THE DETERMINANTS OF MALNUTRITION IN HAITI

by

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CHAPTER I
INTRODUCTION

The high incidence of malnutrition in developing countries not only weakens adults and decreases their capacity to produce goods and perform services but according to the Protein Advisory Group (1), it is the primary or underlying cause in a high proportion of the deaths of children under five years of age. Mahler (2) refers to malnutrition as a "vicious spiral" in which malnourished children with decreased learning abilities become first, poorly nourished adults with decreased earning abilities and then, parents of malnourished children. According to Monckeberg (3) children living in poverty frequently have a disorganized family structure—an absent father and a mother working long hours. The mother may be unable to provide adequate stimulation, affection, security, or food. Those children whose environment is unkind to them will probably not finish primary school. Without a primary education, people are left out of today's affluent society and the gap between "haves and have nots" not only widens but is perpetuated from one generation to the next. The causes of malnutrition are no longer thought to be related primarily to suboptimal food intake but also to a myriad of other factors linked to poverty and underdevelopment (3). Poverty, insufficient education, and inadequate sanitation are only a few of the social conditions affecting malnutrition. As nutritionists began to recognize the complexity of the causes of malnutrition they began to look for effective educational interventions.
Griffin and Light (4) stated that, "Only through responsible education can individuals learn conduct appropriate to survival and self-realization." Mothercraft Centers in Haiti have used this percept to teach mothers child care techniques they could practice using their limited economic resources. The evolution of the Mothercraft Centers from Bengoa's (5) concept of nutrition rehabilitation to Haiti's adaptation has been well summarized by Fougere and King (6). According to King et al. (7) these centers have been successful in rehabilitating malnourished children and in preventing malnutrition in their younger siblings.

Although the child-feeding practices taught in the Mothercraft Centers are within the economic resources of the average family in the community, there are children who have not benefited from the program. Ballweg (8) speculated that some mothers lacked the food purchasing power necessary to implement what they learned at the center. Scrimshaw and Behar (9) stated a similar view that, "Education alone will fail if there is not enough good food within the purchasing power of the people educated." Behar (10) claimed that people cannot be educated without solving the real problem; that mothers know more than they are given credit for; and that they would have fewer malnourished children if they were given the right resources and facilities. He suggested that malnutrition can be alleviated by reducing infection and by improving environmental sanitation and personal hygiene.

The alleviation of malnutrition requires more than just an increase in the quantity or quality of food intake. Call and Levinson (11) suggested three steps in planning a nutrition intervention. First,
identify both the problem and the target population and then acquire baseline data including food availability, nutritional status, and community resources. Second, identify primary determinants or causal factors of the problem. Third, conduct a cost-benefit analysis to identify the interventions that will provide the greatest improvement for the least amount of money. In the past according to Acuna (12), nutrition planners have implemented in one country interventions that were effective in another country but which did not necessarily match the needs, expectations, attitudes, or behavior of the new country. This can occur when the planning process is concerned only with step one.

This study is concerned with the second step in Call and Levinson's planning process. The purpose of this research is to examine factors known to cause malnutrition in developing countries and to identify the most important determinants of malnutrition in Haiti. These determinants will be categorized as socio-economic, education, or health interventions. The effect of interventions within each category, as well as the effect of the entire category, on malnutrition will be studied. The results of the study will identify determinants of malnutrition that apply to Haiti. This information will provide the Bureau of Nutrition with a more scientific basis for planning future nutrition intervention programs.
The complexity of the etiology of malnutrition was recognized at a 1975 international conference on At-Risk Factors and the Health and Nutrition of Young Children held in Cairo, Egypt (13). Guidelines, to help determine the health and nutritional status of young children, described the conditions pre-disposing a child to malnutrition as at-risk factors. An at-risk factor was defined as,

A major, identifiable biological or environmental circumstance or event, affecting women in child bearing years, especially during pregnancy and lactation, or infants and young children, which increases the risk of severe illness, especially malnutrition or developmental abnormality in young children, and therefore suggests the need for prevention, and special care and attention. (13)

The classification of at-risk factors in several ways, including type of factor (biological or environmental), population affected, or factors used as early warning signals, was suggested.

Shah et al. (14) used at-risk indicators in his study in rural Bombay. Biological and environmental factors were divided into those that indicated severe malnutrition, those that may lead to severe malnutrition, and those that would lead first to improper and inadequate child care and feeding or to faltering of weight gain and then to severe malnutrition. The conditions identified by this study allowed early identification of children in need of special treatment or surveillance.

A model of family at-risk factors influencing protein-calorie malnutrition was developed in Tanzania by Okeahialam (15). This model
was based on the observation that

... the nutritional status of the child in this environment is dependent on several inter-related variable factors which also determine the standard of family health. Thus they may aptly be described as the family factors of protein-calorie malnutrition. Some of these involve the child only, others are maternal, paternal, or result from remote or direct influences of the extended family.

The effect of each of the family factors on the etiology of protein-calorie malnutrition, Okeahialam concluded, is a socio-economic problem that cannot be solved by the medical profession alone.

Factors affecting nutritional status were separated into direct and indirect determinants by Levinson (16) when he studied children in rural India. His hypothesis was that the direct causes of malnutrition, food intake and presence or absence of disease, were functions of such indirect factors as family purchasing power, nutrition and health beliefs of the mother, nutritional content of the food, presence or absence of health care, nonfamily feeding programs, and several other social and environmental phenomena. Multiple regression analysis was used to identify the factors significantly associated with nutritional status.

Conceptualization of at-risk factors influencing protein-calorie malnutrition can also be based upon socio-economic, nutrition education, and health factors. Before a nutrition education program can be justified as an effective intervention, the influence of education and socio-economic factors on malnutrition of the target population must be analyzed. Inadequate food resources may be more
directly implicated in malnutrition than poor utilization of available food. Levinson (16), in addressing the Western Hemisphere Nutrition Congress, IV, said,

"Nutrition education programs can be critically important and yet, almost by definition, have relatively little effect on the lowest income groups whose nutritional status is most limited by purchasing power rather than be deleterious belief patterns. Such programs, where effective, provide their major benefits to those economically more advantaged and may have the net effect of widening existing differentials in well-being."

Health status also affects nutritional status. High disease levels interfere with food utilization, decrease appetite, and inhibit immunological response. Mahler (2) suggested that malnutrition, linked with poverty and its inevitable consequences of insufficient education and an inadequate sanitary environment, is a health rather than a medical problem.

**Incidence of malnutrition in Haitian children**

Widespread malnutrition in pre-school Haitian children has been found by several investigators in studies conducted between 1956 and 1976. A summary of recent studies using the Boston and Iowa standards with the Gomez classification to determine degree of malnutrition in Haitian children is presented in Table 1. Little change has occurred in the general incidence of malnutrition during this time. All of the investigators, except Jelliffe, used the Iowa and Boston anthropometric standards (17). A correlation between those standards and the height and weight of well nourished Haitian children was established by King et al. (18) in a study of height and weight measurements of
Table 1. Summary of studies determining the prevalence of protein-calorie malnutrition in Haitian children.

<table>
<thead>
<tr>
<th>SURVEY</th>
<th>DATE</th>
<th>DISTRICT</th>
<th>NO. CHILD SURVEYED</th>
<th>AGE RANGE (months)</th>
<th>NORMAL (%)</th>
<th>1° (%)</th>
<th>2° (%)</th>
<th>3° (%)</th>
</tr>
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<tr>
<td>Boykin</td>
<td>8/72</td>
<td>Southeast</td>
<td>133</td>
<td>12-60</td>
<td>10.5</td>
<td>34.6</td>
<td>48.1</td>
<td>6.8</td>
</tr>
<tr>
<td>Gonzales</td>
<td>7/73</td>
<td>Artibonite</td>
<td>228</td>
<td>0-48</td>
<td>65.8(^1)</td>
<td></td>
<td>34.2(^2)</td>
<td></td>
</tr>
<tr>
<td>AFOB</td>
<td>12/74-2/75</td>
<td>All</td>
<td>1542</td>
<td>0-59</td>
<td>17.8</td>
<td>28.9</td>
<td>35.6</td>
<td>17.4</td>
</tr>
<tr>
<td>Lamothe</td>
<td>7/76</td>
<td>Northwest</td>
<td>551</td>
<td>0-72</td>
<td>34.3</td>
<td>41.9</td>
<td>20.5</td>
<td>3.3(^3)</td>
</tr>
</tbody>
</table>

\(^1\) Includes normal and 1° malnourished children.  
\(^2\) Includes 2° and 3° malnourished children.  
\(^3\) Study conducted in area with established nutrition centers.
7,409 children whose age could be verified. The children were classified as wealthy urban, poor urban, and rural. Findings showed a height and weight handicap associated with socio-economic status. The high correlation between the height and weight of the wealthy urban Haitian children and children in the United States suggested that the Iowa and Boston standards are appropriate for use in height and weight comparisons among Haitian children.

Another tool that is widely used to determine the extent of malnutrition in a population is the classification proposed by Gomez (19). This system compares a child's weight for a specific age to fiftieth percentile of a standard weight for the same age. Degree of malnutrition is calculated according to the deviation from the fiftieth percentile. Degree of malnutrition according to the Gomez classification is as follows:

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<th>Degree</th>
<th>Percentage of Standard</th>
</tr>
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<tr>
<td>Normal</td>
<td>Above 90% of the standard</td>
</tr>
<tr>
<td>First degree</td>
<td>75-90% of the standard</td>
</tr>
<tr>
<td>Second degree</td>
<td>60-74% of the standard</td>
</tr>
<tr>
<td>Third degree</td>
<td>Below 60% of the standard</td>
</tr>
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Jelliffe and Jelliffe (20) surveyed 1,322 Haitian children from one to three years of age to determine the prevalence of protein-calorie malnutrition. A balance beam scale was used to weigh the children in twenty-four rural villages and two urban slums. Advance announcement of the survey team's presence in the village was not given so that predominately sick children from the surrounding villages would not bias the survey sample. Jelliffe used the Jamaican standards with the Gomez classification to report the prevalence of malnutrition. Only 39% of the children were of normal weight for age.
Twenty-four percent were second or third degree malnourished. Toureau et al. (21) examined 5,589 children to assess the incidence of xerophthalmia in Haiti. The study, sponsored by the American Foundation for Overseas Blind (AFOB), was conducted from December 1974 to February 1975. A multi-stage stratified technique was used to select twenty-five sample sites representative of the widely varying terrain of Haiti. A random sample of 1,542 children, birth to seventy-two months of age, was selected for weighing on a Detecto bathroom scale. The Boston standards and the Gomez system were used to classify the children according to degree of malnutrition. Over 50% of the children were suffering from second or third degree malnutrition. This does not include 1.7% of the population who showed clinical signs of kwashiorkor or marasmus. The normal group included only 17.8% of the sample. Because the Jamaican standards are about 20% lower than the Boston standards, Amedee et al. (22) of the Bureau of Nutrition, compared the two studies using the same standard to determine if there had, in fact, been a highly significant increase in the prevalence of malnutrition in less than twenty years. The Jamaican standard was used in the comparison because the original data for 1,143 of the AFOB cases was available for recalculation. Amedee's findings showed a decrease in the prevalence of malnutrition rather than a sharp increase from 1958 to 1975. Caution was urged in use of the comparison due to the seasonal differences in data collection and differences in sample selection.

Brookens (23) examined 133 children in August 1972 in an effort to validate an age-independent assessment of nutritional status. All
children whose age could be verified and whose mothers agreed to the study were examined in four villages in Southeastern Haiti. Second or third degree malnutrition was found in 54.6% of the children. One year later Gonzales (24) reported that 34.2% of the children she examined in the Artibonite region suffered from second or third degree malnutrition. A July 1976 survey conducted for the Bureau of Nutrition by Lamothe and Haverberg (25) in three areas of the Northwest found only 23.8% of the children were second or third degree malnourished. Weight, clinical signs of malnutrition, family size and disease incidence were obtained for 562 children. The low prevalence of malnutrition in comparison to that found in other studies may be due to the existence of nutrition centers in the areas surveyed.

**Socio-economic factors associated with malnutrition**

Socio-economic factors such as family characteristics, occupation, and economic resources have been associated with malnutrition in several developing countries, including Haiti. Family size was recognized as a significant factor in the etiology of malnutrition by Gupta and Mwambe (26). The majority of the families (60.8%) of malnourished children studied in Tanzania had more than three children at home. Only 34.7% of the families could be classified as completely stable or normal with no social problems such as a broken home, alcoholism, sickness, or death. Graham (27) found that household size had a significant positive effect on height for age when there were fewer than two persons per room and a negative effect when there were more than four persons per bed. Among the Indian families studied
by Levinson (16), family size was the primary determinant of diarrheal disease. He suggested that this relationship was due either to crowding and inferior sanitation or to a tendency of parents to provide poorer care to later-born children. The effect of household size on nutritional status of pre-school children in Haiti is unclear. Ballweg (8) found that when family size reached five, the proportion of children who were severely malnourished increased. This pattern did not hold, however, for families with eight or nine children. Webb et al. (28) examined a larger sample than Ballweg (N = 231 versus N = 114) and reported that the data failed to support the assumption that family size was a major source of nutritional problems.

Monckeberg's (3) claim that children living in poverty frequently have a disorganized family structure seems to have some validity. Family dysfunction, especially maternal deprivation, was closely related to the nutritional status of children studied by Okiahialam (15). Lack of maternal care, caused by the mother's unmarried or abandoned status or employment, resulted in transfer of the child's care to a grandmother or aunt. These children were frequently malnourished. According to Ballweg (8) marital status of the mother did have some effect on the nutritional status of Haitian children, but the presence of the father in the household was far more important.

Rawson and Berggren (29) investigated the relationship between family structure, child location, and nutritional disease in Haiti. Most of the families lived in clusters of houses inhabited by extended family groups. Mobility between the community and other communities and mobility within the community causing relocation was reported.
Most children had moved because of the breakup of the union of their parents. However, a surprising number of children were moved by their parents to the house of a grandparent, aunt, or uncle when the family had four or more living children. These children usually moved into a house near the parents in an arrangement that benefited both parents and grandparents but not always the child. There was a significant difference in nutritional status between children who lived with both parents and children who lived with only one parent or another relative. Rawson concluded that, "children who did not live with both parents were at much higher risk for malnutrition than those who lived with both parents."

Some attention has been given to the occupation of both parents of malnourished children. Perhaps a more important factor than occupation is that increased earnings do not compensate for the loss of the mother's time at home. Approximately one-fourth to one-third of the Philippine women studied by Popkin and Solon (30) were peddler/vendors, dressmakers, shoemakers, or artisans in addition to the long, arduous hours they spent in house-related tasks. Although total food expenditures in working mother households increased, the child's food intake decreased. When the mother was not home, the child was likely to be served a more simple gruel or soup without vegetables. When the child was fed the normal soup, it was not encouraged to eat the vegetables. This food practice adversely affected vitamin A consumption of the children. There was a significant decline in breast feeding if the mother worked in another barrio. If the infant could not be breastfed at the mother's place of employment, the child
was bottle fed or breastfed less frequently. Working mothers were also unable to take advantage of many of the social services. Day care centers cost more than the mothers could afford to pay or they simply did not have the time to take the child to the center. Working mothers were also less likely to attend weekly meetings of the Mothercraft Center or take their children to a health clinic than non-working mothers. Rawson and Valverde (31) also found an association between mothers who work outside the house and children with below normal weights in rural Costa Rica. Mothers who had to work usually picked coffee or rolled cigars. Coffee picking paid more but was seasonal and required long hours away from home. Cigar rolling was low paying but the work could be done at home in combination with other household duties. The mothers who picked coffee had to leave their preschool children in the care of an older sibling who provided suboptimal care. These children tended to have below normal weights. Shah et al. (14) studied mortality at-risk factors in rural India. A major indicator, other than malnutrition, was economically active mothers. When the mother was away working the care of the child was left to a young mother substitute who did not provide the child with an adequate amount of food.

