THE UNIVERSITY OF MANITOBA

FACTORS AFFECTING RECOVERY OF PRE-SCHOOL CHILDREN SUFFERING FROM PROTEIN-ENERGY MALNUTRITION IN GEORGETOWN, GUYANA.

BY

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the University of Manitoba in partial fulfillment of the requirements
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES CONTD.

LIST OF ILLUSTRATIONS

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ABSTRACT

Factors affecting recovery of pre-school children suffering from Protein-energy malnutrition in Georgetown, Guyana

A study investigating factors affecting the recovery of pre-school children suffering from protein-energy malnutrition was carried out in Georgetown, Guyana. Protein-energy malnutrition results in impaired growth of children, decreased resistance to disease and impaired behavioral and intellectual development.

Review of the literature indicated that factors such as income spent on food, household size, diet of child, decreased immunity of child to disease, living conditions, personal hygiene of mother and child, clinic attendance, nutrition knowledge and nutrition practices of guardians of children are important in the etiology of Protein-energy malnutrition.

Guyana has been identified by the "Fourth World Food Survey" (1977) as having a high percentage (32.1%) of malnourished children under five years of age and the "National Food and Nutrition Survey of Guyana" (1976) recommended that further investigation be done of social and economic factors associated with malnutrition in Guyana. The objectives of this study were: (i) to assess the influence of various factors which may affect improvement in nutritional status of children under five years of age attending the malnutrition clinic of the Georgetown Hospital, Guyana, and (ii) to assess whether the supplementary food and nutrition advice provided by nurses and the doctor at the clinic effected improvement in the nutritional status of the child.

Subjects were chosen from the Malnutrition Clinic of the Georgetown Hospital. Information was gathered through interviews with mothers/guardians and also from children's clinic health records on 117 children, 0-5 years old. Seventy-one interviews were carried out and complete information on all factors investigated was collected on forty-three subjects.

Factors investigated were availability of food to subjects, personal hygiene of mothers and children, and sanitation of the environment, use of available medical services, nutrition education of the mothers/guardians, additional disease(s) present in children on entry to clinic, weight for heights of children on entry to clinic and household size.

Analysis of the data found that use of supplementary food, weight for heights of children on entry to clinic, frequency of use of bread and cereals and fruits and vegetables were significantly associated with nutritional status. Supplementary food appeared to be more consistently associated with improvement of nutritional status than did other factors. The results of this study are compared to results of researchers in Guyana and other countries, and differences in findings are discussed. The non-significance of several of the factors may have been due to the homogeneity of the sample and/or the rather small sample size.

The Malnutrition Clinic of the Georgetown Hospital seemed to have been effective in improving the nutritional status of several of the children attending, apparently through provision of supplementary food.

INTRODUCTION

Guyana is a socialist republic lying on the northeastern coast of South America. The country has an area of 83,000 square miles, and extends between 1° and 9° North latitude, and 56° to 62° West longitude. Guyana is bounded on the West by Venezuela, East by Surinam, North by the Atlantic Ocean, and South and Southwest by Brazil (see Fig. 1). It is divided into three main geographical zones: the Coastal Plain, the Equatorial Forests which lie south of the Coastal Plain and extend to the border of Brazil and Venezuela, and the Savannah grasslands, which lie behind the coastal belt in the Northeast and beyond the forests in the Southwest (see Fig. 2).

Guyana was a British colony until 1966, when it gained independence and became a member of the British Commonwealth.

The population of Guyana is approximately 800,000, and is comprised of persons from six different races, namely East Indians, Africans, Chinese, Amerindians, Caucasoid, and Mixed. The two main ethnic groups are the East Indian descendants who comprise over 50 percent of the population, and the Afro-Guyanese, who comprise approximately 30 percent of the total population. Ninety percent of the population lives on the Coastal Plain, which has a population density of over 300 persons per square mile. Georgetown, the capital city of Guyana, had a population of 190,000 at the 1968 census (National Food and Nutrition Survey of Guyana, 1976).

The social class system in Guyana was adapted from the British, being tempered by ethnic subculture stratification. Sixty percent of all Afro-Guyanese were found living in urban areas at the 1970 population census. The African lower class woman is fully responsible

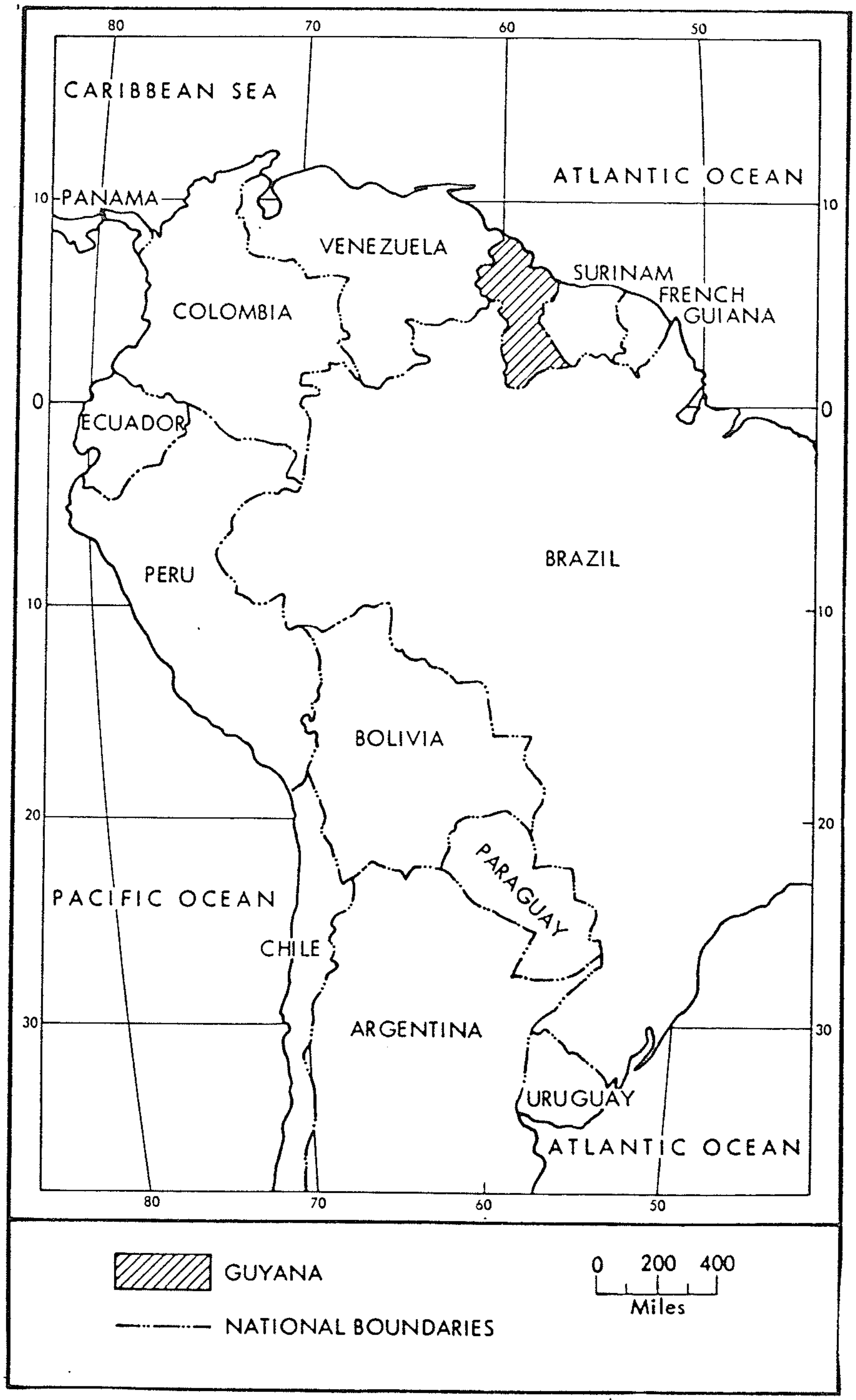


Fig. 1: Position of Guyana in South America

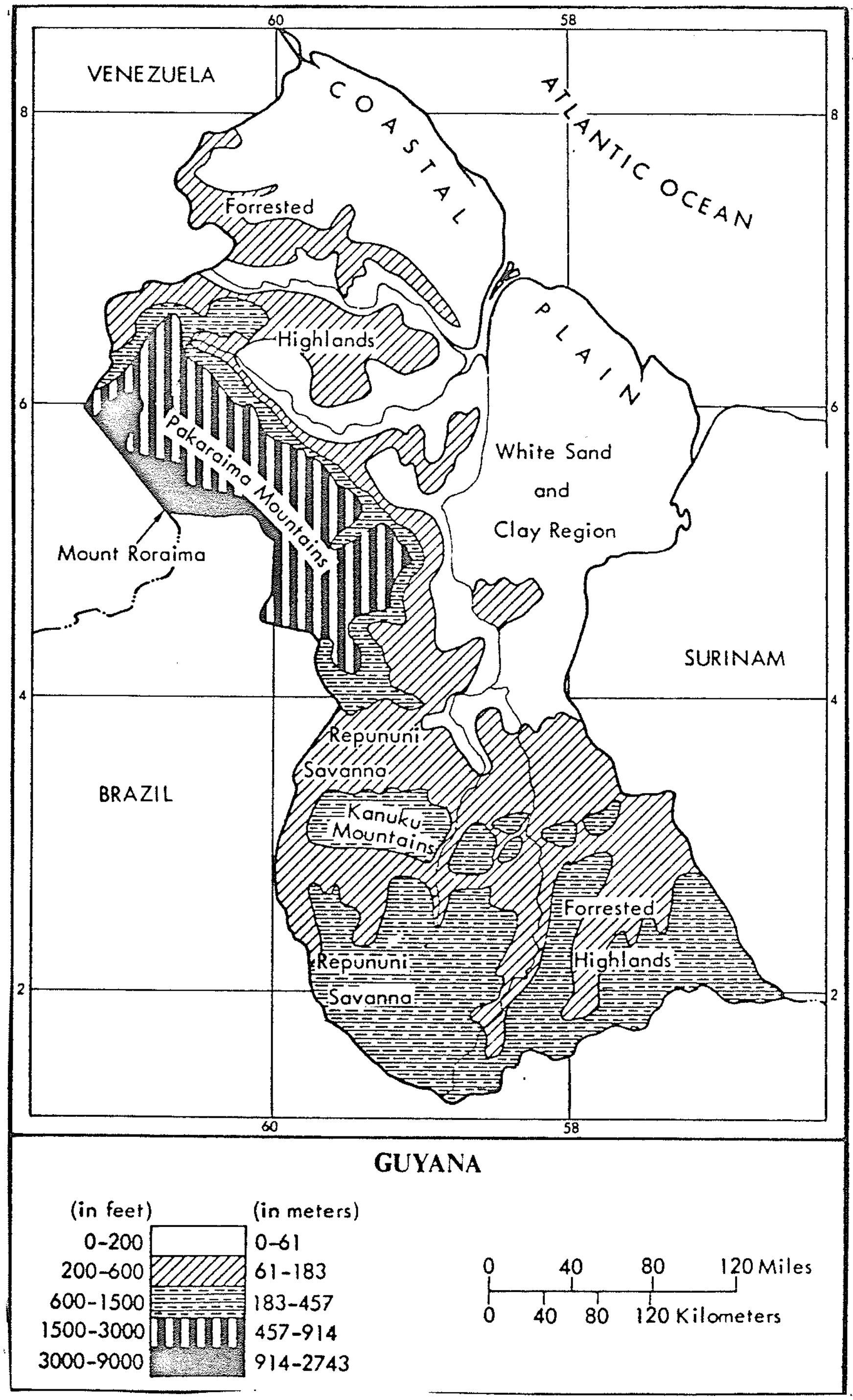


Fig. 2: Natural Regions and Relief of Guyana

for the welfare of her children and even her children's children, since the children's father often does not live at home, and in many cases, does not support his children (Area Handbook of Guyana, 1969, p. 85).

