This is to certify that the

thesis entitled

Environmental Factors Predicting Nutritional Status in Young Nicaraguan Children

presented by

Patricia J. Britten

has been accepted towards fulfillment of the requirements for

M.S. degree in Nutriton

Kathryn Dewey
Major professor

Date November 18, 1977

ENVIRONMENTAL FACTORS PREDICTING NUTRITIONAL STATUS IN YOUNG NICARAGUAN CHILDREN

By

Patricia Jean Britten

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Food Science and Human Nutrition

1977

ABSTRACT

ENVIRONMENTAL FACTORS PREDICTING NUTRITIONAL STATUS
IN YOUNG NICARAGUAN CHILDREN

By

Patricia Jean Britten

Dietary and medical histories, growth status, and environmental factors related to the nutritional status (length for age) of 68 Nicaraguan children 9 months to 4 years old were studied. Length for age correlated significantly with number of persons (r=0.24) and presence of nonsibling children (r=0.31) in household, report of milk in child's diet recall (r=0.37), report of child as "healthy" (r=0.24), few clinical signs of chronic disease (r=0.21), child's hemoglobin concentration (r=0.27), absence of protuberant abdomen in child (r=0.22), and number of mother's miscarriages (r=-0.21). Children with normal nutritional status were reared in extended families with access to adequate human and physical resources for their care, and were relatively healthy by examination and report. They did not differ from marginal to malnourished children in age of weaning or introduction of other foods. Factors positively related to growth can be utilized as indigenous methods of preventing malnutrition by interventionists.

ACKNOWLEDGMENTS

The author extends sincere thanks to the following people:

To Dr. Kathy Kolasa for her total support of this research and my graduate program. In addition, her encouragement of high writing standards was appreciated.

To Drs. Carolyn Lackey, Jenny Bond, and William Weil for their encouragement, advice, and confidence in the project. Dr. Lackey is especially thanked for editorial assistance.

To Marcia Griffiths for her advice, assistance, and insights while in Nicaragua.

To the people of Orinoco, Marshall Point, and La Fe for welcoming us into their homes and lives, and to their children for submitting to the measurements and examinations, even under protest.

To the Gerber Foods Company and the Dept. of Food Science and Human Nutrition for financial support.

To Sharon and Keith Kennedy, Bev Phillips, and the Community Nutrition graduate students for providing willing assistance in preparation of the thesis and a welcome escape valve.

Finally, an enormous thank you to Alan Britten for his participation in the research, his many suggestions and insights, and his battles with the Orinoco grass lice. This research was truly a joint effort and Alan's contributions made the project feasible.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Protein-calorie malnutrition (PCM) has long been recognized as a major cause of morbidity and mortality throughout most developing countries. In the Caribbean area, Cook (1969) reported that in half of the deaths of children under five years old, there was evidence that malnutrition was a contributing factor. Both Jelliffe (1966) and Williams (1966) identified malnutrition in young children as a major public health problem in the developing world.

Malnutrition in children under five years of age also has been identified as a major health problem in the east coast region of Nicaragua, Central America. Griffiths (Kolasa, 1976) estimated that approximately seven cases of kwashiorkor per month were admitted to Gray Memorial Hospital in Puerto Cabezas on Nicaragua's east coast. Anderson and coworkers (1976) reported the weight-for-age classifications of children in nine eastern Nicaraguan villages. Fifty-seven percent were within normal range based on Instituto de Nutricion de Centro America y Panama (INCAP) standards, 35 percent were low weight, 8 percent were malnourished and 1 percent were very malnourished.

The scope and consequences of malnutrition in young children, then, have been well documented throughout the developing world, including eastern Nicaragua. The research reported here focused on

factors associated with young children's nutritional status in several small villages within eastern Nicaragua.

Societal problems or imbalances which can lead to PCM including economic and social factors and poor feeding practices also have been studied (Guzman, 1968; Antrobus, 1971; Rawson and Valverde, 1976). The study of these related factors, however, has not provided a solution to the malnutrition problem. Child rearing practices are one group of factors associated with the development of PCM. Poor child rearing practices which may be detrimental to the child must be replaced with another practice or method. In most nutritional intervention programs in the past, the practices used for replacement have come from outside the area studied. Researchers and interventionists carefully select alternate strategies and methods which they attempt to introduce in order to maximize the benefits to the child and the probability of adoption. However, the proposed changes still may be rejected by area residents as economically or culturally infeasible.

One way to identify beneficial practices substitutable for poor practices is to look for them within the community itself. Wray (1972) stated that the human race has survived because women in general have been competent as mothers. He suggested examining the child rearing practices of mothers whose children are thriving to identify what the mothers are doing to make a difference. These mothers have coped with the complex problems of rearing a child in difficult surroundings. Therefore, their solutions may be workable in their cultural and economic context while imported solutions may not be.

Richardson (1968) also suggested that research should include methods for identifying inventiveness and skills used within the community in feeding children. He felt that the local differences in customs and practices could supply potential answers for preventing malnutrition.

Wishik and Van der Vynckt (1976) located the unusually well-nourished children in an area to identify the factors which differentiated them from other children in the same area. These children were called the "positive deviants." Wishik and Van der Vynckt (1976) proposed that the differences in nutritional status within a homogenous group would be due to differences in socio-economic status, genetic traits, susceptibility or exposure to disease, the mothers' fertility behavior or the children's diets.

No other surveys in which researchers specifically looked for positive indigenous practices which protected children from malnutrition were found in the literature. The majority of reported research efforts have been focused on what can or does go wrong in the rearing of children. Little attention has been paid to the healthy well-nourished children who are surrounded by poverty, poor sanitation, and apparent lack of a good quality diet and yet thrive. The mothers of these children may be providing whatever is needed, whether by design, instinct or accident. These children and their mothers, then, were the foci of the research to be reported here.

This research was an attempt to identify factors in the near environment of a child which would predict nutritional status, as indicated by attained growth. It was assumed that if certain children in

the community had benefited from some particular child rearing practice or environmental factor protecting them from malnutrition, that practice or factor would correlate positively with attained growth. Single factors or groups of factors which are highly associated with good nutritional status are those that should then form the basis of intervention programs in the area.

The specific environmental factors examined in this research were the past and present diet of the child, family composition and living situation, past and present health status of the child, and mother's beliefs about child rearing and feeding.

Three experimental hypotheses were proposed to be tested in the research project:

1. Children who eat a wider variety of foods will be longer for their age than those who eat a more limited variety of foods.
2. Children who are weaned later in life will be longer for their age than those who are weaned earlier.
3. Children without evidence or history of parasitic infestations and with history of fewer infections will be longer for their age than those with parasites and more frequent infections.

CHAPTER II

MEASUREMENT OF NUTRITIONAL STATUS

The clinical syndromes of kwashiorkor and marasmus are very severe forms of protein-calorie malnutrition (PCM), appearing late in the disease process and in relatively few children. They have been considered the visible part of the malnutrition iceberg. Less severe forms of malnutrition often are not recognized by clinical examination but are still important due to their high prevalence and association with morbidity and mortality (Behar, 1975).

Most of the children in the world with PCM do not exhibit the signs of kwashiorkor or marasmus. The major sign of their malnutrition is retardation in growth and development, only apparent when their ages are known (Gershoff, 1977).

Measures of growth have been considered sensitive to early malnutrition changes. These measures are the most practical way to assess nutritional status. A decrease in growth rate has been seen before other signs or symptoms were evident in most types of malnutrition (Jackson, 1966; Jelliffe, 1970).

From research on two West Indian islands, Standard and coworkers (1966) concluded that a child's growth (as measured by weight) was the most useful index of malnutrition. Other clinical signs investigated often were caused by nonnutritional factors or

did not occur frequently enough to be of value in diagnosis. The use of anthropometric measurements in assessing nutritional status has been widespread and widely recommended (Jelliffe, 1966; Christakis, 1973).

The two most frequently used anthropometric measures of growth are height or length, and weight. Both measures provide information about the total body size, rather than one component of the body such as fat.

Height or Length as an Indicator of Nutritional Status

Garn (1973) described height as "the most used measure of nutritional status during the growing period." He stated that height was more sensitive as a group measure of nutritional status than any biochemical measurement, because it has a small measurement error and is growth cumulative. A single measure of height is more meaningful in nutritional terms than a single measure of weight because height does not fluctuate rapidly due to illness or other factors as weight can. Since height is a stable measure, it is useful as a measure of chronic malnutrition or long-term nutritional status.

For very young children, heights are difficult or impossible to measure accurately, so recumbent length is used as a standard measure (Jelliffe, 1966; Garn, 1973). Reference standards provide length measurements for up to three years of age and standing height thereafter (Hammill et al., 1976).

The children included in the present research project were from nine months to four years of age. Length was considered the best single estimate of the child's nutritional status, and was the single dependent variable used in statistical analysis.

Weight as an Indicator of Nutritional Status

Weight has been a widely used indicator of nutritional status, especially useful for early detection of changes in growth rate in a longitudinal study of children. As a longitudinal measure, it has been the main assessment tool used in the ongoing nutritional surveillance program in eastern Nicaragua (Griffiths, 1977). Jelliffe (1966) described deficiency in weight for age as the best indicator of PCM. More recently, however, weight for age has not been considered a satisfactory single measure of nutritional status in a cross-sectional study as it does not differentiate between past and present PCM (Waterlow, 1977a). The weight of children is sensitive to rapid changes and a single measurement may fluctuate for nonnutritional reasons. It can be, however, a useful measure of current acute malnutrition. By measuring both height and weight, past and present, acute and chronic malnutrition can be differentiated (Seoane and Latham, 1971). Weight was included in the research project as a supplementary predictor of nutritional status because past weights of many area children were available for comparison. Also, weight in combination with other measures could give valuable information about past and present nutritional status, and weight was a simple measurement to take.

Arm Circumference as an Indicator of Nutritional Status

Jelliffe (1966) suggested that arm circumference be used in field studies as the only practical method for assessing body muscle mass. Arm circumferences were measured in rural Guatemalan children, muscle areas were calculated, and comparisons were made with a

well-nourished sample of U.S. children (Martorell et al., 1976). While muscle areas of the Guatemalan group were consistently smaller on an age basis, the muscle areas of the two groups were similar when weight was held constant.

In the Guatemala study, arm circumference increased only slightly with age in the preschool years (Martorell et al., 1976). Therefore, the measure has been used as an age-independent index of nutritional status (Shakir and Morley, 1974). In Indian preschool children, arm circumferences of children with PCM were significantly smaller than those of normal children throughout the age range studied (Visweswara and Darshan, 1970).

Triceps Skinfold as an Indicator of Nutritional Status

Measuring the thickness of a skinfold over the triceps has been recommended as a practical field method for assessing body fat (Jelliffe, 1966). In the rural Guatemala study, there was considerably less fat in the moderately malnourished children than in presumably well-nourished U.S. children, even when weight was held constant (Martorell et al., 1976). These findings suggested a depletion of fat reserves in the malnourished children.

Head and Chest Circumferences as Indicators of Nutritional Status

Both head and chest circumferences are recommended measurements in nutrition surveys for young children (Jelliffe, 1966). The head grows slowly after the first year, though its circumference can be slightly affected by malnutrition in the second year of life. In comparison to the increase in chest size with growth, the head size

is stable. The ratio of head to chest (or chest to head) circumference has thus been used as an indicator of nutrition related growth failure (Jelliffe, 1966; Jansen, 1973). However, utilizing this ratio to compare moderately malnourished Guatemalan children with well-nourished Denver children, Martorell and coworkers (1975c) found no differences between these groups. They concluded that the ratio had no power to differentiate either populations or individuals who were moderately malnourished from those well nourished.

Summary

Length; weight; triceps skinfold; and arm, head and chest circumferences were used in this study. They were chosen because together they provide a fairly complete description of a child's attained growth and nutritional status.

CHAPTER III

ENVIRONMENTAL FACTORS INFLUENCING NUTRITIONAL STATUS

The developing child is influenced by interactions with the physical and cultural environment. Within these complex interactions several systems have been documented to be critical influences on nutritional status. Among these are the child's family, health, and feeding pattern. Specific factors which can affect child growth and nutritional status have been identified in each of these areas.

Relationship of Family Structure and Socioeconomic Status to Nutritional Status

Antrobus (1971) completed an extensive examination of factors related to child growth on St. Vincent, a Caribbean island with many ecological and cultural similarities to the eastern Nicaraguan communities included in this research. He found that the environmental variable having the most negative influence on growth was a large number of other young children in the home. His explanation for this correlation between number of children and growth was that with several young children in the home, the feeding and care of each one would fall more upon the older siblings and less upon the adults. His interpretation was that care by an adult would lead to better child feeding and therefore better growth.

A second factor highly related to child growth in Antrobus's study (1971) was the history of sibling deaths. In homes where one or more children had already died, he concluded that the circumstances leading to those deaths probably still persisted and exerted an adverse influence on growth of the remaining children.

In other areas of the world, researchers have reached similar conclusions concerning the relationship of child growth to the availability of competent adults to care for them. Grewal and coworkers (1973) found that in rural India a greater percentage of children with poor rather than with good nutritional status were reared in a nuclear family in which the mother worked. The poorly nourished children did not have a mother to care for them throughout the day and because the family was nuclear, did not have an adequate mother substitute. The researchers concluded that the quality of maternal care played a critical role in determining nutritional status of the child.

In Uganda, McDowell and Hoorweg (1977) studied environmental factors related to a child's recovery from malnutrition. Several variables describing the size of the household were found to be important in determining a rural child's rate of recovery. Larger households led to an improved recovery. The researchers interpreted this relationship to mean that large families, presumably extended families, were more stable and able to provide better care for the malnourished child.

In general, researchers agreed that having enough competent help to care for and feed young children was critical in preventing malnutrition. A child left in the care of fairly young siblings or

left by himself for extended periods while the mother worked was not protected from malnutrition. Adequate human resources within the family appear essential for a child's health and growth, either by helping to care for the child or by freeing the mother of other responsibilities so that she can care for him.

Rawson and Valverde (1976) identified environmental risk factors for malnutrition in rural Costa Rica. They found that family access to land was the primary variable affecting nutritional status in that area, but that the amount of land controlled by the family only indirectly operated as an influence. In families with little land the income available for food was limited; the mother often worked outside the home and housing quality was poor. Therefore, the children in families with little land had fewer available physical and human resources. In a similar study relating land access to nutritional status in Guatemala, researchers also showed that family land access and the prevalence of moderate malnutrition in farming families were negatively correlated (Valverde et al., 1977).

The economic and educational influences on growth of young slum children in Peru were studied in detail by Graham (1972). Attained height of the children was used as the indicator of growth. The mother's education, the money available for food in the family, and the housing quality as represented by the number of persons per bed all were shown to be related to a child's growth. The importance of these three factors, education, income, and housing, in influencing children's nutritional status also was emphasized by Pellett (1977). In Libya, gross poverty and inadequate housing have recently been

largely eliminated, but the education of women has not kept pace with progress in other areas. Pellett (1977) blamed the continuing high incidence of marasmus in Libya on mothers' ignorance of hygiene. He saw the need for adequate income, housing and education together in order to decrease the incidence of malnutrition.

The importance of formal education for mothers in influencing children's nutritional status may be an urban phenomenon. The Pellett (1977) and Graham (1972) studies dealt with children in urban environments. Traditional values and practices in rural areas may allow mothers to rear healthy children without formal schooling. Researchers working in rural areas have found no relationship between parental education and the nutritional status of their children (Antrobus, 1971; Rawson and Valverde, 1976).

Relationship of Disease to Nutritional Status

The synergistic effects of infections and malnutrition are commonly recognized (Scrimshaw et al., 1968; Scrimshaw, 1970; Rosenburg et al., 1976). The means through which an infectious disease can affect nutritional status include (1) decreased appetite, (2) use of nutrient poor diets as therapy, (3) decreased digestion or absorption due to medicines and (4) increased loss of body nitrogen (Scrimshaw et al., 1968). It is obvious from the above mechanisms that not only the infection itself but also the medical responses to the infection, whether scientific or folk, influence nutritional status.

Anderson and coworkers (1976) concluded that one of the most serious nutritional problems in eastern Nicaragua was the

mismanagement of diarrheal disease and the prevalence of parasitic infestation in children. These problems were considered to contribute to growth retardation in young children.

Researchers in rural Guatemala found the incidence of dysentery (Mata et al., 1971) and diarrhea (Martorell et al., 1975a) to be negatively correlated with incremental growth in young children. No significant correlations between respiratory illnesses or fever and growth rate were found. Martorell and coworkers (1975b) estimated that about 10 percent of the growth retardation in the rural Ladino Guatemalan children studied was specifically associated with diarrheal disease.

Recently, Mata and coworkers (1977) documented the importance of infectious disease as a cause of weight loss and of arrested growth for young Guatemalan children. A pattern of frequent illnesses during the prolonged weaning period for these children resulted in a slower growth rate.

In a rural area of Columbia where nearly half the preschool children showed some evidence of malnutrition, a comprehensive health care program was established which markedly decreased the incidence of diarrhea and infant mortality (Pradilla, 1977). Despite an unrelated qualitative and quantitative drop in food intake of the children examined, malnutrition was eradicated almost completely. Without the disease stress, even inadequate diets resulted in improved nutritional status.

Relationship of Feeding Practices to Nutritional Status

Poor weaning practices have been identified as the most important contributing factor to nutrition problems in eastern Nicaragua. Specific concerns included the late introduction of solid foods (at six months of age or later), lack of certain foods in the weaning diet, feeding substances of little nutritive value and withholding breast milk in some circumstances. Villages in which solid foods were introduced to children early had the lowest prevalence of malnutrition in children as measured by weight for age (Anderson et al., 1976).

Grewal and coworkers (1973) found the age at which supplementary foods were introduced to Indian children was inversely related to their nutritional status. Families with "normal" weight children began feeding milk, semi-solids and the family diet to the children three to six months earlier than families with malnourished children. Delayed supplemental feeding and frequent infections were considered to act together to produce a large calorie deficit in the children, leading to clinically evident malnutrition.

Early introduction of supplementary foods, however, had a negative influence on growth of Caribbean infants (Antrobus, 1971). Children to whom foods were introduced before four months of age were significantly lighter in weight at one to two years than other children examined. The negative effect of early feeding was attributed to a simultaneous decrease in the daily frequency of breast-feeding. Important nutrients available in the milk were unavailable to the child.

The duration of breast-feeding was the most important nutrition practice affecting the growth of Vincentian children (Antrobus, 1971). Children rated as having "good growth" were weaned at almost 13 months on the average, compared to those with "poor growth" who were weaned at 6 months.

It appears from these studies that an optimum time period exists for introducing solid foods to infants. Both prolonged breast-feeding with delayed introduction of other foods and early weaning with substitution of other foods for breast milk have been shown to be detrimental to child growth in developing countries.