When Ballweg (8) examined family characteristics and nutrition problems of preschool children in Haiti, he found the two most frequent occupations of the mothers were cultivator and street merchant. There was a higher proportion of malnourished children among charcoal makers than among other occupations. Women who sell charcoal spend a great deal of time away from home preparing,
transporting, and selling the product. Ballweg suggests that this large amount of time away from home adversely affects the feeding practices of the preschool children. The French anthropologist, Metraux (32), published an extensive study of life in southern Haiti. The women in about one-half of the families studied had one or more occupations in addition to household related tasks. These occupations, similar to those identified in the Philippines by Popkin and Solon (28), primarily involved marketing. In addition to working in the fields along with the men, the women had primary responsibility for selling the produce. Underwood (33) described the three levels of local markets in Haiti as: peddler/vendors selling local produce from house to house or village to village; small markets set up spontaneously along the side of the road or at a special event; and the state supervised and controlled regional markets. Most peasant women engage in one or more of these activities, especially as peddler/vendors or small market proprietors. Other occupations identified by Metraux included embroidering, dressmaking, candlemaking, and basket-weaving.

Economic resource indicators include measures of wealth as well as income. Levinson (16) found that a wealth index was not a statistically significant predictor of nutritional status even though he was able to obtain more precise estimate of it than of income. Factors included in the wealth index were: size, construction, and ownership of the house; use of electricity; an animal score; source of water; a ranking of other possessions owned; land ownership; and additional income.
Rawson (31) found land tenure as a primary but indirect factor causing malnutrition in Costa Rica. Workers were divided into three occupational groups: salaried agricultural workers; farmers and skilled workers; and merchants. They were further classified as having access to less than or more than two manzanas of land. Intervening variables that had a direct impact on malnutrition were occupation of the father, occupation of the mother, and ownership of the house plot. If the father had access to less than two manzanas he was forced to work as a day laborer to support his family. This brought relatively little cash income to the family and prevented the father from working the land he had. The mothers in these households frequently had to work to supplement the family income. Valverde et al. (34) used Rawson's methodology to study the relationship between land tenure and nutritional status in Guatemala. Children of farmers and skilled workers tended to have the lowest prevalence of malnutrition. The risk of malnutrition was two to three times greater when the family had access to less than two manzanas than when they had access to more than five manzanas.

Graham (27) observed that while it is extremely difficult to learn true family income it is possible to acquire fairly reliable data on available food money. In a follow-up study of over 100 nutritionally rehabilitated children, approximately six and one-half years after hospital discharge, Graham found that the greater the amount of food money available, the higher the child's height/weight quotient. When real food expenditure of the family in the Columbian study reported by Drake and Fajardo (35) decreased, malnutrition
increased. Insufficient money to buy food was the biggest single factor causing malnutrition in urban Nigerian children studied by Collis and Jones (36). Ignorance of the best foods, rather than lack of food money, was the biggest factor in rural areas. Burgess (37) identified factors causing or contributing to protein-calorie malnutrition as inadequate diet, lack of suitable foods, and failure to use available resources. Lack of suitable foods was due to low fertility of the soil, unwillingness to cultivate crops of high nutritional value or a lack of sufficient money to purchase food to supplement home grown produce. If the family did not own the house plot the house was built so that it could be easily dismantled and moved. Insecurity of the land tenure tended to discourage the house owner from maintaining the house and resulted in substandard, dirt floored houses. These families were forced to purchase more and grow less of their food requirements even though their cash resources were less than those of families with larger land holdings. Failure to use available resources was related to lack of nutrition education, especially knowledge of the special nutritional needs of children and the importance of breast feeding. An increase in available money may not immediately improve the nutritional status of the family. Autret (38) found that in low income groups, as food money increased, the quantity of food purchased increased with little change in quality. As income continued to increase, food quality began to improve. A negative change in diet was sometimes noted when a family went from a subsistence to a cash economy. The quality of the diet decreased
because families purchased cheap foods inferior to those formerly
grown or caught.

When Ballweg (8) explored economic factors associated with
malnutrition, he found no relationship between land tenure and
nutritional status. Although no published reports of the effect of
food money on nutritional status were found, Grant and Groom (39)
reported that poorer Haitian families consumed more roots and tubers
and fewer cereals, grains, and other foods. The poorest families
consumed almost no sources of animal protein. Sebrell et al. (40)
reported similar findings from a 1958 nutritional survey on Haiti.

Educational factors associated with malnutrition

Nutrition education has been defined by Berg (41) as "the process
of acquainting people with the value of resources already available to
them and persuading them to change existing practices." A child is
most vulnerable to nutritional insult after he is weaned and before he
is able to consume enough food of sufficient quality to meet his
nutritional needs (42). During this period, the mother must practice
good food habits and make use of all food resources available to
her in order to prevent the malnutrition of her child. Human milk is
an important economic resource in a developing country. Cost
comparisons between maternal diets based on everyday foods and formula
preparation show that lactation is less expensive (43). In a recent
monograph Jelliffe (44) summarized current findings in infant
feeding. A comparison of the physio-chemical properties of human milk
and cow's milk showed that human milk is more advantageous. The
immunological properties of human milk help protect the infant from infection, especially gastroenteritis. Other benefits of breast feeding discussed were protection from allergy to cow's milk, contraceptive effect, and enhanced mother-child interaction. Jelliffe concluded that breast milk is the only food necessary for a child the first four to six months of life. After that time and until weaning breast milk should be supplemental with mixtures of vegetable proteins. Omololu (45) considered breast feeding "the only rational, sensible, cheap, and safe way to feed infants" in developing countries with poor standards of sanitation. Not only does breast milk increase resistance to diarrheal disease, but it is safe, needs no special preparation and is readily available.

There has been an unfortunate trend in developing countries away from breast feeding towards bottle feeding (46). Sousa et al. (47) noted that a general decline in breast feeding in Brazil produced an increase in early protein-calorie malnutrition and frequent bouts of gastroenteritis. The causes of early weaning were studied in order to establish a program to encourage breast feeding. Bottle feeding was introduced early; 24% of the infants received bottle feeding at birth, 72.6% by two months, and 88.0% by six months. Most of the mothers used overdiluted cow's milk in the bottle. Intengan (48) found that breast feeding is declining rapidly in Japan and the Philippines. The greatest danger of bottle feeding in developing countries according to Intengan is poor hygiene and sanitation. The bottles are not properly cleaned prior to use and the available water may not be potable. The milk or formula may be overdiluted due to
ignorance of the mother or lack of money to buy enough processed milk. Mothers of malnourished Peruvian children studied by Graham and Morales (49) replaced breast milk with water, soup, cornstarch or tea. When the oldest child was seven or eight years old, the mother often went to work, leaving the infant in the care of the oldest sibling. The infants received no food while the mother was away working and frequently developed marasmus. Children in this study who developed kwashiorkor had been successfully breast fed but received an inadequate diet after weaning. Onset of kwashiorkor was associated with measles or prolonged bouts of diarrhea. Gupta and Mwambe (50) also found a relationship between termination of breast feeding and malnutrition. Marasmus was seen in younger children when breast milk was reduced without an adequate substitution. Kwashiorkor was seen after weaning in children who were not properly weaned. Problems in weaning diets included carbohydrate-based weaning foods, an exclusive adult diet, or continued bottle feeding only past the time when the child needed supplemental foods. Duration of breast feeding, introduction of supplementary foods, and age were highly correlated with protein-calorie malnutrition in a retrospective study by Gurson et al. (51). Supplemental foods were introduced at a relatively early age to both the experimental and the control group. Starchy foods and liquid parts of the family diet had been given to the malnourished children while the control children had received more nutritious foods. The younger children were more vulnerable to malnutrition although longer breast feeding decreased the risk. In Guatemala, Schrimshaw (42) found that disease incidence was related directly to the weaning
process and the weaning diet. Disease incidence was highest during weaning but decreased as the child began to consume an adequate diet. The use of weaning multimixes has been suggested by Jelliffe (52) in rural areas where nutritional health is dependent upon optimal use of available foods. Multimixes are a mixture of foods which, when eaten together, will provide all the essential amino acids in the amounts needed to promote growth as well as to maintain life. They are based on the local staple which may have social or religious significance as well as being readily available. The basic staple foods are legumes; cereals; and the tuber, plantain, breadfruit groups. Jelliffe recommends that a small amount of animal protein be added to the staple mixture to improve protein quality and that fat or sugar be added to improve caloric content. Legumes and/or dark green leafy vegetables should be added to improve nutritional value. Multimixes are proposed as supplemental foods for children between 4 and 6 months of age.

The Haitian Bureau of Nutrition, according to Amedee (53), encourages weaning between twelve and eighteen months of age. Most mothers, the Bureau has found, wean their children around eighteen months of age. There have not been many studies on the quantitative aspects of child feeding. According to Jelliffe (46), most studies of child feeding practices have provided only qualitative information. Quantitative data is difficult to obtain because early childhood is a period of dietary transition when the feeding pattern is changing and consumption is increasing. Eppright et al. (54) studied frequency of eating and meal patterns in preschool children in the North-Central
United States. At two or three years of age an approximately equal number of children ate either 4 to 5 or 5 to 6 times a day. Meals accounted for 60-65% of the feedings while the rest were considered snacks. After three years of age the most frequent pattern was 4 to 5 times a day with most of the children eating 5 to 7 times a day. Most of the children had established a pattern of meals and snacks by the time they were three years old. Eating less than four times a day had a negative effect upon caloric, calcium, protein, ascorbic acid and iron intake. Eating more than 5 or 6 times a day had a positive effect on caloric, calcium and protein intake. Feeding patterns are different in tropical areas, according to Cameron and Hafvander (55).

In most industrialized societies, the infant is scheduled to have about four regular meals a day during the second half-year of life, including one or two milk feeds from either the breast or a formula. In many tropical areas, the baby nibbles, so to speak, and sucks the breast or is given a bottle frequently, maybe 10 to 20 times a day, in response to crying or restlessness. The same is often true with the additional food, for the young child may be given small portions more or less continuously throughout the day. It is difficult for even the mother to estimate the total amount of food intake, but investigations have shown that often the baby is not given enough food, and what there is is of poor quality. Therefore, it is important to teach mothers that enough food of the right kind must be given or the infant will become undernourished.

In the report of a nutrition survey in Haiti, Sebrell et al. (40) noted that no more than two meals per day, excluding breakfast, were usually served. Breakfast, if any, was sweet coffee or tea plus a biscuit. The composition of the meals depended upon the work load.
If the work was completed early, a light meal was served around noon, followed by a heavier meal in the evening. If the work was not completed until 2-3 p.m., the mid day meal was heavier, with a much lighter meal served in the evening. Grant and Groom (39) found that urban Haitian families had a light morning and evening meal with the main meal in the middle of the day. The poorest urban families sometimes had only sweetened ice water in the evening. Poor rural families also ate less than other families; sometimes eating primarily mangos when they were in season. Families studied by Ballweg (8) consumed from one to three meals per day, with an average of 1.9 meals per day. Children whose families had only one meal a day were far more likely to be malnourished than children whose families prepared two or three meals a day. Although the children who ate three meals a day were most likely to be of normal nutritional status, eating two meals a day did not predispose a child to malnutrition.

Williams (56) has likened sanitary conditions in developing countries today to those existing in England at the time of Dickens. The spread of infectious disease depends upon environmental conditions as well as the presence of the disease agent and the condition of the host. For example, the spread of parasites is dependent upon a climate and soil that permit survival of the eggs and larvae (57). According to Jelliffe (46), standards of environmental sanitation in developing countries, including potable water and solid waste disposal, are defective. This has resulted in an increased incidence of infections and parasites that are waterborne, spread by flies, or due to fecal contamination of the compound. The lack of potable water is one of the
most serious public health problems in Haiti (58). Only 28% of the urban areas had access to piped water in 1974. This condition did improve in Port-au-Prince with the expansion of the public water system in 1976. In the rural areas there were only five aqueducts which provided water to less than 4% of the total population. The Haitian government is working to increase the number of potable water systems. There are few functioning sewerage systems outside of Port-au-Prince. To help alleviate the unsanitary conditions, all the nutrition centers use latrines and teach the mother the importance of proper sanitation (59).

Mothercraft Centers, as the name implies, have focused on the education of the mother. The major emphasis is on improved child care practice, especially feeding and sanitary care. If, as Behar (10) claimed, mothers know more than they are given credit for, attendance at a Mothercraft or Nutrition Center will not significantly affect the mothers' nutrition knowledge. Adelman (60) expected to find that nutrition education made mothers in Kinshasa Province, Zaire, more aware of nutritional requirements which would lead to the improved nutritional status of their children. This hypothesis was not supported for either children who were still breast feeding or those who had been weaned. Nutrition education was, however, related to decreased disease frequency in children who had not been weaned. Beaudry-Darisme and Latham (61) found no difference between the nutrition knowledge of the experimental and the control mothers. King et al. (7) did not use mothers' nutrition knowledge as a criteria for evaluation of the benefits of Mothercraft Centers. If the mother is applying what she learns at the center, the longer a child is in the center, the more it
should improve, and should continue to improve after it leaves the center. All the rehabilitated children in the follow-up studies summarized by King had improved their growth rate while in the Center. Two years later 81% had a higher percent standard weight gain than at discharge. Although the usual stay at a nutrition center is three to four months, the more severely malnourished children tended to be enrolled for more than one session (8,61). This decreased benefit from the centers may be due to the severity of the malnutrition or additional health problems (7,61), lack of money to apply what has been learned (7,8,61), or a failure of the educational process of the center (61).

Health factors associated with malnutrition

The interaction between nutrition and infection has been well documented by Scrimshaw et al. (57). Not only does infection adversely affect nutritional status but nutritional deficiencies reduce the capacity of the host to resist infection. Diarrhea, parasite infestations, and infectious diseases have been highly associated with the synergism between nutrition and infection.

Weanling diarrhea, a major cause of death in developing countries, is the result of a variety of bacterial diseases and infections (57). Although, frequently, no definable infectious agent can be identified, diarrhea and often fever are present. A warm tropical climate may contribute to the incidence of diarrheal disease but in most cases the pathogens gain access to the gastrointestinal tract through the ingestion of contaminated food or water or through direct contact with unclean
hands (62). The only infection variable to emerge as a significant indicator of nutritional status in Levinson's study (16) was diarrheal infection. Disease morbidity was low and parasite infestation almost nonexistent among this sample population. Drake and Fajardo (35) reported a strong relationship between frequency of diarrhea and malnutrition during the promotoral program in Candelaria, Colombia. There was a significant association between decrease in incidence of diarrhea and age of the child and duration of the family's participation in the program. Laditan and Reed's (63) study of the age of onset and the importance of infection in severely malnourished Nigerian children suggested that diarrhea was at least partly responsible for the chronic undernutrition of marasmic children. In children with inadequate weaning diets, the final deterioration in nutritional status was precipitated by gastroenteritis following measles. In a two year analysis of the causes of child mortality in four highland Guatemalan communities, Behar et al. (64) noted that diarrhea and childhood infections were responsible for two-thirds of the deaths. Approximately two-fifths of the children from one to five years of age who died during the observation period had symptoms of kwashiorkor. This disease was precipitated in almost every case by a prior episode of diarrhea, measles, or other infection. The overall mortality rate of the communities studied, forty times higher than in the United States or Western Europe, was ascribed to the synergism of nutrition and infection.