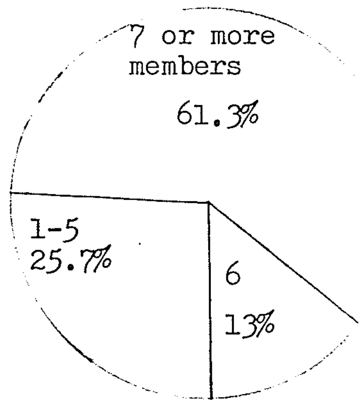
The urban population is usually more affected by internally and externally induced social change than the rural population (National Food and Nutrition Survey of Guyana, 1976). Thus, food shortages present over the last three years, especially in the summer of 1979 when this survey was executed, had a considerable impact on the availability and quantity of goods such as milk, black-eye peas, split-peas, and oil. These foods are the primary high-protein, high-fat foods available to the Guyanese population, which has a predominantly carbohydrate diet.

Agricultural production, food purchasing, preparation and consumption, is organized basically within the family or household group. The "household" was defined by the National Food and Nutrition Survey of Guyana (1976) as a group of people who are related and who share budget, housing, and meals; the"family",on the other hand, being confined to parent (a mother, father) and their children. The preschool child and pregnant and lactating mothers are cared for and fed almost entirely in the household group (National Food and Nutrition Survey of Guyana, 1976).

The 1976 National Food and Nutrition Survey of Guyana, which is representative for the entire country, found the average size of the household to be six, with urban African households having an average size of 6.4 persons, urban East Indians 5.5 persons, and other ethnic groups 5.3 persons. The larger household size (greater than six) accounted for more than half the total population of the country (see

Fig. 3), there being a negative association between household size and income per capita per annum.

Fig. 3:
Distribution of Household size in Guyana



The shortage and expensive costs of high protein foods is a serious food problem in Guyana, which may result in protein malnutrition (Area Handbook for Guyana, 1969, p. 85).

The Food and Nutrition Survey of Guyana discovered that 43 percent of children under five years of age were in Gomez I classification, 16 percent of children in Gomez II, and 1.7 percent in Gomez III. The Gomez classification is described on page 40 of this thesis. This national survey found malnutrition to be more severe in the rural areas than in the urban areas (22 percent of rural children in Gomez II and III compared to 7 percent in urban areas). Six percent of the African and twenty-five percent of the East Indian children fell into these categories.

Weight for age and length for age anthropometric measurements taken in urban Guyana in 1971 demonstrate that 19.9 percent of children under five were below the third percentile of the Harvard Standards for weight for age, and 10.6 percent for length for age. Areas of high prevalence of Protein-Energy Malnutrition (PEM) are Tiger Bay, Albouystown, Campbellville, and Kitty (the National Food and Nutrition Survey of Guyana, 1976) (see Fig. 4).

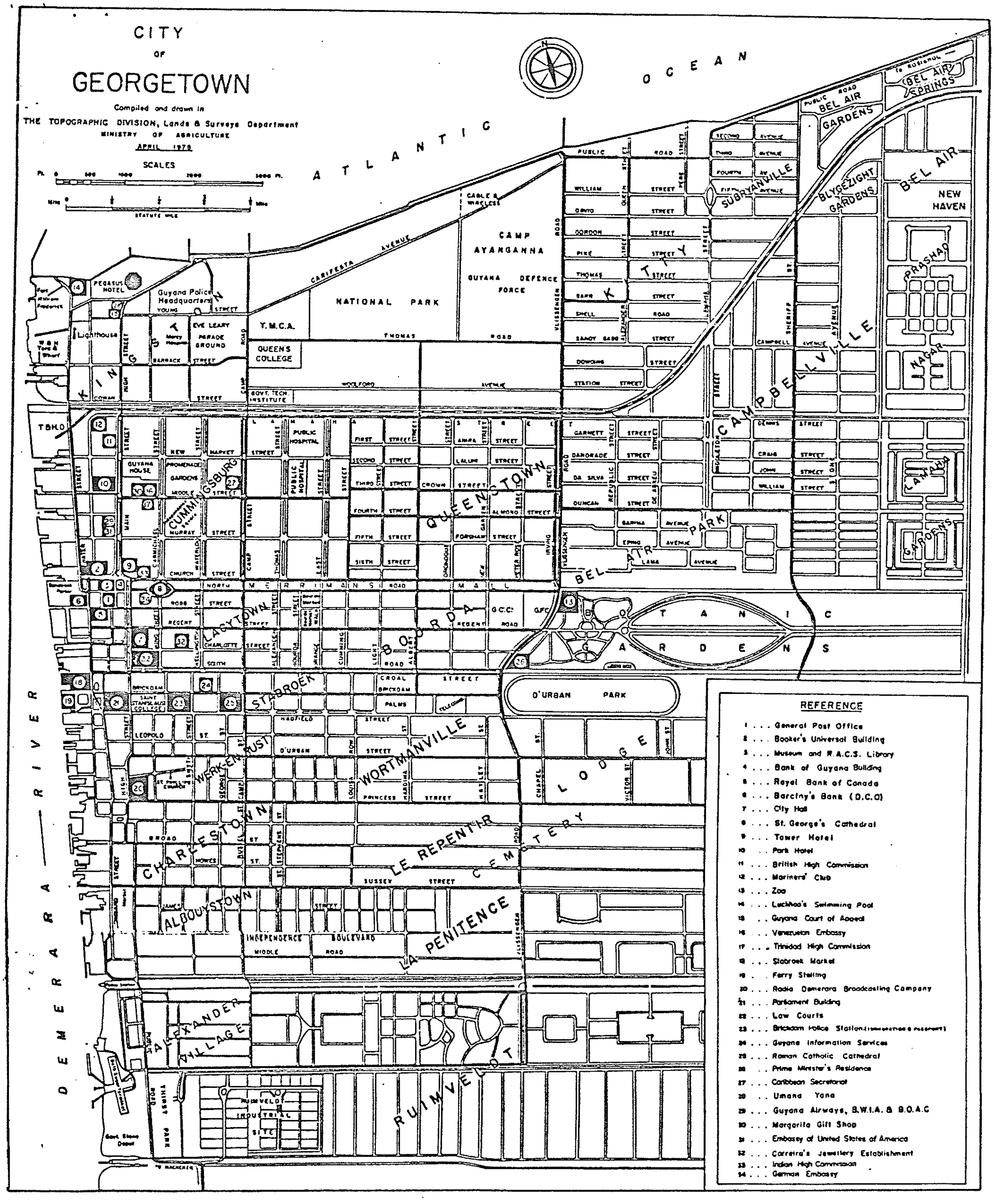


Fig. 4: Districts of the City of Georgetown

The pre-school mortality rate was calculated to be 10.6 per thousand in 1976, with 2.7 recorded due to diarrhoeal disease, 1.1 to avitaminoses and other nutritional diseases, 0.7 to anaemias, 0.3 to measles, and 0.2 to influenza. Unfortunately, no current information was available on infant mortality rates in Guyana.

This present study investigated factors associated with protein-energy malnutrition in preschool Guyanese children and the impact of the malnutrition clinic in Georgetown on their nutritional status.

REVIEW OF LITERATURE

Physiology and Biochemistry of Protein Energy Malnutrition

Protein-Energy Malnutrition (PEM) usually results from a diet low in calories and/or protein. Infants and children suffering from this disease, whether mild to moderate or severe, exhibit retardation in physical growth, mental and behavioral development, in addition to decreased resistance to infections. Protein-Energy Malnutrition can be manifested in several forms, with kwashiorkor at one end of the spectrum, marasmus at the other, and varying degrees of marasmic-kwashiorkor in between (Alleyne et al, 1977, Chapter 3, "Protein-Energy Malnutrition").

Marasmus can be classically defined as the outcome of a diet which is normally balanced but which is inadequate in total amount of protein and calories. Kwashiorkor, on the other hand, results from a diet which is inadequate in protein but contains sufficient calories to maintain some normal physiological requirements for energy (Milner, 1976). The Food and Nutrition Survey of Guyana executed in 1971/72 discovered only the marasmic form of PEM in Guyana. This situation is analogous to that in St. Lucia, where underweight was prevalent among children under five years of age (National Food and Nutrition Survey of St. Lucia, 1975), but different to that in Jamaica, where protein-energy malnutrition of marasmic, marasmic-kwashiorkor and kwashiorkor types occur (Ashworth and Waterlow,1970).

The different types of Protein-Energy Malnutrition can be differentiated clinically, since each evinces a different physical appearance. Kwashiorkoric children are oedamatous, and display changes in skin and hair. The oedema is of the pitting type, and is found mainly at the extremities and sacrum (Jelliffe 1966, p. 36). Skin changes which occur are due to diffuse or patchy hypopigmentation, with areas of hyperpigmentation. This results in the classical syndrome of "flaky-paint" dermatosis. Often some areas of the skin become raw and ulcerated, especially at flextures, groin, and buttocks. In addition, there may be open or healed sores present, and the skin may become infected with scabies. The hair in kwashiorkor becomes lighter and straighter, and dark hair may turn brown, red, blond, or even gray. The hair usually becomes dry, thin, silky, and escapes easily from the scalp (Jelliffe, 1968, p. 124). Kwashiorkor has also been associated with Vitamin A deficiency and keratomalacia in Indonesia (Oomen, 1954), and Vellore, South India (Pereira, Begum and Dunn, 1966).

In both kwashiorkor (Neave, 1965; Trowell & Davies, 1952), and marasmus (Jelliffe, 1968, p. 136), there is a gross waste of muscle and a stunting in length. However, in marasmus, there is a marked wasting of subcutaneous tissue, unlike kwashiorkor, where the subcutaneous tissue is well preserved. Oedema, which is present in kwashiorkor, does not occur in marasmus. The skin in marasmus is dry with patchy hypopigmentation and scaling. The hair may also be dry, sparse, and lighter than normal in colour. The age of onset of marasmus is earlier than kwashiorkor, since it occurs at approximately one year of life in contrast to kwashiorkor which occurs between eighteen months and two years of age. Examples of this are shown in Table 1.

Table 1: World-Wide Variation in Ages of Onset of Kwashiorkor and Marasmus.

Country	Age of Onset	Author
Kwashiorkor		
Jamaica	9-18 months	Alleyne et al. (1977)
Johannesburg	9-18 months	
Uganda	19-24 months	Whitehead (1969)
Gambia, W. Africa	24-30 months	
Guatemala	41 months	Waterlow & Alleyne (1971)
Vellore, S. India	12-36 months	Pereira & Begum (1974)
Marasmus		
Jordon	7.7 months	McLaren (1966)
Jamaica	11.9 months	Alleyne et al (1977)
India	6-18 months	Gopalan (1968)

Kwashiorkor usually occurs at a later age than marasmus since it is often due to weaning of the child on a bulky, high carbohydrate, low protein diet which provides sufficient calories for maintenance of some body functions, but inadequate protein. Marasmus, however, is primarily due to an insufficient supply or dilution of supplementary milk in the child's diet, infection produced by unhygienic bottle feeding, too early weaning, or an insufficient amount of calories and protein in the diet after weaning.

