.1 ± 0.5 (20)

* $p = 0.03$, $t = -2.33$, significantly different from second measure.
** $p = 0.03$, $t = -2.36$, significantly different from second measure.
\+ $p < 0.05$, $t = -2.13$, significantly different from survey group, Table 1.
++ $p < 0.05$, $t = -2.18$, significantly different from survey group, Table 1.

closer together, as illustrated in Table 3, and, their diets were less diverse.

Household Sketch

The following household sketch, as taken from ethnographic visitation, is presented to give the reader a more vivid impression of the reality of life of the study participants. The account gives appreciation for the complexity of the measures used in statistical analyses, for how important beliefs are in determining practices, and for the important role that ethnographic work can play in elucidating the mechanism of association of significant survey variables. Clearly no one family will include all relationships suggested by analysis of 146 children, but it is intended as a case study. Names have been changed to protect the privacy of the participants.

Yanza Tacuri

Rosa Tacuri and Fernando Yanza live on one of the main cobblestone streets, about eight blocks from the center of town. They rent three rooms in a house, one of which has a large door into the street that they use as a store front. Fernando works there making shoes. He works for himself and usually makes children's shoes; he also was trying belt-making while I was visiting, because shoes weren't selling well (this was in February and March). When he has made a quantity, he takes them to Cuenca or Guayaquil to sell them. Fernando said he does all kind of things to earn money: carpentry, help in a mechanic shop, etc. He estimated that he earns 1,750 sucres a week (US$19.40) but he spent 2,000 on food

TABLE 3

FACTORS RELATED TO LOW WEIGHT-FOR-AGE
INDEPENDENT SAMPLES t-TEST
GUALACEO, ECUADOR

Variable	Mean ± SD (N = 26) < 80% W/A*	Mean ± SD (N = 116) > 80% W/A*	t
Household			
Household income (square root of)	43.6 ± 14.6	59.9 ± 34.5	3.59**
Parental education (years)	12.2 ± 6.1	17.6 ± 8.9	3.56**
Household food expenditure (sucres/week)	418.8 ± 548.5	1824.3 ± 752.9	2.49**
Material goods owned (0-5)	1.3 ± 1.1	1.9 ± 1.4	2.05**
Maternal			
Birth-spacing (months)	21.8 ± 9.2	31.4 ± 17.1	3.06**
Fertility	4.3 ± 2.8	3.1 ± 1.7	-2.96**
Migration (years residency)	14.3 ± 12.3	18.2 ± 12.2	1.48
Arm circ (cm)	26.9 ± 4.0	27.1 ± 3.5	0.84
Age (years)	27.8 ± 6.7	27.8 ± 5.7	0.01
Child			
Dietary diversity (items/24 hours)	5.1 ± 2.0	7.7 ± 2.5	4.63**
Age (months)	29.5 ± 17.3	30.9 ± 17.1	0.36

* Per cent of NCHS 50th percentile (23).
** Significant difference between groups, $p < 0.05$.

(US$22.00), Furthermore, the rent on the house is 1,120 sucres per month (US$12.44), including electricity.

Two rooms have wood floors while the other has dirt floor. They cook in the room with the dirt floor, on a three-burner kerosene stove. In the back of the house there is a community "pila" (cement slab on one side and water storage on the other), that is shared by everyone in the building (about four families). The building looks like a big house with a center courtyard, but it is broken into several homes. Most of the residents are related. There is a grassy area in the back that is used as a bathroom, no latrine, or other receptacle. Fernando says that he drinks (alcohol) occasionally, but that is bad; he doesn't want to drink anymore, but he sometimes does on social occasions. His friends say that he doesn't like them if he doesn't drink with them.

Rosa is from El Pam, a small agricultural community in the county of Paute, which borders the county of Gualaceo. Fernando has lived in Guayaquil for eight years, the last two of which Rosa lived with him. They met in Guayaquil while Rosa was living with and working for an aunt. Then they lived in El Pan for a few months before moving to Gua-

laceo, three years ago. They married by civil law two years ago. Fernando said that they didn't marry right away to "see if they understood each other". Fernando is 33 years old, and Rosa 28. Fernando completed elementary school, and Rosa completed three years of schooling.

Rosa and Fernando have had six children in eight years, three were born in Guayaquil (in a hospital), and three in Gualaceo (in the hospital). The oldest three were baptized in the Catholic church in Guayaquil; the youngest three have not been baptized, as Fernando doesn't believe in baptism anymore. Rosa, however, wants to baptize them.

Rosa told me of the Waco and Waca (male and female) that live in the mountains. They are old magical people, who take children that aren't baptized to keep for themselves. For a child to be protected, he or she should wear a cross blessed by a priest. Also, a child that ins't baptized can't be buried in the cemetery and won't go to heaven.