Summary

Researchers studying the impact of various factors on children's nutritional status have found that certain factors consistently influence child growth. These factors include the human resources available within the family for child care; the incidence of disease, especially diarrhea and parasitic infestation; and the pattern of breast-feeding and introduction of other foods.

CHAPTER IV

METHODS AND PROCEDURES

The methods used in this study included two interviews with the principal caretaker of the children studied, a medical examination of each child, seven anthropometric measurements of each child, and observations of the child's home environment. Specific factors studied were each child's past and present diet, past and present health status, the family composition and living situation, and each caretaker's beliefs about child rearing and feeding. The research team consisted of a graduate student in nutrition, hereafter called the researcher, and a medical student.

Preliminary Work

Three open-ended interview schedules in English and data sheets were developed before the research team entered the field. The dietary and family interview schedule was anticipated to take one-half hour to administer, the first and second medical schedules less than one-half hour each. The final interview schedule, concerning beliefs about child feeding and rearing, was partially developed before entering the field, and finalized after the first interviews were completed. Questions about topics of special concern identified in the first interview were included. The questions for all interview schedules were original, and were selected after review of the literature and

discussion with several professionals. The interview schedules were approved by the Michigan State University Committee for Research Involving Human Subjects. All interview schedules and data sheets are included in Appendix A.

Pretesting

The pretesting of the interview materials was conducted in Barrio San Luis, a small community on the outskirts of Puerto Cabezas in Eastern Nicaragua. A local paraprofessional nutrition leader arranged appointments with families for pretesting and accompanied the researchers to introduce them, assist in taking anthropometric measurements, and translate when necessary. The revisions made after pretesting were generally rewordings of certain questions. No major changes in the interview schedule were required.

Sample Selection

The age range (9 months to 4 years) of children examined in the study was selected to include those children most likely to show nutritional problems. Beghin (1976) recommended using as wide an age range as possible and including newborns. For this study however, growth failure in early months was assumed to be caused by genetic, maternal or perinatal factors. Also, nutritional problems on Nicaragua's east coast area were reported to appear at about nine months of age (Griffiths, 1977). This age, then, was chosen as the earliest that the effect of postnatal environmental factors on growth could be observed in this research project. Four years of age was selected as the upper limit for a child to participate in the study,

since the history of breast-feeding and introduction of other foods for older children would be so far in the past that the child's principal caretaker probably would not be able to remember it well.

Research Site Selection

The factors considered in selecting a research site were the size of the community, the language spoken, the information about growth of children available in the community, the cooperativeness of village health workers and others, and the similarity of children's nutritional status to that of children in other east coast communities.

An orientation period to eastern Nicaragua for the research team was spent in Puerto Cabezas. Discussions concerning possible research sites were held with the nutritionist and the director of the MUCIA/University of Wisconsin/Nicaragua Medical Project (WMP).[1] Two villages with medical clinics on Pearl Lagoon were possible sites. One, Tasbapauni, was too large for this study, as sampling would have been necessary. The other, Orinoco, was of appropriate size. The WMP staff reported that the people of Orinoco were interested and cooperative in health related projects.

Orinoco children were representative in weights-for-age according to data available through the WMP on children in many areas along the east coast. The proportions of normal weight, low weight, and malnourished children in Orinoco were similar to the averages in other communities. For these reasons, Orinoco was selected as the

---

[1]The WMP is an ongoing project sponsored by the Midwestern Universities Consortium for International Activities (MUCIA), for the purpose of training medical and nutrition students while providing primary health care in rural communities on the east coast of Nicaragua.

primary research site. Two other small villages close to Orinoco, Marshall Point and La Fé, were included in the Orinoco area for data collection.

Data Collection

The researchers resided in the village of Orinoco from January 13 to February 17, 1977 and all data were collected during this period. Day trips were made to Marshall Point and La Fé during this period to interview major caretakers and examine children in those villages.

The first interview was conducted in a clinic or school. The researcher took anthropometric measurements of the children and interviewed the mother or other person caring for the child. The person interviewed about the child will be referred to as the respondent. Information was obtained through the interview about the child's family, diet history and present diet. The medical student physically examined each child and obtained the child's general medical history from the respondent.

A second interview took place in the child's home three weeks later. A second medical history was taken, dealing with the child's health in the preceding three weeks only. It was expected that by defining the time period with reference to a specific event (the first interview) and alerting the respondent at the end of the first interview, a more complete history of the child's health would be obtained. Questions concerning the respondent's food beliefs, knowledge and reasons for certain child rearing practices were included in the second interview.

During the home visit, the researcher also observed the house size and structure and asked the respondent about water sources, water and food storage and sanitary facilities. Obtaining these data while in the home allowed the substantiation of responses by actually observing the resources and facilities available.

During all interviews, respondents had difficulty answering some questions. When this occurred, the questions were reworded to help the respondent understand, or probing questions were used to obtain more information.

Informed Consent

The research project was explained to eligible villagers before the first interview and they were asked to participate. If they consented, they signed an informed consent form (Appendix A), indicating that they understood the project, willingly participated, knew they were free to stop at any time, and knew that information they provided would be treated confidentially.

Field Notes

Notes were kept daily by the researcher while in eastern Nicaragua to record information informally obtained about the area. Observations around the village and on trips to the farm areas were included. Records of food preparation were documented with notes and limited photography. A listing of foods available in one of the local shops was made while interviewing the shop owner and observing the shop.

Anthropometric Measurement Techniques

Length (mm) was measured on a GPM anthropometer modified with a perpendicular fixed board at the foot and a second board attached to the slide, flush with the anthropometer's aluminum bar. The anthropometer was placed on a flat board bed in Orinoco, and on a board bench in Marshall Point and La Fé. Two examiners were needed to hold the child in position. The respondent, if cooperative, or the nutrition leader if the respondent failed to understand instructions, helped hold the child. Respondents were used when possible to reduce the child's anxiety. The respondent or nutrition leader held the child's head against the fixed board at the end of the anthropometer. The researcher held the child's knees straight, moved the sliding board against the heels, and took the reading to the nearest millimeter. The child's shoes were removed before laying the child down. If the child resisted the measurement, a third person, either the nutrition leader or practical nurse, assisted in holding the child's body and legs in proper alignment.

Weight (kg) was measured on a Salter scale with the child sitting in a pair of short denim pants with a long strap to hook onto the scale. All children were weighed on the same scale. Shoes were removed; all other clothing was left on as the children almost universally loudly protested its removal. The children's clothing was very light weight, usually consisting of a cotton dress and nylon underpants for girls, a cotton shirt and sometimes cotton shorts for boys. The mother or respondent put the child into the pants in most

cases. Similar pants and scale had been used in the villages before so the mothers were familiar with them. The researcher lifted the child and hooked the pants strap onto the scale. Then the child hung freely until the scale needle was steady. The weight of each child was read to the nearest tenth of a kilogram. The weight of the pants was subtracted and the child's weight was recorded. The pants were weighed often during the study, but not with every child. The weight of the pants was constant at each measurement at 0.2 kilograms.

Chest, head and abdomen circumferences (mm) were measured with a fiberglass tape measure by the researcher while the child was held by the respondent. Measurements were read to the nearest millimeter. Placement of the tape for head circumferences was according to Jelliffe (1966). Chest circumferences also were attempted according to Jelliffe's (1966) description, but as he noted, accurate readings were difficult or impossible to obtain due to the child's crying or screaming. Often the screaming was initiated by the removal of the child's shirt or dress. Abdomen circumferences were attempted at the level of the umbilicus, but were difficult to obtain for the same reason.

Arm circumferences (cm) were measured by the researcher as described by Jelliffe (1966) with a clear plastic insertion tape designed and supplied by Dr. Robert Stewart, Gerber Products Company, and were recorded to the nearest half-centimeter.

Triceps skinfold thicknesses (mm) were measured by the researcher with a Lange caliper, according to the method described by Jelliffe (1966), and were recorded to the nearest millimeter. In children who resisted the measurement, the respondent held the wrist to keep the arm in proper orientation--straight and at the side. Three readings were taken and the average, rounded to the nearest millimeter, was used in data analysis.

Heights of parents (cm) were measured with the same anthropometer used for the child's length. For simplicity, the head and foot boards were not removed. The parents stood without shoes on the fixed board with back to the anthropometer. The sliding board was brought down to rest against their heads. Then the subjects were asked to push up with their heads against the board without raising their heels. The stretched measurement was recorded to the nearest millimeter.

One or both parents were not available to be measured in many cases. If so, the respondent was asked to estimate the height of the missing parent(s) using themselves, the nutrition leader, the practical nurse, the researchers or any other person present as guides. When the parent was well known to the nutrition leader, practical nurse or clinic lab worker, his height was discussed among them and a general decision was reached. The estimated heights were usually described as "just about Julio's height" or "a little taller than me but not so tall as you." The persons used as references were measured and an estimate was recorded in centimeters followed by an "E."

In data analysis, the heights or estimated heights of the parents were averaged to obtain a figure for mid-parental height.

Medical History and Physical Examination Techniques

The first medical history interview and the physical examination were completed in the clinic by the medical student. The medical history for the child was obtained by directly questioning the respondent according to the medical history interview schedule (Appendix A). Answers indicating that the child had had a disease were followed by questions probing further into the sickness to clarify the data.

Physical examination of the child followed the medical interview. The child was held by the respondent or by the examiner. A general observation was made to note any obvious abnormalities.

The child's head was examined first through observation and palpation. Ears were examined with a Welch Allen halogen otoscope to identify abnormalities in the tympanic membranes. The throat and tongue were examined under illumination, using disposable sterile tongue blades. Often children needed restraining during this part of the examination, and the practical nurse helped to hold them.

The child's shirt or dress was then removed and a general survey of the skin was made. Lungs were examined by finger percussion and by auscultation using a Littman stethoscope. Abdominal examination was difficult in many children. The child was asked to lie down on his back, which often upset the younger children. Cardiac examination was repeated in this position in those children who were not crying.

If the child was crying, abdominal palpation was done during inspiration. In this way an estimate of liver and spleen size could be made. These organs also were measured by finger percussion, though in a small child this method is less accurate than palpation.

After the entire body had been examined, the respondent was asked for permission to take a sample of blood from the child for hemoglobin measurement. One to two drops of blood were collected from the child's finger directly into the sample chamber of a Buffalo Medical Instruments hemoglobinometer. The sample was hemolyzed, the sample chamber was assembled and placed in the hemoglobinometer, and hemoblogin was determined by color match. A value for hemoglobin in grams per deciliter was read from the scale on the side of the instrument. In previous trials against blood of known hemoglobin content by the same person, this method proved to be accurate to $\pm$ 1.0 gram per diciliter. Most children reacted negatively to having blood taken until given a balloon in reward. The respondents, however, usually were very eager to have the child's blood "checked."

Data Analysis

The data were analyzed on a CDC 6500 computer, utilizing Statistical Package for the Social Sciences (Nie et al., 1975) programs. Frequencies were calculated for all variables.

National Center for Health Statistics (NCHS) (undated) values, presented for use in 1976, were used as the reference standards for growth. These values were recommended for international use as references by the World Health Organization (Waterlow, 1977b). The length measurements were transformed into percents of standard length

for age to facilitate comparisons between children of different ages. Percent of standard rather than percentiles were used for reference in this research since most of the children's lengths were below the NCHS fifth percentile. Within the age range of studied children percentile curves and percent of standard curves are approximately parallel. The fifth percentile is between 93 and 95 percent of the 50th percentile from 9 to 48 months for both males and females. Percents of standard length were calculated by dividing the child's length (mm) by the NCHS 50th percentile value for length (mm) for the child's age in months. The quotient then was multiplied by 100 to obtain a percentage. The percentage of the standard length for age will be referred to as "length for age."

Weight measurements were transformed into percents of standard weight by the same method, also using NCHS reference standards for weight. The percentage of standard weight for age will be referred to as "weight for age."

Pearson product-moment correlations were calculated between selected variables and length for age. The variables describing physical status used in correlation tests were the child's weight for age, skinfold thickness, arm circumference, head circumference, and mid-parental height. Variables tested related to the child and his family were child's age; mother's age' number of siblings alive; interval to birth of next sibling; number of children living in house; number of siblings having died; number of mother's miscarriages; number living in house; presence in house of mother, father, grandmother, grandfather, aunts, uncles, and cousins; father's and mother's

years of education; number of food trees owned by family; and an index of housing quality. The index of housing quality was created by adding one point for the presence of each of the following items: board walls, a separate cookhouse, a tin roof, and painted exterior walls.

Dietary variables tested included age the child was weaned; age when tea, milk, frescos,[1] pops,[2] eggs, breadkind,[3] fruit, rice, soups and sauces, fish and meat, and family diet were introduced; servings given to child of starches, grains, animal foods, milk, sweet drinks, starchy drinks, sauces, and fruits; and an index of the number of the above types of foods given. The index of food types was created by adding one point for the presence of each of the following in the child's 24 hour dietary recall: starches; grains; meat, fish, or eggs; milk; sweet drinks; starchy drinks; sauces; and fruits. Health variables tested were hemoglobin; presence of protuberant abdomen; report of general health, neonatal health, and present health; and an index of clinical signs of health. The index of clinical signs of health was created by adding one point for the absence of each of the following signs of chronic disease: protuberant abdomen, hepatomegaly, splenomegaly, adenopathy, heart murmur, skin ulceration or depigmentation, and hemoglobin less than 10 g/dl.

---

[1]Frescos are cold, sweetened drinks.

[2]Pops are boiled, gruel-like beverages made from starches.

[3]Breadkind includes any starchy vegetable.

A multiple regression equation was computed to identify the extent to which certain independent variables (environmental factors) predicted length for age.

CHAPTER V

THE RESEARCH SITE

The east coast of Nicaragua is a flat lowland area, with forest and swamps predominating towards the south, and savannah in the north (Figure 1). From an airplane flying south down the coast, the rivers edged by forest and the savannah in drier areas are obvious. As one heads south, the forest occupies more and more of the land while the savannah disappears.

The low and swampy nature of the land makes overland travel usually impossible for more than short distances. Transportation throughout the area, then, is mainly by boat. The Nicaraguan airline provides service between three east coast locations--Puerto Cabezas, Corn Island, and Bluefields.

The area is sparsely populated; small villages are widely separated in many areas with miles of uninhabited forest or savannah between them. The eastern lowlands and plateau of Nicaragua encompass 50 percent of the land area of the country but only contain 7 percent of the population (May and McLellen, 1972).

The people of the coast, "costeños," are culturally and economically separate from the rest of Nicaragua. While the Spanish settled the western part of Nicaragua, the east coast never was dominated by them. The Spanish found little there of interest and in

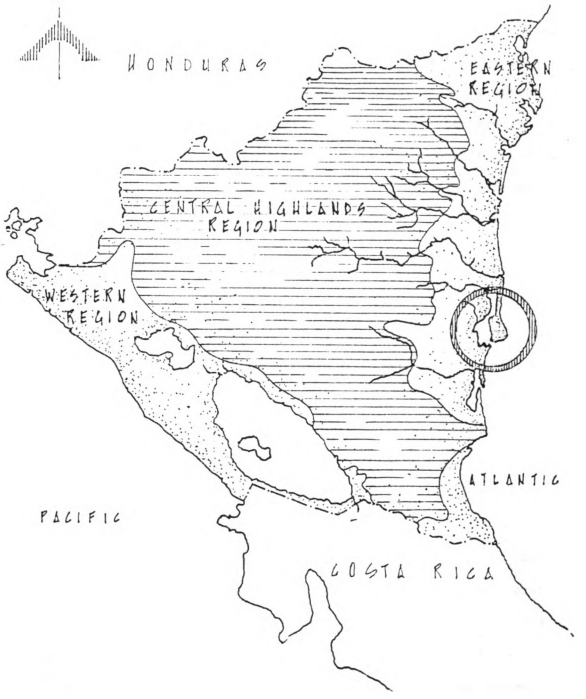

Figure 1.--Map of Nicaragua By Regions, With Research Area Circled.

addition, the Miskito Indians living there were good fighters. The English formed alliances with the Miskitos and had closer contact with them, then, than did the Spanish (Nietschmann, 1973).

The cultural and economic separation of the east coast from the rest of Nicaragua has continued largely because transportation and contact have been difficult between the population centers in western Nicaragua and the Caribbean coast. No roads connected the two areas at the time of this study; all travel was by boat or airplane.

The Site

The village of Orinoco was the principal research site for this study. Two smaller nearby villages, Marshall Point and La Fé (Grass Bank) also were included in the study. The people of the three villages were culturally and economically very similar. In fact, many had kinship ties.

Orinoco was located directly on the northwest shore of Pearl Lagoon (Figure 2). Pearl Lagoon formed the southern edge of the village; to the east and west were swamps. The forest, or "bush," bordered the village on the north.

Nietschmann (1973) aptly titled his book describing the East coast "Between Land and Water," as the villagers on Nicaragua's east coast certainly were balanced on a narrow rim between the forest and the lagoon or ocean. Contact with the lagoon was much more a daily part of village life than was contact with the forest. The lagoon was used for transportation, fishing, and recreation; several outhouses were built over the lagoon; its edge was the location for boat

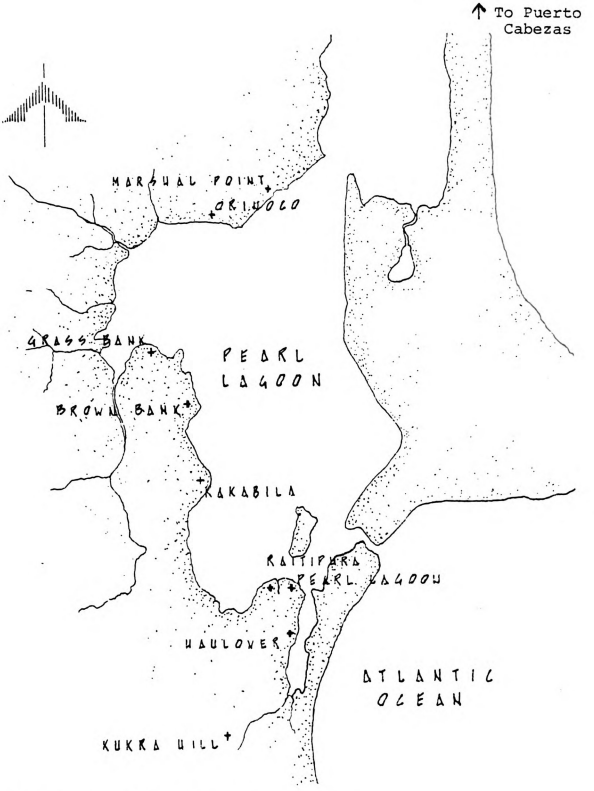

Figure 2.--Map of Pearl Lagoon Area.

building and boat storage. The forest was utilized as a source of fuel, lumber, thatch material and game animals.