In addition to external changes in the malnourished child, there are also physiological and biochemical changes in internal organs and tissues (Waterlow & Alleyne, 1971; Alleyne et al (1977) P.55. The mucosa of the small intestine undergo atrophic change which leads to a reduction in the total absorptive space and enzyme activity. One category of enzymes, the disaccharides, are of major importance, especially in nutritional rehabilitation of the child. If the production of the disaccharidase, lactase, is reduced, nutritional rehabilitation using diets containing considerable amounts of lactose from milk will cause reduced energy absorption and recovery will be slower.

The reduction in the capacity for digestion and absorption is a common response of animals and man to reduced dietary intake. Enteritis may occur which reduces the efficiency of the digestive and absorptive functions of the gut, enhancing the development of malnutrition and thereby exacerbating the process that perpetuates malnutrition (Alleyne et al, in "Protein Energy Malnutrition", Chap. 4). The small intestine, in addition to reduction in total absorptive space and enzyme activity, becomes particularly susceptible to bacterial contamination of the gut, since there is a decrease in gut motility and hypochlorhydra which favor bacterial over-growth of the small bowel (Gracey, et al, 1973).

Anaemia is also commonly associated with protein-energy malnutrition, and is related to a reduction of protein, iron and folic acid in the diet. Iron deficiency is more likely to occur in marasmic infants in the first year of life, particularly if they were also premature births (Alleyne et al, 1977 in "Protein Energy Malnutrition", Chap. 4). Evidence from the National Food and Nutrition Survey of

Guyana (1976) indicates that 41 percent of children from 0.5 to 5 years were anaemic. Anaemia was related to iron, folic acid and protein deficiencies and may also be due to the presence of internal parasites.

Important prominent features of protein-energy malnutrition are muscle wasting and retardation of growth in infants and children. Retardation in growth is due to an impairment in endochondral bone growth (Himes, 1978). The attained weight of individual bones and the skeleton as a whole is less in starved or clinically malnourished children than in well-nourished children of the same age (Himes, 1978). This depressed growth in bone weight can begin with the foetus *in utero*, and may be associated with the level of maternal nutrition as well as individual differences in the availability of nutrients to the foetus (Adams, 1971). Despite depressed growth in protein-energy malnutrition, the bones still continue to become heavier although at a much slower rate than normal (Himes, 1978). When dietary restriction is below energy requirement for body maintenance, calories appear to be most important for bone growth irrespective of source. Malnourished animals which are nutritionally rehabilitated display a compensatory"catch-up" period of rapid growth, although the more mature the bone at the time of rehabilitation, the smaller the catch-up growth and the less the finally attained size. Similarly, if the period of malnutrition occurs relatively late in the growth period, the bone will be little affected by the nutritional insult since adult size will already have been attained (Himes, 1978). When animals which are severely malnourished while young are nutritionally rehabilitated, "catch-up" growth in bone length and extended growing period are insufficient to allow attainment of normal adult bone length (Adams, 1971). Thus, duration as well as timing of protein-energy malnutrition is important in the bone growth period.

Protein-energy malnutrition also has a marked effect on the metabolism of carbohydrates, lipids, protein, minerals, vitamins, energy and thermoregulation. Glucose intolerance, lactose intolerance (Alleyne & Picou, 1971), decreased basal metabolic rate, and hypothermia (Alleyne et al, 1977, from "Protein Energy Malnutrition", Chap. 4) are all unfortunate results of PEM.

Socio-economic Factors Associated with Protein-Energy Malnutrition

Protein-energy malnutrition may be considered superficially as an inadequacy in the intake of protein and energy from food. Many social, cultural, and economic factors are associated with adequate food intake of individual children, and these factors influence the incidence and duration of protein-energy malnutrition.

Malnutrition occurs primarily in developing countries[1] or in poor populations in developed countries (FAO, 1975). Inadequate income is thought to be causally related to the occurrence of PEM and is associated with other factors such as unhygienic living conditions, infectious diseases and inadequate caloric and/or protein intakes (Kanawati & McLaren, 1973; Cravioto & Delicardie, 1976). A socio-economic survey executed in Sri Lanka during 1969/1970 discovered that among the poorest households, two-thirds of the monetary expenditure was for drink and food, the amount rising to seventy percent if liquid was included (FAO, 1973). In Guyana, it was estimated that the

1 countries which are non- or partly-industrialized.

lower income households spent eighty-seven percent of their income on food (National Food & Nutrition Survey of Guyana, 1976, p. 28), and in St. Lucia, food expenditure was estimated to be sixty-one percent or more (National Food & Nutrition Survey of St. Lucia, 1978, p. 43). Substantial changes and improvement in feeding habits occur as income rises, through an increase in consumption of protein foods such as meat, milk, and milk products and fish (FAO, 1973). Among the poor in developing countries, diets are dominated by starchy roots and tubers (Jelliffe, 1962; FAO, 1973). In Guyana, 48.5 percent of urban households were determined to be consuming less than 80 percent of the recommended intakes for energy, and 39.7 percent of urban households consumed less than 80 percent of recommended intake for protein (National Food & Nutrition Survey of Guyana, 1976).

Pereira and Begum (1974) in Vellore, India, and Jansen and coworkers (1977) in Brazil discovered that the total availability of calories and protein is greatly dependent on income, with the lowest income families being seriously short of food. These findings are in agreement with those of Khan and Gupta (1977) in Lusaka, Zambia, Kanawati and McLaren (1973) in Lebanon, and Wray and Aquirre (1969) in Candelaria, Columbia, who recognized that the amount of money spent on food per person per month was inadequate to support a family with the high cost of living in their respective countries.

Factors which are important in considering over-all purchasing power are: the use of food as an indicator of socio-economic status, seasonal changes in food production,which is of particular importance in a rural community, the total income and amount of money available to spend on factors other than food, and the change in eating habits and food availability in the shift from a rural to an urban area.

Quality and quantity of foods have been used as indicators of socio-economic status of consumers (de Garine, 1972). The correlation between monetary income and the structure of the dietary system are of importance if the different socio-economic strata within a country are investigated (de Garine, 1972). This point has already been elucidated by the results of the survey performed in Sri Lanka in 1969/1970.

In rural areas, cropping patterns may be used as an indicator of "energy-flow" within a family (Longhurst, 1979). Imbalances between energy expenditure and consumption at certain times of the year will lead to changes in body energy stores for certain family members. A negative balance will lead to a reduction in these stores and may eventually result in PEM if the individual can no longer adapt to such reductions.

Money which is spent on clothes, rent and fuel reduce the amount of income available for purchasing food. Among the underprivileged groups, the cost of fuel has an effect on the choice of foods consumed by the family. They usually veer towards one-pot meals and meals which do not take a long time and large amounts of fuel to cook (de Garine, 1972). In Guyana, meals normally consist of one or two pot meals among the overall population, so this system of meal preparation does not necessarily reflect poor socio-economic status.

Persons and families who move from a rural area into an urban area are susceptible to malnutrition because food becomes available only for cash, and their small income does not enable them to feed or house themselves adequately. Overcrowding, cross-infection, and poor dietary intake in these urban areas accentuate the development of malnutrition (Alleyne et al, 1977, in "Protein-Energy Malnutrition", Chap. 1). Of particular importance in these communities is the desire of mothers to emulate the more sophisticated practices of mothers in developed countries in infant feeding. The use of commercial baby formulas in lieu of breast-feeding is instrumental to the health of the infant, since these mothers do not have the money or nutrition knowledge to ensure successful infant feeding. The evaluation of the sociocultural status of a community in Kerala, South India, by Gokulanath and Verghese (1969) indicates that there is also a dissociation of cultural values and a decay of the traditional ways of life. Possession of material objects and monetary gain are indicators of high social status, likewise the adoption of values from a modern urban industrialized society. This adoption of values is reflected by the use of expensive milk baby foods and tinned baby foods at the time of weaning instead of the less expensive food available locally (FAO, 1971; Jelliffe, 1962; Gokulanath & Verghese, 1969). These values are also emulated in Guyana, where the majority of babies are given supplementary milks such as Lactogen and SMA before four months of age (National Food & Nutrition Survey of Guyana, 1976, p. 44).

Nutritional practices may occur which lead to the development of protein energy malnutrition. Early weaning (before four months of age) and late weaning (after six months of age), and inadequate child feeding are two of the most important practices which have a negative impact on the nutrition status of the child in its first two years of life. In some countries, children are not given other foods to supplement breast milk or baby formulas until after six months of age.

Milk alone cannot provide enough nutrients for a child of that age, and its diet becomes chronically short of important nutrients. This practice can precipitate the child into marasmus if prolonged for a long period of time. "Too early" weaning or too early introduction of supplementary milk can lead to infection from unsterilized utensils and over-dilution of baby formulas by poor and uneducated mothers or guardians (FAO, 1971).

The weaning food provided to children in many countries are poor substitutes for breast milk, being cereal gruels or starchy staples, such as plantain and sweet potato (Khan & Gupta, 1977; Alleyne et al, 1977, in "Protein-Energy Malnutrition", Chap. 2). Rice, flour and bananas are fed to children in Surinam at an early age because they are considered to be "good" foods (Van Stavern et al, 1971). Bush teas, rice and plantain porridge are given to both urban and rural children in Guyana. These may be diluted by water, water and milk, or milk alone, and in eighty percent of the cases, the porridge or pap is so thin that it could pass through the nipple of a bottle (National Food & Nutrition Survey of Guyana, 1976).

Fruit, ground provisions, green vegetables and eggs are accepted by most Guyanese parents as suitable for children under one year of age. However, peas, fish and meat are unacceptable to a significant minority. Most children begin to eat meals prepared for the rest of the family by two and a half years of age (National Food & Nutrition Survey of Guyana, 1976, p. 46).

African tribes such as the Baganda (Goodal, 1979) and Zulu (Slome, 1960) customarily send a child away from its mother as soon as she becomes pregnant. This can have a traumatic effect on the physical and emotional development of the child. The child is at once deprived of its major source of protein, i.e. breast milk, and of the love and care of a parent to which it has become emotionally attached. Both factors can precipitate a child into kwashiorkor even though other members of the family provide the child with shelter and food (de Garine, 1972; Slome, 1960; Goodal, 1979). The above mentioned practice is not a custom in Guyana, and children are not separated from their mothers at the advent of another child in the family.

The history of methods of feeding since birth, the types of food material used for supplementary feeding, and the influence of elders in conditioning the feeding habits of children play an essential part in the eventual outcome of a child's nutritional status (Gokulanath & Verghese, 1969). Lack of nutrition education and the number of years of schooling of the homemaker are also conditioned social indicators of PEM. Dickins (1965) quoted the results of the 1955 Household Food Consumption Survey of the U.S. Department of Agriculture which indicate that homemakers with higher education provided better diets than those with fewer years of formal education. Livingston (1971) indicated that in the United States, education, environment and attitudes of parents have an effect on the nutritional status of the child. These findings are in agreement with those of Al-Isi, Kanawati and McLaren (1975) in Lebanon, and Spalding and coworkers (1977) in the Gambia, who recognized that malnourished children often belong to poor mothers who had a low level of education (Spalding et al, 1977) or are illiterate (Al-Isi et al, 1975). Al-Isi, Kanawati and McLaren (1975) discovered that mothers who had formal schooling for seven or eight years showed a significantly greater nutritional knowledge than those who attended school for five years or less. This was thought to be partly due to the inclusion of nutrition education material at the eighth grade of the curriculum.

Nutrition education incorporated into the formal school system provides good nutrition knowledge and induces good nutrition practices which can be integrated into the culture of the community.