Rosa and Fernando don't want any more children, but they haven't decided what to do. They told me that some people visited them looking for more women to undergo a new procedure of tubal ligation. The physician to do it would only come if there were at least six women willing to do it.

The children are Magdalena (seven years old), Mercedes (six years old), Geovany (five years old), Laura (46 months old), Gabriel (25 months old), and Guillermo (13 months old). In April, Laura's weight was 78°/o of the standard median, and her height was 85°/o. Gabriel's weight was 91°/o of the standard median, and his height was 89°/o. Guillermo's weight was also 78°/o of the standard median, and his length was 87°/o. All three children are severely chronically undernourished, and Laura and Guillermo are also severely currently undernourished.

When I measured the children again in August (four months later and after the bean and corn harvest), Laura's weight was at 87°/o of the standard, and her height at 92°/o. Gabriel's weight was at 93°/o of the standard and his height at 91°/o. Guillermo's weight was at 76°/o of the standard, but his length was not taken. Laura and Gabriel had improved markedly in weight, but Guillermo had not, a fact which suggests that factors other than food availability are limiting his intake. At one year of age, many of the harvest foods are not seen as appropriate for him.

Gabriel has both a cleft lip and a cleft palate. The lip has been operated on, but the palate has not. He talks very little and dribbles food when he eats, although, it seems that his parents are particularly careful to see that he eats. The operation for the cleft palate will cost 30,000 sucres (US$333.00), and they don't have the money. Rosa stated the pregnancy was normal and that she didn't take any drugs or pills, and Fernando said it must have been something in the atmosphere because other children were born with cleft lips and palates around the same time.

Rosa told me that all of her children nursed for one year, except for Gabriel, because he couldn't. She said that at night she gave the breast and during the day the feeding bottle to all of the children (except only the bottle to Gabriel). She followed this pattern from birth, and she weaned them when she became pregnant again. The physician told her to wean them when pregnant because the milk now belonged to the baby that will be born and would give diarrhea to the child. Rosa's arm circumference was 92°/o of the stantard, suggesting that she is reasonably well-nourished.

The children began eating at two months of age, but they do not eat "hot" food because it will give them diarrhea (pork, beans, hen, chocolate, and guinea pig, especially). In April, Laura had a dietary diversity score of six; for rice, broth, milk, coffee, bread, and egg, and Gabriel had a dietary diversity score of six as well, for the same foods. Guillermo had a dietary diversity score of five, because he was given bits of rice, bread, and broth, he nursed, and was given the feeding bottle. Fernando said that all of the children have diarrhea constantly, he thinks, from "hot", "heavy" food. He also said that Laura never gets sick: diarrhea isn't seen as illness.

In general, he said, one should eat both hot and cold foods, except children should not eat extremely hot and extremely cold foods. When sick, however, certain foods must be avoided, depending on the illness, hot food should be avoided for cold illnesses and vice versa. For example, with an open wound, a "hot" situation, you should not eat "hot" food.

Correlates of PCNS

Using bivariate statistics (regression and independent samples t-test, $p < 0.05$), variables that were positively related to child Z score for weight-for-age were parental education, household income (and square root of), material goods owned, migration (years of residency in Gualaceo), birth-spacing, maternal arm circumference, child dietary diversity, dietary quality, servings of fruits and vegetables, servings of meat, and servings of milk. Fertility and migration were negatively related.

Multiple regression involving migration (years of residency), household income (square root of), maternal arm circumference, fertility, material goods owned, birth-spacing, dietary diversity, and parental education predicted 63% of the variability in child weight-for-age, although only birth-spacing, dietary diversity, fertility and migration (years of residency in Gualaceo) contributed significantly to the model (Table 4).

Using bivariate statistics (bivariate regression and independent samples t-tests, $p < 0.05$), variables that were positively related to child Z score for height-for-age were parental education, household income (and square root of), material goods owned, migration (years of residency in Gualaceo), consentual union, birth-spacing, child dietary diversity, dietary quality, servings of fruits and vegetables, servings of meat, servings of milk, bottle-feeding and birth weight. Previous preschool child death, fertility, migration and geophagia were negatively related.

Multiple regression analysis involving consentual union, fertility, geophagia, household income (square root of), bottle-feeding, migration (years of residence in Gualaceo), dietary diversity, brith weight, material goods owned, previous preschool child death, and parental education predicted 43% of the variability in child height-for-age, although, as indicated in Table 5, only dietary diversity significantly contributed to the model.

Dietary diversity was still a significant correlate of both child Z score for weight-for-age and height-for-age after controlling for household income (square root of) and parental education.