Parasites such as round worms and hookworms are frequently found in the tropics and sub-tropics, especially in humid areas. They are found less frequently in arid tropical areas. Children from one to five
years of age spend much time in the feces-contaminated compound around
the house and they begin to crawl and then become more independent.
High adult roundworm infestation, according to Jung and Jelliffe (65),
produces a clinical picture similar to malnutrition. As much as 5-10% of
the child's weight may be represented by the parasite; a large
nutritional drain. This large mass of parasites may successfully
compete with the child for food, especially protein from the intestinal
tract. Hookworm, which causes anemia and chronic blood loss, may
precipitate kwashiorkor.

Collis and Jones (36) noted that parasites retard weight gain and
may also interfere with resistance to bacterial and viral infections,
especially in poorly-nourished children. Scrimshaw et al. (57) agreed
that any unusually heavy parasite infestation can induce protein-
calorie malnutrition in a person with adequate dietary intake by
interferring with intake, absorption, and retention of protein.

Infectious diseases in malnourished Thai children were studied
by Morehead et al. (66) in an effort to reduce mortality rates. All
thirty-five children in the study were diagnosed as having either
marasmus, kwashiorkor, or a combined marasmus-kwashiorkor. In addition,
 thirty-two had one or more infections. There was a high incidence
of riboflavin, calcium, and iron deficiency and of parasite infestation.
Twenty-four of the patients had forty major, life-threatening, infections.
Twenty-six patients had thirty-seven minor infections. Eighteen
patients had both major and minor infections. Some of the patients
had infections that were not suspected from the physical examination
but were found in the examination of blood, urine or stool specimens.
Although the study did not examine how malnutrition is related to faulty resistance to infection, it did find that these malnourished children had a higher incidence of mixed infections than is usually found in well-nourished children with acute illness.

The health and nutrition survey of Kinshasa, Zaire conducted by Adelman (60) examined the effect of frequency of disease, as well as special diseases, on the nutritional status of 4,391 children from six months to four years of age. Children who had been sick one or more times weighed significantly less than children who had never been sick. Regression analysis showed that children who had not been weaned and who had diarrhea weighed significantly less than other breast-feeding children. Correlation analysis further showed a significant association between weight and anemia, flu, skin disease and malaria. For children who were already weaned, only diarrhea significantly reduced weight. The diseases in these children that significantly increased frequency of disease were cold, cough, diarrhea, fever, measles, bubo, malaria, bronchitis, anemia, whooping cough, asthma, constipation, flu, skin disease, vomiting, pneumonia, and yellow fever. In a long-term field study of the influence of infections on nutrition and the growth of children in Guatemala, Mata et al. (67) discovered that infection with an enteric virus during the first three months of life affected growth. These children had a weight deficit throughout the first year that was not associated with birth weight. Children more than three months of age tended to lose weight when frequent infection was combined with inadequate dietary intake.
The diseases that had the greatest impact on retarded growth were whooping cough, dysentary, and broncho-pneumonia.

The most common form of childhood disease in the tropics is upper respiratory infection according to Webb (68). The disease pattern in the tropics is similar to that seen in temperate climates except that it is usually more acute due to lack of accessible medical services and complicated by malnutrition, bacterial infection, or parasites. Measles and whooping cough are two infectious diseases cited by Morely (69) as predisposing a child to malnutrition. Loss of appetite, painful mouth, fever, and diarrhea seen in measles greatly reduce the amount of food the child will eat and farther complicate his nutritional status. Whooping cough, not only produces a weight loss similar to that following measles, but also makes the child more liable to broncho-pneumonia or other upper respiratory infection.

Reliable mortality and morbidity figures are difficult to obtain in Haiti despite the government's attempt to collect these statistics. The United States Department of Health, Education, and Welfare in its Syncrisis study of Haiti (70) has reported comprehensive three year epidemiological data from the Les Cayes Sanitary District. These morbidity statistics came from medical facilities and do not represent prevalence in the general population. The data did, however, provide an indication of the relative frequency of hospitalization for communicable diseases in southern Haiti. Upper respiratory infections, including influenza and broncho-pneumonia, and parasites were the most frequent causes of hospitalization. There were almost the same number of admissions for both diseases; together they accounted for 54% of the
hospitalizations. Diarrhea, gastroenteritis, and dysentery were next most frequent, accounting for 16% of the admissions. Only about 10% of the admissions were due to malnutrition. This could be due to the effectiveness of nutrition centers in the district or to the practice of listing the major infection a malnourished child also has, rather than malnutrition, as the admitting diagnosis. Tuberculosis and malaria were seen in three to four percent of the admissions. Smallpox has not been found in Haiti since 1921. Measles, diphtheria, and poliomyelitis, frequently of concern in other tropical countries, did not seem to be a major problem in Haiti.

Age and sex are additional variables that should be examined in a study of malnutrition in preschool children. The importance of age, as noted by Levinson (16), is that severity of malnutrition increases as the child grows past six months of age. This effect begins at weaning and usually continues until the child is able to consume enough food to meet his nutritional needs or until his body adapts to a low dietary intake. Sex is an important variable in those parts of the world where a premium is placed on one sex over the other. Levinson (16) reported that boys were thought to be more important than girls in India and consequently there was a higher incidence of malnourished girls. Gupta and Mwambe (26) found more malnutrition among boys than girls in Tanzania even though a nutrition survey in the country did not show any sex differences. Most nutrition surveys in Haiti have not reported findings by sex. Ballweg (8) did find that preschool girls in Fond Parisien were more likely to have severe nutritional problems than boys.
Summary

Malnutrition is well known in Haiti. Approximately one-fourth to one-half of the children weigh less than seventy-five percent of the average weight for their age. Studies of the causes of malnutrition have focused primarily on the socio-economic, educational, or health factors involved. Socio-economic factors, including large households, dysfunctioning families due to loss of one or both parents, and maternal deprivation resulting from mothers who work long hours outside the home, have been related to the malnutrition of young children in developing countries. Wealth indicators, such as land tenure or a composite index, used to examine the relationship between nutrition and economics have had mixed results. The amount of food, money or land available has been more important than land ownership or a wealth index in determining nutritional status. Although the cost of food prepared in the nutrition centers is based upon the median food money available, no studies have been done in Haiti to examine the effect of the actual amount of money spent for food upon the nutritional status of the child. A better wealth indicator than land tenure would be useful in studying economic status in Haiti. The mixed results from the use of animal ownership as a measure of wealth suggests that use of this measure should at least be explored.

The impact of the mother's occupation on the child's nutritional status is difficult to assess. There is some evidence that the number of hours the mother is away working and the child's caretaker in the mother's absence are more important than the mother's occupation in determining the child's nutritional status. Additional information
is needed to evaluate the effect upon the child of the mother's long
hours away from home working and the adequacy of the caretaker.

Nutrition education interventions have been effective in combating
malnutrition in many countries, including Haiti. These programs have
not always been completely successful. Where mothers have not been
convinced of the superiority of breast milk over formula feeding,
protein-calorie malnutrition and gastroenteritis have increased as
bottle feeding increased. Lack of nutrition knowledge has also resulted
in children being weaned too early or being fed a high carbohydrate,
low protein weaning diet. These practices make children more vulnerable
to malnutrition. Little is known about meal patterns in Haiti. The
effect of meal frequency on malnutrition will be studied in an effort
to substantiate previous work.

The lack of potable water and effective solid waste disposal
creates unsanitary environments that predispose children to diarrhea,
parasites, and infectious disease. The interaction between nutrition
and infection is noted in studies showing that disease frequently
precipitates malnutrition and in studies showing that malnourished
children have more diseases than well-nourished children. Prior
studies in Haiti have not examined disease incidence or prevalence
in relation to malnutrition in children.

The importance of education versus economics in alleviating
malnutrition has been widely discussed in the literature. Educators
feel that education is necessary if people are to make the most of
their economic resources. Economists are convinced that until
economic resources are increased people will not be able to practice
what they already know. A third group of public health officials acknowledges the interaction between nutrition and infection. This group says that until the environment is cleaned up and children have fewer diseases, malnutrition will continue to be a problem in developing countries. The effect of economics, education, and health have not been previously studied together in Haiti.
The relationship of socio-economic, education, and health factors as proposed by this study is presented in Figure 1. This study attempted to determine which of the three sets of factors has the most significant impact on malnutrition, which factors within each category are most significantly associated with malnutrition, and what combination of factors from all three groups would be most effective in combating malnutrition among preschool children in rural Haiti.

Data Collection

A survey was conducted in Haiti, January 5-28, 1978, with the cooperation of the Bureau of Nutrition and the Haitian American Community Help Organization (HACHO). The study was designed to collect data from several regions, reflecting the diverse climatological and topographical conditions of Haiti. The country is divided into five regions. The North is a well-watered area, suitable for cultivation of tropical crops. The eastern part of this region receives somewhat less rainfall than the rest. The Northwest, which comprises most of the Northern peninsula, is arid and mountainous. The plain, south of the mountains in this region, is primarily desert. This region has been subject to severe drought in recent years. In the South many short rivers flow to the coast from the mountains, creating valleys and small fertile plains. The highest agricultural yield is found in this area. The Artibonite, the central region, includes lowlands and a large plateau. The Artibonite River provides water for
Figure 1. Determinants of malnutrition -- Conceptual Model.
irrigation plus energy for the hydroelectric plant that provides power for Port-au-Prince, the capital. The West (geographically the southeast) ranges from arid plains to high mountains to the fertile valleys of the southern coast.

The survey sample reflected geographic as well as urban-rural differences in the population. The map in Figure 2 shows the location of all 13 survey sites. Data were collected in three regions, the West, the North, and the Northwest. The sample in the West included urban sites in Port-au-Prince and rural communities on the southern coast near Jacmel. This rural area was extremely fertile and very similar to the South which was not surveyed. The North included both urban respondents from Cap Haitian and rural respondents. In each area sites were clustered near a central location that could provide food and lodging for the survey team. The teams surveyed a different site each day. Table 2 shows the distribution of respondents in the sample.

The survey team consisted of a physician from the Bureau of Nutrition and an interviewer, except in the Northwest where the HACHO public health nurse in charge of the clinics in the Northwest and the nutrition center supervisor conducted the survey. The investigator accompanied all teams except one of the teams in Port-au-Prince and the team in the North. The survey sites were usually the local nutrition center or health clinic except for two communities in the Northwest where an attempt was made to go from house to house. This method severely curtailed the sample size so at the final site in the Northwest, the team remained at the nutrition center and the mothers came to the center.
Table 2. Distribution of respondents by regions of Haiti.

<table>
<thead>
<tr>
<th>Region</th>
<th>Locality</th>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>West (Port-au-Prince)</td>
<td>Nan Mapou</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>San Fils</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Route Frire</td>
<td>16</td>
</tr>
<tr>
<td>(Jacmel)</td>
<td>La Montagne</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Peredo</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Chavalier</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Oranges</td>
<td>6</td>
</tr>
<tr>
<td>(Jacmel)</td>
<td>Autrel/</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bocan Patroit</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Arbre</td>
<td>10</td>
</tr>
<tr>
<td>Northwest</td>
<td>La Faucette</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Gens de Nante</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Carice</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Pilate</td>
<td>13</td>
</tr>
</tbody>
</table>

Total number of respondents: 160
Respondants were mothers of children under five years of age. The mothers of children enrolled in the center who were helping on the day of the survey were interviewed as well as other mothers who lived near the center. The women were isolated from the rest of the group during the interview so their replies would not bias or be biased by other waiting respondants. After the mother was interviewed, her children under five years of age were weighed and measured. A total of 167 mothers were interviewed and their children weighed and measured. Usable data were obtained from 160 mothers. Cases were eliminated only when the child's age, sex, height, or weight were missing.

Three young women were selected by the Bureau of Nutrition to conduct the interviews. All had prior experience directing a nutrition center and interviewing. One day of training was spent at the Bureau of Nutrition to make certain the interviewers understood each question and how to ask it in Creole. A second day was spent at the site of a mobile health clinic in Port-au-Prince testing the schedule and the data collection process. No changes in the schedule were necessary after the pretest. A HACHO public health nurse was later trained to collect data in the Northwest with the investigator.

The survey instrument (Appendix I) consisted of two parts: a survey schedule used to interview the mother and a physical examination schedule to record specific data about each child, including height and weight. The mother's interview schedule contained twenty-five questions relating to the mother, her occupation, food and economic resources, sanitation facilities, food knowledge, and household composition. The physical examination contained fourteen questions
about the child feeding practices and the disease status of the child in addition to height and weight measurements. All of the questions were objective and required the interviewer to either circle or check an expected response or write a short reply. Interviews averaged fifteen to twenty minutes in length depending upon the number of children under five years of age the mother had.

An English draft of the survey schedule was revised in Haiti with the help of Madame Yvette Papillon, Dr. Michael Amedee, and Agranoem Eli Laroche. Although the questionnaire was printed in French, the interviews were conducted in Creole. Therefore, the Creole interpretation of and possible response to each question was determined. Care was taken to provide linguistic equivalence between the English and the Creole questions Deutscher (71) warned that there is danger that research conducted in a language and culture unfamiliar to the investigator will produce disparate results due to different connotations. The assistance of the Bureau of Nutrition personnel enabled the researcher to meet Deutscher's criteria for cross-cultural research; familiarity with the cultural milieu as well as the language and conceptual equivalence of the questions without striving for lexical comparability.

Data analysis

Descriptive statistics were used to present quantitative findings and to show pertinent relationships among the variables. Ordinary least squares multiple regression analysis was used to determine the combined power of socio-economic, education, and health variables and the relative power of each independent variable.
separately in explaining malnutrition in the sample population.

Multiple regression is a method of explaining or predicting the variance of a dependent variable by estimating the collective and separate contributions to that variance of two or more independent variables (72). A linear equation is used to predict the variance on the dependent variable caused by the independent variable. The basic linear equation is

\[ Y' = a + bx \]

where \( Y' \) = the predicted values of the dependent variable; \( x \) = the value of the independent variable; \( a \) = the intercept constant; and \( b \) = the regression coefficient. In multiple regression analysis the linear equation may be extended to include any number of independent variables:

\[ Y' = a + b_1x_1 + b_2x_2 + \ldots + b_kx_k \]

where \( b_1, b_2, \ldots, b_k \) are regression coefficients associated with the independent variables \( x_1, x_2, \ldots, x_k \) (76). Ordinary least squares regression analysis produces the regression line as linear equations with the smallest squared difference between the predicted value of \( Y \) and the actual value of \( Y \). This technique is particularly useful in studying the disparate variables that affect malnutrition although it requires certain basic assumptions about the data (73-75). These assumptions and how they were handled during the analysis are as follows.

1. Interval level measurement. All variables were intervally measured except for sex, feeding method, have diarrhea now, and have parasites now, that could only be measured categorically. Kerlinger
and Pedhauzer (72) state that it is possible to create dummy variables from categorical variables and to use these dummy variables as independent variables in a regression analysis. Dummy variables were created by assigning an arbitrary number to the members of a given category and another arbitrary number to non-members of that category. For example, in the category sex, males were assigned a value of 1 and female a value of 0. Dummy variables were also created to handle the categorical variables of feeding method, have diarrhea now, and have parasites now.