Marshall Point was along the lagoon to the east and could be reached from Orinoco by a foot trail close to the lagoon edge, an hour's walk, or by dugout canoe. Marshall Point was the only settlement which could be reached overland from Orinoco; there was daily communication and travel between the two villages. La Fé was also directly on Pearl Lagoon, facing Orinoco across a seven mile wide bay. The only means of reaching La Fé from Orinoco was by boat, sailing if the breeze was good or paddling if there was no wind. By sail, the trip took one hour or more, without wind, paddling could take three to four hours. There were fewer trips from Orinoco to La Fé than to Marshall Point, but at least several times a week boats traveled between the two villages.

The village of Orinoco consisted of 90 households, with an approximate population of 800 (Figure 3). There were two churches in the village, Roman Catholic and Anglican. However, the people of Orinoco formed one congregation and all attended the church having services. A government-operated school in Orinoco provided education up to the sixth grade. The school was housed in three separate buildings, with two grades in each. The community recently purchased a rice mill for everyone's use. The mill both hulled and polished the rice. It was located in its own building close to the lagoon. Anyone using the mill had to pay 12 percent of the rice hulled in order to help pay off a loan taken out by the village for its purchase.

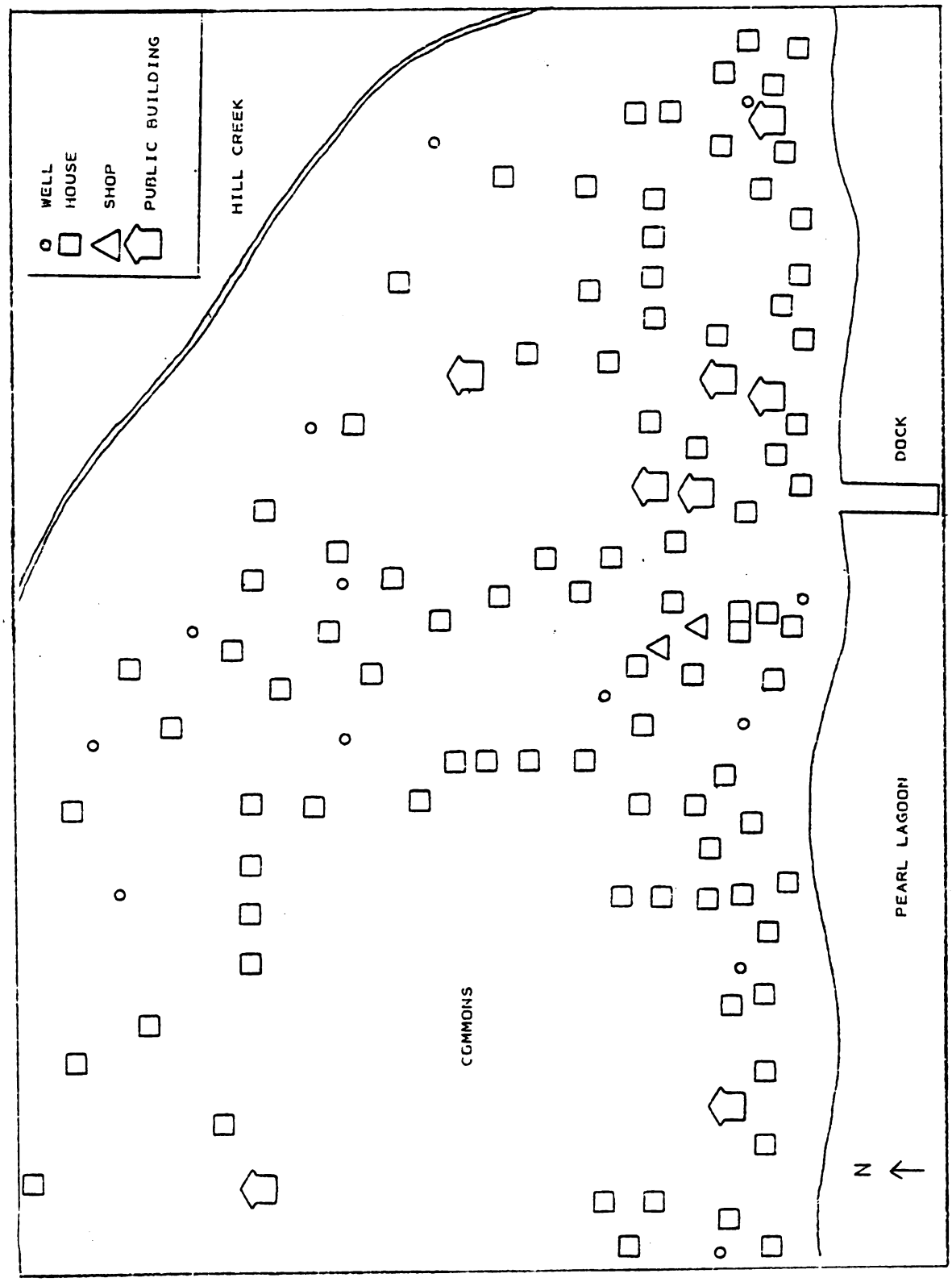

Figure 3.--Map of Orinoco.

The village's water supply was from 13 open wells scattered throughout the village. The locations of the wells are indicated on the village map (Figure 3). A few households collected and stored rain water for drinking but the majority used well water for all purposes. The lagoon was not used as a water source; for much of the year it was brackish.

Two small shops were operated in the village, selling foods and other needed items such as soap and nails. The food items most commonly purchased by villagers were sugar, flour and rice. Three other households in the village commonly stocked and sold a few supplies, but did not have a "shop."

The smaller villages of Marshall Point and La Fé, though distinctive, were in many ways very similar to Orinoco. Marshall Point (Figure 4) had 25 households and approximately 200 people; La Fé (Figure 5) had 26 households and about 200 people. Both had one church and a school through the sixth grade.

The People

Almost all the residents of Orinoco, Marshall Point, and La Fé claimed to be Creole, a mixture of ethnic groups. A few older citizens said they were fully Carib, which they claimed meant fully black. However, the Caribs from whom they were descended were Carib Indians who had been resettled in Honduras from the Caribbean island of St. Vincent. Caribs by the time they were resettled had long intermarried with escaped Negro slaves and were therefore very black in appearance.

The majority of the people, who called themselves Creole, were a mixture of Indian, Negro and sometimes Caucasian. The

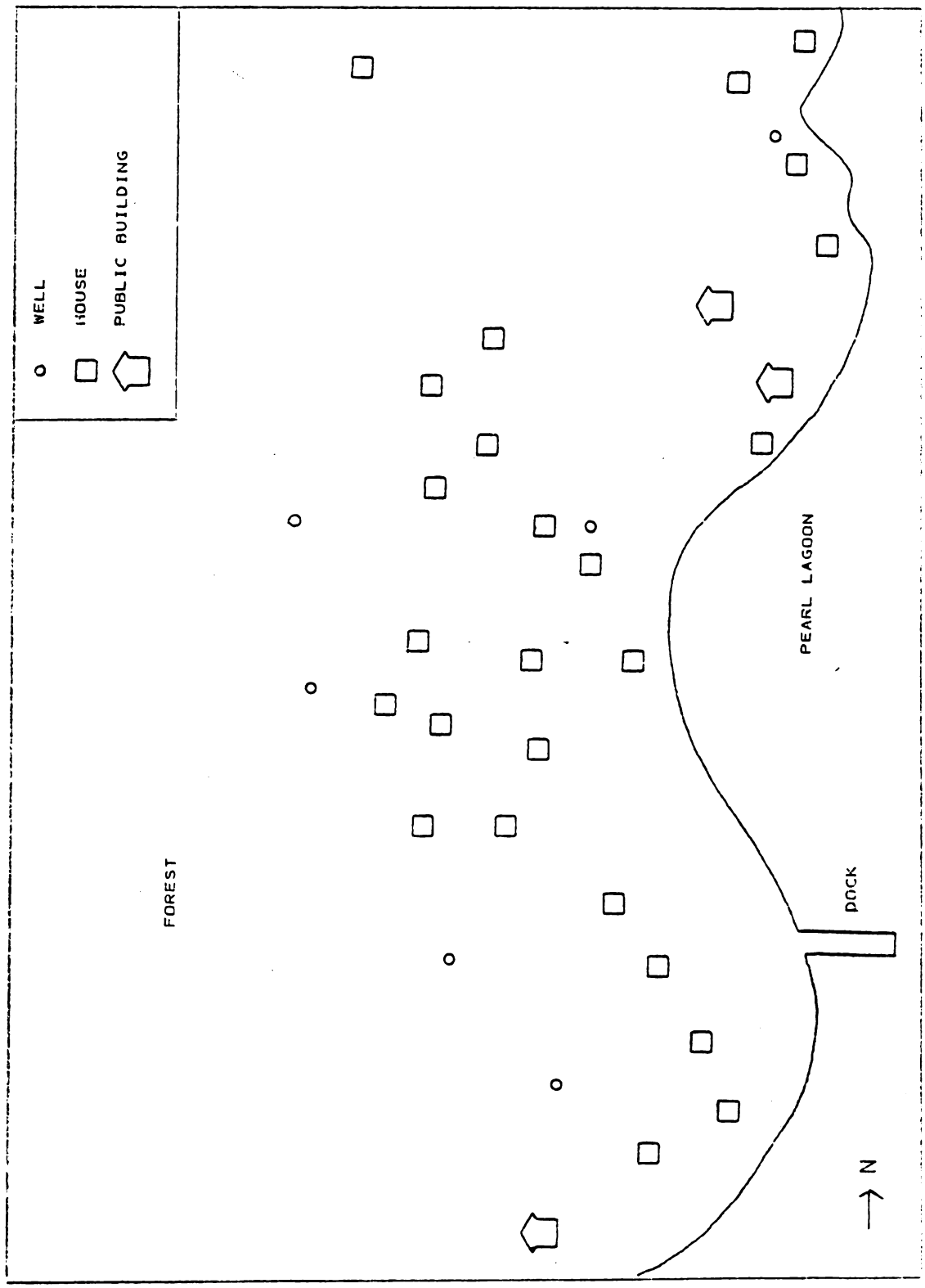

Figure 4.--Map of Marshall Point.

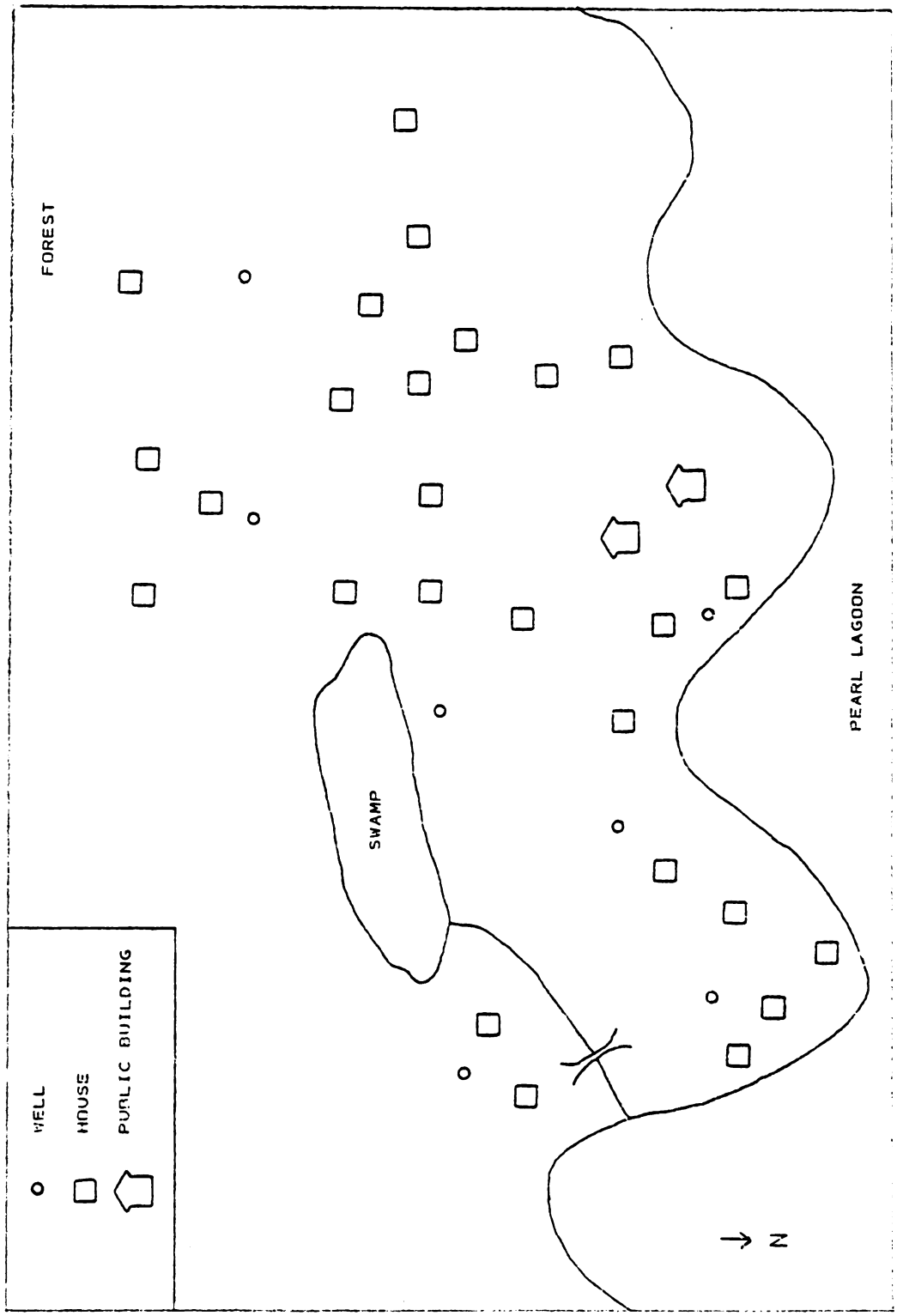

Figure 5.--Map of La Fe.

description of what constitutes a "Creole" varies. Nietschmann (1973) described Creoles as "mixed descendants of Negroes, English and some Indians." May and McLellan (1972) stated that "the Indian-Negroes call themselves 'creoles.'" In Orinoco, several Creoles interviewed explained that Creole simply meant any mixture of races.

At the time of the study, one Spanish speaking Ladino family from western Nicaragua had moved into Orinoco. They lived on the edge of the forest, separate from any of the other houses in the village. However, they did attend church services in the village and buy goods at the shops. They rapidly were clearing land to plant in the forest.

Agriculture and Food

The people of Orinoco depended on subsistence agriculture for their major food supply, as did most villagers on the east coast. The crops were grown in small cut and burned areas of the forest called plantations. A single family usually had several plantations which were widely separated and only grew one or two crops on any single plantation. All of the plantations were remote from the villages and usually were reached by dugout canoe.

The researchers observed the plantations of one village family. Their plantations were typical of those of the established families in the village. Their closest plantation was approximately one and a half hours away by dugout canoe. It was a coconut plantation with about 50 coconut trees, several miles up river from the mouth of the Wawasang River and fairly close to the river. A second plantation was located near the headwaters of a small creek emptying into the Wawasang;

only dasheen, a root crop, was grown there. Dasheen grows well in very wet areas and this plantation was extremely swampy. The third and fourth plantations were located on another stream flowing directly into Pearl Lagoon, further from Orinoco than the Wawasang. One of these plantations was used to grow rice, the other red beans.

Starchy root crops such as dasheen and cassava were the most widely cultivated crops and made up a major portion of the villagers' diets. Other starchy vegetables common in the village diet were coco (a root), breadfruit, green banana, plantain, and cosco (similar to a green banana).

Rice and red beans were seasonally important in villagers' diets. Few of the villagers stored enough rice or beans to use year round; they were usually sold as a cash crop. However, enough rice remained in the village to be a fairly common item in the diet.

Coconuts were widely utilized to make coconut milk. This milk was used in cooking a popular staple dish called "rundown." Rundown consisted of one or several starchy vegetables and fish boiled in the coconut milk.

Fish was the most common animal food in the diet. During the dry season, when Pearl Lagoon became salty, salt water fish and shrimp were caught from dugout canoes. In the rainy season, fresh water fish were caught in the lagoon and in the Wawasang River.

The forest behind the village had a large variety of game animals which were hunted and eaten. Two to three times a week a game animal was brought into the village. If the animal was large,

most of the meat was sold. Meat from smaller animals was sometimes sold or all might be eaten by the family of the hunter.

Terry (1977) identified the food sources and dietary patterns in Kakabila, a Miskito village also on Pearl Lagoon (Figure 2). Cassava was found to be a core food in the Kakabila diet, as it was eaten daily and formed a substantial part of the diet. Fish, green bananas, breadfruit, coconut milk, coconut water and mangoes were considered secondary core foods. These foods, with the exception of mangoes which were not in season during this research period, all were observed to be major components of the typical Orinoco diet. However, dasheen rather than cassava was the major starchy root eaten in Orinoco.

The Research Population

All households in the three villages with a child or children between nine months and four years old were asked to participate in the research project and all agreed.

Sixty-eight children within the age range were examined and their mothers or other persons responsible for their care were interviewed. In Orinoco and Marshall Point, all children from nine months to four years old were examined. In La Fé, only the youngest child in a family within the age range was examined. This variation in procedure was necessary in order to see all of the eligible households within a limited amount of time.

The Children

The children examined in this study ranged from nine to 48 months old. Of the 68 children seen, six (9%) were 12 months old or less, 29 (43%) were from 13 to 24 months old, 18 (26%) were from 25 to 36 months old, and 15 (22%) were from 37 to 48 months old. Twenty-six (38%) of the children were male; 42 (62%) were female. The number of females and the number of children 13 to 24 months old is higher than would be expected by chance. There is no apparent reason for the imbalance in the numbers of children of each sex. One possible explanation for the large proportion of 1 to 2 year olds in the study could be that in La Fé only the youngest sibling within the age range was chosen. However, this selection due to time limitation eliminated only one child over two years old who otherwise would have been included in the study.

The Respondents

Fifty-six (82%) of the 68 respondents were mothers. Other respondents were fathers (2x), grandmothers (6x), aunts (2x), a sister (1x), and a cousin (1x). In most cases, the respondent was the person principally responsible for taking care of the child. In three instances the mother and in four the grandmother were not the respondent in the clinic interview even though they were identified as the child's major caretaker. Reasons for not interviewing the major child caretaker included her illness, absence from the village for a short time or inability to answer the questions. Three of the major caretakers who were not able to bring the child to the clinic for the first

interview were, however, the respondents in the second interview conducted in the home.