Infectious diseases are also thought to precipitate protein-energy malnutrition (Scrimshaw, Taylor & Gordon, 1968). These are usually associated with poor environmental sanitation. In slum areas, the poor housing and sanitation, the lack of waste disposal systems, even water supply networks, place the family, especially the vulnerable young child, in an unsatisfactory hygienic environment (FAO, 1975). Christiansen et al (1973) discovered that low income families tend to live in more crowded dwellings with poorer sanitary conditions, which led to higher levels of disease and consequently lower levels of physical growth in children. Khan and Gupta (1977) showed that food was generally prepared, in low income families, under unhygienic conditions which could lead to infection. Even in communities where money is available to buy food and enough food energy is consumed, infection, poor hygience and disease, especially malaria (Longhurst, 1979) and diarrhoeal disease (Wray, 1969) can neutralize these benefits. Latidan and Reeds (1976), in a village study in Ibadan, Nigeria, found that most children in that community suffering from PEM were precipitated into this undernourished state after an attack of measles. Their discovery was substantiated by Browne and Browne (1977) who noted that in Bulape, Zaire, major health problems were tuberculosis, malaria, measles, the pneumonia-diarrhoea complex, and protein-energy malnutrition. In Guyana, the National Food and Nutrition Survey executed in 1971/1972 reported that approximately two-fifths of young children in both rural and urban areas suffered from some type or respiratory infection at the time of examination.

Malnourished children suffer more severe infectious episodes than their well-nourished counterparts (Cravioto and Delacardie, 1976). Vega-Franco and colleagues, as quoted by Cravioto and Delacardie in their paper on "Malnutrition and its effects at the individual and community level" indicated that frequency and severity of bacterial complications in measles in children below five years of age increased in direct proportion to the severity of malnutrition; total duration of sickness is thus increased, making treatment more expensive, besides the risk of death due to a process generally benign in a well-nourished population. The causes and results of infection will be discussed in more detail in a later section of this thesis.

Several of the factors affecting nutritional status may also act in concert rather than individually to contribute to protein-energy malnutrition. Families of lower social status tend to have a greater number of children who are closely spaced than well-nourished families. This creates more demand for food at a crucial age (Christiansen et al, 1973). Wray and Aguirre (1969) observed in Cardaleria, Columbia, that children belonging to a larger family (more than four persons) having an illiterate mother, especially if she was over thirty years of age, were likely to be malnourished. Grantham-McGregor, Desai and Buchanan (1977), in Kingston, Jamaica, found in addition that children receiving poor maternal care were likely to have repeated attacks of gastro-enteritis and poor milk intake. They were also likely to be of birth order greater than six and to be living in below average housing.

Maternal care, family size and the stability of the family unit have an important impact on the outcome of the nutritional status of the child. Parents of low socio-economic status are less attentive, since with increasing family size, it is difficult for the mother to direct her attention to any one child, especially if the children are closely spaced in time. Crowding of the dwelling may also make interaction between the mother/guardian and child difficult (Rawson & Valdere, 1976; Christiansen et al, 1973).

Factors which contribute to the development of malnutrition also act in a reverse manner in the recovery of the child from malnutrition. McDowell and Hoorweg (1975) summarize the influence of social environment on the recovery from malnutrition in Fig. 5. The ideas and concepts of family members on child feeding,the family size, time available to spend with child, suitability of cooking and distribution of food resources in the family, interact to determine the adequacy of the child's diet which in conjunction with the presence or absence of illnesses, affects the recovery of the child.

The National Food and Nutrition Survey, 1976, identified factors such as income spent on food, household size, the presence of parasites and respiratory disease as being associated with protein-energy malnutrition.

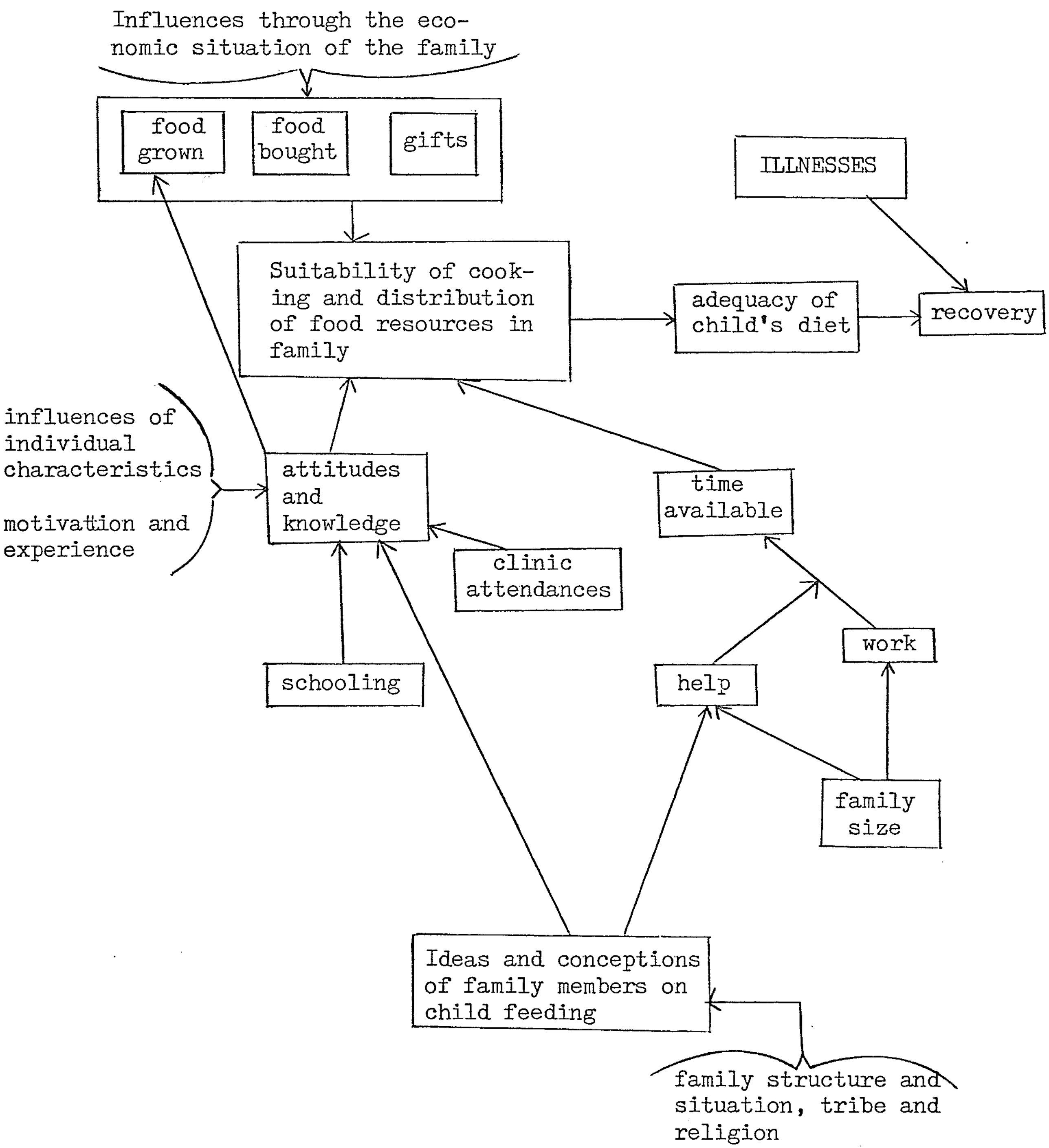


Fig. 5: Summary diagram of the influence of social environment on recovery from malnutrition
(taken from McDowell & Hoorweg, 1975)

Treatment of Protein-Energy Malnutrition

Treatment of children suffering from protein-energy malnutrition is usually done at two adjacent levels. Any infections or electrolyte imbalances are cleared and the malnourished child is given a high calorie,high protein diet based on powdered milk or local foods. In this study, children entering clinic were treated for any additional diseases present and given dry skimmed milk (DSM) or corn-soya milk (CSM) with special instructions on how to mix the supplementary food. The supplementary diet is usually based on the amount of extra energy and protein necessary for "catch-up" growth of a child in order that he/she may reach standard weight for age, height for age, or weight for height, depending on the local or international standards being used.

Spady and coworkers (1976) in a study with eleven severely malnourished Jamaican children, estimated maintenance energy requirements of these children to be 82 kilocalories per kilogram body weight per day, with an added 4.4 kilocalories for each gram of weight gained. Ashworth (1969) demonstrated that rapid recovery rates are achieved if caloric intake is sufficiently high. The majority of Jamaican children investigated by Ashworth grew at rates four to six times as great of normal infants of similar weight and height. Jackson, Picou and Reeds (1977) in a study with five severely malnourished Jamaican children given a high-calorie, high-protein diet, calculated the cost of tissue growth to be eight kilocalories per gram of fat and 1.2 kilocalories per gram of protein. The energy cost of growth can give a good indication of the composition of tissue laid down during recovery from protein-energy malnutrition. Spady et al (1976) estimated that forty percent of new tissue laid down during recovery was fat tissue and sixty percent was protein.

High-calorie, high-protein diets used for nutritional rehabilitation are often composed of powdered milk to which some type of oil and sugar are added. Brooke and Wheeler (1976) treated 25 seriously malnourished Jamaican children of mean age 1.17 years with a diet which provided 135 kilocalories of energy, 9 percent of which was supplied by protein. The majority of children achieved an intake of one hundred and ninety nine kilocalories per kilogram per day on this diet, composed of dried full-cream milk and oil. After seven weeks of treatment, total body potassium had increased by 90 percent, the arm muscle circumference based on Tanner and Whitehouse (1975) had increased to two standard deviations of normal weight for age, the height age had increased by 8.8 weeks based on Tanner, Whitehouse and Takaishi (1975) standards, and the mean head growth was 1.9 centimetres compared to 0.75 centimeteres as expected. There was also an increase of 120 percent in summed skin-fold measurements of these children.

Ashworth (1969) fed eight severely malnourished children with a diet providing 165 kilocalories per kilogram per day, and 3.8 grams of protein per kilogram body weight per day. On reaching standard weight for height, the children had voluntarily reduced their consumption of feed from 160 kilocalories per kilogram per day to 116 kilocalories per kilgram per day, the children having taking 15 weeks to reach standard weight for height. Pereira and Begum (1974) found that kwashiorkoric children fed a diet of 100 kilocalories per kilogram per day lost oedema but did not gain weight. Thus a diet providing 100 kilocalories per kilogram body weight per day was inadequate for weight gain. Ifekwunigwe (1975), in a study done during the Nigeria-Biafra war, with 5,000 children of age six months to twelve years suffering from severe PEM, used a kwashiorkor food mix prepared from dried skimmed milk, calcium caseinate, sucrose, and vegetable oil. This mixture provided 5 grams of protein per kilogram of body weight and 200 kilocalories per kilogram of body weight per day and caused a weight gain of 2.8 kilograms in twelve weeks. Picou and colleagues (1975) of the University of the West Indies, in "Malnutrition and Gastroenteritis in Children. A manual for hospital treatment and management." recommended a high calorie milk formula containing 135 kilocalories and 3 grams of protein per 100 ml of feed. This feed is composed of milk (skimmed or whole), sugar, oil, and water and the amount given to the child is based on its body weight. This diet is used at the malnutrition clinic in Guyana. With high calorie feeding on this diet, most severely malnourished children (body weight less than 60 percent weight for age) recovered after four to six weeks, in a hospital environment. Graham, Cordano and Baertl (1964) demonstrated that for the most severely underweight children six to thirty months of age, a diet based on milk providing 175 kilocalories per kilogram per day and 2 grams of protein per kilogram per day was necessary for adequate weight gain. However they also showed that in the least malnourished children, a good mixture of vegetable protein or a mixture of wheat and fish protein appeared to be as efficacious as milk.