Interaction of illness variables (geophagia and sick) with dietary diversity was not significant.

TABLE 4

RELATIVE IMPORTANCE OF CORRELATES OF PRESCHOOL CHILD NUTRITIONAL STATUS (WEIGHT-FOR-AGE) MULTIPLE REGRESSION ANALYSIS GUALACEO, ECUADOR

	Dependent variable weight-for-age (Z score)		
Independent variable	B	SE(B)	t
Constant	-1.589	0.825	-1.93
Migration (years of residence)	-0.018	0.008	-2.20*
Household income (square root of)	-0.011	0.005	-1.96
Maternal arm circ.	-0.012	0.029	-0.40
Fertility	-0.196	0.072	-2.74*
Material goods owned	-0.053	0.080	-0.66
Birth-spacing	0.034	0.006	5.61*
Dietary diversity	0.232	0.050	4.63*
Parental education	-0.003	0.020	-0.17

Proportion of explained variance (R^2) = 0.627.
F-Statistic = 8.42.
* $p < 0.05$.

If more than one variable obviously measured the same thing (e.g. dietary diversity and dietary quality), only one was included in the multivariable analysis. Square root of household income was chosen over household income because it gave a better prediction. The continuous migration variable (years of residency in Gualaceo) was chosen over the categorical variable because it includes more information, and dietary diversity was chosen over dietary quality, servings of meat, servings of milk and servings of fruits and vegetables, because it gave the best prediction and it is the easiest to obtain, making it a more useful indicator.

Correlates of Dietary Diversity, Birth-spacing, Migration and Fertility

The variables found to be significant in multivariate analyses were then analyzed to identify their correlates in order to better depict the pathway determining PCNS. These variables were dietary diversity, birth-spacing, migration (years of residence in Gualaceo) and fertility.

Dietary diversity was the best single indicator of PCNS (both weight-for-age and height-for-age), and was significant in multivariate analyses of both weight-for-age and height-for-age.

TABLE 5

RELATIVE IMPORTANCE OF CORRELATES OF PRESCHOOL CHILD NUTRITIONAL STATUS (HEIGHT-FOR-AGE) MULTIPLE REGRESSION ANALYSIS GUALACEO, ECUADOR

	Dependent variable height-for-age (Z score)		
Independent variable	B	SE(B)	t
Constant	-3.398	1.094	-3.11
Consensual union	-0.561	0.794	0.71
Fertility	-0.071	0.107	-0.66
Geophagia	-0.644	0.720	-0.89
Household income (square root of)	0.002	0.006	0.32
Bottle-feeding	0.658	0.341	1.93
Migration (years of residency)	-3.981	0.013	-0.31
Dietary diversity	0.159	0.077	2.06*
Birth weight	0.001	0.025	0.03
Material goods owned	0.047	0.134	0.35
Previous preschool child death	0.900	0.596	1.50
Parental education	-0.005	0.034	0.14

Proportion of explained variance (R^2) = 0.425.
F-Statistic = 2.55.
* $p < 0.05$.

Variables that were significantly positively related to dietary diversity in bivariate analyses (bivariate regression and independent samples t-test, $p < 0.05$) were parental education, material goods owned, household income (square root of), household food expenditure, maternal arm circumference, dietary quality, servings of meat, servings of fruits and vegetables, servings of milk, and child age. Variables that were significantly negatively related were previous preschool child death, sick and geophagia.

A multiple regression equation with sick, previous preschool child death, household food expenditure, maternal arm circumference, geophagia, child age, and household income (square root of), material goods owned, and parental education predicted 55% of the variability in dietary diversity. Nevertheless, as Table 6 shows, only parental education, child age, maternal arm circumference and household food expenditure significantly contributed to the model.

Variables found to be significantly positively related to fertility in

TABLE 6

RELATIVE IMPORTANCE OF CORRELATES OF DIETARY DIVERSITY
MULTIPLE REGRESSION ANALYSIS
GUALACEO, ECUADOR

	Dependent variable dietary diversity		
Independent variable	B	SE(B)	t
Constant	-2.573	1.842	-1.40
Child sick	-0.033	0.471	-0.07
Previous preschool child death	-0.402	0.609	-0.66
Household food expenditure	0.001	0.000	2.85*
Maternal arm circ.	0.175	0.059	2.98*
Geophagia	-0.518	0.852	-0.61
Child age	0.050	0.014	3.38*
Household income (square root of)	-0.000	0.014	-0.02
Material goods owned	-0.244	0.176	-1.39
Parental education	0.138	0.034	3.99*

Proportion of explained variance (R^2) = 0.548.
F-Statistic = 9.680.
* $p < 0.05$.

bivariate analyses (bivariate regression and independent samples t-test, $p < 0.05$) were household raises animals, maternal age and arm circumference, as well as child weaning age. Variables that were significantly negatively related to fertility were parental education, mother works away from the child, consensual union and used birth control.