2. Residuals are independent of the independent variable. The least-squares regression equation produces residuals that are not correlated with the independent variables so this assumption cannot be directly tested. Blalock (73), however, says this assumption is violated if all relevant variables are not included in the model. This analysis included all factors found by other investigators to be significantly associated with malnutrition in Haiti plus additional factors found to be significant in other developing countries but not previously tested in Haiti. No known factors deemed appropriate to Haiti were left out of the regression equation.

3. The sum of the residuals have expected values of zero. This condition is also produced by the least-squares solution so it cannot be directly tested (73).

4. Residuals are normally distributed. The chi-square statistic was used to test the null hypothesis that the sample was drawn from a normal population. The variables able to feed family from the garden, months spent in the nutrition center, and have parasites all differed
from the frequencies expected in a normal distribution. Further
examination showed that the differences were probably related to
the attempt to include urban-rural and geographic differences in the
sample. Families in the urban areas were least likely to have a garden
or to be able to feed the family from the garden. Most of the data
collection in Jacmel and the North was in the nutrition centers so
an effort was made in Port-au-Prince and the Northwest to interview
mothers whose children were not attending a nutrition center. This
was reflected in the proportion of children in each region who had
attended a center. Parasites are less likely to be found in arid
climates and were found less frequently in the Northwest, an area that
is just beginning to recover from a long drought.

5. Residuals are linearly related to the independent variables.
Scatterplots of each independent variable were examined for nonlinearity
as suggested by Draper and Smith (76). Although there was some scatter-
ing of residuals, no distinctive non-linear trends, as described by
Draper and Smith, was detected.

6. Residual variance is constant across all combinations of
levels of independent variables. This is the assumption of homo-
scedasticity or equal standard deviations. A plot of standardized
residuals against standardized expected Y values was examined for
abnormalities. Again no significant abnormalities were detected.

7. Independent variables are not correlated. To test for
multicollinearity, the correlation of each independent variable with
every other independent variable was examined. The range of absolute
values for correlation coefficients among the independent variables
was .004 to .346. The average of these values was .169. Extreme collinearity was defined by Kim (77) as correlation coefficients ranging from .8 to 1.0. The correlations among the independent variables in this data appeared to be small enough to rule out a problem with multicollinearity.

8. Effects of the independent variables can be added together to predict the dependent variable. To find out if the additive model was the model that best fit the data, the independent variables were tested for interaction according to the method suggested by Kerlinger and Pedhauer (72). Significant interaction was found between the variable weaning age and the variables months in the nutrition center, number of illnesses, have parasites, and sex as well as between the variables sex and feed family from garden, sex and number of illnesses, months in the nutrition center and have parasites, age and have parasites, and age and sex. The Johnson-Neyman technique, as described by Kerlinger and Pedhauer (72) was then applied to determine if the point of intersection of each pair of interacting variables fell within the region of significance. According to this technique, only the interaction of weaning age with months in the nutrition center, have parasites with age, and sex with age fell within the region of significance. One of the interactions was expected; another may have been related to the sample selection. As a child grows older it has increased exposure to parasites in the environment and thus greater probability of having parasites. Therefore, an increase in parasites with age would be expected. In a country, such as India, where male and female children are treated differently, sex-age interactions are
expected after weaning and until the child is able to consume enough food to meet his needs or has survived long enough to be out of immediate danger. Such differences are not expected in Haiti. There was a significant difference in second and third degree malnutrition between males and females which may be an artifact of this sample. The interaction between weaning age and months in the nutrition center could not be satisfactorily explained so this interaction term was entered into the final equation.

Anscombe and Tukey (78) believe that the ideal conditions of residual analysis are seldom, if ever, satisfied in practice. This examination of the assumptions of regression analysis has attempted to detect and measure the departure of the data under study from those assumptions. According to Blalock (73), "some moderate departures from normality and equality of variance can be tolerated without necessitating the use of nonparametric alternatives." This data does not seem to deviate enough from the assumption to prevent the use of multiple regression analysis.

The regression equation may be solved in several ways (77). In a simple regression analysis all the independent variables are entered into the equation at the same time. All variables, for which coefficients can be calculated, are in the solution regardless of their contribution to the explained variance. With hierarchical inclusion the variables are entered into the equation in the order specified by the researcher. This procedure is appropriate when causal order among the variables is necessary for the interpretation of the data. Variables may also be entered into the equation on the
basis of same pre-established statistical criteria. Variables may be entered into or removed from the equation on the basis of their contribution to the explained variance. Or, in a stepwise procedure, as each new variable is added to the equation, variables that no longer meet the criteria for inclusion may be deleted.

Simple regression analysis was modified slightly for this study. Instead of entering all the independent variables into the equation at the same time, the variables were divided into three groups: socio-economic, education, and health. Each group was examined separately using ordinary least squares regression analysis. All variables that were significant at .05 or more, with both dependent variables in the preliminary equations, were included in the final equations.
CHAPTER IV
RESULTS

Descriptive Findings

Some regional differences were found but most of these seemed to be related to urban or rural residence. Results are reported as one sample but significant differences between regions are noted.

Incidence of malnutrition

Malnutrition was identified by two methods: percent deviation from a standard and degree of malnutrition. Percent of deviation from the 50th percentile of the anthropometric standards published by the National Center for Health Statistics (NCHS) (79) was calculated for height/age, weight/age, and height/weight. An average of these three was also calculated. To obtain degree of malnutrition, weight/age was plotted on the growth chart used by the Bureau of Nutrition in the nutrition centers. This chart uses the 50th percentile of the Boston anthropometric measurements as the normal growth curve. The summary of anthropometric findings based on the NCHS standards, presented in Table 3, shows a great difference in incidence of malnutrition when values are calculated by different parameters. Height/age, an indicator of long-term nutritional status, and the age-independent indicator, height/weight, have similar means and ranges. The correlation between these parameters, as shown in Table 4 was low indicating that they are probably measuring different aspects of malnutrition. An almost perfect (.990) correlation was found between weight/age and the average. The difference between the
Table 3. Percent deviation from normal height, weight, and height/weight found in 160 Haitian children in January 1978.¹

<table>
<thead>
<tr>
<th>Percent of standard</th>
<th>%</th>
<th>(N)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Height/age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 90.0</td>
<td>45.6</td>
<td>(73)</td>
</tr>
<tr>
<td>75 - 90.0</td>
<td>53.1</td>
<td>(85)</td>
</tr>
<tr>
<td>60 - 74.9</td>
<td>1.2</td>
<td>( 2)</td>
</tr>
<tr>
<td>&lt; 60</td>
<td>0.0</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>**88.8 ± 6.3 (71.3 - 106.3)**²</td>
<td></td>
</tr>
<tr>
<td><strong>Weight/age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 90.0</td>
<td>11.9</td>
<td>(19)</td>
</tr>
<tr>
<td>75 - 90.0</td>
<td>30.6</td>
<td>(49)</td>
</tr>
<tr>
<td>60 - 74.9</td>
<td>43.1</td>
<td>(69)</td>
</tr>
<tr>
<td>&lt; 60</td>
<td>14.4</td>
<td>(23)</td>
</tr>
<tr>
<td></td>
<td><strong>73.9 ± 13.3 (42.2 - 115.2)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Height/weight</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 90.0</td>
<td>45.6</td>
<td>(73)</td>
</tr>
<tr>
<td>75 - 90.0</td>
<td>48.1</td>
<td>(77)</td>
</tr>
<tr>
<td>60 - 74.9</td>
<td>6.2</td>
<td>(10)</td>
</tr>
<tr>
<td>&lt; 60</td>
<td>0.0</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td><strong>89.8 ± 9.8 (72.7 - 121.0)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 90.0</td>
<td>22.5</td>
<td>(36)</td>
</tr>
<tr>
<td>75 - 90.0</td>
<td>63.8</td>
<td>(102)</td>
</tr>
<tr>
<td>60 - 74.9</td>
<td>13.8</td>
<td>(22)</td>
</tr>
<tr>
<td>&lt; 60</td>
<td>0.0</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td><strong>84.2 ± 8.5 (64.3 - 111.1)</strong></td>
<td></td>
</tr>
</tbody>
</table>

¹Compared to the standards published by the National Center for Health Statistics (NCHS) of the United States.

²$\bar{x} \pm SD$ (range).
Table 4. Correlations between anthropometric parameters used to determine malnutrition in 160 Haitian children.

<table>
<thead>
<tr>
<th></th>
<th>Ht/age</th>
<th>Wt/age</th>
<th>Ht/wt</th>
<th>Average</th>
<th>Gomez</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ht/age</td>
<td>1.000</td>
<td>0.794</td>
<td>0.223</td>
<td>0.735</td>
<td>0.768</td>
</tr>
<tr>
<td>Wt/age</td>
<td>1.000</td>
<td>0.741</td>
<td>0.990</td>
<td>0.908</td>
<td></td>
</tr>
<tr>
<td>Ht/wt</td>
<td>1.000</td>
<td>0.816</td>
<td></td>
<td>0.641</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>1.000</td>
<td></td>
<td>0.899</td>
<td></td>
</tr>
<tr>
<td>Gomez</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.000</td>
</tr>
</tbody>
</table>

1 Based on the National Center for Health Statistics (NCHS) standards.

2 Degree of malnutrition based on the Boston standards and the Gomez classification.
means and the distribution of cases within each percentile group of these parameters indicated that they were not of equal value as indicators of malnutrition. Using the average only, 13.8% of the children were between the 60-74.9th percentile and no children were below the 60th percentile; that is, there were no severely malnourished children when this indicator was employed.

A comparison of the degree of malnutrition with weight/age based on the NCHS standards and the Boston standards using the same percentile distribution as the Gomez classification is shown in Table 5. The distribution of normal to severely malnourished children using the Boston standard was similar to findings from previous studies in Haiti (Table 1). Use of the NCHS standards showed a much higher prevalence of second and third degree malnutrition and a lower prevalence of normal children than with the Boston standards. The weight of 57.5% of the children, using the NCHS standard, and 40.1%, using the Boston standard, was below the 75th percentile. Regardless of the standard used, this high percentage of second to third degree malnutrition is a great detriment to the Haitian people. Further analysis of the data was conducted to identify factors that could reduce this extremely high incidence. The degree of malnutrition of the children in this study is plotted on the growth curve used by the Bureau of Nutrition (Figure 3).

**Household characteristics**

The 160 respondents ranged in age from 17 to 45 years of age with a mean age of 30.4 years. Only 20.0% said they could read. This
Table 5. Comparison of degree of malnutrition in 160 Haitian children using the NCHS\textsuperscript{1} and the Boston weight/age standards.

<table>
<thead>
<tr>
<th>Percent of standard</th>
<th>NCHS</th>
<th>Boston</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>(N)</td>
</tr>
<tr>
<td>90 ≥ 100</td>
<td>11.9</td>
<td>(19)</td>
</tr>
<tr>
<td>75 – 89.9</td>
<td>30.6</td>
<td>(49)</td>
</tr>
<tr>
<td>60 – 74.9</td>
<td>43.1</td>
<td>(69)</td>
</tr>
<tr>
<td>&lt; 60</td>
<td>14.4</td>
<td>(23)</td>
</tr>
</tbody>
</table>

\textsuperscript{1}National Center for Health Statistics.
reported literacy was similar to that reported in other studies and to government figures. Most households were composed of a nuclear family, although there were also many extended family households reported. There was an average of 5.50 ± 2.30 persons per household. Households were slightly larger in the Northwest ($\overline{X} = 7.41$) and slightly smaller in the North ($\overline{X} = 4.35$). About half of the respondents (55.3%) had only one child less than 5 years of age at home. Slightly more than one-third (37.1%) had 2 children and only 7.5% had 3 children under 5 years old. Respondents in Port-au-Prince tended to have more children under 5 years than respondents in the other regions although the difference was not significant. The mean age of the children was 29.41 ± 14.6 months. Children in Port-au-Prince and the Northwest averaged less than 2 years while children in the other two regions were closer to 3 years of age. Jacmel and the North also had the highest percentage of children attending a nutrition center. The sample included 89 males (55.6%) and 71 females (44.4%). The percent of children in each region that had attended a nutrition center and the average number of months they had attended is shown in Table 6. The average stay for the 68.1% who had attended a center was 3.2 months.

Anthropologists (31,80) have reported that Haitian peasant Farmers frequently have several common-law wives, each living on a separate plot of land. To determine if the father lived with the family, the women were asked the name, age, and relationship to her of all persons residing in the household. A large percentage (63.1%) of the women named their husband as a member of the household. The number of households with the father present ranged from 56.7% in the
Table 6. Percent of children attending a nutrition center by region and average length of stay in the center.

<table>
<thead>
<tr>
<th>Region</th>
<th>Attending Center</th>
<th>Months in Center</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>(N)</td>
</tr>
<tr>
<td>Port-au-Prince</td>
<td>52.3</td>
<td>(22)</td>
</tr>
<tr>
<td>Jacmel</td>
<td>80.5</td>
<td>(33)</td>
</tr>
<tr>
<td>Northwest</td>
<td>17.6</td>
<td>(3)</td>
</tr>
<tr>
<td>North</td>
<td>85.0</td>
<td>(51)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>68.1</td>
<td>(109)</td>
</tr>
</tbody>
</table>
North to 78.6% in the Northwest. No attempt was made to determine actual marital status because this was thought to be less important than the presence of the child's father in the house.

**Occupational characteristics**

When the occupations of adult household members were examined, an average of 1.81 working adults per household were found. In 8.8% of the households the only occupation given was housework, with no indication of an occupation that would provide money for food purchases or a garden that would produce food. Haitian peasant women traditionally work in the fields and sell the produce from the fields as well as take care of the family. Respondants were asked to name all their occupations. The occupations were then categorized as housework, house and field work, sell produce, revender (buy in one community and sell in another), shopkeeper, artisan, skilled worker, unskilled worker, and charcoal maker. Although the average number of occupations was 1.38, there was a statistically significant difference between regions. A great majority of the respondents in the West (Port-au-Prince, 83.3%; Jacmel, 87.8%) had only one occupation while 88.3% in the Northwest had two or more occupations. In the North 66.7% had only one occupation. House and field work was the most frequently given occupation (Table 7). At least 43.7% of the respondents were involved in the market place as either produce sellers, revenders, or shopkeepers. The Haitian government has a community development program, involving artisans, in the Northwest. Artisans and charcoal makers were found only in this region. Less than 10% of the total
Table 7. Occupations reported by Haitian women in January 1978.

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Number</th>
<th>% total respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>House and field work</td>
<td>78</td>
<td>48.8</td>
</tr>
<tr>
<td>Housework only</td>
<td>45</td>
<td>28.1</td>
</tr>
<tr>
<td>Sell produce</td>
<td>20</td>
<td>12.5</td>
</tr>
<tr>
<td>Vend/revend</td>
<td>42</td>
<td>26.2</td>
</tr>
<tr>
<td>Shopkeeper</td>
<td>8</td>
<td>5.0</td>
</tr>
<tr>
<td>Skilled worker</td>
<td>6</td>
<td>3.8</td>
</tr>
<tr>
<td>Artisan</td>
<td>4</td>
<td>2.5</td>
</tr>
<tr>
<td>Charcoal maker</td>
<td>6</td>
<td>3.8</td>
</tr>
<tr>
<td>Unskilled worker</td>
<td>9</td>
<td>5.6</td>
</tr>
</tbody>
</table>

Total occupations = 218

\[ X = 1.36 \pm .65 \]

\(^1\)Total is greater than 100.0\% because respondents were asked to name all their occupations.
sample said they were in skilled or unskilled occupations such as teachers, dressmakers, maids, or cooks. Although the women in the Northwest had more occupations, they reported fewer days away from home working. The average number of days away from home working per week was 3.15 with a range from 1.96 in the Northwest to 3.73 in Jacmel. Care of the young children during the mother's absence was left primarily to the grandmother (33.3%), older sibling (25.6%) or another female friend or relative (29.1%). Fathers or other males cared for only 12.0% of the children.