Nitrogen retention in severe marasmic and partially malnourished children is dependent on the total intake of calories as well as the quantity and quality of protein ingested. If the caloric requirements are not met, protein is wasted, since it is then used for energy. Graham, Cordano and Baertl (1964) discovered that nitrogen retention was highest when milk was used and that increased caloric intake led to increased efficiency of utilization of protein. Martorell and Klein (1980), in a study of rural Guatemalan children, showed that protein energy and energy supplements were related to growth rates. This finding substantiated an earlier finding by Martorell and colleagues (1978) who determined that supplements providing both protein and energy were significantly related to growth rates. However, the effect per calorie was similar in both types of supplements, and the relationship was not altered by the presence of protein in the supplement nor by sex, home dietary intake, morbidity and socio-economic status. The increased growth was thus thought to be due to energy alone. This conclusion may be correct if energy intake alone spares the protein which would otherwise have been converted to glucose for energy metabolism and for synthesis and growth (Payne, 1975).

Maclean and Graham quoted in Nutrition Reviews (38), Jan. 1980, p. 13-15, examined the growth of Peruvian children recovering from protein-energy malnutrition and investigated the protein intake on the utilization of dietary energy by feeding the children a diet of 125-150 kilocalories with protein levels of 4.0, 5.3, 6.7 or 8 percent of the energy. They concluded that protein intake greater than 5.3 percent of dietary energy is adequate for normal weight gain. The protein intakes beyond which no further weight gain occurred were above those recommended by FAO/WHO, and Maclean and Graham suggested that these be reviewed in the light of their recent findings.

Improvement in nutritional status after food supplementation should be measured using height and weight, since these are the most sensitive indicators of nutritional status. This was recommended by Martorell Klein and Delgado (1980), after investigating the effect of food supplementation on anthropometric measurements such as supine length, arm length, weight, head circumference, arm circumference, and calf circumference. In Guyana, the weight for age measurement is used to assess nutritional status.

Martorell et al (1976) in reviewing studies done on protein and calorie supplementations during protein-energy malnutrition, found suggestive evidence that these are related to changes in growth. Proteins, calories, or both will have an impact on physical growth depending on which nutrient is limiting in the home dietary intake. Growth in weight which includes growth in fat may be responsive to caloric supplementation even when calories are not limiting. Growth in height may be responsive to caloric supplementation even when energy is limiting since some protein may be diverted to satisfy energy needs. But growth in height which is closely related to growth in muscle mass, is more dependent on adequate protein intake. Gopalan and colleagues (1973) found that under caloric limitation, calories will improve not only growth in weight, but growth in height as well. In contrast, Malcolm's study as quoted by Martorell et al (1976) suggests that protein supplementation will affect growth in height and weight while calories alone will affect growth in weight but not height.

If the child is not severely malnourished and/or not in hospital, supplementary food may be distributed to the mothers/guardians of undernourished children in the community. In the present study, supplementary food was donated to mothers/guardians of children who were attending the malnutrition clinic. Evaluation of a supplementary feeding programme established by UNICEF in Trinidad in 1973 indicated that supplementation had a beneficial effect on more than half of the recipients and the weight gain in the beneficiaries was significantly greater than in the controls.

Several problems can however occur when food supplements are distributed within a community. These include the displacement of food from the regular diet by the supplement, and the difficulty in attributing any increase in height and weight of the population to the use of supplementary food, if the amount of displacement is not measured (Baertl et al, 1970; Martorell et al, 1976). Valdere and coworkers (1979), in evaluating the dietary impact of a high-energy, supplement, discovered that energy intakes improved significantly in children under five years of age. The supplement did not modify protein intakes nor alter the consumption of specific foods, although it reduced the usual food consumption in children 24-47 months by 12 percent and children under 24 months by two to three percent. However, the decrease in usual energy intake was more than compensated for by the energy provided in the food supplement and the protein changes in the "usual" diet were small enough to have been made up by the small protein content of the food supplement. Food supplements, especially protein-rich ones, are thought to achieve stabilization of food supply in communities where there is marked seasonal variation in availability of foods (Cohen and Clayden, 1979; Baertl et al, 1970). No measure of displacement is made at clinics distributing supplementary food in Guyana.

Food supplementation is shown to be associated with growth in individual children; however, the impact of a food supplementary programme may be negligible when tested in an open community. This effect is exemplified in a study done in rural Lesotho on growth patterns of children receiving food supplements. This study was made of children under five years of age who were attending a comprehensive child care clinic in rural Lesotho and data was collected from 1,300 children over the period 1969-1974. There was overall no particular trend of improvement in weight-for-age over this period of time. However, children who attended regularly were found to be heavier at 18 months than those who did not. The food supplement, skimmed milk power (DSM) was not given to some children, since mothers claimed it caused diarrhoea, and its impact on young children was also negated because it was used by other family members (Cohen and Clayden, 1979).

Food supplements are considered to have some impact on the health of the community via infant morbidity and mortality rate even if not in improvement in nutritional status of the community. Gordon and Schrimshaw (1971) discovered a decrease in infant mortality in a rural Guatemalan village due to food supplementation. A similar result was evinced by Cohen and Clayden (1979) in Lesotho,and Baertl and coworkers (1970) in Northern Peru, where there was a decline in infant and preschool mortality rate with food supplementation. Wray (1978) reported a decrease in diarrhoeal disease in 182 children followed for 12 months in a food supplementation programme in Candelaria, Columbia, during 1964-1965, despite no improvement in environmental sanitation. Nutrition supplementation was found to benefit mostly the severely malnourished when improved nutritional status was measured by increments in weight and height (Rao, 1977).

To measure the effectiveness of a food supplementation programme, evaluation should be built into the programme and based on anthropometric measurements of growth and development, supported by biochemical procedures and sometimes dietary intake (Gordon & Schrimshaw, 1973). Factors governing what any particular intervention programme will achieve depends upon the nature of the nutrition intervention, other factors affecting nutritional status, frequency and severity of malnutrition in the area, and characteristics and behavior of the population to whom the programme applies. It is important that food intervention reaches the intended target population in numbers of persons, in specified amounts and with prescribed regularity (Gordon & Schrimshaw, 1973). Gongora and Shaw (1977) emphasize the need for evaluation of supplementary feeding programmes to cover not only nutrition and related health aspects of food and projects, but also their organizational, managerial and logistics component in order to develop a delivery system with greatest efficiency at least cost. Supplementation programmes should be broadened to influence nutritional thinking, as well as nutritional status and to inculcate sound and permanent food consumption and hygienic habits (Gongora and Shaw, 1977).

Results of Protein-Energy Malnutrition

Two of the major results of PEM in children under five years of age are impairment of the immune system and retardation in intellectual and behavioral development. These occur in addition to retardation of growth which may be severe or mild, depending on the effect of malnutrition. Growth retardation, intellectual and behavioral defects, may be considered long-term disabilities, since recovery to the potential of optimum development may never occur. However, the immune system will recover with nutritional rehabilitation.

The Immune Response in Protein-Energy Malnutrition

One of the most important functions of the immune system is protection from infectious diseases. Immune deficiency may result from sub-optimal nutrition and result in increased susceptibility of the individual to infection.

The immune system may be divided into two main components. These are the T or thymus-derived, thymus-dependent components, and the B or bursa, bone-marrow derived, bursa-dependent components during post-natal life (Good, 1977; Faulk, Paes & Mango, 1976). T-cells are responsible for many cell-mediated immunity reactions and B-cells are responsible for immunoglobulin (Ig) and antibody production.

T-cells, B-cells and their products along with macrophages, complement and non-specific factors of resistance are responsible for host defense against infections created by certain viruses, fungi, facultative intracellular pathogens, such as tuberculosis bacillus, leprosy bacillus (Good, 1977) and pneumococcal pneumonia (Faulk, Paes & Mango, 1976).

Central and peripheral organs of the immune system demonstrate morphological and histopathological evidence of damage during malnutrition (Schonland et al, 1972) which are clinically associated with a compromised ability of the host to deal effectively with infections.

A reduction in mucosal immune response such as Ig A in naso-pharyngeal secretions (Faulk, Paes & Mango, 1976) and decreased phagocytic activity (Selvaraj & Bhat, 1972) may explain the observed susceptibility of malnourished children to infection.

Non-specific host factors, in addition to the specific responses mentioned above, play an important part in resistance to infection. The most important non-specific host factors in host resistances are maintenance of skin integrity, mucosal surfaces and connective tissue through normal tissue replacement and repair; production of tears, secretions, enzymes, gastric acid and mucous; maintenance of specialized epithelial structures and function such as ciliated respiratory epithelium to remove bacteria and debris and fibroblastic respiration. These are all adversely affected in malnutrition (Schrimshaw, Taylor & Gordon, 1968). Severe protein depletion accompanied by atrophic changes of the skin with extensive desquamation, atrophy of the gastrointestinal mucosa, tissue necrosis, ulcer formation and poorly walled off infections, provide a portal of entry for infection (Jelliffe, 1976).

One of the most important diseases affecting malnourished children is diarrhoea, which is significantly correlated with growth (Mata, 1977; Whitehead, 1977; Whitehead et al, 1976). Marked microbial contaminations of the upper gastrointestinal tract by anaerobic, pathogenic organisms such as <u>E-coli</u>, pseudomonas sp, <u>Salmonela paratyphi</u>, shigella sp and Candida sp were discovered in malnourished children with diarrhoea (Gracey, Suhayona & Stone, 1973; Neumann, 1975; Gordon & Schrimshaw, 1970). These authors concluded that the above mentioned microbial abnormality may be related to the pathogensis of diarrhoea in PEM.

Infection and nutrition are thought to have a synergistic effect and infection of a minimally nourished child can precipitate him into a state of malnutrition. For example, measles, chicken pox, and whooping cough can precipitate a marginally malnourished child into kwashiorkor. Nutritional supplementation is thought to have a positive effect on the control of infection (Wray, 1978), such as diarrhoeal disease, although Schrimshaw (1970) reported no effect in a Guatemalan village study made in 1959-1964. Infections have been found by some authors to affect growth in children. Martorell et al (1975) reported that fevers and respiratory tract infections appeared to have no significant effect on growth, although diarrhoea led to defects in weight and length. These findings are contrary to those of Mata et al (1977), who discovered that fevers and respiratory tract infections did affect growth.

Infections can also affect nutritional status via loss of appetite and decreased tolerance for ingested food (Gordon & Schrimshaw, 1970). The above discussion may help to explain the presence of infections in malnourished children discovered in the National Food and Nutrition Survey of Guyana executed in 1971/72.

Intellectual and Behavioral Development

Another important result of malnutrition is an impairment of intellectual and behavioral development. It is hypothesized that deficits in brain size and cell number may affect cognitive and behavioral development in animals (Chase, 1976; Winnick & Rosso, 1974). However, researchers have not yet been able to extrapolate results of animal experiments to explain how deficits in human brain size and number are related to the receipt, transmission and responses to environmental stimuli.

Studies done with both animals and humans indicate an association between malnutrition (mild to severe) and intellectual and behavioral development. Non-human primates fed a low protein diet played significantly less, showed less social behavior, less grooming and more aggressive behavior than animals fed a high protein diet (Zimmerman et al, 1973). These results correlate well with the fact that malnourished individuals are apathetic, lethargic and irritable (Barnes, 1976; Kallen, 1973).