The Household

Selected household composition characteristics for families in the study are presented in Table 1. The mothers of children in the study ranged in age from 16 to 45 years. Fathers whose ages were known were between 23 and 57 years old, but in 43 percent of the cases, the father's age was unknown. Mothers were present in 85 percent of the households, and fathers in 65 percent.

The households were large; 80 percent of the households had between five and ten persons. The median number of children in the household was four. Often, some of the other children in the household were not siblings but were other relatives such as young aunts or uncles, cousins, nieces or nephews. The large number of households with additional relatives present indicated a pattern of extended families living together. Over one-third of the households included a grandmother, over one-quarter a grandfather, aunt or uncle, and almost one-quarter a cousin, niece, nephew or similarly related young person.

The presence of extended families may be explained by the subsistence nature of the economy. A young couple would not be able to set up their own household until they could collect enough lumber and other materials to build a house. They commonly lived with the female's parents or other older relatives until the house was built. Therefore, some young mothers in the study were living with their

Table 1.--Selected Household and Family Characteristics of the Research Population.

Characteristics	Children N=68	
	No.	%
Mother's Age (years)		
Under 20	4	5.9
20-29	36	52.8
30-39	17	24.9
40-45	9	13.3
Unknown	2	2.9
Father's Age (years)		
20-29	14	20.7
30-39	11	16.1
40-49	12	17.6
50-59	2	3.0
Unknown	29	42.6
Number of Persons Living in House		
3-4	8	11.7
5-6	19	27.9
7-8	21	30.9
9-10	15	22.1
11-12	3	4.4
14	1	1.5
18	1	1.5
Number of all Children in House		
1-2	14	20.6
3-4	25	36.8
5-6	13	19.1
7-8	14	20.6
9	1	1.5
Unknown	1	1.5
Relatives of Studied Child Present in House		
Mother	58	85.3
Father	44	64.7
Grandmother	24	35.3
Grandfather	20	29.4
Aunt	20	29.4
Uncle	20	29.4
Cousin (or similar relative)	16	23.6

Table 1.--Continued.

Characteristics	Children N=68	
	No.	%
Number of Siblings Alive[a]		
0	8	11.8
1	19	27.9
2-3	14	20.6
5-6	14	20.6
7-8	8	11.8
9-10	5	7.3
Number of Siblings Who Died After Birth		
0	47	69.1
1	10	14.7
2	6	8.8
3	2	2.9
4	3	4.4
Number of Siblings Miscarried		
0	47	69.1
1	10	14.7
2	5	7.4
3	2	2.9
4	1	1.5
5	1	1.5
Unknown	2	2.9

[a]No children in the sample had four siblings.

family of origin, and some of the older mothers had adult daughters and grandchildren living with them.

Siblings

Eighty-eight percent of the children studied had at least one brother or sister living. The number of siblings living ranged from zero to ten. The distribution was highly skewed. Half the children had two or fewer living siblings, and approximately 40 percent had five or more living siblings. The large number of children with no or few siblings was not indicative of final family size in this area, but of the young age of most respondent mothers. The majority of mothers were under 30 years old and probably would continue to have children for about ten more years. Birth control methods were not widely used in the area. According to the practical nurse at the clinic, only one woman in Orinoco was attempting to use a birth control method during the time the researchers were in the village.

Since the children in the study were very young (about one-half under two years old), most were the youngest in the family. Thirty-one percent had a younger sibling; 69 percent had no younger siblings. For those with a younger sibling, the interval between the two births ranged from 14 to 41 months.

Thirty-one percent of the respondents had had at least one child die, and 31 percent had at least one miscarriage. The majority (69%) of village women interviewed were able to give birth to and rear all of their children successfully. These women considered themselves fortunate that all their children had lived. When asked if they had

ever had a child die, their negative response often was supplemented with "I've been lucky" or "Thank the Lord."

Summary

The research site was an isolated agricultural community capable of subsisting on its own resources. Villagers farmed small areas of the forest and fished in the lagoon and rivers to provide food for their families. Village shops supplemented the variety of available foods.

Of the 68 children between nine and 48 months old examined, most were cared for by their mother. Many of the children studied lived in large households, and extended families were common in the area.

CHAPTER VI

CHILDREN'S GROWTH STATUS, DIET, AND HEALTH

The growth status of each child nine months to four years old in the Orinoco area was identified and environmental factors which could influence growth were examined. A description of the children's growth patterns, their diets and their health statuses are included here.

Anthropometric Measurements

Seven anthropometric measurements of the children were taken: recumbent length; weight; triceps skinfold; and arm, head, chest and abdomen circumference. Of these, the data from the first five were analyzed. Chest and abdomen circumferences were not considered accurate by the research team.

The lengths of studied children are presented graphically in Figures 6 and 7. Only 6 percent of the children were above the National Center for Health Statistics (NCHS) 50th percentile length for their age (100% of standard). Nearly three-quarters of the children were below 95 percent of standard, which falls between the NCHS fifth and tenth percentiles.

For all children examined, the length for age ranged from 82.6 percent to 105.6 percent of standard. The mean length for age was

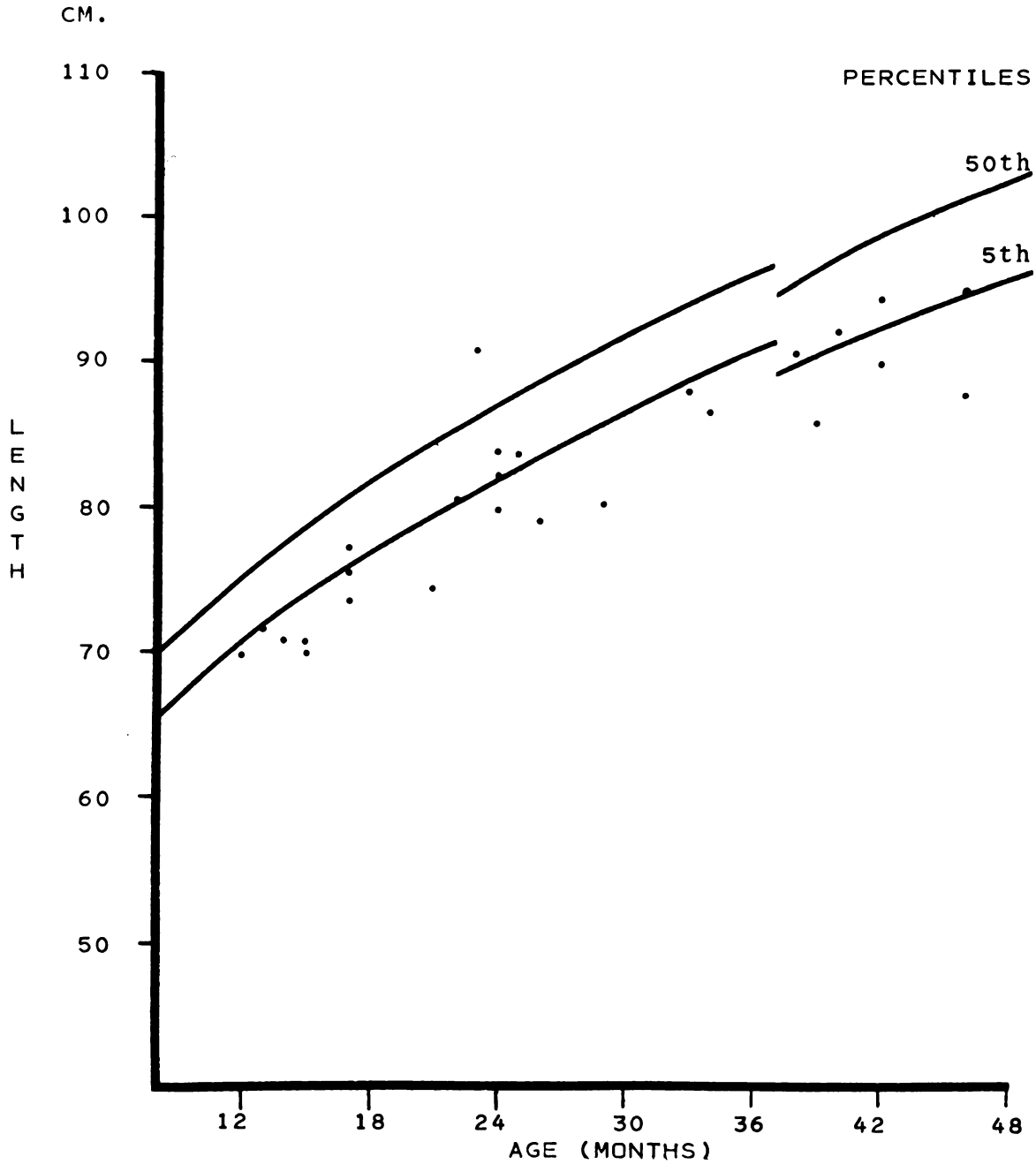

Figure 6.--Lengths for Age of Male Children.

Reference lines from NCHS Growth Charts for 0-36 months and 2-18 years.

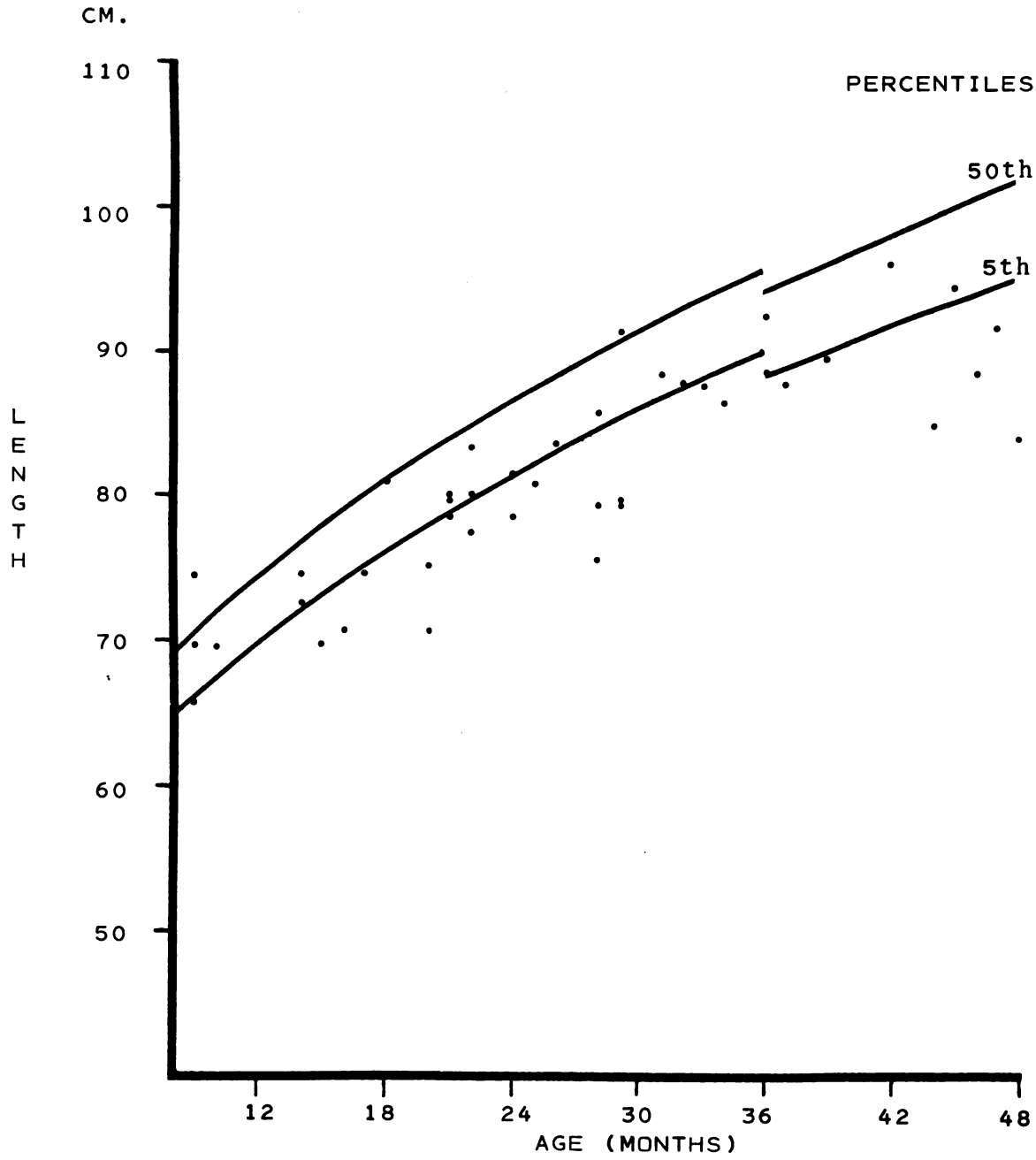

Figure 7.--Lengths for Age of Female Children.

Reference lines from NCHS Growth Charts for 0-36 months and 2-18 years.

92.9 percent; the median was 93.5 percent. The number of children and their lengths for age are presented in Table 2.

Table 2. Percent of Standard Length for Age of Orinoco Area Children Nine Months to Four Years of Age.

Percent of Standard Length for Age	Children N=68	
	No.	%
<85%	2	3.0
85 to 89.9	15	22.0
90 to 94.9	33	48.5
95 to 99.9	14	20.6
100 to 104.9	2	3.0
≥105	2	3.0

The children's weights for age, also expressed as a percent of standard, ranged from 65.4 to 116.7 percent. The mean weight was 89.4, and the median 88.7 percent of standard, respectively. The weights of studied children are presented graphically in Figures 8 and 9.

The low lengths and weights for age were expected from previous studies on the east coast of Nicaragua (Anderson et al., 1976; Brownlee et al., 1975). Eighteen percent of the children examined were classified as malnourished according to weight for age standards used in the MUCIA/University of Wisconsin/Nicaragua Medical Project (WMC). However, the occurrence of both lengths and weights above the NCHS 50th percentile was an indication that larger, apparently well-nourished

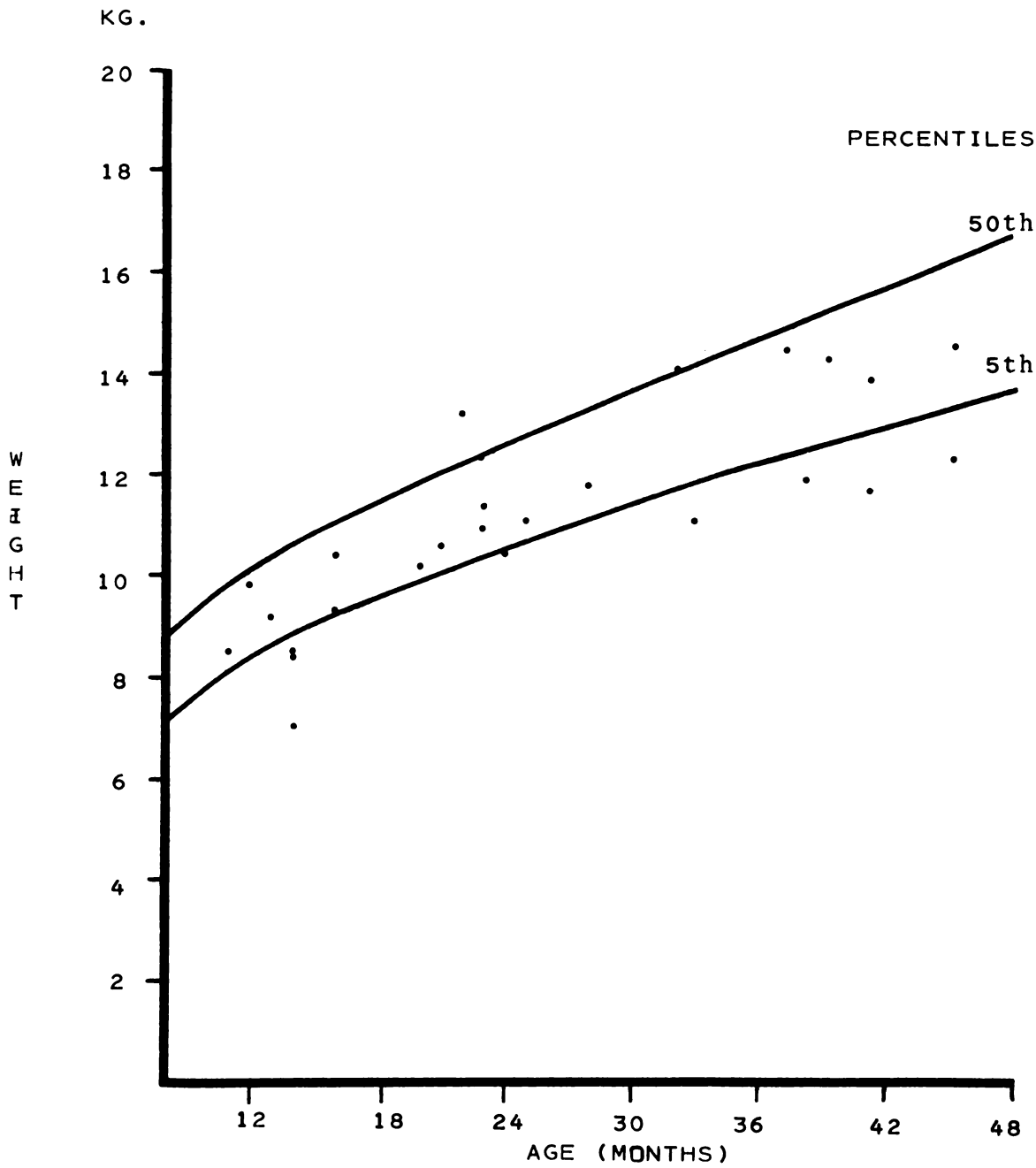

Figure 8.--Weights for Age of Male Children,

Reference lines from NCHS Growth Charts for 0-36 months and 2-18 years.