**Economic resources**

A garden is very important to the peasant since it represents a primary source of income as well as food for the family. Land tenure can be used as an indicator of the family's wealth. As expected, significantly fewer respondents in Port-au-Prince (27.5%) had gardens than in any other region. The percent of gardners in other regions ranged from 65.0% in the North to 87.5% in the Northwest. Most of those with gardens either owned (41.1%) or rented (35.8%) the land. Only 23.2% used land they did not own or pay for in cash or crops except in Port-au-Prince where the majority of those with gardens used the land without paying for it. In the Northwest, families were more likely to own their land while in Jacmel they were more likely to rent the land. Land tenure varied a great deal in the North. These significant differences between regions can probably be attributed in part to urban-rural differences. In addition to the urban respondents in Port-au-Prince, one of the survey sites in the North was in the
environ of Cap-Haitien, the second largest city in Haiti. Data from this site may have contributed to the mixed land tenure findings in the North.

There was also a significant difference in the ability to feed the family from the garden. In Port-au-Prince 71.0% were never able to feed their families sufficient food from the garden while 60.0% in the Northwest were always able to do so. In Jacmel 57.6% and in the North 67.9% almost always had enough food from their gardens. Respondents were asked if they received food from their families or for work in an effort to determine the availability of food that was not purchased or grown by the household. A majority of the women (64.7%) never received food from their families but almost a third (30.8%) sometimes did. Limited opportunities to receive food for work in Port-au-Prince were reflected by the fact that 90.2% of the respondents in that region did not participate in such programs. In the other regions 60.5 - 63.3% of the women received food for work.

Animal holdings were assessed as a possible alternative to land tenure as a wealth index. In an attempt to minimize respondent error, the women were asked what kinds of animals they owned but not the number of each kind of animal. The economic importance of the animals named was rank ordered by Agronome Eli Laroche of the Bureau of Nutrition. The ranked order from least to most important was: chicken, goat, pig, beef, donkey, horse. An animal score was obtained by assigning points to each animal relative to its economic importance as determined by Agronome Laroche. By this method chicken = 1, goat = 2, pig = 3, beef = 4, donkey = 5, and horse = 6. The assigned number
for each animal owned was added to determine the animal score. The contrast between urban and rural areas was again reflected in animal holdings. Significantly fewer households in Port-au-Prince had animals than in other regions and those who did have animals had fewer different kinds, mostly chickens or goats. Households with animals ranged from 14.3% in Port-au-Prince to 70.6% in the Northwest. Respondents in the Northwest not only were more likely to own animals, they were also more likely to own a greater variety of animals and more important animals such as burros. The communities surveyed in the Northwest tended to be more isolated than those in other regions. Donkeys, used to carry charcoal and produce to market and water from the source, were owned by 50.0% of the respondents in the region. No other respondents had donkeys although three families in the North had horses. Animal ownership is summarized in Table 8.

Wealth, as reflected by land or animal holdings is not always a good predictor of money spent for food. Peasants will frequently use any extra cash to increase their land holdings or capital goods rather than to change the quantity or quality of the family's food intake. The amount of money spent for food has, therefore, been a better predictor than wealth of nutritional status. Respondents were asked how much money they spent for food the last time they went to the market. They were also asked when they last went to the market and when they would go again. This information was used to determine how much money was spent per day on food. The mean total food expenditure, per market trip, was $4.54 ± 5.36 gourdes$¹ with a range from 80 centimes

¹One gourde = $.20 United States currency.
Table 8. Summary by region of animal ownership and animal score as reported by Haitian women in January 1978.

<table>
<thead>
<tr>
<th>Region</th>
<th>Own animals</th>
<th>No. animals owned</th>
<th>Animal Score $^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port-au-Prince</td>
<td>14.3 (6)</td>
<td>2.0</td>
<td>4.2</td>
</tr>
<tr>
<td>Jacmel</td>
<td>56.1 (23)</td>
<td>2.26</td>
<td>4.2</td>
</tr>
<tr>
<td>Northwest</td>
<td>70.6 (12)</td>
<td>3.17</td>
<td>9.0</td>
</tr>
<tr>
<td>North</td>
<td>58.3 (35)</td>
<td>2.16</td>
<td>5.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>47.5 (76)</td>
<td>2.34</td>
<td>5.3</td>
</tr>
</tbody>
</table>

$^1$ Obtained by ranking animals owned in order of economic importance, assigning a numerical value to each animal corresponding to the rank order, and adding the rank order values for each type of animal owned by a family.
to 25 gourdes. In general the women went to market every 2-3 days although they went more frequently in Port-au-Prince and the North. In Jacmel over a third (38.5%) of the respondents said they only went to market once a week. A few women, especially in the Northwest, did not know when they would go to market again. The mean daily food expenditure per household was 2.00 ± 2.46 gourdes. The women were also asked about the adequacy of their food money using a scale ranging from absolutely insufficient to absolutely sufficient. Although a few women in each region said they had enough or almost enough food, 83.0% of all respondents said their food money was absolutely insufficient or not sufficient to meet their family's needs. More women in the Northwest than in any other region thought they had sufficient food money.

Charcoal must be purchased by many Haitians in order to cook their food. The possibility of using gourdes spent for charcoal as an additional economic indicator was explored. Only 46.2% (N = 74) of the total sample purchased charcoal. Of this group, 65 of the women spent one gourde or less.

**Nutrition knowledge and practice**

Children in developing countries who are breast fed generally follow the same growth pattern as well nourished children from developed countries (81). It is not until the child is weaned that the growth curves diverge and the child from a developing country often falls below the child from a wealthy family in his country or a child in a developed nation. Food offered to the child at weaning may be of low
nutrient density, low caloric density, an incomplete protein, or any combination of these. The mothers were given a list of foods commonly eaten in Haiti and asked to choose the one best food to give a child at weaning. The foods were ranked on a scale of 1 to 5 in order of their increasing protein value:

1. starch or plantain
2. rice or corn
3. black beans
4. black beans and corn
5. milk or egg.

Only the animal sources of protein, egg and milk, and the combined vegetable protein, black beans and corn, would offer a growing child all the essential amino acids needed to promote growth in addition to body maintenance. The majority of the mothers (56.5%) selected black beans and corn as the best weaning food. Another 32.7% selected either milk or egg. These responses are presented in Table 9. The women were given a second list of foods and asked to select the one food that was best for their family to eat. These foods were similar to the list of weaning foods but without any animal source of protein. Table 10 shows the results of this question. Over 90% of the respondents selected either black beans and corn or black beans and rice as the best food for their family. A nutrition knowledge score was obtained by adding together the scores from best weaning food and best family food. The women did have some concept of good foods for their families since 85.0% had a nutrition knowledge score of 8 or 9. The mean score was 7.92 \pm 1.24. Although nutrition is one of the topics taught to the mothers of children in the nutrition centers, there was no correlation between the mothers nutrition
Table 9. The best weaning food for children as reported by Haitian mothers in January 1978.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Food</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Starch or plantain</td>
<td>4.8 (7)</td>
</tr>
<tr>
<td>2</td>
<td>Rice or corn</td>
<td>4.8 (7)</td>
</tr>
<tr>
<td>3</td>
<td>Black beans</td>
<td>1.3 (2)</td>
</tr>
<tr>
<td>4</td>
<td>Black beans and corn</td>
<td>56.5 (83)</td>
</tr>
<tr>
<td>5</td>
<td>Milk or egg</td>
<td>32.1 (48)</td>
</tr>
</tbody>
</table>

TOTAL 100.0 (147)

1Some responses were invalid because the mother named more than one food.
Table 10. The best food for the family as reported by Haitian women in January 1978.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Food</th>
<th>Response</th>
<th>(N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plantain</td>
<td>2.5</td>
<td>(4)</td>
</tr>
<tr>
<td>2</td>
<td>Corn or rice</td>
<td>4.4</td>
<td>(7)</td>
</tr>
<tr>
<td>3</td>
<td>Black beans</td>
<td>1.2</td>
<td>(2)</td>
</tr>
<tr>
<td>4</td>
<td>Black beans and rice or</td>
<td>91.9</td>
<td>(147)</td>
</tr>
<tr>
<td></td>
<td>Black beans and corn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>100.0</td>
<td>(160)</td>
</tr>
</tbody>
</table>
knowledge score and the number of months the child had been in the
nutrition center.

The increase in bottle feeding and concomittant decrease in
breast feeding observed in other developing countries may not have
occurred to the same degree in rural Haiti. Only 3 mothers in the North
and 3 in Port-au-Prince said that they usually bottle fed their
infants. At least one-third of the women in each region relied on
the breast alone. Although 59.5% of the respondents claimed to combine
breast and bottle feeding, bottle feeding was rarely seen during the
data collection while mothers nursing on demand were frequently
encountered.

More women weaned their children between 16 and 18 months than
at any other time but there were some regional differences. Children
in Port-au-Prince were more likely to be weaned early (36.4% at less
than 6 months of age) while those in the Northwest were more likely
to be weaned later (36.4% at more than 18 months) than other children.
There were 31 children (19.4%) in the sample who had not been weaned.

Children began to eat family foods before they were weaned.
Only 7.7% of the sample never ate the regular family foods while 71.8%
always did so. Other responses to eating family food ranged from
rarely (7.1%) to sometimes (7.7%) and generally (5.8%). At least
one-half of the mothers said their children ate 3 or more meals each
day except in the North where two-thirds of the children received
only 2 meals per day. The average number of meals consumed per day
was 2.5 ± .7.
Sanitation practices

In Haiti it is estimated that only 12.5% of the population has access to potable water (58). Piped water is only available to individual homes in some areas of the larger cities. The majority of the population obtains water from a community faucet, a well, a spring or a river. If the source of water is not near the house much time must be spent in collecting water for household use. Source of water varied greatly by region. Almost all of the respondents in Port-au-Prince (97.6%) and 60.0% in the Northwest received their water from a pipe or faucet (Table 11). While a river provided water for 46% of the people in Jacmel and the North, springs or pipes were important sources also. Surprisingly, only 4 respondents in the sample received water from a well. The high percentage of women in the Northwest who received water from a pipe or faucet probably reflected the high priority the Haitian government has placed on digging wells and bringing water to this arid region.

Potable water is important in disease prevention. In the United States, community water treatment is taken for granted. In developing countries such as Haiti water treatment is up to the individual household. Mothers of children in the nutrition centers are taught to treat water before drinking it. Almost 60% of the women said they never treated their water while another one-third said they did sometimes. Women in Port-au-Prince were most likely and women in the Northwest were least likely to treat the water.

In addition to potable water, sanitary sewers or use of a latrine can help reduce infectious disease and parasitic infestation.
Table 11. Source of water reported by Haitian women in January 1978.

<table>
<thead>
<tr>
<th>Source</th>
<th>West % (N)</th>
<th>South % (N)</th>
<th>Northwest % (N)</th>
<th>Northeast % (N)</th>
<th>Total % (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well</td>
<td>2.4 (1)</td>
<td>--</td>
<td>13.3 (2)</td>
<td>1.7 (1)</td>
<td>2.5 (4)</td>
</tr>
<tr>
<td>Spring</td>
<td>--</td>
<td>39.0 (16)</td>
<td>26.7 (4)</td>
<td>18.3 (11)</td>
<td>19.6 (31)</td>
</tr>
<tr>
<td>Pipe</td>
<td>97.6 (41)</td>
<td>14.6 (6)</td>
<td>60.0 (9)</td>
<td>33.3 (20)</td>
<td>48.1 (76)</td>
</tr>
<tr>
<td>River</td>
<td>--</td>
<td>46.3 (19)</td>
<td>--</td>
<td>46.7 (28)</td>
<td>29.7 (47)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>26.6 (42)</td>
<td>25.9 (41)</td>
<td>9.5 (15)</td>
<td>38.0 (60)</td>
<td>100.0 (158)</td>
</tr>
</tbody>
</table>

1 Missing two responses.
Sanitary sewers are available to only a small percentage of the urban population. The community latrine in many rural areas is reserved for visitors and kept locked when not in use. Although 59.4% of the population never use a latrine, 80.5% of the women in Port-au-Prince do use them.

Health indices

The synergistic effect of infection and malnutrition was examined by looking at such parameters as medical clinic visits, frequency and type of illness, and diarrhea and parasite incidence. Rural Haitians have limited access to health care facilities. Mobile clinics are used, particularly in the Northwest, to provide care to more people. In these clinics the medical team comes only once a week and the people come from many miles around. Despite the difficulty sometimes encountered in getting to a clinic, 69.4% of the children had visited a clinic. There was a statistically significant difference between regions as shown in Table 12. Although only 47.1% of the children in the Northwest had visited a clinic, those who had gone had made an average of 4.6 visits. This was the highest average number of clinic visits for any of the regions. In contrast, the 81.0% of the children in Port-au-Prince who had been to a clinic had averaged only 3.0 visits.

Diarrhea frequency has a debilitating effect on undernourished children in developing countries. Mothers were asked if their child had diarrhea at the time of the interview and how frequently the child suffered from diarrhea. The majority of the children
Table 12. Percent of Haitian children who had been treated in a clinic and the average number of clinic visits by those children.

<table>
<thead>
<tr>
<th>Region</th>
<th>Treated in Clinic</th>
<th>Number of visits $^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>(N)</td>
</tr>
<tr>
<td>Port-au-Prince</td>
<td>81.0</td>
<td>(34)</td>
</tr>
<tr>
<td>Jacmel</td>
<td>65.9</td>
<td>(27)</td>
</tr>
<tr>
<td>Northwest</td>
<td>47.1</td>
<td>(8)</td>
</tr>
<tr>
<td>Northeast</td>
<td>70.0</td>
<td>(42)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>69.4</td>
<td>(111)</td>
</tr>
</tbody>
</table>

$^1$Of those who had attended a clinic.
(79.2%) did not have diarrhea at the time of the survey. Although there were no significant differences between regions, almost one-third of the children in Port-au-Prince did have diarrhea. This region also had the greatest number of children (38.1%) who often had diarrhea. Approximately one-third (34.4%) of the children rarely or never had diarrhea while 43.1% sometimes did and 22.5% often did. There was a slight correlation (.215) between having diarrhea at the time of the study and the frequency of diarrhea as reported by the mother.

The children were not checked for parasites by the survey teams but the mothers were asked if the child had parasites. The total percentage of children having parasites was 80.5%. The Northwest region differed significantly with only 29.4% of the subjects reporting parasites. In contrast almost all (96.6%) of the children in the North were infested according to their mothers.