Multivariate analyses with mother works away from the child, household raises animals, maternal arm circumference, child weaning age, used birth control, consentual union, maternal age and parental education yielded an equation that predicted 58% of the variability in fertility. However, as the data on Table 7 indicate, only maternal age, used birth control, and parental education, significantly contributed to the equation.

Variables found to be significantly positively related to migration (years of residence in Gualaceo) in bivariate analyses (bivariate regression and independent samples t-test, $p < 0.05$) were household raises animals, material goods owned, maternal arm circumference and age and used birth control. Parental education was significantly negative related to migration (years of residency in Gualaceo).

A multivariate equation that included material goods owned, parental education, household raises animals, maternal arm circumference, used birth control, and maternal age predicted 20% of the variability in migration (years of residency in Gualaceo), although only material goods

TABLE 7

RELATIVE IMPORTANCE OF CORRELATES OF FERTILITY
MULTIPLE REGRESSION ANALYSIS
GUALACEO, ECUADOR

	Dependent variable fertility		
Independent variable	B	SE(B)	t
Constant	-1.409	1.437	-0.98
Mother works	-0.220	0.418	0.53
Raises animals	0.394	0.401	0.98
Maternal arm circ.	0.037	0.043	-0.82
Child weaning age	-0.021	0.023	-0.88
Used birth control	-0.774	0.310	-2.50*
Consensual union	-0.307	0.690	-0.45
Maternal age	0.193	0.028	6.98*
Parental education	-0.051	0.022	-2.36*

Proportion of explained variance (R^2) = 0.577.
F-Statistic = 13.831.
* $p < 0.05$.

owned, household raises animals, maternal arm circumference and maternal age significantly contributed to the model (Table 8).

Schematics of Correlates of PCNS

In order to integrate the results of the various multiple regression procedures, two schematic models of correlates of PCNS were developed. Using the household, mother, child conceptual framework, factors related to PCNS, have been placed in the appropriate column. On the whole, child factors are assumed to be more strongly related to PCNS than maternal, and maternal more than household. When a household variable was found to be related to a maternal or child variable and PCNS the causal route was assumed to be *primarily through* the maternal or child variable. If a household variable was related to both a maternal and a child variable, both are shown if the maternal variable is not related to the same child variable. If the maternal variable is related to the same child variable, it is assumed that the household variable affects the child through the mother (Figure 1). In Figure 2, only the primary correlates (those found significant in multiple regression analyses) are shown, to simplify the model.

Conclusions

Thus, protein child nutritional status (PCNS) in Gualaceo was better where:

TABLE 8

RELATIVE IMPORTANCE OF CORRELATES OF MIGRATION
(YEARS OF RESIDENCY IN GUALACEO)
MULTIPLE REGRESSION ANALYSIS
GUALACEO, ECUADOR

	Dependent variable migration		
Independent variable	B	SE(B)	t
Constant	7.808	6.232	-1.25
Material goods owned	1.811	0.550	3.29*
Parental education	-0.069	0.091	-0.75
Raises animals	4.497	1.719	2.62*
Maternal arm circ.	0.549	0.221	2.48*
Used birth control	1.018	1.441	0.71
Maternal age	0.306	0.119	2.58*

Proportion of explained variance (R^2) = 0.198.
F-Statistic = 12.190.
* $p < 0.05$.

1. Births in the family were further apart
2. The child's diet was more diverse, and this was where:
   a. The child was older
   b. The mother had a greater arm circumference
   c. The parents had more education
   d. More money was spent on food
3. There were fewer children in the family, and this was where:
   a. Mothers were younger
   b. Parents had more education
   c. Parents had used birth control
4. The family had lived longer in Gualaceo, and this was where:
   a. The household raised animals
   b. More material goods were owned.

DISCUSSION

Limitations of the Study

The longitudinal subset was biased in that it included mostly households selected for the ethnographic study because they were the first measured, so that anthropometric data would reflect data on ethnographic households and these households had been selected to have at least two preschool children (of opposite sex). Therefore, they tended to be families of short birth-spacing and high fertility. This explains, in part, the poorer nutritional status of the longitudinal subset as compared to the whole