There is a direct association between deficits in height and weight of severely malnourished children and retardation in psychomotor, adaptive language and socio-personal behavior (Cravioto & Delicardie, 1976; Klein et al, 1971). Apathy, a symptom usually associated with PEM, leads to functional deprivation of the malnourished individual from experiences which form an integral part of his cognitive development and functional avoidance of new experiences and environmental stimuli (Cravioto & Delicardie, 1976; Levitsky & Barnes, 1970).

Conversely, lack of environmental stimulation of the malnourished child stems from the social conditions under which he exists. A number of measures of socio-economic status, such as father's occupation, mother's educational level and maternal literacy have been found to be related to intellectual development (Barnes, 1976; Christiansen et al, 1971; Cravioto & Delicardie, 1976; Habicht, 1973; Klein et al, 1971; Patel et al, 1971). The most important environmental stimulation has been thought to be the mother/child interaction.

Children whose diet has been supplemented show a high degree of interaction with the mother by being more demanding for the mother's attention (Chavez et al, 1971). Food supplementation has been shown to have a positive effect on intellectual development of the malnourished child by Chavez et al (1971) and no effect by Klein et al (1971) in a study of Guatemalan infants and pre-school children.

The reduction in response to external stimuli shown by pre-school children suffering from marasmus or kwashiorkor decreases as the child becomes older, regardless of whether he is nutritionally rehabilitated or not. Social followup of deprived subnormal subjects indicates that gradual improvement in psychological tests occur (Lloyd-Still, 1976). However, children malnourished before six months of age are thought to have sustained a permanent mental deficit (Cravioto & Robles, 1965). Hertiz et al (1972) found that intellectual level as measured by neurological status, intersensory competence, and a variety of language, perceptual and motor abilities was lowest in children who were malnourished before two years of age, when compared to their brothers and classmates. One aspect of intellectual development which was strongly resistant to recuperation was related to memory. Mackay et al (1971), in a study with Colombian children between birth and seven years old,discovered that combinations of psychological stimulation, nutritional supplementation and health care applied for one to four years prior to primary school, resulted in improvement of intellectual level to various degrees, except for some aspects of memory which were found strongly resistant to recuperation. Children having a reduced head circumference to height ratio have also been shown to have a greater deficit in intellectual development (Habicht, 1971; Klein et al, 1971).

No investigation of the effects of malnutrition on intellectual and behavioral development was made in the present study. However, the importance of effects of PEM on behavioral and intellectual development cannot be negated or ignored.

Assessment of Nutritional Status

Nutritional status in infants and pre-school children can be measured directly or indirectly and then compared against local or international standards for growth. Measurement of nutritional status is useful in detection of sub-clinical protein-energy malnutrition, monitoring of long-term recovery from severe PEM and assessing the effectiveness of preventative programmes (Alleyne et al, 1977, in "Protein Energy Malnutrition", Chap. 8). Direct assessment is performed on an individual via dietary, anthropometric, biochemical and clinical measurements. Indirect assessment utilizes food-balance sheets, specific mortality rates, cause of death records and health service statistics of a particular community. The indirect method of assessment may also utilize information provided by a survey considering dietary, anthropometric, biochemical and clinical parameters. Anthropometric measurements are used in Guyana to assess nutritional status of individuals. Indirect measures of assessment such as food-balance sheets exist for many countries, but tend to mask prevalence as well as regional and social distribution of the nutritional problems in a community (Evers & McIntosh, 1977; National Food and Nutrition Survey of Guyana, 1976).

Indicators of Protein-Energy Malnutrition include:

1) Ratio of deaths occurring before five years of age to total deaths in the population;

2) Infant Mortality Rates (IMR) ratio of deaths under one year to the number of live births in one year expressed as a percentage or per thousand infant population;

3) Second year mortality rate (Gordon, Wyon & Ascoli, 1967);

4) One to four year old mortality rate (Bengoa, Jelliffe & Perez, 1959), and

5) Cause specific mortality rates of children under five years old (Jelliffe, 1966; Jelliffe, 1971).

Cook (1969) in discussing infant mortality rates in the English-speaking Caribbean, showed that the Infant Mortality Rate for Guyana in 1966 was 41.3 per thousand deaths, comparable to the rest of the Caribbean which ranged from 34.7 in 1968 for Jamaica to 73.4 in 1965 for St. Vincent. The ratio of deaths of children under five years old to total deaths per population was calculated to be 10.6 per thousand in 1976 (Ministry of Health Statistics, Guyana). Gastroenteritis accounted for twenty-five percent of these deaths, and pneumonia for twelve percent. Protein-energy malnutrition was not mentioned as a cause of death, and was named as such in only a small percentage of the cases. However, since protein-energy malnutrition frequently occurs in conjunction with gastro-intestinal and respiratory tract infections, it is possible that PEM was responsible for a portion of deaths registered as gastroenteritis and pneumonia or other infections. Cravioto and Delicardie (1976) assumed that mortality due directly or indirectly to protein-energy malnutrition is manifested in pre-industrial societies as an excess of deaths over the rate for the same age group in a society where malnutrition is not prevalent.

Direct assessment of nutritional status as stated above utilizes dietary, anthropometric, biochemical and clinical measurements. Dietary assessment is performed by precise weighing of food and a dietary recall method, such as a twenty-four hour recall, or a three, five, or seven day record. Food frequencies or dietary histories are used mainly to provide an idea of the types of foods eaten, and is usually compared to a food guide such as the Canada Food Guide. The twenty-four hour recall and dietary records are converted to individual nutrients by comparing the types of foods eaten and their weight (per hundred grams) to food composition tables prepared for that particular country or region, for example, the Caribbean Food Composition Tables (1974) and the United States Department of Agriculture Food Composition Tables (1975).

In addition to dietary assessment, anthropometric measurements are used to indicate nutritional status either at the individual or community level when a survey is executed. Anthropometric measurements usually include weight, length or height, arm-, head- and chest-circumference and triceps skin fold (Lloyd-Still, 1976; Jelliffe, 1976). In this study, only length and weight were used as anthropometric measurements. Anthropometric measurements are widely used especially in young children as a measure of growth and thus nutritional status (Kanawati & McLaren, 1976). Growth is considered one of the most sensitive indicators of nutritional status in a child as certain nutrient deficiencies, especially protein and/or caloric deficiency are reflected in an alteration of body measurements (Wray & Aguirre, 1969). Growth and development are retarded before either changes such as anatomical and biochemical lesions appear, thus height and weight reductions indicate subclinical malnutrition (Jelliffe, 1966).

Anthropometric measurements are advantageous since they are easy to make, inexpensive, and persons performing them need not be highly trained. These measurements are usually compared to local standards for growth (weight for age, height for age, weight for height) if they are available, or international standards if they are not. The main disadvantage of using international standards is that they take no account of ethnic differences, which can lead to a false assessment of nutritional status. Local standards should be based on anthropometric data from individuals who are receiving an optimal diet and must take into account ethnic variations in the community (Alleyne et al , 1977 , in "Protein-Energy Malnutrition", Chap. 8; Lloyd-Still, 1976).

Standards are reported as mean values and standard deviations or in centile forms and may be committed to percentile growth charts for one or many children (Kanawati, 1976). Data may also be classified as percentage deviation from the norms (Jelliffe, 1966; Kanawati, 1976). Percentile growth charts based on the Gomez classification are used at clinics in Guyana. Several standards of anthropometric measurements are in use today based on weight for age, height for age, weight for height, head/chest circumference, mid-arm circumference, mid-arm muscle circumference and triceps skin fold, since these measures have been demonstrated to be important indicators of protein-energy malnutrition. The four main classifications in current use are the Wellcome classification 1970, the Waterlow classification 1972, the McLaren, Pellet and Read classification (1967), and the Gomez classification (1956) (Alleyne et al , 1977 , in "Protein-Energy

Malnutrition", Chap. 1). The standards used by the malnutrition clinic from which subject were taken, were those of Gomez.

The Wellcome classification is simple and based on the presence or absence of oedema. It is also subdivided into (1) 80-60 percent standard weight for age using the fiftieth percentile of the Boston Growth charts as the standard value, and (2) less than 60 percent.

Table 2: Wellcome Classification

	Oedema	
Weight (% of standard)	Present	Absent
80-60%	kwashiorkor	underweight
60%	marasmic-kwashiorkor	marasmus

The main advantage of the Wellcome classification is its simplicity; however, it has the disadvantage of not being useful if age is unknown.

The Gomez classification, established in 1956, is one of the earliest classifications of protein-energy malnutrition and is divided into primary, secondary and tertiary malnutrition depending on the percentage deficit weight for age from normal which is taken as the fiftieth percentile of the Boston Growth standards. The following table illustrates the different grades of malnutrition in the Gomez classification.

Table 3: Gomez Classification

Gd I	76-90% expected weight for age
Gd II	75-61% expected weight for age
Gd III	<60% expected weight for age

The Gomez classification is useful in assessing the nutritional status of communities; however, it is not applicable to classification of severe forms of protein-energy malnutrition. The National Food and Nutrition Survey of Guyana done in 1971/1972 used eighty percent weight for age as a cut-off point rather than seventy-five percent based on the experience in Jamaica, where seventy-five percent as the cut-off point for Grade II malnutrition did not reveal any statistical differences between groups. Thirteen percent of pre-school children in Guyana was shown to have a weight between seventy-five and seventy-nine percent of standard weight for age (National Food and Nutrition Survey of Guyana, 1976).

Jelliffe (1966) modified the Gomez classification by using four groups at ten percent body deficits weight for age and Bengoa (1970) also based his classification on that of Gomez, but included all cases with oedema as tertiary malnutrition, regardless of weight. McLaren, Pellet and Read (1967) based their classification mainly on clinical signs such as oedema, dermatosis, and oedema plus dermatosis. Hair change and hepatomegaly were combined with differing serum albumin concentrations. The only anthropometric measurement used was applied for patients with marasmus, which was an upper limit of seventy-five percent in the standards.

International standards in current use today are based on those by Stuart and Stevenson (1959), called the Harvard Standards, the Boston Standards developed in 1959 and the standards of the National Centre for Health Statistics (1976) from the United States.

The most recent standards for preschool children (0-5 years) are those of the United States Centre for Health Statistics (1976), compiled from longitudinal studies done by the Fels Research Institute, Yellow Springs, Ohio, from birth to twenty-three months, and data compiled from three national surveys in the late 1960's and mid-1970's. The World Health Organization (1978) based their present standards of weight for age and height for age on data from the United States (1976), because the data are recent, sample size is large and representative of the United States population including ethnic groups, the measurements were made by carefully trained staff using correct anthropometric techniques, the data are cross-sectional and are readily available for statistical analysis (WHO, 1978).

Height is used as a measure in most classifications since it is a good indicator of linear growth and the most severe retardation in height growth occurs in the latter half of the first year of life (Standard, Desai & Miall, 1969; Rea, 1971). Alleyne et al (1977) P.144 and Waterlow, 1972, 1973, agree that height is an indication of long-term previous dietary history. Waterlow (1972) has based his classification on the difference in the height for age as compared to the standards. Four groups have been defined, namely children who have 1) normal weight for age, weight for height and height for age; 2) acute malnutrition - those with normal height for age, low weight for age, and low weight for height, 3) acute or chronic malnutrition - those with low height for age, low weight for age, and low weight for height. The marasmic cases fall into this group, and 4) past chronic malnutrition - low height for age, low weight for age, and normal weight for height. Children recovered from protein-energy malnutrition and nutritional dwarfs will fall into this category.