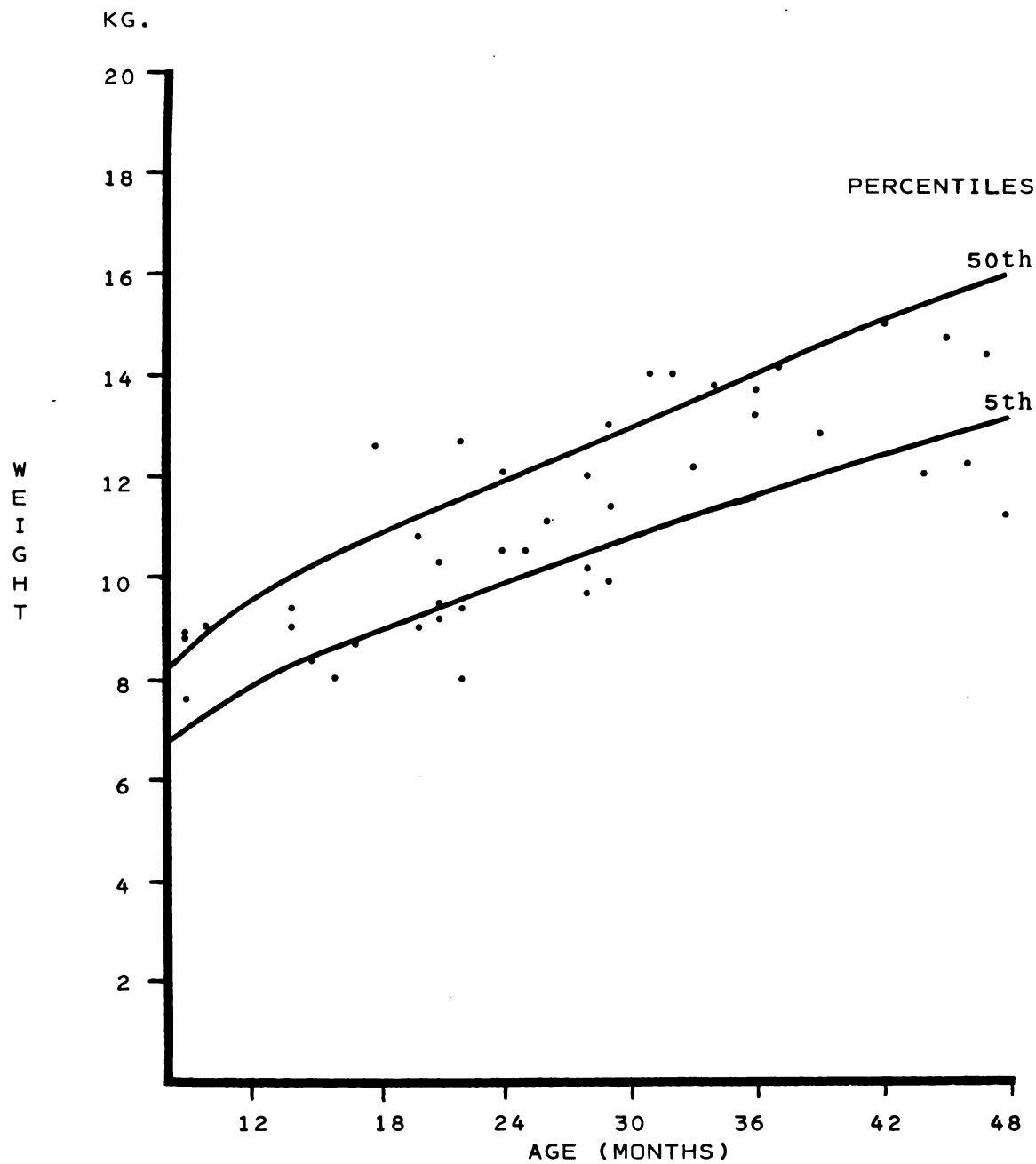

Figure 9.--Weights for Age of Female Children.

Reference lines from NCHS Growth Charts for 0-36 months and 2-18 years.

young children did live in these villages, and could be studied to identify factors contributing to their growth.

A high positive correlation ($r = 0.714$, $p \leq .001$) was found between length and weight for age. This relationship was expected since no acute wasting or severe edema was identified in the children examined.

The arm circumferences of the children ranged from 12.5 to 18.0 centimeters, with a mean and median value of 15 centimeters. In one case, an accurate arm circumference was not obtained. Head circumferences ranged from 44.5 to 51.9 centimeters, with a mean of 47.6 and a median of 48.0 centimeters. Five of the children had large braids so an accurate head circumference reading could not be taken. The range of triceps skinfold thickness was five to sixteen millimeters. The mean was 8.6 millimeters; the median was 8 millimeters. The skinfold thicknesses of studied children are presented graphically in Figure 10. Mean arm circumference and triceps skinfold values were larger than those reported in rural preschool Guatemalan children (Martorell et al., 1976), but were slightly less than values reported for U.S. preschool children of low socio-economic level (Crispin et al., 1968). The median head circumference is within the normal range for two year old U.S. children (Hammill et al., 1976).

The children's arm circumferences were found to correlate significantly with their length for age ($r = 0.23$, $p \leq .05$). Neither triceps skinfold nor head circumferences significantly correlated with length for age.

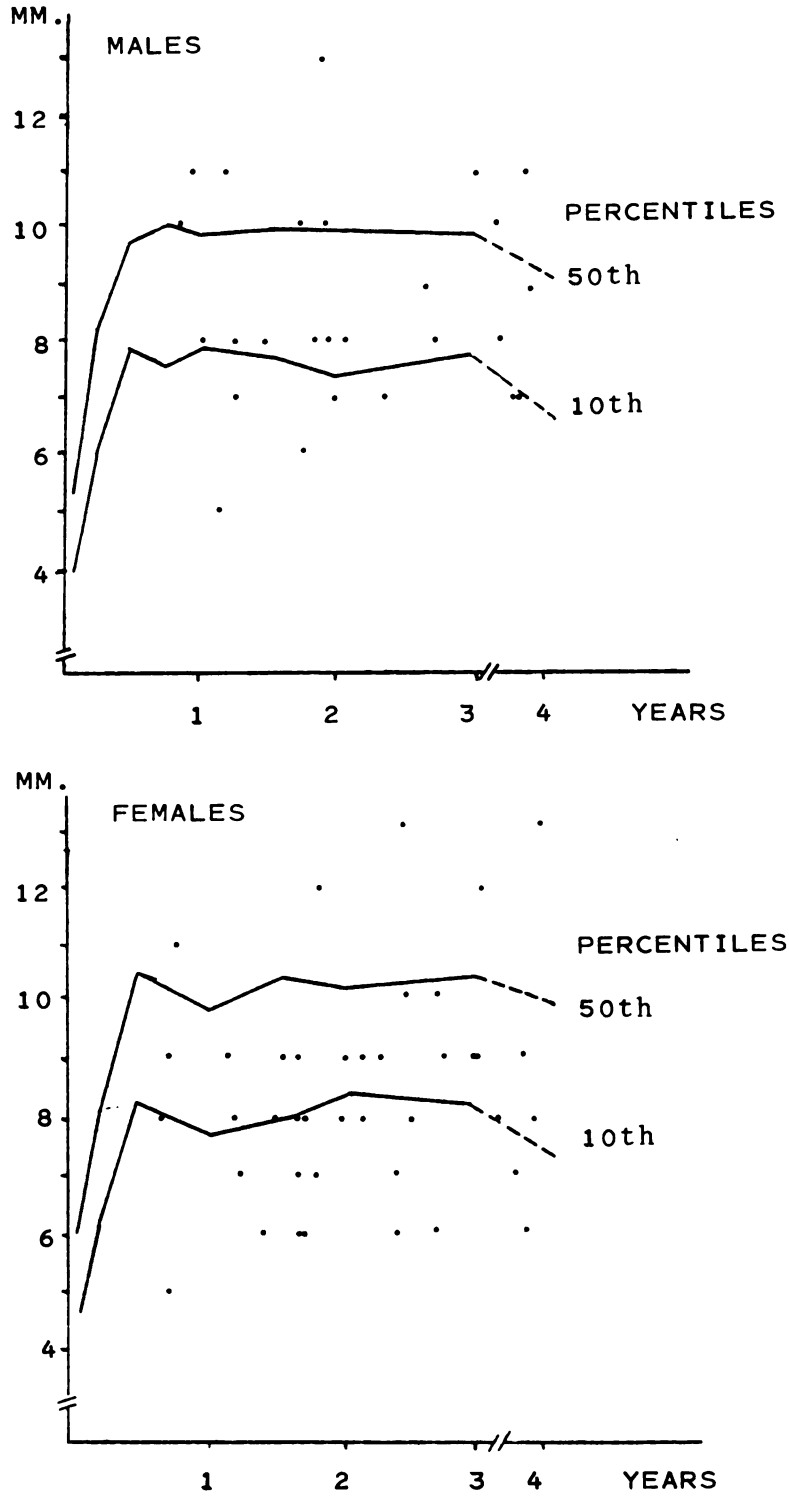

Figure 10.--Triceps Skinfold Thicknesses of Children.

Frisancho and Garn (1971) did not find fatness, as estimated by the triceps skinfold thickness, to be related to height in Honduran children unless they examined only the extremely short and tall. They concluded that the children's degree of fatness was generally not large enough to be reflected in height differences. A similar conclusion might be reached in the present study. Almost all the children examined were lean. Approximately 60 percent had a skinfold thickness between seven and nine millimeters, and about 80 percent between six and ten millimeters. The leanness of the children and the small deviation of most measurements from the median could explain the lack of correlation between this variable and length.

Head circumference while rapidly increasing during the first year of life is sensitive to malnutrition. However, in older children, head circumference is more stable and less sensitive to nutritional problems that could lead to stunting of growth in length. Since the younger children in the group studied were relatively longer than older children, it can be assumed that the slowing of the growth rate was more profound after the first year in these children. In this population, head circumferences did not necessarily reflect the children's growth in length.

Breast-Feeding

Breast-feeding was the accepted method for initial infant feeding in the Nicaraguan villages studied. Only one child of 68 had not been breast-fed. He reportedly had refused the breast. Although breast-feeding was almost universal and continued commonly for a

substantial period of time, bottles and other foods were introduced to the child very early in many families.

Children were weaned from the breast between three and 24 months of age (Table 3). One child in four was weaned from the breast before ten months of age and half by twelve months. Sixteen percent of the children examined were still breast-fed at the time of the study and their mothers planned to wean these children at 12, 16, 18 or 24 months. One mother still breast-feeding a child over 12 months old said she would wean him "when I vexed" (when she is angry with the child).

The most common reasons for weaning a child were that the child was the appropriate age to wean (19 cases, 36% of those already weaned), the mother had become sick or had left town (13 cases, 25%) or the mother had become pregnant again (12 cases, 23%). Other reasons given for weaning were that the mother needed to work away from home (2 cases), the mother considered her milk to be no longer good for the child, and the mother wanted the child to eat other foods (1 case each). Five children had weaned themselves, according to the respondents.

A few mothers in the Orinoco area were weaning children at a very early age, while almost half (46%) weaned children between seven and twelve months of age. When asked how long a child should be breast-fed, however, the great majority stated that breast-feeding should continue longer than twelve months (Table 4). Only about one-third of the mothers felt that twelve months or younger was an appropriate age at which to wean a child. The difference between

Table 3.--Age Children Were Weaned From Breast in Orinoco Area, As Reported by Respondents.

Age in Months	Children N=68	
	No.	%
< 4	3	4.4
4 to 6	0	0.0
7 to 9	14	20.6
10 to 12	17	25.1
13 to 15	10	14.7
16 to 18	7	10.3
19 to 21	1	1.5
22 to 24	3	4.4
Unknown	1	1.5
Not Weaned	11	16.2
Never Breast-fed	1	1.5

Table 4.--Age at Which a Child Should be Weaned From Breast, As Reported by Orinoco Area Respondents.

Age in Months	Respondents N=68	
	No.	%
<12	13	19.1
12	10	14.7
13 - 17	13	19.1
18	15	22.1
>18	4	5.9
Unknown	13	19.1

actual weaning ages and weaning ages considered appropriate was consistent with the reasons given by respondents for weaning. In close to half of the interviews, the reason for weaning was related to the mother's perceived ability to breast-feed, not to the child's need for breast milk. Mothers had become pregnant again, had become sick, or had left town to work. Therefore, they were unable to continue breast-feeding their children even though they might not have considered the child old enough to be weaned.

In a question related to weaning before the appropriate age, respondents were asked if there were any circumstances or times when breast milk might be bad for an infant. Nineteen (31%) respondents did not know of any time that breast milk would be harmful, 11 (18%) considered breast milk bad when the mother was pregnant, 8 (13%) each when the mother was hot from the sun, or when the milk was

"salty," 5 when the child was "old," 4 when the mother was sick or the breast was infected, and 2 when the child was sick or refused the breast. An additional three gave a combination of answers. This long list is indicative of the many reasons some Orinoco area children could be weaned earlier than planned. Their mothers may be convinced that even though they were young, continued breast-feeding would be harmful.

The perception that breast milk could become "salty" and therefore harmful deserves special mention. Although few women in the Orinoco area claimed to have experienced "salty breast milk," 61 percent of the respondents had heard of it and knew some details of its supposed etiology. An additional 23 percent had heard of it but knew no details; the remaining 16 percent had never heard of "salty breast milk." A composite description of the problem was developed by the researcher. When a child suddenly refused to suck his mother's breast, the mother became convinced that something was wrong with her milk. By seeing a doctor, talking to friends or tasting the milk, she came to the decision that the milk was "salty." The child would then be fed totally by bottle, as she believed that "salty" milk would harm him. Some women claimed that the condition was temporary and the child could later be breast-fed again. Others considered the "saltiness" permanent and weaned the child. The condition would not always reoccur with subsequent children, but one woman in the village claimed a history of "salty breast milk" with four of her last five children.

"Salty breast milk" was an explanation often offered during the period of the research for lactation difficulties. One respondent who

had recently experienced lactation failure felt that she was too old and had no milk left. She did not think her milk had been "salty." Several other respondents, however, mentioned this woman to the researcher as an example of someone with "salty breast milk."

Bottle Feeding

Most of the children examined had not been breast-fed exclusively. Infant feeding in the Orinoco area usually consisted of breast milk supplemented from birth or shortly thereafter with various liquids by bottle. Among the respondents, 48 (71%) reported giving a bottle regularly to their children, another 2 sometimes gave a bottle, and 16 (23%) had never offered their child a bottle. One child had refused a bottle; the remaining child had been totally bottle fed, never breast-fed. The use of bottles started very early in the child's life. Of the respondents who bottle fed, 80 percent gave the bottle from birth.

Bottle feeding was used to supplement the breast milk, providing extra food for the child, and also to free the mother to do other work during the day. One or both of these reasons were given for bottle feeding by 80 percent of the respondents. To supplement ("to help the breast") was the reason for 25 respondents; to free the mother ("When I busy") was the reason for 21. Both reasons were given by five respondents. In one case, a bottle was given to accustom the baby to it before weaning; in another the respondent claimed the baby wanted the bottle.

When children are breast-fed beyond six months, they require additional calories from other foods. Almost all the mothers interviewed

were breast-feeding over six months, and therefore their use of additional feeding to supplement breast milk was appropriate. The reason that bottles were used for these added feedings probably related to the other major reason given for bottle feeding, that mothers considered themselves too busy to breast-feed often during the day. A bottle could be propped near a baby while the mother worked or a young child could hold the bottle for the infant. Spoon or cup feeding would have required the mother to stop working and feed the child. Nutritionists and others in international health work have considered bottles to be an unsanitary method of infant feeding in primitive living conditions, contributing to gastroenteritis (Pellett, 1977; Jelliffe and Jelliffe, 1975), but Orinoco area mothers felt that the bottle provided many advantages.

Foods Introduced Early

The food most commonly given to infants within a few days of birth was homemade anise tea, which 73 percent of all respondents gave to their newborn infants. The tea was given either in a bottle or in a soaked corner of a cloth. This tea was used as a purge for the newborn baby.

Other teas made from local herbs and purchased spices also were popular supplemental foods for young infants. They were usually highly sweetened with white sugar. Teas were introduced to infants by 63 percent of the respondents within the first month. Popular teas were fever grass (lemon grass), mint, orange and lime leaf, chainey root, barsley, colandro and marjan, all locally grown or harvested. Cinnamon, nutmeg and ginger were purchased to make tea. Tea was given

to children because it was an available food or one which would fill up the child. It was not considered by the respondents as a source of nutrients for growth (Table 5).

Cow's milk was nearly as popular as tea for supplemental infant feeding, 60 percent giving milk within the first month of life. Cow's milk was given at some time to 53 (78%) of the children studied, while 11 (16%) had never been given milk. In the remaining four children, whether milk had been given was unknown. The most common form of milk available was canned powdered full-fat milk, sold in local shops for C$10.50 (about $1.50, U.S.) per pound. Dried skimmed milk powder was available in plastic bags for C$7.50 ($1.07 U.S.) per pound. Other sources of milk were condensed milk and fresh cow's milk if the family had a lactating cow. Milk was considered "healthy" for babies; over one-half of the respondents felt that milk contributed to growth or provided nourishment for the child (Table 5).

Pop, a boiled gruel-like beverage made from a variety of starches,[1] was another popular infant food, but was not fed commonly to infants at a very young age. Only 15 (22%) introduced pop within the first month, but 37 (54%) introduced it before the family diet was given to their child. Pop was considered a healthy food for children which would fill them or provide nourishment for growth (Table 5).

If the mother could afford milk powder, it was sometimes added to pop. A common pattern was for the mother to buy a can of milk

---

[1]Respondents reported making pop from flour, cassava starch, cornstarch (the three most common), oatmeal, barley, green banana, rice and parched corn.

Table 5.--Reasons Selected Foods Were Fed to Young Children, As Reported by Orinoco Area Respondents.

Reason for Giving Each Food	Percent of Respondents Giving Reason for Feeding Each Food					
	Pop	Rice Water	Fresco	Milk	Green Banana	Teas
Available	8.2	1.6	3.3	0.0	1.6	21.3
Easy to digest	3.3	0.0	3.3	0.0	9.8	1.6
Filling	26.2	8.2	0.0	0.0	19.7	13.1
For growth, nourishment	23.0	8.2	3.3	59.0	13.1	0.0
Contained vitamins	1.6	3.3	19.7	9.8	31.1	0.0
To cool or for thirst	1.6	24.6	54.1	0.0	0.0	6.6
Healthy for baby, did not know why	13.1	6.6	8.2	14.8	3.3	3.3
Combination of above or other reason	6.6	6.6	3.3	3.3	13.1	21.3
Did not give this food	9.8	29.5	0.0	6.6	3.3	14.8
Did not know reason	6.6	11.5	4.9	6.6	4.9	18.0

powder and use small amounts in a pop or as plain milk for her young children, until she ran out. Then she would make pop without milk until she could afford to buy a new can of milk, usually a period of several weeks.

Frescos, cold sweetened drinks, were given to seven (10%) of the children by one month of age. Frescos were made from a fruit juice, highly diluted and sweetened, or occasionally from a purchased powder similar to soft drink mixes. The fruit juice used depended on the fruits then in season. The researchers were in the village between major fruit seasons, but small amounts of citrus fruits occasionally were available and were used for frescos. Frescos were usually given to quench the child's thirst or to "cool the body" (Table 5), though about one in five respondents considered them a source of vitamins. The other drink given to "cool the body" or quench thirst was rice water (Table 5), but this was not as popular an infant food in the Orinoco area as fresco, tea, milk or pop.

The first solid food introduced to infants often was mashed, boiled green banana. Several local mothers explained that these bananas were an excellent infant food because bananas did not contain starch as did other available vegetables. Starch was considered bad for young infants. The banana was considered by respondents to be a good source of vitamins and iron, as well as a filling and nourishing food (Table 5). Bananas and other breadkind (any starchy vegetable) were introduced to infants from one to 12 months old, with half of the respondents starting them between five and nine months.