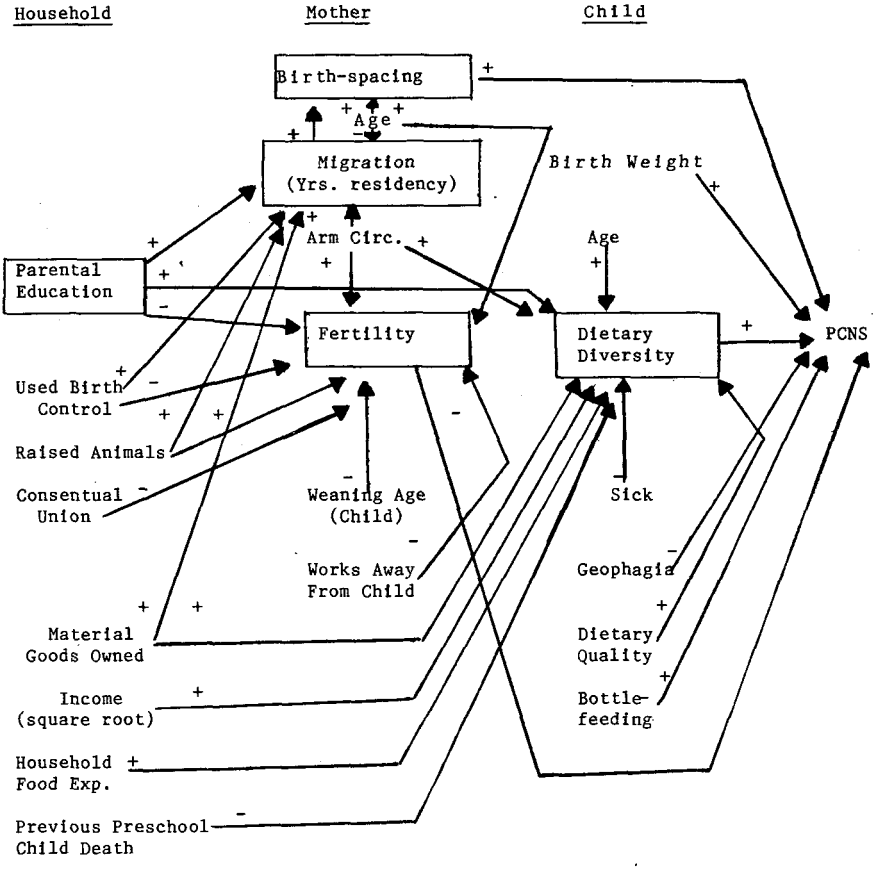

FIGURE 1

Factors related to PCNS and hypothesized causal route Gualaceo, Ecuador

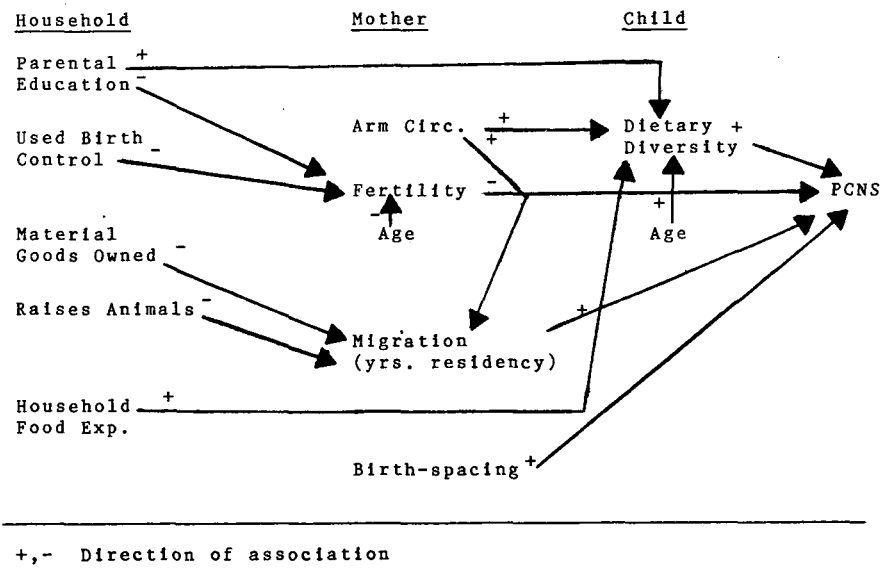

FIGURE 2

Relationships among primary correlates of PCNS Gualaceo, Ecuador

survey group. However, one would expect the relationships between the independent variables and nutritional status to be strongest in the more highly-stressed groups, so this bias may give power to statistical analyses that was lost due to small samples sizes.

Another related bias is that household and maternal data were replicated in families with more than one child. This is because the child was the unit of analysis. As families with more children tended to be poorer families, household and maternal findings in multivariate analysis reflect poor families more than wealthy ones. On the other hand, this is the group we are most interested in.

In multivariate procedures with the dietary diversity variable, only children 12 to 60 months were included because dietary diversity was not calculated for children under 12 months since it was not considered appropriate, and only cases with full data sets (e.g. included dietary diversity) were entered into the procedure. Thus, multivariate procedures really reflect correlates of children aged 12 to 60 months. Again, this was really the group of interest.