In the early stage of food deprivation nutrient levels in body stores and tissues may be exhausted long before clinical and anthropometric changes occur (Evers & McIntosh, 1977; Kanawati & McLaren, 1976). Emphasis should be placed on biochemical tests related to the more common nutritional disturbances of the community. Total serum protein concentration and hemoglobin tests are performed at the Malnutrition Clinic of the Georgetown Hospital in order to test for the severity of malnutrition and the presence of anaemia. Total serum protein concentrations have been found to be depleted only in severe PEM, measurement of plasma albumin concentrations, however,has been demonstrated useful in kwashiorkor. Normal values are considered greater or equal to 3.5 grams per decilitre, values between 3 and 3.5 grams per decilitre are sub-normal, and values lower than 3 grams per decilitre indicate pathophysiology (Alleyne et al, 1977). Whitehead Coward and Lunn (1973) found that an albumin concentration below 3 grams per decilitre was accompanied by a decreased insulin concentration and increased growth hormone and cortisol concentration which facilitated body wasting.

Tests for iron, folic acid, B_{12} and other vitamins can be performed and values compared to normal standards, if anaemia and vitamin deficiencies are suspected. Since anaemia (mainly iron deficiency anaemia) is a problem in all age groups in Guyana, and often accompanies protein-energy malnutrition (National Food and Nutrition Survey of Guyana, 1976), haemoglobin levels of the malnourished children are tested at the Malnutrition clinic of the Georgetown Hospital. Biochemical tests are advantageous since they are independent of exact age but disadvantageous because they require elaborate laboratory facilities and trained technical staff (Jelliffe, 1969). Biochemical tests can be used to assess an individual's nutritional status by comparing to normal values or they can be used in conjunction with food consumption surveys, anthropometric and clinical assessment to provide a general picture of the status of the community (Evers & McIntosh, 1977).

Clinical assessment in PEM can be made in combination with anthropometric,dietary and biochemical methods to provide a more comparable picture of the health of individuals. Clinical characteristics for kwashiorkor and marasmus have been previously discussed in this thesis.

STATEMENT OF PROBLEM

Guyana has been identified by the "Fourth World Food Survey", p. 30, as having a high percent of malnourished children under five years old (32.1%) when compared to other countries in the Caribbean such as Barbados (16.5%) and Jamaica (18.4%).

Factors other than amounts and types of foods have been thought to be associated with protein-energy malnutrition. Household income, race, sex of child, and main provider's employment are socio-economic factors identified by the "National Food and Nutrition Survey of Guyana" (1976) as being associated with nutritional status. One recommendation forthcoming from this survey was further investigation of social and economic factors associated with malnutrition. Based on this recommendation factors found to be significantly associated with malnutrition in the literature were researched in urban Georgetown.

OBJECTIVES OF STUDY

The objectives of this study were:

(i) To assess the influence of various factors which may affect improvement of nutritional status of children under five years old attending the Malnutrition Clinic of the Georgetown Hospital, Guyana.

(ii) To assess whether the supplementary food and nutrition advice provided by nurses and the doctor at the clinic effected improvement in nutritional status of the child.

Function of the Malnutrition Clinic of Georgetown Hospital

Children who are noted to suffer from protein-energy malnutrition by Health Visitors, nurses and doctors from various health centres along the Coastal Plain, the Outpatients Department of the Georgetown Hospital or Convalescent Home for Children, are referred to the Malnutrition Clinic.

The grade of malnutrition of each child is assessed using the Gomez classification, which measures the percentage underweight of a child compared to the fiftieth percentile of the Boston Standards for weight for age. The Gomez classification has already been described on page 41 of this thesis.

The policy of the clinic is to provide medical care for the children and nutrition education for the mothers/guardians of these children. Children are discharged from the clinic when they have attained 90 percent weight for age nutritional status.

Children attending the Malnutrition Clinic have been recommended, since 1974, to use a High-Calorie, High-Protein Multimix for nutritional rehabilitation. This multimix was devised by the Tropical Metabolism Research Unit and Department of Paediatrics, University of the West Indies, Jamaica (Picou et al, 1975). The diet is based on milk, vegetable oil and sugar. Soya, arachis (peanut) and corn oil are preferred, but other vegetable oils can be used. This diet aims at providing 150-165 kilocalories/kilogram body weight/day. It provides 40 kilocalories/gram protein and 3 grams protein/100 ml. feed. This diet should enable a Grade III malnourished child (Gomez classification) to reach 90 percent standard weight for age in six weeks (Picou et al, 1975). The initial feeding schedule is based on the weight of the child, five or six feeds per day being suggested.

Dried, skimmed milk (DSM), corn-soya milk (CSM) and tinned cheese, donated by the World Food Programme, were distributed monthly to each child until April 1979. Children attending the clinic in 1977 were, in addition, provided with flour and Pison, a DSM/wheat flour multimix.

Instruction on the method of preparing this multimix was given verbally and in writing to each mother/guardian, who was then responsible for providing the oil and sugar used in the multimix.

HYPOTHESES

Nutritional status of pre-school children suffering from PEM is positively related to:

(1) The availability of food to the children.

(2) The personal hygiene of the mothers/guardians and children, and sanitation of the environment.

(3) Frequency of use of available medical services.

(4) Nutrition education of the guardians.

(5) The degree of malnutrition of children on their first visit to clinic, and

(6) The presence of diseases associated with PEM.

One sub-hypothesis was also tested:

(1) Malnourished children belonging to smaller households recover in a shorter time than those who belong to larger households.

A conceptual model of these hypotheses is shown in Figure 5. This model theorizes that food availability, sanitation, use of medical services, education of the mother/guardian, and length of stay at clinic interact to decide the nutritional status of a child.

Variables Used in Testing Hypotheses

The variables used to test the seven hypotheses were:

(1) Average income spent by a member of the household on food every week.

(2) Household size.

(3) Amount of supplementary food provided by the clinic for each child.

(4) Types and amount of food groups eaten each day by child.

(5) Sanitation index of mother, child and environment.

(6) Child's attendance at clinic.

(7) Number of times child was sick when attending clinic.

(8) Nutrition knowledge index of mother or guardian.

(9) Nutrition practice index of mother or guardian.

(10) Additional diseases present in child on entry to clinic.

(11) Nutritional status of child on first visit to clinic.

(12) Period of time child attended clinic.

(13) Change in nutritional status of child.

METHODOLOGY

Sample

Subjects chosen were all urban children, under five years of age, living in Georgetown who had attended the Georgetown Hospital Malnutrition Clinic during the period May 1, 1978 - June 30, 1979. Both discharged children and children who were registered as attending clinic during the time period of May 1, 1978 - June 30, 1979.

Information concerning the subjects was elicited by Personal

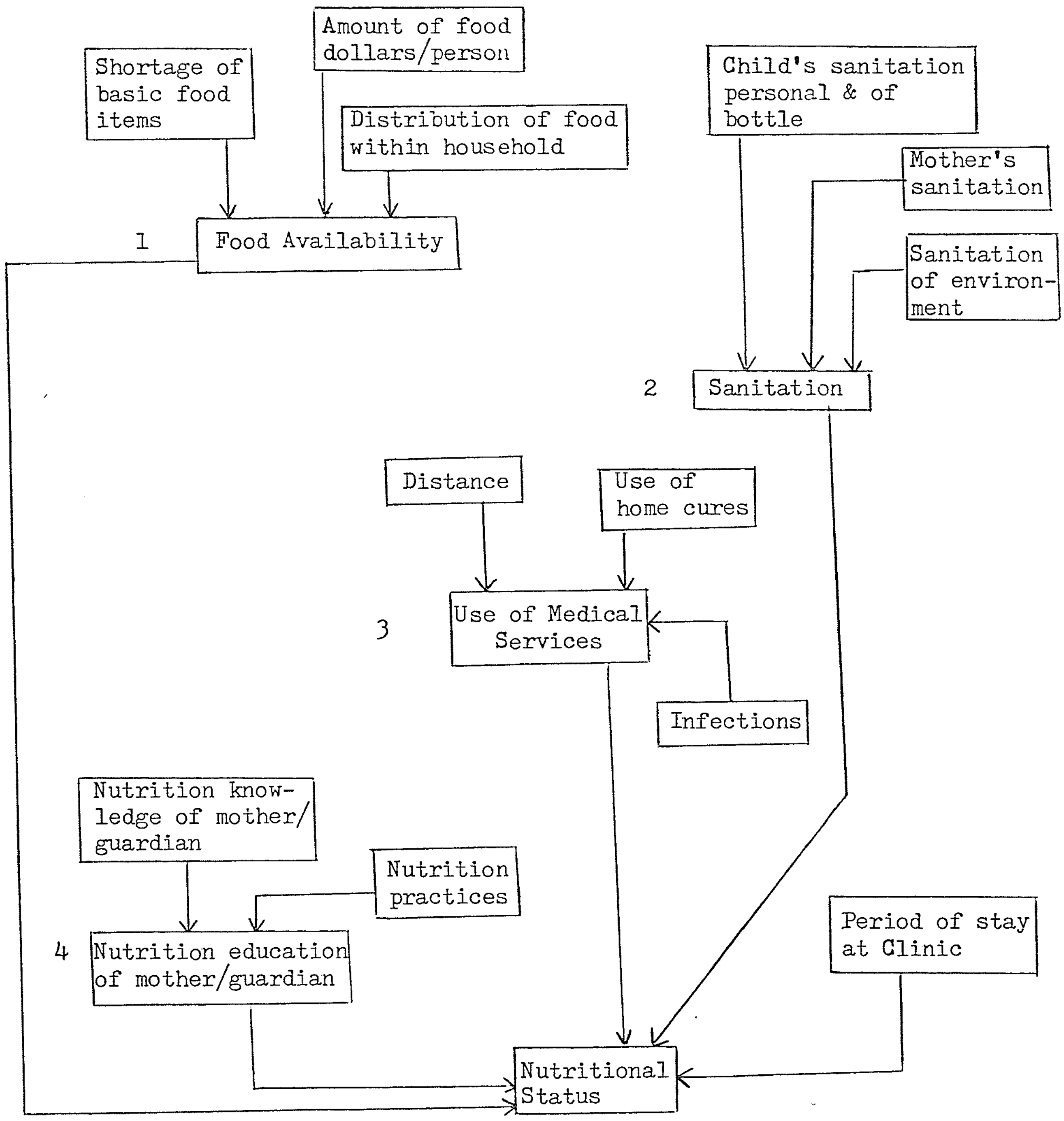


Figure 5: Conceptual Model of Hypothesis

Interview technique and examination of the children's personal charts retained by the Malnutrition Clinic. Information on 117 subjects was collected from the clinic charts. This information included weight, length, age, period of stay at clinic, diseases other than PEM present in child, child's attendance at clinic, number of times child was sick when attending clinic, and supplementary food provided by clinic for each child. However, information such as sanitation, nutrition knowledge, nutrition practices, food-dollars per person per week, food-groups eaten and descriptive characteristics of child and household was collected via interviews on only 71 subjects, due to difficulty in locating some mothers/guardians or children at their stated place of abode. Forty-three of the 71 interviews provided complete information on factors being researched. Characteristics of the 28 subjects not used in the analysis were assessed as fully as possible to compare the representativeness of the sample of 43 to the larger sample of 71.