Family Diet

Children began to eat the family diet at widely varying ages (Table 6). Almost one-half of the respondents reported giving their children "little bits of everything" between 9 and 14 months of age.

The "family diet" introduced to these children relied heavily on breadkind for substance (Table 7). Breadkind included many starchy vegetables. The most common of these in the Orinoco area were dasheen and green banana. Cassava and breadfruit also were eaten by many children (Table A-1, Appendix B). Breadkind, especially dasheen, was considered by villagers to be the basis of a person's diet. An older man explained that one could not eat fish without dasheen, but could eat dasheen without fish because "dasheen, that's our food."

Table 6.--Age At Which Orinoco Area Children Began to Eat the Family Diet, As Reported by Respondents.

Age in Months	Children (N=68)	
	No.	%
Under 6	3	4.4
6-8	6	8.8
9-11	9	13.2
12-14	23	33.8
15-17	1	1.5
18-20	6	8.8
21-24	3	4.4
Not yet eating family diet	8	11.8
Unknown	9	13.2

Table 7.--Selected Foods Eaten Regularly, Sometimes, or Never by Orinoco Area Children, As Reported by Respondents.

Food	Percent of Children Eating Food			
	Everyday or Nearly Everyday	Sometimes	Never	Food Not Mentioned
Breadkind	88.2	2.9	1.5	2.9
Fish or Meat	64.7	11.8	0.0	11.8
Tea or Cocoa	63.2	0.0	0.0	32.4
Fruits in Season	55.9	1.5	0.0	41.2
Rice	51.5	22.1	0.0	20.6
Bread and Buns	50.0	17.6	0.0	27.9
Milk	22.1	5.9	13.2	57.4
Pop or Porridge	14.7	7.4	5.9	70.6

Fish or meat were the next most common foods consumed regularly (Table 7), as almost two-thirds of the children ate either fish or meat everyday or nearly everyday. Fish was eaten much more commonly than meat (Table A-1, Appendix B). Other foods reported to be eaten everyday or nearly everyday by at least half the children included tea or cocoa, fruits in season, rice, and bread or buns (Table 7).

The types of food reportedly eaten by the children in the previous 24 hours (Table 8) were similar to those eaten most days. Most children had eaten at least one starchy vegetable, grain product, animal product, sweet drink and starchy drink during the day of the diet recall. No children were reported to have eaten any green or yellow vegetables in the 24 hour dietary recall.

Table 8.--Number and Categories of Different Foods Eaten by Children in Previous 24 Hours, As Reported by Respondents.

Food Items	Children (N=65)[a]	
	No.	%
Starchy Vegetables:		
0 foods	7	10.3
1 food	21	32.3
2 different foods	22	33.8
>2 different foods	15	23.1
Sweet Drinks (frescos, tea, coffee):		
0 drinks	9	13.8
1 drink	38	58.5
2 different drinks	18	27.7
Animal Products (fish, meat, eggs):		
0 foods	13	20.0
1 food	35	53.8
2 different foods	15	23.1
>2 different foods	2	3.1
Grains (rice, wheat, oats):		
0 foods	14	21.5
1 food	30	46.2
2 different foods	21	32.3
Starchy Drinks (pops, cocoa):		
0 drinks	25	38.5
1 drink	35	53.8
2 different drinks	5	7.7
Milk in Foods or Drinks:[b]		
0 foods or drinks	44	67.7
1 food or drink	20	30.8
2 different foods or drinks	1	1.5
Sauces (fish, meat, rundown):		
0 sauces	49	75.4
1 sauce	15	23.1
2 different sauces	1	1.5

Table 8.--Continued.

Food Items	Children (N=65)[a]	
	No.	%
Fruits:		
0 foods	50	76.9
1 food	15	23.1
Nonstarchy vegetables:		
0 foods	65	100.0

[a]Three respondents were not able to report what their child had eaten in the past 24 hours.

[b]Double counting, drinks and foods containing milk also are counted under another heading.

An index of the number of different food types eaten by the children was constructed. The types of foods were those listed in Table 8. Scores on the index ranged from two to seven different types of foods eaten that day, but about three-quarters of the children had eaten foods from four to six of the categories.

A typical, though not universal, diet for children in the study was described by the researcher. In the morning, bread and tea were eaten. For the main meal of the day, served at midday, a starchy root, boiled fish, and fresco were eaten. The evening meal was similar to breakfast or included rice and cocoa.

Health Status

Respondents were questioned about their child's health in general. Thirty-five (51%) considered their child to be basically healthy, 31 (46%) considered their child to be sick more often than healthy, and two did not know.

Sixteen of the children considered sick frequently were reported to have had several minor illnesses, including diarrhea,[1] fevers, "asthma,"[2] and colds. Seven children were reported to have had a single major illness--pneumonia, severe diarrhea or infection, or debilitating fever.

The occurrence of these illnesses cannot be documented and the diagnosis in most cases was the mother's own. However, the general

---

[1]Diarrhea was defined by the research team to be more than five liquid stools in 24 hours.

[2]Asthma as reported by respondents appeared to have been a common term for a variety of diseases causing breathing difficulty.

pattern of illnesses seen in Orinoco area children can be surmised from the respondents' reports. Many of the children reported sick often had contracted several different illnesses, but of those with only one predominant illness, diarrhea was the most common problem. Fevers, "asthma," and colds were other recurring and common problems.

According to respondents, 45 (66.2%) of the children examined had been sick in the past month, 19 (28%) had not, and in four cases the respondent did not know. Thirty-eight children (56%) were reported to have had diarrhea within the month previous to the first interview. This prevalence rate for diarrhea is lower than the incidence rate reported for rural Guatemalan children, aged 6 to 36 months, of 72 cases per 100 children per month (Mata et al., 1977).

Forty-five of the children (66%) were reported to have had worms at some point in their life. The respondents knew if a child had had worms because they had seen the worms in the child's stool or in a few cases, in his nose or mouth. In addition, 44 (65%) were reported to have had infrequent fevers and eight (12%) to have had frequent fevers. In the Guatemala research, about 70 of 100 children per month had a low grade, and 10 a high (>39.5 C) fever (Mata et al., 1977).

Fourteen (31%) of the children were reported to have had colds within the month previous to the first interview. However, during the period of the study, a cold epidemic occurred in Orinoco and 45 (74%) of the children studied had had a cold between the first and second interviews. Thirty-four (56%) had the cold at the time of the second

interview. The practical nurse and several respondents attributed the large number of colds to the dry season, as it was cool then.

Second medical histories were obtained on 61 (90%) of the original 68 children; seven respondents were unavailable for the second interview or had not cared for the child during the three week period. Though 45 children had been reported to have had a cold, only 22 children (36%) were considered to have been ill within the three week period. The colds in most cases were little more than runny noses. Of the 45 children with a cold, only 29 had a cough, 3 vomiting, and 2 a fever.

The most common illness within the three week period other than a cold was diarrhea, which nine children (14.8%) had. The reported diarrhea was of short duration; three children had it for one day only, four for two days, one for four days and one for an unknown duration.

The histories of illness as presented by these respondents were qualitatively similar to case reports from rural Guatemala (Mata et al., 1977). Respiratory infections and diarrhea predominated; many children had had a series of minor illnesses almost overlapping in time.

Physical examination results substantiated the many reports of frequent infections and parasitic infestation (Table 9). Over half the children examined had protuberant abdomens and lymphadenopathy. While protuberant abdomens do not necessarily indicate parasitic infestation, parasites were the most logical explanation for the high prevalence of protuberant abdomens seen in the Orinoco area.

Table 9.--Most Commonly Observed Clinical Signs of Chronic Disease in Orinoco Area Children.

Clinical Sign	Children With Positive Sign N=68	
	No.	%
Protuberant Abdomen	41	60.3
Lymphadenopathy	39	57.4
Hepatomegaly	32	47.1
Splenomegaly	14	20.6
Skin infections	12	17.6
Apathy	10	14.7
Skin depigmentation	9	13.2
Pale conjunctivae	9	13.2
Skin ulceration	8	11.8
Abnormal breath sounds	8	11.8

Approximately 30 stool samples were examined by the medical student for ova and parasites while in Orinoco. At least two intestinal parasites were identified in each sample. Lymphadenopathy, observed in inguinal, cervical or axillary nodes, indicated the presence of infections in the children. Many infections, ulcerations, or the resulting depigmentations were found on the skin (Table 9).

Almost half the children (47%) had hepatomegaly (Table 9). This high prevalence, and the prevalence of splenomegaly (Table 9) were consistent with widespread malaria (Hunter et al., 1976; Torcer, 1977).

Hemoglobins of the children ranged from 7.5 to 13.0 grams per deciliter. The median value was 10.5 g/dl. Twenty-one percent of the children had hemoglobins under 10 g/dl. Children with hemoglobins less than 10 g/dl were considered anemic by the WMP medical director.

CHAPTER VII

CHILD GROWTH AND ENVIRONMENTAL FACTORS: RELATIONSHIPS

The children examined in this study included both those with normal growth and nutritional status, and those whose growth had been stunted. No relationship was found between the children's lengths and the averaged heights of their parents. Therefore, the small size of certain children was not attributable to genetic factors. In addition, the children's ages were negatively correlated to their lengths for age ($r = -0.285$, $p < .01$). This correlation indicated that the stunting of growth was progressive with time, resulting in older children being relatively shorter for their age than younger children. The growth stunting, then, must have been caused by factors within the child's environment. Therefore, children with normal nutritional status in the community may have differed from other children in some environmental factors. In the following section, relationships between growth status and environmental variables will be examined.

Family

Several variables describing family composition were related significantly to the children's growth status (Table 10). The total number of children in the household was not related to the child's length for age, but the total number of people in the house was

Table 10.--Selected Environmental Factors Related[a] to Children's Growth as Measured by Length-for-Age, Orinoco Area Children.

Factor	R Value	Significant at P
Family:		
Presence of nonsibling children in household	0.312	<.01
Number of persons living in household	0.239	<.05
Number of miscarriages mother reported having	-0.214	<.05
Diet:		
Report of at least one serving of milk to child in 24-hour dietary recall	0.367	<.001
Health of child:		
Hemoglobin concentration	0.274	<.05
Reported to be usually healthy	0.235	<.05
Score on clinical health index[b]	0.211	<.05
Absence of protuberant abdomen	0.225	<.05

[a]Pearson product-moment correlation.

[b]A higher score indicated fewer signs of chronic disease. Signs included: Hepatomegaly, splenomegaly, protuberant abdomen, adenopathy, heart murmur, skin ulceration or depigmentation, and a hemoglobin under 10 g/dl.

positively related to growth status. The relationship must, then, be due to the presence of additional adults in the house. The presence of nonsibling children in some households, usually cousins, nieces or nephews, also was positively related to growth. The presence of nonsibling children and additional adults in the house occurred in extended family households in the Orinoco area. Children living in such households were longer for their age than children in smaller, nuclear households.

The availability of human resources to care for children and to procure food was found to be very important for child growth in several areas of the world (Antrobus, 1971; Grewal et al., 1973; McDowell and Hoorweg, 1977). Apparently, these human resources available through extended families also were needed in Orinoco for optimal child growth. In the subsistence economy of the area, more working family members may have procured more food. When enough adults were available to care for children, plant or harvest in the plantations, and fish, the children were apparently better nourished.

The mother's health and fertility patterns also were related to the growth of her children. Mothers who had not had miscarriages reared children with improved growth status. Mothers having one or several miscarriages may have had health problems resulting in other infants of low birth weight. These small infants may not have caught up and still have been small when studied. Maternal health, then, may have affected the child's growth during the prenatal period.

Diet

No variables concerned with weaning, introducing solid foods, or starting the family diet were found to correlate significantly with the children's lengths for age in this research. Children fed pop at early ages tended to be smaller, but this relationship was not significant. From the research of Anderson and coworkers (1976), it was expected that children's diets during the weaning period would be critical to their successful growth.

In a Miskito village on Pearl Lagoon, Terry (1977) reported variation in the weaning pattern of children. One eight month old child was fed small amounts of a wide variety of family foods while still breast-feeding. Another child of 15 months was fed little other than breast milk, and had not begun to eat small amounts of other foods until 13 months of age. The ages at which other foods were introduced to children in this research appeared to be within acceptable limits for normal growth and nutritional status. However, the failure to find a relationship between dietary variables and growth may have been due to incomplete or inaccurate data. Terry (1977) noted and these researchers observed that young children in the area were fed small pieces of foods from the plates of other family members. When asked to recall the age at which a child started to eat certain foods, the respondents may not have recalled the "little bits" their children once ate from their plates, or the age at which the practice started. Therefore, the use of recall data regarding the introduction of foods could be too inaccurate to identify existing relationships.

The lack of a relationship between length of breast-feeding and a child's growth, though, was considered by these researchers to be real. Mothers were well aware of the age at which they had weaned their child, and in addition, usually knew why the child was weaned at that time. The length of breast-feeding in the Orinoco area was considered to be within limits for normal child growth. The second research hypothesis, that children weaned later would be relatively longer than those weaned early, was not supported by these data.

The variety of foods in the present diet of these children was not related to their growth status. The variety of foods eaten was estimated by an index of the number of food types eaten. The data on present diet, collected through a 24-hour dietary recall, are considered qualitatively, though not quantitatively accurate. Therefore, the first research hypothesis, that children eating a wider variety of foods would be relatively longer than those with a more limited diet, also was not supported by the data.

The inclusion of milk in the child's diet was related to his growth status (Table 10). Some mothers utilized milk in pop or cocoa, or mixed it with bread. Since milk was an expensive purchased food, children who had been served milk the day of the 24-hour dietary recall were probably from households with greater than average resources. Therefore, the relationship between growth and milk in the diet may be due to the nutritional value of the milk or to better access to all resources in families who could afford milk. Resources whose availability could be related to children's growth status include food, housing, sanitary facilities, and medical care.

Health

Several of the variables describing the child's health status were found to correlate with length for age (Table 10). Two of these variables were hemoglobin concentration and the absence of a protuberant abdomen. Low hemoglobin concentrations and the presence of protuberant abdomens are typical clinic findings in hookworm infestation (Hunter et al., 1976). Both may be caused by other factors, including dietary causes. However, since every stool sample examined by the medical student in Orinoco contained hookworm ova or larvae, infestation must be considered seriously as a possible cause of low hemoglobins and protuberant abdomens. Children with relatively high hemoglobin concentrations and those without protuberant abdomens were not shown to be free of hookworm. In fact, many probably were infested. However, these findings do indicate a need to more closely examine the relationship between parasitic infestation and nutritional status.

The overall health of each child was established through clinical examination and the recall of the child's caretaker. Children described as healthier by either method were relatively longer than those considered less healthy.

Available data tend to support the third research hypothesis, that children without evidence of parasitic infestation and with a history of few infections would be longer for their age than those with parasites and frequent infections. No direct evidence of parasitic infestation was obtained. However, two clinical signs of hookworm infestation were correlated negatively to growth status. Children's health history was impossible to obtain in detail, so frequency of

infections is not known. The children considered usually "healthy" by respondents, though, were relatively longer than those considered usually "sick."

Regression Equation to Predict Child's Length for Age

Selected environmental variables were entered into a multiple regression equation to determine how much of the variance in the children's lengths for age would be explained by the factors studied (as outlined on pages 27 and 28). The following variables were found to predict significantly length for age: the respondent's report of the child's usual health, the inclusion of milk in the child's diet as reported in the 24-hour dietary recall, the number of people living in the household, the child's score on an index of clinical signs of health, the number of miscarriages mother reported (negative correlation), and the presence of nonsibling children in the household. These variables explained 32 percent of the variance in children's length for age ($p < .01$). The prediction from the regression equation supports the findings from correlation analysis.

Conclusions and Implications

Children with normal nutritional status were identified in the research area. Approximately one-third of the children examined had normal weights for their ages according to INCAP standards. About one-quarter were above 95 percent of the NCHS 50th percentile length for their age. These larger children had normal nutritional status in an area where childhood malnutrition was widespread. Length differences were considered to be due to environmental rather than genetic

causes, since no correlation was found between children's lengths and their parents' heights. Longer children were found to differ from other area children in two ways.

First, these children lived in large households in which adults other than parents and nonsibling children also lived. These households probably were extended families. Large households in Orinoco may have had the ability to provide a more stable food supply, since more family members were available to fish, farm and hunt. In addition, children living in extended families could be cared for by adults, rather than by siblings, when the mother was absent. The increased availability of physical and human resources in large extended families may have allowed improved nutritional status of children reared in them. Further in-depth research is recommended to identify the specific benefits to children of living in extended families.

Second, the longer children were found to be healthier on physical examination, and were reported to be healthier by their major caretaker. With less disease stress they may have been able to maintain a normal growth pattern throughout infancy and childhood. Causes of disease were not examined in this study. Further research identifying factors associated with apparent disease immunity in certain children is recommended. Among these factors may be parental response to a child's illness, the daily pattern of breast-feeding, cleanliness, and genetic differences.

No dietary differences were found between relatively longer and shorter children. Neither of the two hypotheses suggesting a relationship between a child's diet and his length for age was

supported. The conclusion was reached, then, that within the usual dietary patterns offered to children in the Orinoco area, all were at least marginally sufficient for normal nutritional status.

However, the methods for collecting dietary information were considered imprecise. Research tools which would more precisely identify a child's diet during the weaning period, both qualitatively and quantitatively, are needed. Flores (1962) suggested visiting the homes of a small sample of young children twice per day to obtain information from their mothers about the children's food intake. Even more frequent visits might be useful if children were fed many times during the day.

Intervention programs attempting to improve nutritional status of eastern Nicaraguan children should examine the human and physical resources available to mothers of malnourished children. Then mothers could be shown how other family members or the household's resources could help them provide appropriate care for their children. If resources were not available within the family, program workers could locate and suggest sources of help for the mother within the community. Adult female relatives share many responsibilities in these communities, even when living in separate households. An increased cooperative effort in child care might improve the quality of care children receive in both households.

In addition, interventionists should promote better sanitation and health care which would reduce the disease stress suffered by young children in the community. Control of parasites could be accomplished by constructing and using latrines, and upgrading wells with

walls and covers. Parasites found in Orinoco children were transmitted through skin contact with soil contaminated by ova in human feces, and through contaminated drinking water or food. Ova in human feces often were disseminated through the village as free roaming pigs ingested the feces and passed the ova undigested. Penning the pigs was considered by villagers to be a way to decrease soil contamination. However, penning pigs would not control the parasites and would be costly since the pigs would then need to be fed.

Both the animal "filth" and the unclean drinking water were recognized as environmental hazards by most villagers. These hazards were accepted as part of their lifestyle, however. Interventionists attempting sanitation projects will need to identify other motivating forces before villagers will accept these changes.