Seasonality

The weight of preschool children (longitudinal sample) increased significantly from April to August 1984. Harvest of the primary crops, corn and beans, occurred from late June through July. Thus, April was a relatively leaner time than August. Although the study population is not primarily an agricultural one, the agricultural cycle still appears to affect PCNS, probably through decreased prices caused by increased food availability after the harvest. Children whose weight-for-age improved or stayed the same differed from those whose weight-for-age decreased only in parental education. It could be hypothesized that parents with more education better utilize available resources. They may be better shoppers – they are more acclimated to cash economy – getting more food for their money when more is available and is less expensive.

Furthermore, October to April is the rainy season. Infectious disease is more prevalent during the rainy periods (29). Also ethnographic results show food withdrawal during illness, in addition to the biologic decrease in appetite. Thus, illness may be related to the lower nutritional status found in April through decreased dietary diversity. As the interaction of dietary diversity and illness was not significant, this pathway is probable. Clearly, further research on the impact of season on PCNS, and the mechanism, would be useful.

Correlates of PCNS

Clearly, many of the correlates of PCNS identified are related, but the multiple regression analysis helps to identify the more important variables. Most importantly, relatively high R^2 values were found, indicating a good prediction of PCNS. It is believed that this is due to the methodology with which questions were selected and the precision with which they were asked, as a result of prior ethnographic work.

Obviously, diet affects nutritional status, whereby a more diverse diet with more food, especially meat, milk and fruits and vegetables, leads to higher weight- and height-for-age. Furthermore, more stable families (those that have lived longer in Gualaceo and where parents are in consentual union) are better adapted to a cash market and the social and physical strains of town life. Families with fewer children that are spaced farther apart can spend more time and money on each child. Mothers with larger arm circumference are probably better breast-feeders (30) and are probably of higher socioeconomic status. Parents with more education and households with higher income have more resources to offer a child.

Education was related to PCNS even after controlling for income.

This is important for policy because it is probably easier to educate people than to create jobs or increase income.

Bottle-feeding

Children that were bottle-fed were taller. Although one might expect these children to be smaller due to the likelihood of infectious disease as a consequence of poor sanitary and educational conditions (31), apparently the excess food available to these children, and the fact that they were from wealthier families, and gained in other ways, indicates that bottle-feeding technology was adequate. This adequate bottle-feeding technology may be related to the cultural tradition of herbal infusions for infants from a feeding bottle (32), or to the presence of a national supplementation program which provides oatmeal milk (Leche de avena) and training on bottle preparation.

Also, the hot-cold theory creates a situation where many foods are not acceptable for small children, but milk is. Milk has been found a good indicator of PCNS in Bogotá, Colombia as well (33). Bottle-feeding and servings of milk were correlated.

Breast-feeding

Maternal beliefs regarding breast-feeding (decreased milk supply from the wind, sun, wet, cold; diarrhea in the suckling from breast-feeding when pregnant, decreased nutritional value of milk after 12 months) serve to protect mothers from stress conditions, and also provide culturally-acceptable reasons for weaning (often reported as the insufficient milk syndrome), which put the infant at higher health and nutritional risk. Similar restrictions on breast-feeding were found in Bogotá, Colombia.

In our etnographic study, the idea that breast milk has no nutritional value after 12 months of age was found to be taught by physicians who argue that if women continue to breast-feed, they will not introduce solid foods. Rather than explain that a child needs solid food by six months *in addition to* breast milk, it was advised that women wean. This was accomplished by telling women that "breast milk has no nutritional value after 12 months"; that it is "like water".

This belief also supports the association of bottle-feeding and PCNS. With early weaning and late introduction of complementary foods, especially "hot" foods, one can see why bottle-fed children show better PCNS than non-bottle-fed ones.

Mothers believe that breast-feeding for extended periods will weaken them. This belief has been cited in Lima, Peru and Bangkok, Thailand as well (31,34). In Bangkok, this was more common among less-educated women. Education was a correlate of bottle-feeding in this study as well. The "slimming" effect of breast-feeding is seen as weakening because of the association of losing weight and illness. In the ethnographic study it was found that modern women admire the slim look that they see in mass media, but still fear losing weight because of the association with illness.

The beliefs that male infants suck more (harder and longer at a feed) may have a biological basis, because male infants consume more breast

milk (35) and grow at a faster rate (36). Nevertheless, this has been used as rationale in some areas of Ecuador to wean girls earlier (37). This practice could be related to the higher national mortality figure for girls than boys, ages one to four (38). However, this was not reflected in age at weaning or nutritional anthropometry in the study sample.