The mothers were asked how frequently their children were ill and what illnesses they had had. The illnesses reported are shown in Table 13. Almost all of the children had had upper respiratory illness and fever. Only one case of measles or malaria was reported. Whooping cough and chicken pox were the major childhood diseases reported. The number of times a child had any one illness was not determined. Diarrhea and parasites were recorded separately and were not included on this list. The scale for frequency of illness ranged from never to almost always. While 66.0% said their children were ill from time to time, there was little consensus among the regions. There was almost no correlation (.021) between the frequency of illness reported by the mother and the number of different illnesses she also
Table 13. Child illnesses reported by Haitian mothers in January 1978.

<table>
<thead>
<tr>
<th>Illness</th>
<th>Number Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper respiratory infection</td>
<td>153</td>
</tr>
<tr>
<td>Fever</td>
<td>150</td>
</tr>
<tr>
<td>Whooping cough</td>
<td>43</td>
</tr>
<tr>
<td>Colic</td>
<td>30</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>19</td>
</tr>
<tr>
<td>Chicken pox</td>
<td>12</td>
</tr>
<tr>
<td>Cough</td>
<td>9</td>
</tr>
<tr>
<td>Eye</td>
<td>9</td>
</tr>
<tr>
<td>Skin</td>
<td>8</td>
</tr>
<tr>
<td>Other (including measles, malaria, convulsions)</td>
<td>14</td>
</tr>
</tbody>
</table>
reported. The average number of different illnesses was 2.85 ± 0.96 with a range from 1.86 in the Northwest to 3.05 in Jacmel.

An illness index was constructed to determine if several illness parameters could be added and used to explain more of the variance in malnutrition. To construct the index responses to whether or not the child had diarrhea or parasites, the frequency of diarrhea and illness, and the number of illnesses reported other than diarrhea or parasites were added together. Having diarrhea or parasites was assigned a value of one. Not having diarrhea or parasites was assigned a value of zero. The index had a possible range from 2 to 18. The mean score was 10.80 ± 2.19. The Northwest had the lowest illness index, 8.5, while Port-au-Prince had the highest illness index, 11.2.

Predictive findings

Quantitative results of the socio-economic, education, health, and malnutrition variables were presented in the preceding section. The relationship of these variables as proposed in Figure 1 will be examined in this section. The analysis was a two-step process: first, the independent variables in each group were examined to determine which had the greatest effect on malnutrition; second, the selected variables from each group were examined together to identify those factors that explained the greatest amount of malnutrition in the sample population. Ordinary least squares multiple regression analysis was used in both steps.
Estimating malnutrition

Four parameters were used to determine malnutrition: height/age, weight/age, height/weight, and an average of the three. The percent of deviation of each parameter from the 50th percentile of the NCHS standard was calculated. Percent weight/age was also translated into degree of malnutrition using the Boston standard and the Gomez classification. The five dependent variables used to estimate malnutrition are summarized in Table 14. All regression equations were run using all five measures of malnutrition. The amount of variance explained was greatest when degree of malnutrition was the dependent variable except in the equations with the education variables. In these equations more of the variance was explained when height/age was the dependent variable. When either weight/age or the average was used as the dependent variable, the amount of explained variance was almost identical and usually 1-3% less than when degree of malnutrition was used. These findings differ from Levinson's (24) in which use of the average resulted in higher $R^2$'s. Slightly less variance was explained in almost all equations using height/weight. After examining all the regression equations generated by the analysis, weight/age was deemed to be the most appropriate measure of malnutrition. A decision was made to report weight/age as the dependent variable except when discussing the education equations in the first part of the analysis. In these equations height/age will also be reported as the dependent variable. A further decision was made to discuss both weight/age dependent variables; weight/age based on the NCHS standards and degree of malnutrition based on the Boston standards.
Table 14. Summary of dependent variables used to estimate malnutrition in Haitian children less than five years of age.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Parameter Measured</th>
<th>Standard used to Determine</th>
</tr>
</thead>
<tbody>
<tr>
<td>MALNUTR 1</td>
<td>Weight/age</td>
<td>NCHS(^1)</td>
</tr>
<tr>
<td>MALNUTR 2</td>
<td>Weight/age</td>
<td>Boston</td>
</tr>
<tr>
<td>MALNUTR 3</td>
<td>Height/age</td>
<td>NCHS</td>
</tr>
<tr>
<td>MALNUTR 4</td>
<td>Height/weight</td>
<td>NCHS</td>
</tr>
<tr>
<td>MALNUTR 5</td>
<td>Average MALNUTR 1,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MALNUTR 3 and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MALNUTR 4</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\)National Center for Health Statistics.
In the future these variables will be referred to as MALNUTR 1 and MALNUTR 2 respectively. When height/age is reported it will be referred to as MALNUTR 3.

Socio-economic determinants of malnutrition

The marketing system in Haiti is based upon a cash rather than a barter economy. The family garden or fields do not always provide enough cash crops to meet family needs forcing household members to engage in additional occupations. The economic factors thought to be most appropriate to Haiti were divided into occupation related variables, household characteristics, and economic resources and then examined in relation to their effect on malnutrition. Results of all the equations using the socio-economic determinants are presented in Table 15. To interpret regression equations, when all the independent variables except one are held constant, a one unit change in the variable under study will cause the dependent variable to change in the direction and magnitude of the coefficient of the variable under study. For example, in the first regression equation in Table 15, holding days away from home working, household size, and father in the household constant, a one unit increase in number of occupations would improve malnutrition by 1.037 percent. Conversely, a one unit decrease in number of occupations would increase malnutrition by 1.037 percent. Then holding number of occupations, household size and father in household constant, a one unit increase in days away working would result in a .018 increase in malnutrition. This procedure is repeated until the effect of each independent variable in the regression equation
Table 15. Regression equations with socio-economic variables and ordinary least squares multiple regression analysis used to estimate malnutrition.

1. MALNUTR 1 = 67.363 + 1.037 (number occupations) - .018 (days away working) + .856 (household size)\(^1\) + .522 (father in household) \(R^2 = .026\)

2. MALNUTR 1 = 64.066 + .809 (number of occupations) + 1.625 (sufficient food money)\(^1\) - .034 (days away working) + .874 (household size)\(^1\) + .764 (father in house) \(R^2 = .043\)

3. MALNUTR 1 = 63.228 + 3.394 (feed family from garden)\(^2\) + .996 (gourdes for food)\(^3\) - .311 (land tenure) - 6.244 (number different animals)\(^1\) + 1.838 (animal score)\(^1\) + .003 (gourdes for charcoal) \(R^2 = .255\)\(^3\)

4. MALNUTR 1 = 63.963 + 1.459 (food available)\(^2\) + .714 (gourdes for food)\(^3\) + .461 (land tenure) - 4.793 (number different animals) + 1.570 (animal score) \(R^2 = .205\)\(^3\)

5. MALNUTR 1 = 58.778 + .018 (animal score) + .947 (number of occupations) + 1.636 (sufficient food money)\(^1\) + .217 (household size) + .139 (father in house) + 1.767 (feed family from garden) + 1.008 (gourdes for food)\(^3\) - .339 (land tenure) \(R^2 = .200\)\(^3\)

6. MALNUTR 2 = .807 + .043 (number of occupations) + .020 (days away working) + .066 (household size)\(^1\) + .081 (father in house) \(R^2 = .034\)

7. MALNUTR 2 = .617 + .030 (number of occupations) + .094 (sufficient food money) + .020 (days away working) + .067 (household size)\(^2\) + .095 (father in house) \(R^2 = .046\)

8. MALNUTR 2 = .736 + .195 (feed family from garden)\(^1\) + .046 (gourdes for food)\(^3\) + .042 (land tenure) - .354 (number different animals) + .095 (animal score) - .001 (gourdes for charcoal) \(R^2 = .190\)\(^2\)

9. MALNUTR 2 = .893 + .045 (food available) + .033 (gourdes for food)\(^3\) + .124 (land tenure) - .294 (number different animals) + .086 (animal score) \(R^2 = .145\)\(^2\)

10. MALNUTR 2 = .374 + .001 (animal score) + .048 (number of occupations) + .099 (sufficient food money) + .026 (household size) + .029 (father in house) + .117 (feed family from garden) + .0465 (gourdes for food)\(^3\) - .005 (land tenure) \(R^2 = .149\)\(^2\)

\(^1\)Significant at .05.
\(^2\)Significant at .01.
\(^3\)Significant at .001.
has been examined while holding all other variables in the equation constant. The $R^2$ given at the end of each regression equation indicates how much of the variance in the dependent variable, malnutrition, can be explained when all of the variables in the equation are added together.

The occupation related variables, number of occupations and days spent away from home working, were first put into an equation with the household characteristic variables, household size and presence of the father in the household. In this equation only 2-3% of the variance in malnutrition was explained. Household size was the only variable that was significant in all equations. When the sufficient food money variable was added to the equation, variance explained increased to only approximately 4%. Household size continued to be significant but the new variable was also significant with MALNUTR 1. $R$ square change was less than .002 for the variable, time spent away from home working. Although this factor has been related to the incidence of malnutrition in other developing countries, it was not important in this Haitian sample and was not included in any further analysis.

The variables reflecting economic resources, able to feed family from garden, gourdes spent for food, land tenure, number of different animals owned, animal score, and gourdes spent for charcoal, were included in a wealth or resource equation. These variables explained 25.5% of the variance in MALNUTR 1 and 19.0% of the variance in MALNUTR 2. Gourdes spent for food was the most significant variable in both equations but able to feed family from garden, number of animals owned, and animal score were also significant. Land tenure,
more an indicator of wealth than liquid assets, produced an R-square change of .0019 which indicated almost no effect on malnutrition. The amount of gourdes spent for charcoal may be more dependent upon availability of free fuel rather than availability of money. That might account for the very small R-square change of .00085 attributed to this variable.

A food availability variable was constructed by adding a positive response to food received from other family members or work to the response for the ability to feed the immediate family from the garden. When this new variable was substituted for able to feed family from the garden, the amount of variance explained dropped in both equations. Number of animals owned and the animal score, derived from a ranked value assigned to each animal, had an expected high correlation of .951. Although both were significant, animal score produced a slightly larger R-square change and was selected for inclusion in the final socio-economic equation. Other variables in the final equation were: number of occupations, household size, presence of father in the household, gourdes for food, sufficient food money, able to feed family from garden, and land tenure.

In the final socio-economic equation the total explained variance was 20.0% of MALNUTR 1 and 14.9% of MALNUTR 2. The most useful variables in the equation were those relating to the availability of food money or food. Gourdes spent for food was significant at .001 in both equations. The mother's report of sufficient food money available was significant when MALNUTR 1 was the dependent variable but not with MALNUTR 2. Able to feed family from the garden was
significant at .10 in the same equation. All other socio-economic variables had extremely small F-values and were not useful in accounting for change in the dependent variable. Gourdes spent for food and able to feed family from the garden were chosen for the final equation specified by the model.

Educational determinants of malnutrition

Education helps members of a society to deal with the physical and social constraints of their environment. Nutrition centers, the primary instrument of nutrition education in Haiti, have attempted to reduce protein-calorie malnutrition by improving the mother's child rearing skills and abilities within her environment. Factors that can be changed by education were divided into feeding practices, nutrition knowledge, and sanitation variables. The child feeding practice variables, usual feeding method, weaning age, child eats family foods, and number of meals eaten daily, were analysed with the nutrition knowledge variables, best weaning food and the nutrition knowledge score. The number of months the child had spent in a Nutrition Center was also included in this equation. The results of the education equations are shown in Table 16. Only 14.4% to 15.9% of the variance in weight/age was explained by the education variables. However, 20.6% of the variance in height/age was explained by these variables. Evaluations of the educational benefits of the nutrition centers have been based upon the long-term effect on both the child and subsequent siblings. Since height/age reflects long-term nutritional status, a greater amount of variance explained in this dependent variable could
Table 16. Regression equations with education variables and ordinary least squares multiple regression analysis used to estimate malnutrition.

1. MALNUTR 1 = 72.470 - 1.505 (months in nutr ctr)$^3$ - 1.267 (best weaning food) + .918 (nutr knowledge) + .395 (usual feeding method) + 1.445 (weaning age)$^2$ + .213 (eat family food) - 2.432 (number meals/day)$^1$  
   $R^2 = .144^2$

2. MALNUTR 1 = 70.450 - 1.543 (months in nutr ctr)$^3$ + .290 (sanitation index) - 1.338 (best weaning food) + .931 (nutr knowledge) + .695 (usual feeding method) + 1.383 (weaning age)$^2$ + .029 (eat family food) - 2.284 (number of meals/day)$^1$  
   $R^2 = .147^2$

3. MALNUTR 1 = 71.733 - 1.562 (months in nutr ctr)$^3$ + .819 (source of water) - 1.308 (best weaning food) + .778 (nutr knowledge) + 1.079 (usual feeding method) + 1.332 (weaning age)$^2$ - .001 (eat family food) - 2.372 (number of meals/day)$^1$  
   $R^2 = .153^2$

4. MALNUTR 2 = 1.263 - .120 (months in nutr ctr)$^3$ - .013 (best weaning food) + .035 (nutr knowledge) + .066 (usual feeding method) + .089 (weaning age)$^2$ - .023 (eat family food) - .128 (number of meals/day)  
   $R^2 = .159^2$

5. MALNUTR 2 = 1.049 - .124 (months in nutr ctr)$^3$ + .031 (sanitation index) - .021 (best weaning food) + .037 (nutr knowledge) + .098 (usual feeding method) + .083 (weaning age)$^1$ - .043 (eat family food) - .112 (number of meals/day)  
   $R^2 = .164^2$

6. MALNUTR 2 = 1.223 - .124 (months in nutr ctr)$^3$ + .052 (source of water) - .016 (best weaning food) + .027 (nutr knowledge) + .108 (usual feeding method) + .082 (weaning age)$^1$ - .037 (eat family food) - .125 (number of meals/day)  
   $R^2 = .166^2$

7. MALNUTR 3 = 89.464 - .923 (months in nutr ctr)$^3$ - 1.706 (best weaning food)$^1$ + 1.650 (nutr knowledge)$^2$ - .796 (usual feeding method) + .272 (weaning age) - .466 (eat family food) - 1.232 (number of meals/day)$^2$  
   $R^2 = .202^3$

8. MALNUTR 3 = 90.697 - .910 (months in nutr ctr)$^3$ - .177 (sanitation index) - 1.662 (best weaning food)$^1$ + 1.639 (nutr knowledge)$^2$ - .980 (usual feeding method) + .310 (weaning age) - .354 (eat family food) - 1.323 (number of meals/day)$^2$  
   $R^2 = .206^3$

9. MALNUTR 3 = 89.276 - .918 (months in nutr ctr)$^3$ - .075 (source of water) - 1.709 (best weaning food)$^1$ + 1.657 (nutr knowledge)$^2$ - .809 (usual feeding method) + .298 (weaning age) - .423 (eat family food) - 1.233 (number meals/day)$^2$  
   $R^2 = .197^3$

$^1$Significant at .05;  $^2$Significant at .01;  $^3$Significant at .001.
be expected. For this reason results of the equations with MALNUTR 3 will also be reported in this section.

The number of months spent in the nutrition center had a highly significant (.001) negative effect on nutritional status of the child. Weaning age explained a significant amount of the variance but usual feeding method before weaning was unimportant. The longer a child was breast fed, the less likely he was to be malnourished. Eating family food did not have a significant effect but the number of meals a child ate each day was negatively associated with malnutrition. When number of meals per day was included in an equation with other feeding practices it was not significant. However, when it was included in an equation with all the educational variables, it was significant in explaining variance in MALNUTR 1 (.05) and MALNUTR 3 (.01). The best weaning food and the nutrition knowledge score were significant in the equation with MALNUTR 3 but not in the other equations.