CHAPTER VIII

SUMMARY

The objective of this study was to identify factors in the environment of eastern Nicaraguan children which predicted their nutritional status as measured by length for age. Malnutrition has been documented as a widespread problem in area children (Brownlee et al., 1975; Anderson et al., 1976; Griffiths, 1977), as well as in children elsewhere in the developing world. Environmental factors related positively to growth status can be utilized as indigenous alternatives by interventionists in programs attempting to lower the prevalence of malnutrition.

Environmental factors examined in this study included the family size, composition, and resources; the pattern of weaning, the introduction of other foods to the child, and the child's present feeding pattern; and the present health and health history of the child. Major caretakers of 68 children nine months to four years old were interviewed to obtain the above information. In addition, physical examination and anthropometric measurement of each child were completed by the research team of a nutritionist and a medical student. Observations of household facilities also were made in each child's home.

The dependent variable used as an indicator of the child's nutritional status was the percent of standard length for age, using the National Center for Health Statistics 50th percentile length for his age as a reference standard. Values for this variable ranged from 82.6 to 105.6 percent of standard, with a median of 93.5 percent. Weights and arm circumferences of the children showed a significant positive correlation with their lengths, but head circumferences and triceps skinfold thicknesses did not.

The children's families, their diet histories and present diet, and their health status were described. The environmental variables which were found to correlate positively with length for age were the number of people in the household, the presence of non-sibling children in the household, the report in a 24-hour dietary recall of serving milk to the child, the child's hemoglobin concentration, the report that the child was usually healthy, the child's score in a clinical signs of health index, and the absence of a protuberant abdomen in the child. One factor, the number of miscarriages the mother reported, showed a negative correlation to the child's length for age.

Research hypotheses not supported by these findings were that children weaned later and served a wider variety of foods would be longer for their age than those weaned earlier and served a more limited variety of foods. These data tend to support the research hypothesis that children without evidence of parasitic infestation and with a history of few infections would be longer for their age than children with parasites and frequent infections.

Conclusions from this study were that: (1) children reared in large extended family households had increased access to human and physical resources which allowed normal growth, while children in smaller nuclear households had decreased access to these resources which resulted in slowed growth; (2) children with a history of infrequent disease and few signs of disease had normal length for age but those with a history of or evidence of frequent disease exhibited stunted growth; and (3) the weaning and feeding pattern of all these children appeared to be at least marginally adequate for normal growth and nutritional status.

Methods were suggested to obtain more precise information about foods eaten by children during the weaning period.

LIST OF REFERENCES

LIST OF REFERENCES

Anderson, C., C. A. Leino, J. McInerney, and B. Swihart (1976). Weaning practices, diversity of nutrient sources, and sanitation with recommendations to modify the nutrition problems in eastern Nicaragua. MUCIA Center for International Health, Madison, Wisc. Unpublished report.

Antrobus, A. C. K. (1971). Child growth and related factors in a rural community in St. Vincent. J. Trop. Pediat. 17, 187-210. (Monograph No. 18).

Beghin, I. (1976). Personal communication. Instituto de Nutricion de Centro America y Panama.

Behar, M. (1975). The nutritionally critical periods of childhood. Assignment Children No. 31, 83-88.

Brownlee, B., R. Goldstein, W. Harris, M. R. Horner, and A. Taylor. (1975). Survey of Infants and Young Children in Northeast Nicaragua, 1975. MUCIA Center for International Health, Madison, Wisc. Unpublished report.

Christakis, G. (ed.) (1973). Nutritional assessment in health programs. Am. J. Pub. Health Supplement No. 63, pt. 2.

Cook, R. (1969). Nutrition and mortality under 5 years in the Caribbean area. J. Trop. Pediat. 15, 109-117.

Crispin, S., E. Kerrey, H. M. Fox, and C. Kies (1968). Nutritional status of preschool children II. Anthropometric measurements and interrelationships. Am. J. Clin. Nutr. 21, 1280-1284.

Flores, M. (1962). Dietary studies for assessment of the nutritional status of populations in nonmodernized societies. Am. J. Clin. Nutr. 11, 344-355.

Frisancho, A. R., and S. M. Garn (1971). Skinfold thickness and muscle size: implications for developmental status and nutritional evaluation of children from Honduras. Am. J. Clin. Nutr. 24, 541-546.

Garn, S. M. (1973). Stature norms and nutritional status. (Editorial). Ecol. Food Nutr. 2, 79-81.

Gershoff, S. N. (1977). Science-neglected ingredient of nutrition policy. J. Am. Dietet. Assoc. 70, 471-478.

Graham, G. G. (1972). Environmental factors affecting the growth of children. Am. J. Clin. Nutr. 25, 1184-1188.

Grewal, T., T. Gopaldas, and V. J. Gadre (1973). Etiology of malnutrition in rural Indian preschool children (Madhya Pradesh). J. Trop. Pediat. 19, 265-270.

Griffiths, M. (1977). Personal communication. Nutritionist, Univ. of Wisconsin/MUCIA/Nicaragua Medical Project, Puerto Cabezas, Nicaragua.

Guzman, M. A. (1968). Impaired physical growth and maturation in malnourished populations. In N. S. Scrimshaw and J. E. Gordon (eds.), Malnutrition Learning and Behavior. MIT Press, Cambridge, Mass., pp. 42-54.

Hamill, P. V. V., T. A. Drizd, C. L. Johnson, R. B. Reed, and A. F. Roche (1976). NCHS Growth Charts, 1976. Monthly Vital Statistics Report, Vol. 25, No. 3. DHEW Publ. No. (HRA) 76-1120. Health Resources Administration, Washington, D.C.

Hunter, G. W., J. W. Swartzwelder, and D. F. Clyde (1976). Tropical Medicine, 5th Edition. W. B. Saunders Co., Philadelphia. Chap. 48.

Jackson, R. L. (1966). Effect of malnutrition on growth of the preschool child. In International Conference on Prevention of Malnutrition in the Preschool Child, Preschool Child Malnutrition--Primary Deterrent to Human Progress. National Academy of Sciences--National Research Council, Washington, D.C., pp. 9-21. (NAS-NRC Publication No. 1282).

Jansen, A. A. J. (1973). The chest-head circumference ratio as an indicator of the nutritional status of young children. J. Trop. Pediat. 19, 162-164.

Jelliffe, D. B. (1966). The Assessment of the Nutritional Status of the Community. World Health Organization, Geneva, Switzerland, 271 p. (WHO Monograph Series No. 53).

Jelliffe, D. B. (1970). Evaluation of nutrition-related village improvement programmes. In P. Gyorgy and O. L. Kline (eds.), Malnutrition is a Problem of Ecology. S. Karger, Basel. pp. 161-164.

Jelliffe, D. B., and E. F. P. Jelliffe (1975). Human milk, nutrition, and the world resource crisis. Science 188, 557-561.

Kolasa, K. (1976). Interview with Marcia Griffiths. Puerto Cabezas, Nicaragua.

McDowell, I., and J. Hoorweg (1977). Environmental risk factors in outpatient recovery from malnutrition. Ecol. Food Nutr., 6, 23-30.

Martorell, R., C. Yarbrough, R. M. Malina, J. P. Habicht, A. Lechtig, and R. E. Klein (1975a). The head circumference/chest circumference ratio in mild-to-moderate protein-calorie malnutrition. J. Trop. Pediat. 21, 203-207.

Martorell, R., J. P. Habicht, C. Harbrough, A. Lechtig, R. E. Klein, and K. A. Western (1975b). Acute morbidity and physical growth in rural Guatemalan children. Am. J. Dis. Child. 129, 1296-1301.

Martorell, R., C. Yarbrough, A. Lechtig, J. P. Habicht, and R. E. Klein (1975c). Diarrheal diseases and growth retardation in preschool Guatemalan children. Am. J. Phys. Anthrop. 43, 341-346.

Martorell, R., C. Yarbrough, A. Lechtig, H. Delgado, and R. E. Klein (1976). Upper arm anthropometric indicators of nutritional status. Am. J. Clin. Nutr. 29, 46-53.

Mata, L. J., J. J. Urrutia, and A. Lechtig (1971). Infection and nutrition of children of a low socio-economic rural community. Am. J. Clin. Nutr. 24, 249-259.

Mata, L. J., R. A. Kromal, J. J. Urrutia, and B. Garcia (1977). Effect of infection on food intake and the nutritional state: perspectives as viewed from the village. Am. J. Clin. Nutr. 30, 1215-1227.

May, J. M., and D. L. McLellan (1972). The Ecology of Malnutrition in Mexico and Central America. Hafner Publ. Co., New York. pp. 239-282.

National Center for Health Statistics. Undated. Percentile values of length and weight for age. Obtained from J. B. Goldsby, Center for Disease Control, Atlanta, Ga.

Nie, N. H., C. H. Hull, J. G. Jenkins, K. Steinbrenner, and D. H. Bent (1975). SPSS--Statistical Package for the Social Sciences, Second Edition. McGraw-Hill, New York.

Nietschmann, B. (1973). Between Land and Water. Seminar Press, New York.

Pellett, P. L. (1977). Commentary: Marasmus in a newly rich urbanized society. Ecol. Food Nutr. 6, 53-56.

Pradilla, A. (1977). The Candelaria project. In R. V. Niehoff and K. L. Neff (eds.), Report of Conference and Workshop on Nonformal Education and the Rural Poor. Program of Studies in Non-Formal Education, College of Education, Michigan State University, East Lansing, Mich.

Rawson, I. G., and V. Valverde (1976). The etiology of malnutrition among preschool children in rural Costa Rica. J. Trop. Pediat. 22, 12-17.

Richardson, S. A. (1968). The influence of social, environmental and nutritional factors on mental ability. In N. S. Scrimshaw and J. Gordon (eds.), Malnutrition Learning and Behavior. MIT Press, Cambridge, Mass. pp. 346-361.

Rosenberg, I. H., N. W. Solomons, and D. M. Levins (1976). Interaction of infections and nutrition: some practical concerns. Ecol. Food Nutr. 4, 203-206.

Scrimshaw, N. S., C. E. Taylor, and J. E. Gordon (1968). Interactions of Nutrition and Infection. World Health Organization, Geneva, Switzerland (WHO Monograph Series No. 57).

Scrimshaw, N. S. (1970). Synergism of malnutrition and infection: evidence from field studies in Guatemala. J. Am. Med. Assoc. 212, 1685-1692.

Seoane, M., and M. C. Latham (1971). Nutritional anthropometry in the identification of malnutrition in childhood. J. Trop. Pediat. 17, 98-104.

Shakir, A., and D. Morley (1974). Measuring malnutrition (letter). Lancet I, 758.

Standard, K. L., H. G. Lovell, and J. S. Garrow (1966). The validity of certain physical signs as indices of generalized malnutrition in young children. J. Trop. Pediat. 11, 100-106.

Terry, R. (1977). Rainy season food behavior of selected families in a Miskito Indian village in east Nicaragua. Unpublished Master's thesis, Univ. of Tennessee, Knoxville.

Torcer, _. (1977). Personal communication. Clinical Division, Instituto de Nutricion de Centro America y Panama, Guatemala.

Valverde, V., R. Martorell, V. Mejia-Pivaral, H. Delgado, A. Lechtig, C. Tellar, and R. E. Klein (1977). Relationship between family land availability and nutritional status. Ecol. Food Nutr. 6, 1-7.

Visweswara, R. K., and S. Darshan (1970). An evaluation of the relationship between nutritional status and anthropometric measurements. Am. J. Clin. Nutr. 23, 83-93.

Waterlow, J. C. (1977a). Biochemical and anthropometric findings in marginal malnutrition. Paper presented at Western Hemisphere Nutrition Congress V, Quebec City, August 17.

Waterlow, J. C. (1977b). Personal Communication. Chairman, Joint FAO/WHO Expert Committee on the Methodology of Nutritional Surveillance.

Williams, C. D. (1966). Malnutrition and mortality in the preschool child. In International Conference on Prevention of Malnutrition in the Preschool Child, Preschool Child Malnutrition--Primary Deterrent to Human Progress. National Academy of Sciences--National Research Council, Washington, D.C., pp. 3-8, (NAS-NRC Publication No. 1282).

Wishik, S. M., and S. Vander Vyncket (1976). The use of nutritional "positive deviants" to identify approaches for modification of dietary practices. Am. J. Pub. Health 66, 38-42.

Wray, J. D. (1972). Can we learn from successful mothers? J. Trop. Pediat. 18, 279.

APPENDICES

APPENDIX A

INTERVIEW SCHEDULES AND DATA SHEETS

EXPLANATION OF NICARAGUAN NUTRITION STATUS INTERVIEW SCHEDULE

1. The interview schedule is written in the male gender for simplicity. When using the schedule the appropriate gender will be used.

2. When the word "child" is used in a question, the child's name will be substituted when the question is asked.

3. Efforts will be made in all cases to obtain the information asked for, or an approximation where appropriate, through probing. Probing questions are not included in the schedule to allow for flexibility in the field situation.

4. It is assumed that most of the respondents will be the child's mother. Therefore questions (except #2) are written as if this were so. If the respondent is not the child's mother, the wording of the questions will be changed wherever necessary.

5. The following abbreviations will be used:
   DK--doesn't know
   NR--no response
   NA--not applicable
   E--estimated (used with ages or heights of parents if necessary)

6. Weaning, as used on these forms, means the time at which the mother discontinues all breastfeeding of the child or in cases where the child was never breastfed, discontinues the feeding system used as an alternate to breastfeeding.

7. Whenever necessary for further clarification or appropriate, comments will be written on the data forms.

8. The interview schedule for the second interview will be completed by adding more questions after the first phase of interviewing. The second interview will then be able to focus on probing into areas identified as problem areas. Answers to the 2nd interview will be recorded in a field notes notebook.

9. One printed interview schedule, covered with plastic, will be used for all interviewing. The answers to the first interview will be recorded on data sheets.

PJB
FSHN
MSU
12/1976

INTERVIEW AND EXAMINATION, NICARAGUA NUTRITION STATUS CONSENT FORM

I,_____, willingly consent to being interviewed about my child's diet, medical history, and family. I also consent to having my child_____physically examined and pricked for a finger blood sample by a medical student.

This project has been explained to me. I understand why the study is being done, and the possible risks and benefits of being part of the study. I understand that I may quit at any time. I have been able to ask questions and know that none of my answers will be told to anyone else. I understand that photographs may be taken of my child during this study and if so, they may be used for publication.

Date_____ Signed_____

Witnessed_____

Interviewer_____

I request, too that any medical information about my child be given to the doctor in Puerto Cabezas.

Date_____ Signed_____

Witnessed_____

Interviewer_____

NICARAGUA NUTRITION STATUS
INTERVIEW SCHEDULE ONE

General

1. What is this child's name?
   When was he born?
   How old is he now?

2. What is your name?
   How old are you now?

3. Do you usually take care of child?
   (If no) Who usually takes care of child?
   How is she related to child?
   How old is she?

Diet

4. Was child ever fed at the breast?
   (If no--Go to question 5)
   (If yes) do you still feed him at the breast?
   (No--Go to question 6)
   (Yes-Go to question 7)

5. Why was child not fed at the breast?
   How did you feed child instead of breastfeeding him?
   Do you still feed child that way?
   (If no) How long did you feed child that way?
   Why did you stop feeding child that way?
   (go to question 8)

6. How old was child when you took him off the breast?
   Why did you take him off the breast then?
   How did you take him off the breast?
   (Go to question 8)

7. When do you plan to take him off the breast?
   Why do you plan to take him off the breast then?
   How do you plan to take him off the breast?

8. Have you ever given child a bottle?
   (If yes) What was the first thing given?
   What else was given?
   How old was child when you gave these?
   Have you given child milk?
   (If yes) What kind of milk was it?
   How did you fix it?
   Was sugar added?
   How often did you give it?
   How old was child when you gave this to him?

9. What other foods did you first feed to child?
   When did you start to feed him that?
   How did you fix that?
   Why did you give him that food?

PJB
FSHN
MSU
12/1976

10. What foods did (or will) you give to child when you took (take) him off the breast?
How do you fix that?
Why do you give him that?

(Ask #11 later)

12. I would like to know what foods and drinks child has eaten today and last night. What did he eat at midday? Morning? Last evening? (Word to match last 3 meal period.)
How was that fixed?
How much of that did he eat?
Did he eat it all?
Who fed him?
Did he have anything else to eat or drink?

13. Are these the kinds of foods and drinks taht child usually eats each day?
(If no) How was it different from the food he usually eats?
Does child usually eat more or less than he ate today?
(If yes) How much does he usually eat?
Why was today different?

11. What foods does child eat nearly every day?
How do you fix taht?
How old was he when he started to eat that?
What other foods does child sometimes eat? How often?

Family

14. I would like to know some information about all of child's brothers and sisters.
Let's start with the first child you gave birth to.
What is his name?
When was he born?
Is he alive now?
(If no)When did he die? What was the cause of death?
How old was he then?
(If yes)Where is he living now?
(Ask for each child--name, age, etc.)

15. Have you given birth to any children who were born dead?
(If yes) How many?
When were they born?

16. I would like to know about all the other people who live in your house.
Please tell me their names.
How is he related to child?
How old id he?
Does he live here all of the time or just sometimes?
(For adult males) What kind of work does he do?

PJB
FSHN
MSU
12/1976

17. Where is child's father? (If not mentioned above)
(If present) Has he been to school? For how long?
What work does he do?

18. Have you been to school?
(If yes) For how long?
Has anyone ever taught you about taking care of or feeding children?
Did you ever hear a charla about taking care of children or feeding them from a nutrition leader?
a health leader?
anyone else?
(If yes) What did they tell you?

Environment (Ask on visit to house)

19. Where do you get your water?
Do you ever catch rain water?
(If yes) For how much of the year?
How do you store it?
What do you use it for?
Do you ever run out of water in the dry season?
(If yes) what do you do?
Do you get water from different wells in the wet and dry season?

20. How do you store water in your house? Please show me.
Do you separate drinking and washing water?
Do you do anything to the water before you use it?
Do you boil any of the drinking water?
(If yes) For whom?
Where do you keep the boiled water?

21. If you save cooked foods for another meal, where do you keep them?

22. Do you have a garden near the house?
(If yes) What do you grow in it?
What food trees do you own?

23. Do you keep any animals?
(If yes) What animals do you have? How many?
(For chickens) What do you do with the eggs?
How many do you sell? How many do you eat?

24-30. Observe on visit to home.