The beliefs that one should not breast-feed with an infected breast or when the child is ill, exacerbates both conditions. These may be related to the beliefs that illness of the mother is passed to the child through breast milk and that if a child has a fever the milk will "spoil" in the child and make him/her vomit (34).

Dietary Diversity

Dietary diversity was the best single indicator of undernutrition. An association between dietary diversity and weight-for-age has been found in other studies as well (33), and dietary diversity was found to be a better indicator than actual consumption. This can be understood in that a diverse diet probably reflects a well-balanced diet sufficient in energy, and enough household resources to obtain and prepare the food. Actual consumption is difficult to measure.

Only milk and milk products, however, showed adequate levels, a finding which further supports the association of bottle-feeding and PCNS. Meat and fruits and vegetables were particularly lacking, suggesting possible protein and vitamin deficiency.

Dietary diversity probably reflects "acculturation" as well, or the knowledge of the culture needed to purchase (or otherwise obtain) and prepare the food. It also probably reflects "socioeconomic status" as one needs resources with which to obtain the food – both financial and educational. Dietary diversity, however, was still strongly related to PCNS after controlling for household income and parental education. Thus, "acculturation" may be playing a particularly important role here, especially as recent migrants, who are less acculturated to urban life, showed poorer nutritional status.

Parental education alone predicted 25% of the variability in dietary diversity. After controlling for child age, maternal arm circumference and household food expenditure, it was still highly significant. More educated, higher-income parents provide more diverse diets. This was also found in Bolivia and Mexico (39) and (40) respectively. Also, both this research and the Bolivian study showed the most limiting dietary factors to be animal meat, fruits and vegetables.

Health

The association of birth weight and geophagia with depressed growth are supportive of findings in the U. S. and India (41, 42). Previous preschool child death may be a measure of the health status of other children in the household.

A variable that was not well-quantified, paternal alcoholism, seemed important to PCNS and household budget in our ethnographic study. Cane alcohol, that which is usually drunk, is made in the region, and although still costly, is readily available. Drinking is an escape for people

caught in a cycle of poverty where work is poorly compensated and the opportunities for improvement seem few.

The high prevalence of dental caries suggests poor dietary habits (sweets, bottle-feeding), poor dental hygiene and perhaps low fluoride-content of water and soil.

Gastrointestinal infections and the resulting diarrhea, food malabsorption, and depressed appetite, all are an important cause of mortality in developing countries (43, 44).

A study on beliefs about diarrhea conducted in Lima, Peru, revealed that diarrhea was not considered an infectious disease (34). Diarrhea was placed within the hot-cold system and was believed to be caused by "invasion of the body by hot or cold or by ingestion of foods designated as hot or cold". Furthermore, in Lima, suspension of milk feeding was thought essential in treatment. Sanjur found that milk was considered the best food for healthy infants, but it was the first to be withdrawn during illness (26). These findings corroborate those found in Gualaceo.

In Gualaceo, milk was thought to cause diarrhea when it was poorly prepared (e.g. not boiled sufficiently), but this was more related to the hot-cold ideology than to bacteriologic quality. Diarrhea was also said to be caused by cold milk and from breast milk when the mother is pregnant. In the latter situation, weaning is often recommended by physicians and is abrupt.

In a random sample of Gualaceo hospital records, the primary diagnosis at first visit to the hospital was gastrointestinal infection in 41% of cases (n = 416). It was also reported as a cause of death in 30% of cases reported to the civil registry in 1982 and 1983. Parents reported cause of death in 1973, 1976 and 1979 to the civil registry. Gastrointestinal infection was reported in 11% of cases for these years, probably reflecting parents' view of diarrhea more than a change in incidence.

Respiratory illnesses are also important causes of preschool child morbidity and mortality in developing countries, though not shown to be related to growth (44). All respiratory diseases were reported to be caused by the cold and include a cold, the flu and bronchitis.

The primary diagnosis of 26% of first visits to the hospital was for respiratory ailment and was considered the cause of death in 19% of deaths reported by physicians (1982 and 1983) and in 63% of deaths reported by parents (1973, 1976 and 1979) to the civil registry.

Bad air ("mal aire") seems to be a composite illness, having symptoms of both gastrointestinal and respiratory disease. This probably reflects "complications" in the western view of medicine.

Clearly, western categories of disease classification may be inadequate in highland Ecuador. Western medical services have not been shown to improve morbidity or mortality when comparing villages that were matched except for western medical care (45).

Birth-spacing

Only maternal age and migration were related to birth-spacing. Recent migrants have children closer together. Migrants tend to be from rural areas and have less access to and information about birth control (46, 47).