Two separate sanitation variables were added into the equation. The first variable, source of water, added less than 1% to the explained variance in MALNUTR 1 and MALNUTR 2 and decreased the amount of explained variance in MALNUTR 3 by 0.5%. In the second variable, responses to source of water, water treatment, and use of a latrine were added to construct a sanitation index. This index was used to determine how much the combination of these variables would add to the explained variance. Addition of the sanitation index increased the explained variance by 0.5% or less in all equations.

The number of months in the nutrition center and weaning age were the only variables from this group that contributed a significant
amount to the variance in all equations with MALNUTR 1 and MALNUTR 2. They were, therefore, selected as the most appropriate education variables for the final equation.

**Health determinants of malnutrition**

The occurrence of disease is the result of a causal triad including the disease agent, host characteristics, and environmental factors. The presence of the disease agent will not cause the disease to occur in the host unless the host is susceptible and the environmental conditions are supportive of the agent. A malnourished child is a susceptible host and the unsanitary environment in which he usually resides is conducive to the development of disease. Present disease status and frequency of disease, as reported by the mother, were examined in relation to malnutrition. Because of the importance of environmental factors in the disease triad, sanitation was reexamined in the context of health. The results of the health equations are presented in Table 17.

The most unexpected finding of the study was that in this sample neither having diarrhea nor the frequency of diarrhea had a significant effect on malnutrition. The low correlation between having diarrhea and the other health and malnutrition variables, as seen in Table 18, further shows the low association between these factors. The health variables, presence of diarrhea or parasites at the time of the study, diarrhea and illness frequency, and number of illnesses, explained 11.5% of the variance in MALNUTR 1 and 13.8% in MALNUTR 2. Having parasites and the number of illnesses reported were highly significant
Table 17. Regression equations with health variables and ordinary least squares multiple regression analysis used to estimate malnutrition.

1. **MALNUTR 1** = 92.107 - 5.262 (have parasites)\(^2\) - .503 (diarrhea frequency) - 1.900 (illness frequency) - 3.228 (number illness)\(^3\) + .378 (have diarrhea)  
   \[ R^2 = .115^2 \]

2. **MALNUTR 1** = 90.461 - 5.282 (have parasites)\(^2\) + .191 (sanitation index) - .292 (diarrhea frequency) - 1.891 (illness frequency) - 3.321 (number illness)\(^3\) + **\(^4\) (have diarrhea)  
   \[ R^2 = .116^2 \]

3. **MALNUTR 1** = 90.631 - 5.455 (have parasites)\(^3\) + .596 (water source) - .160 (diarrhea frequency) - 1.874 (illness frequency) - 3.406 (number illness)\(^3\) + **\(^4\) (have diarrhea)  
   \[ R^2 = .119^2 \]

4. **MALNUTR 1** = 93.369 - 3.236 (have parasites)\(^3\) + 1.194 (water source) - .540 (diarrhea frequency) - 2.420 (illness frequency)\(^2\) - 3.140 (number illness)\(^3\) + 3.527 (sex)\(^2\) - .237 (age)\(^3\) + **\(^4\) (have diarrhea)  
   \[ R^2 = .184^3 \]

5. **MALNUTR 2** = 2.450 - .400 (have parasites)\(^3\) + .038 (diarrhea frequency) - .064 (illness frequency) - .249 (number illness)\(^3\) + .0002 (have diarrhea)  
   \[ R^2 = .138^3 \]

6. **MALNUTR 2** = 2.202 - .397 (have parasites) + .029 (sanitation index) + .058 (diarrhea frequency) - .060 (illness frequency) - .273 (number illness)\(^3\) + **\(^4\) (have diarrhea)  
   \[ R^2 = .143^3 \]

7. **MALNUTR 2** = 2.338 - .408 (have parasites)\(^3\) + .042 (water source) + .058 (diarrhea frequency) - .060 (illness frequency) - .271 (number illness) + **\(^4\) (have diarrhea)  
   \[ R^2 = .143^3 \]

8. **MALNUTR 2** = 2.365 - .246 (have parasites) + .080 (water source)\(^3\) + .037 (diarrhea frequency) - .078 (illness frequency) - .261 (number illness)\(^3\) + .384 (sex)\(^3\) - .014 (age)\(^3\) + **\(^4\) (have diarrhea)  
   \[ R^2 = .221^3 \]

\(^1\)Significant at .05.  
\(^2\)Significant at .01.  
\(^3\)Significant at .001.  
\(^4\)Coefficient could not be calculated by the computer program.
Table 18. Correlation coefficients between diarrhea and other variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Have Diarrhea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ht/age (^1)</td>
<td>.095</td>
</tr>
<tr>
<td>Wt/age (^1)</td>
<td>-.003</td>
</tr>
<tr>
<td>Ht/wt (^1)</td>
<td>-.068</td>
</tr>
<tr>
<td>Average (Ht/age, Wt/age, Ht/wt) (^1)</td>
<td>-.005</td>
</tr>
<tr>
<td>Gomez (^2)</td>
<td>.008</td>
</tr>
<tr>
<td>Diarrhea frequency</td>
<td>.388</td>
</tr>
<tr>
<td>Illness frequency</td>
<td>-.001</td>
</tr>
<tr>
<td>Number of illnesses</td>
<td>.080</td>
</tr>
<tr>
<td>Have parasites now</td>
<td>-.092</td>
</tr>
</tbody>
</table>

\(^1\)Percent deviation from the 50th percentile of National Center for Health Statistics standards.

\(^2\)Degree of malnutrition based on the Boston standards and the Gomez classification.
Illness frequency had a very low correlation (-.021) with number of illnesses and contributed very little to the regression equation. The two sanitation variables used in the education equations were added to separate health equations. Again, the explained variance in malnutrition increased by no more than 0.5% with the use of the sanitation index in place of the variable source of water. Sex and age of the child were then added to the equation. These variables increased the explained variance by 5.0%. In all of the health equations including sanitation, age, and sex the coefficient for presence of diarrhea was so small it could not be calculated by the SPSS program. The health variables deemed most suitable for the final equation were number of illnesses and having parasites. Age and sex, although not specifically health indicators, are child characteristics associated with malnutrition. They were also included in the final equation.

**Determinants of malnutrition**

The final equation combined the most effective determinants in each group of variables: gourdes for food, feed family from garden, weaning age, months in the nutrition center, number of illnesses, and have parasites. Sex, age, and the interaction of weaning age and months in the nutrition center were included in the later stages of this analysis. Results of the analysis are presented in Table 19.

The explained variance was 29.1% for MALNUTR 1 and 29.5% for MALNUTR 2. Gourdes for food, feed family from garden, weaning age, and months in the nutrition center were significant in one or both of the equations. When age was added to the equation, the explained
Table 19. Regression with selected socio-economic, education, and health variables and ordinary least squares multiple regression analysis used to estimate malnutrition.

1. MALNUTR 1 = 69.570 + .758 (gourdes for food) + 1.633 (feed family from garden) + 1.045 (weaning age) - 1.417 (months in nutr ctr) - 1.741 (number illness) - 1.215 (have parasites)  
   $R^2 = .291$

2. MALNUTR 1 = 72.060 + .760 (gourdes for food) + 2.111 (feed family from garden) + .862 (weaning age) - 1.083 (months in nutr ctr) - 1.558 (number illness) - .069 (have parasites) - .178 (age)  
   $R^2 = .320$

3. MALNUTR 1 = 69.337 + .748 (gourdes for food) + 2.173 (feed family from garden) + .889 (weaning age) - 1.036 (months in nutr ctr) - 1.749 (number illness) + .911 (have parasites) - .186 (age) + 4.036 (sex)  
   $R^2 = .349$

4. MALNUTR 1 = 56.146 = .977 (interaction weaning age-months in nutr ctr) + .698 (gourdes for food) + 1.733 (feed family from garden) + 3.252 (weaning age) + 3.188 (months in the nutr ctr) - 1.498 (number of illness) + 2.355 (have parasites) - .131 (age) + 3.764 (sex)  
   $R^2 = .386$

5. MALNUTR 2 = 1.375 + .026 (gourdes for food) + .125 (feed family from garden) + .066 (weaning age) - .112 (months in nutr ctr) - .173 (number illness) - .138 (have parasites)  
   $R^2 = .295$

6. MALNUTR 2 = 1.563 + .026 (gourdes for food) + .161 (feed family from garden) + .053 (weaning age) - .086 (months in nutr ctr) - .159 (number illness) - .052 (have parasites) - .013 (age)  
   $R^2 = .333$

7. MALNUTR 2 = 1.319 + .025 (gourdes for food) + .167 (feed family from garden) + .055 (weaning age) - .082 (months in nutr ctr) - .176 (number illness) + .036 (have parasites) - .014 (age) + .362 (sex)  
   $R^2 = .370$

8. MALNUTR 2 = .520 - .059 (interaction weaning age-months in nutr ctr) + .022 (gourdes for food) + .140 (feed family from garden) + .198 (weaning age) + .174 (months in nutr ctr) - .161 (number illness) + .124 (have parasites) - .011 (age) + .346 (sex)  
   $R^2 = .408$

$^1$Significant at .05;  $^2$Significant at .01;  $^3$Significant at .001.
variance increased to 32.0% for MALNUTR 1 and 33.3% for MALNUTR 2. Age was significant in both equations. Number of illnesses became significant in the equation with MALNUTR 1. Variance again increased when sex was added to the equation to 34.0% for MALNUTR 1 and 37.0% for MALNUTR 2. This variable was significant in both of the new equations.

$R^2$ was further increased when the interaction term, weaning age times months in the nutrition center, was entered into the equation. The final amount of variance explained was 38.6% for MALNUTR 1 and 40.8% for MALNUTR 2. All the variables except have parasites were significant in one or both equations. The interaction between weaning age and months in the nutrition center, feed family from garden, and weaning age were highly significant (.001) in both equations. In addition gourdes for food was highly significant (.001) in the equation with MALNUTR 1 and number of illnesses with MALNUTR 2. Age and sex were significant at .01 with MALNUTR 1 and at .001 with MALNUTR 2. From this group of indicators it appears that the number of months in the nutrition center, able to feed family from garden, weaning age, age of the child, and sex were the best determinants of nutritional status. The amount of gourdes spent for food and the number of illnesses were also very effective. Having parasites was not as effective when many different types of variables were considered as it was when only health variables were considered. While weaning age and months in the nutrition center had a positive effect on malnutrition, the intersection of the two variables had a negative effect on malnutrition. All of the other
variables had a positive effect on malnutrition except age of the child and number of illnesses.
CHAPTER V
DISCUSSION

The results of this study show that of the three factors studied, socio-economic, education, or health interventions, economic intervention has the most significant impact on malnutrition. A high incidence (40.1%) of second and third degree malnutrition was found in this study. This was similar to the average incidence of second and third degree malnutrition (41.5%) reported by the studies shown in Table 1 (p. 7). The significant difference between boys and girls has not been reported by other investigators in Haiti although Ballweg (8) noted a tendency for more girls than boys to be malnourished. The absence of supporting data suggests the finding that boys were significantly more malnourished than girls is a phenomenon of this sample.

Socio-economic variables as a group were more effective than the other groups in causing malnutrition. Within this group the most important determinants were related to food or food money availability.

The average household size of 5.5 persons in this study was interesting in view of Rawson and Berggren's (29) finding that when a family has more than five members, the eldest child is frequently sent to live with a grandparent or other relative. This variable, household size, was significantly associated with an increase in malnutrition when it was examined with other family characteristics and occupational variables. When economic variables were included in the analysis, household size no longer explained a significant amount of the variance.
in malnutrition. This suggests that in larger households there are more people available to grow food or to earn money for food. There was a significant association between the father living in the house and the child's height/age indicating some long-term benefit to the child of living with his nuclear family. Ballweg (8) and Rawson and Berggren (29) also found that the father's presence in the house was positively related to the child's nutritional status.

Occupational patterns of the women were similar to those described by Metraux (32) in Haiti and Popkin and Solon (30) in the Philippines. The women had an average of 1.4 occupations which primarily involved house and fieldwork (76.9%) and/or some form of marketing (43.8%). This compares to Metraux's finding that 49% of the women were involved in marketing. Shah et al. (14), Okeahialam (15), and Popkin and Solon (30) all found that the mother's employment resulted in the child being left with an inferior caretaker. In this study there was no relationship between the number of days the mother was away working and an increase in malnutrition. This suggests that the caretakers were providing adequate care since the mother's absence did not result in a deterioration of the child's nutritional status. The caretakers were primarily the grandmother or another adult female. Only about one-fourth of the children were left with an older sibling. The poorest women in Popkin and Solon's study (30) were unable to earn enough money to replace their services to the household. The extended family groups in which most Haitians, especially in the rural areas, live (29) may provide the child with an adequate substitute for the mother's care.
The data from this study, similar to Ballweg's (8), failed to show that owning or having access to land affected the occurrence of malnutrition in the preschool child. Levinson (16) included land ownership in his wealth index which was not a satisfactory determinant of malnutrition in India. Although land access was not significant in this study, being able to feed the family from the land was highly significant. The studies of Rawson and Valverde (31) and Valverde et al. (33) differed from Levinson and Ballweg by examining the amount of land available to the farmer rather than land ownership. Their findings of a significant association between amount of land access and nutritional status may help explain the significant association in this study between the ability to feed the family from the garden and malnutrition. In the absence of data from this study on the size of land holdings, no correlation can be made between the amount of land available and the capacity to feed the family from the garden.

Use of a food availability variable, including able to feed family from garden, receive food from family, and receive food for work, resulted in a smaller amount of explained variance in malnutrition than the use of able to feed family from garden alone. The failure of this variable to add to the explained variance suggests that food from families or for work does not contribute regularly to most family's diet.

Another part of Levinson's wealth index (16) that had not been reported previously in Haiti was the animal score. This variable, along with the number of different animals owned, was more important than land tenure, in determining malnutrition. Although the number
and the variety of animals owned do indicate some wealth, they are fairly easy to convert to cash if more money is needed. This data is fairly easy to obtain if the peasant is asked only the variety of animals owned and not the number of animals, which might be threatening to the peasant if the interviewer is associated with a government function, such as tax collecting. The results of this study encourage further use of the number of different animals owned or an animal score as a wealth indicator in Haiti.

Gourdes spent for food was the most significant of the economic resource variables. When all the socio-economic variables were included in the equation, gourdes spent for food was, again, the most significant variable. While Graham (27) found that the amount of food money available was one of several significant factors affecting malnutrition, Collis and Jones (36) found it to be the most important factor. This study shows it is one of the most important factors in Haiti. The amount of money spent for food at each market trip averaged less than $1.00 United States currency. Although actual food expenditures were significantly related to malnutrition, the mother's opinion of the adequacy of the food money to meet the family's needs was not. Most women said they did not have sufficient money to buy food. These responses may have been biased by unrealistic estimations of the amount of food necessary for an adequate diet or a desire to purchase more expensive foods than they were currently eating.