PJB
FSHN
MSU
12/1976

NICARAGUA NUTRITION STATUS
INTERVIEW DATA SHEET

ID#_____

VILLAGE_____

GENERAL

1. Child's name_____Date birth_____Age_____
   Clue to age:

2. Respondent's name_____
   Age_____

3. Care of child
   ____respondent
   ____other: name_____
   relationship_____
   age_____

DIET

4. Breastfed
   ____no [Go to #5]
   ____yes, weaned [Go to #6]
   ____yes, not weaned [Go to #7]

5. ____NA
   Reason not breastfed:

   How fed:

   Still fed this way
   ____yes
   ____no--age stopped_____
   reason stopped:

   [Go to #9]

6. ____NA
   Age weaned_____

   Why weaned
   ____another pregnancy
   ____mother left home
   ____right age to wean
   ____milk no good --explain:
   ____other--explain:

   How weaned:

PJB
FSHN
MSU
12/1976

[Go to #8]

7. ____NA
Age plan to wean_____

Why plan to wean
____mother leaving home
____pregnancy
____right age to wean
____other--explain:

How plan to wean:

8. ____NA

Other milk given
____no
____yes [See below]

TYPE	PREPARATION	HOW OFTEN	AGES GIVEN

9. Other foods or drinks while breast [or bottle] fed
____no
____yes [See below]

FOOD	[✓] SPECIAL FOR AGE	PREPARATION	AGES FED	REASON FED THIS

10.

FOODS AFTER WEANING	PREPARATION	REASON FED THIS

NICARAGUA -2-
INTERVIEW DATA SHEET ID#_____

11. FOODS NOW PREPARATION AGE BEGAN TO EAT

12. 24 Hour Recall

FOOD PREPARATION AMOUNT WHEN EATEN

13. Foods typical
____yes
____no---how differs:

Amounts typical
____yes
____usually eats more--comments:
____usually eats less--comments:

PJB
FSHN

MSU
12/1976

FAMILY

14. Siblings

NAME	DATE BORN/AGE	DATE/AGE DIED	REASON DIED	WHERE LIVING

15. Children born dead
____no
____yes--how many_____

16. Household members [Delete details for siblings]

NAME	RELATIONSHIP TO CHILD	AGE

17. Head of household_____Occupation_____
Education
____no
____yes--how long_____

18. Respondent's education
____no
____yes-how long_____

Taught about child care
____no
____yes

Learned about child care from
____nutrition leaders
____health leaders
____school
____others_____
____none of the above

What learned:

NICARAGUA
INTERVIEW DATA SHEET ID#_____

ENVIRONMENT AROUND HOME

19. Water source [describe]:

20. Water storage [describe]:

Treatment before use:

Storage for dry season:

21. Food storage [describe]:

22. Kitchen garden
____no
____yes--foods grown:

23. Domestic animals
____no
____yes--list animals and use:

24. Separate cookhouse
____yes
____no--where cook:

25. House material
____sticks
____boards
____other_____

26. House painted
____yes
____no

27. Type of roof
____thatch
____galvanized
____other_____

PJB
FSHN
MSU
12/1976

28. Number of rooms in house_____

29. Outhouse
___yes
___no

30. Where use bush:

Children play there:

ANTHROPOMETRIC DATA

		COMMENTS
Recumbent length (nearest mm)	_____	
Weight (kg)	_____	
Triceps skinfold (mm)	_____	
Arm circumference (mm)	_____	
Head circumference (mm)	_____	
Chest circumference (mm)	_____	
Abdomen circumference (mm)	_____	
Height of mother (cm)	_____	
Height of father (cm)	_____	

PJB
FSHN
MSU
12/1976

NICARAGUA NUTRITION STATUS
MEDICAL HISTORY INTERVIEW SCHEDULE

GENERAL

1. Child's name and age

PAST MEDICAL HISTORY

I would like to know about the child's health in general.

2. Is child often sick?
   [If yes] What illnesses?
   How often?

3. Has child been sick in the past month?
   [If yes] What was wrong with him?
   What was done?

4. Has child had diarrhea in the past month?
   [If yes] How many times?
   More than five stools in 24 hours?
   Was there blood in the stool?
   Were there worms in the stool?
   When was the last time child had diarrhea?

5. Has the child ever been known to have worms?
   Has he ever passed worms in his stool?
   Have you ever seen any worms coming from his nose or mouth?

6. Has the child had a fever?
   [If yes] When?
   For how long?

7. Has child vomited?
   [If yes] When?
   How long?
   When was last time?
   Were there blood, worms?

8. Has child had a cold in the past month?
   [If yes] Did he have fever?
   Did he vomit?
   Did he have a cough?
   How long did the cold last?
   When did he have his last cold?

9. Has this child ever had skin rashes or problems with his skin?
   [If yes] Please describe

PJB
FSHN
MSU
12/1976

11. Have you ever taken child to visit the clinic
    (a) because he was sick?
        [If yes] What did the nurse/doctor do for him?
    (b) for other reasons? (shots, injuries, etc.)

REVIEW OF SYSTEMS (This section refers to the month previous to the interview, unless specified)

12. Has this child lost weight in the past month?
    Has he been growing well?

13. Has he had ear infections or sore ears?
    [If yes] What was done?

14. Has he had sore eyes or eye infections? Has the light hurt his eyes?

15. Has child had sore throats? More than one per month?
    [If yes] How long did it (they) last?
    What was done?

16. Does this child get colds very often?

17. Have there been lumps in his neck or groin?
    Has the child had weakness?

18. Has his appetite been good?
    [If no] What did you do?
    Was he sick?

19. Has child vomited in the past month?
    [If yes] When?
    When was the last time?
    Does this happen often?

20. Has child had problems urinating? Has he had pain, increased frequency, or change in smell?
    [If yes] When?
    Does this happen often?

21. Has child ever had difficulty walking?
    [If yes] Please describe.

22. Has the child ever had convulsions?
    [If yes] When?
    Did child have a fever then?

FAMILY HISTORY

23. Have any of your other children been sick? Have any of them gone to the clinic or have they seen a doctor for any illness?
    Have any had to go to Bluefields to the hospital?
    [If yes] What was wrong?
    What was done?

PJB
FSHN
MSU
12/1976

24. Does the mother or father have any illnesses?
[If yes] Which ones?

Has the mother or father had any illnesses in the past?
[If yes] Which ones?

PREGNANCY AND LABOR

25. Was the mother sick during the pregnancy?
[If yes] Did she go to the clinic?
What did she take?
What was wrong with her?

26. Was the baby normal sized at birth?
[If no] Was he large?
Was he small?
Weight?
Length?

27. Were there any unusual problems during birth? Please describe.

DEVELOPMENT

28. Did the baby do well after delivery?
Did he have any breathing problems after birth?
Did he turn yellow after birth?

29. Did child grow as expected in the first month after birth?

NICARAGUAN NUTRITION STATUS
MEDICAL HISTORY DATA SHEET

ID#_____

VILLAGE_____

GENERAL

1. Child's name_____Age_____

PAST MEDICAL HISTORY	NO	YES	SPECIFY
2. Sick often	no	yes	
3. Sick past month	no	yes	
4. Diarrhea past month	no	yes	
Number		_____	
>5 stools/day	no	yes	
Blood	no	yes	
Worms	no	yes	
Date last time		_____	
5. Known to have worms	no	yes	
Stool	no	yes	
Nose, mouth	no	yes	
6. History of fever	no	yes	
7. History of vomiting	no	yes	
8. Cold in past month	no	yes	
Fever	no	yes	
Vomit	no	yes	
Cough	no	yes	
How long		_____	
Date last time		_____	
9. Skin rashes	no	yes	
Other skin problems	no	yes	
11. This child visit clinic	no	yes	
Sick	no	yes	
Other	no	yes	

REVIEW OF SYSTEMS

12. Weight loss	no	yes
Growing well	no	yes
13. Ear infections	no	yes
Sore ears	no	yes

	NO	YES	SPECIFY
14. Eye infections	no	yes	
Sore eyes	no	yes	
Light hurts eyes	no	yes	
15. Sore throats	no	yes	
16. Frequent colds	no	yes	
17. Lumps in neck or groin	no	yes	
Weakness	no	yes	
18. Good appetite	no	yes	
19. Vomit in past month	no	yes	
20. Urinary problems	no	yes	
Pain	no	yes	
Increased frequency	no	yes	
Change in smell	no	yes	
21. Difficulty walking	no	yes	
22. Convulsions	no	yes	
FAMILY HISTORY			
23. Other children sick	no	yes	
Visit clinic	no	yes	
Hospital	no	yes	
24. Other illness in family	no	yes	
PREGNANCY AND LABOR			
25. Mother sick while pregnant	no	yes	
26. Birth size normal	no	yes	
Weight			_____
Length			_____
27. Problems during birth	no	yes	
DEVELOPMENT			
28. Neonatal problems	no	yes	
29. Growth normal 1st month	no	yes	

PJB
FSHN
MSU
12/1976

NICARAGUA NUTRITION STATUS
PHYSICAL EXAMINATION

NAME_____ SEX_____ ID#_____

VILLAGE_____ DATE_____ [PHOTO#_____]

		COMMENTS
GENERAL	neg pos	
Emaciation	neg pos	
Weakness	neg pos	
Irritability	neg pos	
Apathy	neg pos	
Pallor	neg pos	
Pulse (Apical)_____		
Respiration _____		
SKIN	neg pos	
Edema pitting	neg pos	
nonpitting	neg pos	
Xerosis	neg pos	
Depigmented	neg pos	
Ulceration	neg pos	
Dehydration	neg pos	
HAIR	neg pos	
Dyspigmented	neg pos	
Pluckable	neg pos	
FACE	neg pos	
Moon sign	neg pos	

		COMMENTS
EYES	neg pos	
Pale conjunctivae	neg pos	
Infection	neg pos	
EARS-Infection	neg pos	
MOUTH	neg pos	
Angular stomatitis	neg pos	
Glossitis	neg pos	
Swollen bleeding gums	neg pos	
Thrush	neg pos	
NECK	neg pos	
Adenopathy	neg pos	
CHEST	neg pos	
Breath sounds [describe]	neg pos	
Consolidation [describe]	neg pos	
HEART	neg pos	
Rhythm	_____	
Murmer	neg pos	

		COMMENTS
ABDOMEN	neg pos	
Protruberant	neg pos	
Ascites	neg pos	
Hepatomegaly CM in (R) MCL	neg pos	_____
Splenomegaly CM in (L) AAL	neg pos	_____
Tenderness [describe]	neg pos	
Bowel sounds:	hyperactive	
	normoactive	
	hypoactive/ absent	

		COMMENTS
NEUROLOGICAL	neg pos	
Ankle jerks absent	neg pos	
Knee jerks absent	neg pos	
Motor weakness	neg pos	
LYMPHATIC	neg pos	
Adenopathy:		
Cervical	neg pos	
Axillary	neg pos	
Inguinal	neg pos	

SKELETAL	neg pos
Open fontanelles	neg pos
Bow legs	neg pos
Craniotabes	neg pos

HEMOGLOBIN _____g/dl

PJB
FSHN
MSU
12/1976

NICARAGUA NUTRITION STATUS
SAMPLE DIALOG FOR END OF THE 1st INTERVIEW

We will return in 3 weeks and would like to talk to you some more then about your child's diet and health. May we come to your home to see you then? We would like to talk to you in your house, so could you please tell us how to find it? We will come to see you 3 weeks from today. We will want to know whether the child has been sick between now and then. Please remember if he has diarrhea and how many times he has it, what the stool looks like, if there are worms in it, and how long the diarrhea lasts. Also please remember if the child gets sick between now and then, especially colds or infections. We will want to ask you about these things when we come back. Thank you so much for your help. Do you have any questions?

NICARAGUA NUTRITION STATUS
2nd MEDICAL INTERVIEW SCHEDULE

1. I would like to know about the child's health since we were here 3 weeks ago.
   Has he been ill?
   [If yes] What was wrong?
   How often was he sick?
   Please describe the illness(es).

2. Has he had diarrhea in the past 3 weeks?
   [If yes] How many times?
   Were there more than 5 stools in one day?
   Was there blood in the stool?
   Were there worms in the stool?
   How long did it last?

3. Has he had a cold in the past 3 weeks?
   [If yes] Did he have a fever?
   Did he vomit?
   Did he have a cough?
   How long did the cold last?
   Does he have the cold now?

4. Has he had rashes or skin problems in the last 3 weeks?
   [If yes] Please describe them.

5. Have any other children in your house been sick since we were last here?
   [If yes] Who was sick?
   What was wrong?

6. Has the child passed any worms in the past 3 weeks?
   [If yes] Were they in his stool?
   Were they coughed up in his nose or mouth?

7. Has the child had a fever in the past 3 weeks?
   [If yes] When?
   For how long?

8. Has the child vomited?
   [If yes] When?
   How long?
   When was last time?
   Were there blood or worms present?

JB
SHN
SU
2/1976

NICARAGUAN NUTRITION STATUS
2nd MEDICAL HISTORY DATA SHEET

Child's Name_____ ID#_____

Respondent's Name_____

		NO YES	COMMENTS
1.	Ill in past 3 weeks [describe]	no yes	
2.	Diarrhea	no yes	
	How often	_____	
	>5 stools/day	no yes	
	Blood	no yes	
	Worms	no yes	
	How long	_____	
3.	Cold	no yes	
	Fever	no yes	
	Vomit	no yes	
	Cough	no yes	
	How long	_____	
	Has now	no yes	
4.	Skin problems [describe]	no yes	
5.	Other children sick [describe]	no yes	
6.	Worms past 3 weeks	no yes	
	Stool	no yes	
	Nose, mouth	no yes	
7.	Fever past 3 weeks [describe]	no yes	
8.	Vomiting past 3 weeks [describe]	no yes	

PJB
FSHN
MSU
12/1976

NICARAGUA NUTRITION STATUS
INTERVIEW SCHEDULE TWO

1. Do you know of any foods or drinks that are bad for babies or children?
   (If yes) What are they?
   Why shouldn't you give these foods to children?

2. What foods or drinks are especially good for children? Why?

3. Do you cook any foods just for your children that you don't eat?
   (If yes) What?
   Why do you cook them for the children?

4. Is there any time when breast milk would be bad for a baby?
   Have you ever heard about breast milk being salty?
   (If yes) What does that mean?
   What can you do about it?

5. How should you feed a child when he has a fever? Diarrhea?
   What should you give him?
   Why would you give that?

6. Why do people give anise tea to newborn babies?
   Do you give it to you babies?
   (If yes) For how long?

7. What leaves and spices do you make tea from?
   Are any of them good for special problems or times? What?

8. For how long should a mother let her baby suck at the breast?
   Why for that long?

9. Why do mothers give bottles while the baby is still sucking the breast?

10. Why do you give these foods to babies (if you do)?
    a. flour or starch pop
    b. rice water
    c. orange juice or fresco
    d. milk
    e. mashed banana
    f. tea

11. Have you ever known anyone who ate clay, dirt, soap, ashes?
    Have you ever eaten any of these things?
    (If yes) Were you (or they) pregnant?
    Why did you (or they) eat it?

PJB
FSHN
MSU
12/1976

12. If you had plenty of money, what foods would you buy for your children?

13. Do your children own shoes that fit them now?
(If yes) How often do they wear them?
Is wearing shoes important? Why or why not?

14. Are animals like cows, pigs, and horses running loose bad for the health of people in the village?
(If yes) Why?

PJB
FSHN
MSU
12/1976

APPENDIX B

SUPPLEMENTARY FOOD CONSUMPTION DATA

Table A-1.--Foods Eaten by 65 Orinoco Area Children,[a] as Reported by Respondents on 24-Hour Dietary Recall.

Food	Children Eating Food				Children Not Eating Food	
	More Than Once		Once			
	No.	(%)	No.	(%)	No.	(%)
Breadkind:						
Dasheen	10	(15.4)	25	(38.5)	30	(46.2)
Green banana	8	(12.3)	31	(47.7)	26	(40.0)
Cassava	-		14	(21.5)	51	(78.5)
Breadfruit	1	(1.5)	10	(15.4)	54	(83.1)
Cake (coco)	-		5	(7.7)	60	(92.3)
Plantain	-		4	(6.2)	61	(93.8)
Coco	-		3	(4.6)	62	(95.4)
Bammy (Cassava)	2	(3.0)	1	(1.5)	62	(75.4)
Grains:						
Rice	12	(18.4)	22	(33.8)	31	(47.7)
Bread or bun	12	(18.4)	22	(33.8)	31	(47.7)
Rice and beans	-		3	(4.6)	62	(95.4)
Macaroni	1	(1.5)	1	(1.5)	63	(96.9)
Tortilla (wheat)	-		2	(3.1)	63	(96.9)
Bread soaked in milk	1	(1.5)	1	(1.5)	63	(96.9)
Animal Foods:						
Boiled Fish	5	(7.7)	22	(33.8)	38	(58.5)
Rundown Fish	2	(3.1)	19	(29.2)	44	(67.7)
Eggs	-		8	(12.3)	57	(87.7)
Meat	-		7	(10.8)	58	(89.2)
Fried Fish	-		5	(7.7)	60	(92.3)
Pop:						
Banana with coconut milk	2	(3.1)	5	(7.7)	58	(89.2)
Flour	2	(3.1)	1	(1.5)	62	(95.4)
Cornstarch	2	(3.1)	1	(1.5)	62	(95.4)
Oatmeal	1	(1.5)	1	(1.5)	63	(98.5)
Parched corn	-		1	(1.5)	64	(98.5)
Rice	-		1	(1.5)	64	(98.5)
Pop made with milk[b]	3	(4.6)	-		62	(95.4)

Table A-1.--Continued.

Food	Children Eating Food				Children Not Eating Food	
	More Than Once		Once			
	No.	(%)	No.	(%)	No.	(%)
Drinks:						
Cocoa	9	(13.8)	18	(27.7)	38	(58.5)
Herb or Spiced Tea	9	(13.8)	19	(29.2)	37	(56.9)
Fruit Fresco	4	(6.2)	27	(41.5)	34	(52.3)
Other Fresco[c]	2	(4.6)	12	(18.5)	50	(76.9)
Milk	6	(9.3)	7	(10.8)	52	(80.0)
Cocoa with milk[b]	2	(3.1)	2	(3.1)	61	(93.8)
Coffee	-		3	(4.6)	62	(95.4)
Coconut water	-		1	(1.5)	64	(98.5)
Rice water	1	(1.5)	1	(1.5)	63	(96.9)
Fruit	2	(3.1)	13	(20.0)	50	(76.9)
Miscellaneous:						
Soup	1	(1.5)	3	(4.6)	61	(93.8)
Purchased snacks (cookies, boca rica)	1	(1.5)	3	(4.6)	61	(93.8)
Peanuts	-		1	(1.5)	64	(98.5)
Cane	-		1	(1.5)	64	(98.5)

[a]Three respondents were not able to report what their child had eaten the previous 24 hours.

[b]Double counting of any type beverage to which milk was added.

[c]Made from purchased soft drink powder, or from soft drinks.