Migrants also had fewer years of education and had lower arm circumferences (lower nutritional status) which could explain the relationship with child nutritional status. Indeed, higher mortality in rural areas has been linked to lower income and educational levels (47). Older mothers had children farther apart. This could reflect decreasing fecundity due to the onset of menopause, decreased frequency of coitus, or could reflect a cultural history where older mothers breast-feed longer, resulting in a longer period of amenorrhea. This research did not address this question extensively and further research in this area would be useful.

Fertility

Mothers had fewer children if they were more educated, had used birth control, were in a consensual union or if they worked away from the child. There were more children in households where animals were raised, where weaning occurred later, and if maternal arm circumference was greater. Thus, more traditional households had more children (raised animals, weaned later). Also, better nourished women (e.g. higher maternal arm circumference) are more fertile (48). More educated, stable (consentual union) women who work outside of the home, and that had used birth control had fewer children.

Migration

Migrants had less education, lower arm circumference, and fewer material goods and were less likely to have used birth control than longer-residents of Gualaceo. These people tend to be poor, rural migrants, seeking a new way of life in a cash economy learning the shoe-trade, with knowledge based in subsistence living.

CONCLUSIONS

Culturally-tailored educational programs about food, illness, sanitation and hygiene, alcoholism, and birth control should improve PCNS. These programs should address hot and cold foods as well as illnesses, magical illnesses and breast-feeding practices. Efforts should be made to make medical and nutritional terms understandable to lay persons. Illnesses, especially diarrhea and respiratory illness, must also be described and treated in accordance with local ideology.

The health services, including nutritional services, could work at identifying the hot or cold natures associated with needed medicines and food supplements, as well as harmless foods of the opposite nature that would serve to neutralize the prescription – in the local ideology – and still be effective in treating the problem from a western point of view. Work also needs to be done in educating health workers about the importance of breast-feeding, even during illness. Perhaps the health services would provide a way to educate and help people with the problem of alcoholism. It also may be the route to educate about and improve sanitary, dental and birth control practices.

On a national and international level, programs designed to redistri-

bute resources, including educational resources, will ultimately serve to improve PCNS (47, 49, 50).

RESUMEN

ALIMENTACION DE NIÑOS PREESCOLARES, SALUD Y ESTADO NUTRICIONAL, EN GUALACEO, ECUADOR

Con el propósito de analizar los factores que están correlacionados con el estado nutricional de niños preescolares menores de cinco años de edad, en Gualaceo, Ecuador, se utilizaron técnicas antropológicas, encuestas, estudios de regímenes alimenticios y antropométricos. Muchos de los niños acusaban talla baja para su edad. El estado nutricional era peor en los niños en las edades comprendidas entre 12 y 23 meses, pero éste mejoraba durante los meses de abril a agosto, sugiriendo cambios en el estado nutricional según la estación del año.

La diversidad en los regímenes alimenticios, espaciamiento entre nacimientos, fecundidad, migración, ingresos del hogar, posesión de bienes materiales y educación de los padres fueron los factores que se encontraron asociados al estado nutricional de los niños (expresados en escala Z de peso para edad). Un modelo de regresión con estas variables explicó un 63°/o de la variabilidad en el peso para edad. La predicción de talla para edad fue similar, pero sólo explicó el 43°/o de la variabilidad en este renglón. Los factores asociados con la diversidad en los regímenes alimenticios, espaciamiento entre los nacimientos, fecundidad y migración fueron: la edad de los niños, la edad y circunferencia braquial de las madres, educación de los padres, uso de anticonceptivos, gastos en comida del hogar, posesión de bienes materiales y la crianza de animales.

La educación de los padres se corelacionó con diversidad en los regímenes alimenticios, fecundidad y migración. En los resultados longitudinales también se relacionaba esta última con cambios en el peso para edad.

Los factores considerados de mayor importancia en relación al estado nutricional de los niños preescolares fueron la temporada previa a la cosecha, y una serie de sucesos comenzando por enfermedades que dieron lugar a una disminución en la variedad de la dieta, lo que a su vez se tradujo en una reducción del nivel nutricional en el mes de abril. La ideología acerca de los alimentos calientes/fríos —lo que resulta en retiro de los alimentos durante las enfermedades y restricción de alimentos ricos en proteínas y calorías— parece ser un mecanismo importante al determinar el estado nutricional de los niños preescolares. Los hábitos relacionados con la lactancia materna, prácticas de saneamiento, higiene, planificación familiar y consumo de bebidas alcohólicas, se sugieren a la vez como áreas que podían ser modificadas para mejorar el estado nutricional de los preescolares. También se sugiere como otro posible rubro para obtener mejorías, la comunicación entre los padres y el personal de salud occidental que proporciona asistencia médica.

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