While economic variables had a far greater effect on present status, represented by weight/age, education variables had a greater effect on the long-term well being, represented by height/age.
Evidence that bottle feeding has become a problem in Haiti was not found. Although 59.5% of the mothers said they combined breast and bottle feeding, usual feeding method had no effect on the occurrence of malnutrition. This suggests that while most women may occasionally offer the infant a bottle, the most frequent feeding method is to offer the breast upon demand. Most of the mothers weaned their children between 16 and 18 months of age. This is consistent with Bureau of Nutrition (53) findings that most women wean their children around 18 months of age. There was a significant association between weaning age and malnutrition. The earlier a child was weaned, the greater the risk of malnutrition. Gupta and Mwambe (50), Gurson et al. (51), and Scrimshaw et al. (42) have all found that early weaning resulted in the substitution of an inadequate, primarily carbohydrate diet, that did not meet the child's nutritional needs. These data suggest the same process may occur in Haiti.

Another finding related to weaning age was the significant interaction between weaning age and the number of months spent in the nutrition center. Weaning age or months in the nutrition center, alone, were positively correlated with malnutrition but, there was a negative correlation between the interaction of the two variables and malnutrition. The later a child was weaned or the longer it stayed in a nutrition center, the less likely it was to be malnourished. However, children who were weaned early and attended a nutrition center were significantly more malnourished than the rest of the sample. This is further evidence that the earlier a child is weaned, the more likely he is to be severely malnourished. As both King et al. (7) and
Beaudry-Darisme and Latham (61) have noted, some children fail to respond to treatment at a nutrition center due to health problems requiring medical treatment. Children who are weaned early may be more likely to be in the group of non-responders and thus spend more months in the center or return for more than one session. Another explanation is that the severity of their malnutrition requires a longer than average period of rehabilitation.

Eating family foods had no effect upon malnutrition. The number of meals a child ate each day did have a surprising negative effect on weight/age. Ballweg's (8) finding of an average of 1.9 meals per day was lower than the average of 2.5 meals per day consumed by the children in this sample. The children in the nutrition center received two meals plus two snacks each day. If the mother counted this as four meals plus the number of meals she provided, she would have said her child ate between four and six meals per day. Since the malnourished children were likely to be in the nutrition center, the number of meals reported for them would have been higher than for normal or non-center children. Thus, attendance at a nutrition center masked true child feeding patterns and prevented an accurate evaluation of this variable.

The food knowledge scores reinforced Behar's (10) claim that mothers know more than they are given credit for. The mother's high nutrition knowledge scores (\( \bar{X} \) 7.9 out of 9.0) did not affect weight/age but did affect height/age. The low correlation between the mother's nutrition knowledge and months in the nutrition center (.04) further suggests that indigenous practices influenced nutrition knowledge scores more than attendance at a nutrition center. The Haitian
peasants observed by Metraux (32) combined staples, such as beans and rice or corn, similar to the multi-mixes proposed by Jelliffe (52). What has not been determined is whether the mothers have learned to provide sufficient food to meet each family member's needs. Further study is indicated to determine what happens to food within the family when the quality of the diet is adequate but the quantity is inadequate to meet everyone's needs.

Sanitation, measured by source of water, treatment of water, and use of a latrine, had little effect on malnutrition when analyzed with either the education or health variables. Good sanitary practices are taught at the nutrition centers and do affect the health of the child. Mothers who know good sanitary methods may not be practicing them because they do not understand the importance of good sanitation or it is inconvenient to practice what they have learned. Regular household and garden related tasks required long and often arduous hours of work. The mothers may not have been convinced that the benefit to the child was worth the extra time and trouble involved in treating water or finding a latrine.

The most unexpected findings of the study were the low incidence (20.8%) of diarrhea at the time of the study and the almost unmeasurable effect of diarrhea on malnutrition. Further, only 22.5% of the mothers said their children frequently had diarrhea. This is not consistent with the findings of numerous other investigators including Levinson (16), Drake and Fajardo (35, Behar et al. (64) and Scrimshaw et al. (57). The actual incidence of diarrhea may have been misrepresented by the mothers who had not observed the child defecating, did not
understand what diarrhea was, or for some reason did not want to admit that her child had diarrhea. Diarrhea was one of the most important causes of hospitalization in Les Cayes in 1973 indicating that diarrhea is a problem in Haiti. These findings are not conclusive and require further investigation.

Although sanitation did not have a direct effect on malnutrition in this study, poor sanitation has been related to parasites by Jung and Jelliffe (65). The high incidence of parasites (80.5%) at the time of the study was significantly associated with malnutrition when health variables were used to explain malnutrition. In the final equation with socio-economic, education and health variables, however, having parasites was the only variable that was not significant with either indicator of malnutrition. These results support the findings of both Collis and Jones (36) and Scrimshaw et al. (57) that parasite infestation retards weight gain and induces malnutrition. However, in this study having parasites influenced malnutrition more when only health factors were being considered. Having parasites was less important when economic and educational factors were also being considered. The interaction between malnutrition and infection, documented by Scrimshaw et al. (57), was corroborated by data from this study. There was a significant association between number of illness and degree of malnutrition. This concurs with Morehead et al.'s report (66) of a greater number of mixed infections among malnourished than among normal children and Adelman's (60) finding that children who had been sick one or more times weighed less than children who had not been ill. Frequency of illness as reported by the mothers in
this study was not associated with malnutrition and had a low correlation (-.02) with the number of illnesses reported.

Upper respiratory infection, the most common form of childhood disease in the tropics, according to Webb (68) and the most frequent cause of hospitalization in Les Cayes in 1973 (70) was the most frequent type of child illness named by the mothers. Fever, the next most frequently named illness, is actually a symptom that is associated with many childhood illnesses. Although measles and whooping cough have been very important in other developing countries in predisposing a child to malnutrition (69), measles has not been very prevalent in Haiti (70). Only one child was reported to have had measles. Whooping cough, on the other hand, has been better known in Haiti and was responsible for some of the hospitalizations recorded in Les Cayes. Whooping cough was the third most frequently named illness. With the exception of the findings for diarrhea, all of the health findings were similar to what is known about disease morbidity in Haiti.
CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

While economic resources, especially the amount of money available to purchase food and the amount of food available from the garden, have a very pronounced effect on the child's current nutritional status, long-term nutritional status may be more affected by nutrition education programs. Health indices as a group were less effective in explaining malnutrition than either economic resources or education but they still must be considered when planning a comprehensive nutrition intervention program. The most effective intervention, based on this data, would help mothers increase the amount of food available from their gardens and the amount of gourdes available to purchase food. It would also try to decrease the number of months spent by a child in the nutrition center by decreasing the number of illnesses per child and by teaching mothers to breast feed longer.

The nutrition centers currently operated by the Bureau of Nutrition have been successful in combating malnutrition and would provide an excellent medium for implementing the interventions suggested by this study. Following are several recommendations for possible modifications in the present procedures of the nutrition centers that would permit implementation of these findings.

First, the mothers might increase their incomes through better marketing practices learned at the center. This information is taught to men in many countries but in Haiti the women do most of the marketing. Cooperative selling might be encouraged. Although marketing
is not a traditional subject in nutrition education, this study
definitely shows that a child's nutritional status is greatly affected
by the amount of money available to purchase food.

Second, the mothers should be taught how to adapt diet to changes
in available food or food money. There is some evidence that mothers
do know what foods are best for their families so that this emphasis
by the nutrition center may not be as beneficial as helping the
mothers adapt to change, either an increase in available food or food
money due to good fortune or a decrease caused by some disaster. If,
as Autret (38) believes, an increase in food expenditures may cause an
initial decrease in the quality of the diet, the women need guidance in
making the best choices of foods no matter what their current circum-
stances are. Women should be taught which foods would provide the
greatest additional benefit to the family when food money increases or
garden productivity increases, freeing more money for additional food
purchases. Likewise, women should learn which foods can be eliminated
first from the diet, with the least harm to the family, when for some
reason, such as death, drought, crop failure, or inflation, there is
less food or food money available than usual.

Third, children who are weaned very early have already been
weaned and become malnourished before they enter the nutrition center.
The mothers of these children must be reached before the child is
weaned. Mothers of children already in the center are taught the
importance of breast feeding which should help subsequent children
but, according to this study, there are a significant number of children
in the centers who have been weaned early. The importance of supple-
mental foods during weaning should be emphasized. All children in the centers are fed the same amounts of the same food. The mothers need some guidance in meeting the different nutritional needs of children at different ages.

Fourth, there should be a more effective interface between nutrition education and health programs. This need is perceived by the Bureau of Nutrition but has not been implemented due to lack of personnel and funds. This should be viewed as an attainable goal with increased effort at attaining it.

The lack of knowledge in several areas with which this study was concerned has prompted several suggestions for further study.

There has been no in-depth study of food behavior in Haiti. Among the questions that could not be answered by available data were the following. How many meals and snacks do children receive each day? Does this differ from adult food consumption? What efforts are made to meet different nutritional needs of different family members? As more money becomes available for food does the quality or the quantity of the diet increase? What effect does the curtailment of food or food money have on the diet—in what order are foods decreased or eliminated from the diet? What foods are grown solely for market? How are they sold? What foods are purchased to supplement those grown in the garden? Is food preserved for family use when less food or food money is available?

Another area in which little seems to be known is the effect of early weaning on incidence of malnutrition. What are the reasons for early weaning in Haiti; the mother's perceived reason and the real
reason? What effect does the mother's nutritional status have on early weaning? What foods are substituted for breast milk? Do these foods differ from foods given to children weaned at the normal time? What are the differences between children who are weaned early and those who are weaned at the normal time in regard to such factors as disease incidence, family structure, or mother's occupation?

An additional study of childhood diseases, especially diarrhea, would be useful. What are the most prevalent diseases of children in Haiti? Are there any differences between well-nourished and malnourished children as to frequency or type of diseases?

Finally, further use and refinement of the use of number of different animals or animal score as a wealth indicator should be explored. Some criteria for measuring wealth or assets is useful in a study similar to this. The reliability and validity of these indicators should be investigated.

This study was undertaken with the purpose of identifying the most effective determinants of malnutrition in Haiti. The results are offered to the Bureau of Nutrition with the sincere hope that they will provide some basis for the continued improvement of a program that has already improved the nutritional status of many Haitian children.
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APPENDIX I

MOTHER'S SCHEDULE

Location ____________________________ No. ____________________

1. What is your name? ______________________________

2. How old are you? ______________________

3. Can you read? Yes No

4. What is your occupation? (check as many as apply)
   ___ house and field work
   ___ housework
   ___ sell in the market
   ___ buy and resell
   ___ dressmaker
   ___ artisan
   ___ shopkeeper
   Other: ____________________________

5. How often each week are you away from home working?
   0; 1/2 day; 1 day; 2-3 days; 4-5 days; more than 5 days; every morning or afternoon.

6. Who takes care of your children while you are working?
   ___ the grandmother
   ___ the older sister
   ___ the aunt
   ___ the cousin
   ___ the godmother
   other ____________________________

7. How much money did you spend for food the last time you went to the market? ____________________

8. What day did you go to market? __________________________
   What day will you go again? __________________________

9. Was this money
   ___ completely sufficient
   ___ almost sufficient
   ___ barely sufficient
   ___ not quite sufficient
   ___ completely insufficient
10. Do you grow food for your family?  Yes No

11. Do you own or rent this land?  __ Own  __ Rent  __ Use without paying

12. How often do you receive food from your family without charge?  __ always  __ often  __ sometimes  __ never

13. Is it your custom to receive food for work?  __ yes  __ sometimes  __ no

14. How often are you able to feed your family from your garden?  
   __ always  
   __ most of the time  
   __ sometimes  
   __ seldom  
   __ never

15. How many different animals do you have?  
   __ chickens  
   __ goats  
   __ pigs  
   __ cows  
   Others:

16. How much money did you spend on fuel in the market?  _____________

17. What is the source of your water?  
   __ well  
   __ stream  
   __ spring  
   __ piped water  
   Other:  

18. How often do you boil or put clorex in the water you drink?  
   __ always  
   __ usually  
   __ sometimes  
   __ never

19. Do you use a latrine?  __ yes  __ sometimes  __ no

20. Which of these foods is the best food to give a child after weaning?  
   __ starch gruel  
   __ rice  
   __ corn  
   __ black beans  
   __ plantain  
   __ milk  
   __ egg  
   __ black beans and corn
21. Which of the following foods would be best for your family?
   - [ ] corn
   - [ ] plantain
   - [ ] rice
   - [ ] rice and black beans
   - [ ] corn and black beans
   - [ ] black beans

22. Where do you get information about the best foods to feed your family?
   - [ ] your mother
   - [ ] your aunt
   - [ ] radio-doctor
   - [ ] your grandmother
   - [ ] your friend
   - [ ] responsible in nutrition center
   - [ ] your sister
   - [ ] your mother-in-law
   - [ ] other

23. How many children do you have under 5 years of age? ____________

24. How many people live in your household? _______________________

25. Please tell me about the people who live in your household.
   Name | Relationship | Sex | Age | Occupation
   ____________________________ | ____________________ | __ | __ | ____________________
CHILD'S SCHEDULE

1. Name ____________________________ Sex: M   F

2. Birthdate ________________________

3. Was this child breast or bottle fed or both?
   ___ breast
   ___ breast and bottle
   ___ bottle

4. At what age was the child weaned?
   ___ less than 6 months
   ___ 6-9 months
   ___ 10-12 months
   ___ 13-15 months
   ___ 16-18 months
   ___ greater than 18 months
   ___ not weaned

5. Does this child eat the same food as the rest of the family?
   ___ always
   ___ generally
   ___ sometimes
   ___ seldom
   ___ never

6. How many meals a day does the child eat?
   ___1
   ___2
   ___3
   ___4 or more

7. How many months has the child attended a nutrition center?
   ___0
   ___1
   ___2
   ___3
   ___4
   ___5
   ___ more than 5

8. How many times has the child been treated in a clinic?
   ___0
   ___1
   ___2
   ___3
   ___4
   ___5
   ___ more than 5

9. Does the child have diarrhea today? Yes   No

10. How frequently has the child had diarrhea?
    ___ never
    ___ rarely
    ___ sometimes
    ___ frequently

11. Does the child have intestinal parasites? Yes   No

12. How frequently has the child been ill?
    ___ never
    ___ almost never
    ___ once in a while
    ___ frequently
    ___ almost always

13. What diseases has the child had?
    ___ measles
    ___ chicken pox
    ___ grippe
    ___ malaria
    ___ fever
    ___ Other
    ___ whooping cough
    ___ tuberculosis

14. What vaccines has the child had?
    ___ BCG
    ___ DPT
    ___ measles
    ___ TAB
    ___ polio
    ___ tetanus
    ___ Other

15. Height: ____________ cm.

16. Weight: ____________ kg.
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THE DETERMINANTS OF MALNUTRITION IN HAITI

by

Meredith Ford Smith

(ABSTRACT)

Socio-economic, education, and health variables were examined to determine the primary causes of malnutrition in preschool Haitian children. A survey of 160 women and their child closest to weaning age was conducted in three regions of Haiti in January 1978. Ordinary least squares multiple regression analysis was used to determine the combined power of the socio-economic, education, and health variables and the relative power of each independent variable separately in explaining malnutrition in the sample population.

Results showed that the amount of food or food money available had the greatest impact on the child's current nutritional status as measured by weight/age. Long term malnutrition, as measured by height/age, was most affected by education. Health variables as a group were least effective in explaining malnutrition although the number of illnesses a child had had was highly related to malnutrition. A strong interaction between weaning age and months spent in a nutrition center suggested that children who were weaned early were more likely to become severely malnourished and required longer periods of nutritional rehabilitation than children who were weaned later.

Recommendations were made to incorporate the findings into current nutrition center programs in Haiti.