The total sample of 117 was comprised of 54 males and 68 females with a mean age on entry to clinic of 16.7 months and mean period of stay at clinic of 7.3 months. The sample of 43 was comprised of 21 males and 22 females with a mean age on entry to clinic of 15.4 months and a mean period of stay at clinic of 8.1 months (see Table 4a). In both the total sample and complete data set, over fifty percent of the subjects had no additional disease. The most prevalent disease with PEM was respiratory infection or a combination of skin, respiratory, or gastrointestinal diseases (see Table 4b).

Table 4a: Characteristic of Total Sample and Complete Data Set

	Males	Females	Age of Children on Entry to Clinic	Period of Stay at Clinic
Total Sample N = 117	54	63	16.7 I 10.59 [a] months	7.3 I 4.89 months
Complete Data Set N = 43	21	22	15.4 I 10.77. months	8.1 I 5.54 months

Table 4b: Additional Diseases Present in Total Sample and Complete Data Set

Additional Diseases	Total Sample N = 117	Complete Data Set N = 43
PEM only	52.0%	55.8%
PEM & gastro-intestinal disease	2.0%	0 %
PEM & respiratory disease	16.5%	23.3%
PEM & skin disease	7.0%	2.3%
PEM & combination of two or more	12.1%	9.3%
PEM & other disease [b]	10.4%	9.3%

[a] Standard deviation from mean.

[b] Diseases such as Down's Syndrome and other genetic and physical disabilities.

Variables designed to test the seven previously stated hypotheses were measured in the following manner:

Food Availability

Food availability was estimated through four indicators:

1. The average income spent per person per week in each household on food.
2. The household size at the time of the interview.
3. The variety of the child's diet as measured by the percentage of recommended servings of four basic food groups: - milk and milk products, meat and meat alternates, bread and cereal and fruits and vegetables suggested by the Canada Food Guide.
4. The energy and protein content of supplementary food distributed monthly by the clinic to each child, expressed as a percentage of the Recommended Daily Allowances for the Caribbean.

Personal Hygiene of Child and Mother/Guardian, and Sanitation of the Environment

A Sanitation Index was compiled by adding scores from indices measuring personal hygiene of the child, mother/guardian and sanitation of the environment. Variables included in indices were cleanliness of clothes, finger-nails and kemptness for child and guardian, with cleanliness and tidiness of house and yard used as a measure of environmental sanitation. Each of the three indices was scored as a ratio of good hygiene or sanitation to perfect hygiene or sanitation considered as unity (see Table 5). The three sub-indices were then added together to form a Sanitation Index.

Table 5: Sanitation Index of Child, Guardian and Environment

	Scoring System	
Sanitation Index of Child		
Personal hygiene of child		
Cleanliness of clothes	dirty[a] 0	clean 1
Kemptness of hair	uncombed 0	combed 1
Cleanliness of fingernails	dirty[b] 0	clean 1
Child bathed	no 0	yes 1
Sanitation Index of Guardian		
Personal hygiene of guardian		
Cleanliness of clothes	dirty 0	clean 1
Kemptness of hair	uncombed 0	combed 1
Cleanliness of fingernails	dirty 0	clean 1
Sanitation of the Environment		
House		
swept	no 0	yes 1
tidy[c]	no 0	yes 1
Yard		
uncluttered with litter	no 0	yes 1

a no visible sign of dirt around neck-line, arm-holes, or other sections of clothes

b no dirt underneath fingernails

c contents of house in order and living room not littered with objects such as books, papers, toys, etc.

Use of Available Medical Services

Use of available medical services was measured individually both by the percent attendance of child at clinic, and percent times child was sick when attending clinic.

1. Percent attendance was calculated as the ratio of actual visits of child to expected visits of child multiplied by 100. Children were expected to attend clinic once a month.

2. Percent times sick was measured by the ratio of times child was sick with colds,fever, diarrhoea and scabies when attending clinic, to expected clinic attendance.

Nutrition Education of the Guardian

The nutrition education of the mother/guardian of the child was measured by two indices:- a nutrition knowledge index and a nutrition practice index as shown in Table 6.

Presence of Additional Diseases in Child

The presence of additional disease(s) in each malnourished child was noted from the child's clinic chart.

Initial Nutritional Status of Child

The initial degree of malnutrition of each child was measured as a percentage ratio of the child's weight for his particular length compared to the expected weight for length. The standards used were those of the National Centre for Health Statistics, 1976, of the United States .

Table 6 : Nutrition Education of Mother/Guardian of Child

	Scoring System	
Index of Nutrition Knowledge		
Nutrition advice received by mother/ guardian received from doctors, nurses or relatives	No 0	Yes 1
Age at which child was first bottle-fed	<4 months 0	>4 months 1
Index of Nutrition Practices	No	Yes
Child breast-fed	0	1
Child completely breast-fed for four months	0	1
Child weaned before four months	1	0
OR		
Child weaned after six months	1	0
Child ate all four food groups per day	0	1

Period of Stay at Clinic

The period of clinic attendance for each child was estimated by the number of months the child attended clinic.

Change in Nutritional Status

The change in nutritional status was used to assess improvement in each child's health. This measure was calculated as the difference between the percentage weight for height of child on his/her final visit to clinic minus the percentage weight for height on his/her initial visit to clinic.

Analysis of Data

Analyses were performed using the Statistical Analyses System (SAS) Package Programme. A Linear Regression analysis was made using the change in nutritional status as the dependent variable. Each variable considered in the seven hypotheses was tested to examine its significance in contributing to the dependent variable. The total sample of 117 and the complete data set of 43 were both analyzed.

Those variables found to be significant below $P < 0.10$ level the complete data set were then used as independent variables in a Multiple Regression equation with change in nutritional status as the dependent variable. The Multiple Regression equation was of the following form:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5$$

The sample was then divided into two groups:

Group I - children whose nutritional status had improved

Group II-- children whose nutritional status remained unchanged or had deteriorated

The Multiple Regression technique was then performed separately on each group to investigate the importance of factors shown to be of significance in improvement or deterioration of nutritional status.

A Discriminant Analysis technique was later used to investigate whether the two groups could be differentiated using the variables considered in the Multiple Regression analysis. This Discriminant Analysis technique may be used to predict the outcome of nutritional status if the two groups proved significantly different.

Tables comparing factors under investigation between the total sample of 117 and complete data set of 43 are shown in Appendix B.

RESULTS

Description of Sample

Results of the interviews indicate that the incidence of illnesses such as colds, diarrhoea, fever and worms are approximately the same in the group of 43 as well as the group of 28 not used in analysis. Approximately 77 percent of children had a cold one month prior to the interviews, 29 percent had diarrhoea, 51 percent had fever, and 25 percent had worms in last year prior to the interview.

The two groups differed in use of medical services by mothers/guardians, food habits of children and mothers/guardians, characteristics of mothers/guardians and fathers of subjects,and characteristics of households. A smaller percentage of mothers/guardians in the group of 28 had a medical facility present in district which they used when compared to the group of 43, i.e. 85.7 percent and 53.6 percent respectively compared to 93 and 67 percent (see Table 7).

Table 7: Use of Medical Facilities by Mothers/Guardians

	N = 43	N = 28
Medical facility present in district	93.0%	85.7%
Persons who used medical facility more than home remedies	67 %	53.6%

A greater percentage of children were breast-fed for less than four months in the group of 43 (51.5%) when compared to the group of 28 (43.8%), and a greater percent of children bottle- and breast-fed simultaneously in the smaller group (68.8% compared to 46.5%). Eighty-nine and 82 percent of children in smaller group drank bush-tea, and porridge respectively when compared to 70 and 81 percent in the group of 43. Approximately 12 and 18 percent more of children's bottles were sterilized and mother's diet was supplemented in the larger group compared to the group of 28.

Ninety-three percent of guardians in the smaller group claimed to have been provided with supplementary food compared to 43 percent in the group of 43 (see Table 8).

Nutrition knowledge was approximately the same in both groups. Eighty percent of guardians thought that breast-milk was better than other kinds of milk, yet only 14 percent named breast-milk as the best kind of milk. Seventy-five percent of guardians claimed to have received nutrition advice from nurses, a doctor or relatives, yet the average age of weaning was nine months instead of four to six months.

Characteristics of the parents and guardians of the subjects differed greatly between the two groups. A higher percentage of guardians had primary school education (85.2%) in the group of 28 and read books, newspapers or magazines (71.4%) regularly, when compared to 76.7 and 58 percent in the group of 43 (see Table 9). A smaller percentage of fathers helped to support their children (36.8%) and lived at home (32.1%) in the group of 28 when compared to the larger group, 52 and 42 percent respectively (see Table 9).

Table 8: Food Habits of Children and Mothers/Guardians in Complete Data Set and Non-Analyzed Group

	% agreement		Partial Completion	
	%	N	%	N
Children breast-fed	76.7	43	76.9	26
Children breast-fed for less than four months	51.5	33	43.8	16
Children who were breast- and bottle-fed simultaneously	46.5	43	68.8	16
Children who were bottle-fed at one moth of age or less	68.5	43	63.6	22
Children whose bottle was boiled at every feed	60.6	43	47.8	23
Children who drank bush-tea	69.8	43	89.3	28
Children who drank porridge	81.4	43	82.1	28
Mothers who supplemented diet during lactation	60.6	33	42.1	16
Mothers who supplemented	39.5	42	26.1	23
Guardians who collected supplemented food from clinic	43	43	92.9	28
Guardians who gave children the supplementary food	62.8	43	92.3	26

Table 9: Characteristics of Mothers/Guardians and Fathers of Subjects

	N = 43[a]	N = 28[a]
Guardians who had only primary school education	76.7%	85.2% (N=27)
Guardians who read books, newspapers or magazines regularly	58.0%	71.4%
Children's fathers who live at home	41.9%	32.1%
Children's fathers who helped to support child	52.0% (N=25)	36.8% (N=19)
Guardians who looked after child by themselves for majority of the time	67.4%	71.4%

[a] Sample size varies depending on information collected

The characteristics of households also differed between the two groups. The group of 28 had a lower percent of households with a vegetable garden (8.0%) and distributed food to the head of household first (71%) when compared to the larger group 21 and 88 percent respectively (see Table 10). A larger percent of households in the group of 28 had access to a refrigerator to store meat, piped water inside of house and flush toilets when compared to the larger group (see Table 10).

Table 10: Characteristics of Households

	N = 43	N = 28
Vegetable garden present	20.9%	8.0%
Households which kept chickens	4.7%	10.7%
Households who distribute food to head of households or adult relatives first	88.4%	71.4%
Households which have access to a refrigerator to store meat	41.9%	53.6%
Households with piped water inside of house	72.1%	75.0%
Households with flush toilets	76.7%	78.6%
Children bathed two or more times per day	81.7%	92.9%

From the above comparisons, it is evident that the group of 43 is not representative of the entire group interviewed, since the remaining 28 show different characteristics to those in the complete data set of 43.

Results of Linear Regression Analysis

Results of the Linear Regression Analysis are shown in Table 11. All variables found to be significant below $P < 0.10$ level were used in a Multiple Regression Analysis. The Multiple Regression equation was of the form

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5$$

where Y = final weight for height - initial weight for height

x_1 = initial weight for height

x_2 = percent of child's requirement of calories provided by supplementary food

x_3 = percent of child's requirement of protein provided by supplementary food

x_4 = percent of food group bread & cereals eaten by child per day

x_5 = percent of food group fruits & vegetables eaten by child per day

The results of Linear Regression Analysis for the complete data set (N = 43) are similar to that of entire sample (N = 117) in household size, and percent of times child was sick when attending clinic, all of which were not significant. In the larger sample, the significance of food-dollars per person, percent of clinic attendance, presence of additional diseases, percent frequency of use of food group milk and milk products, sanitation index, and nutrition knowledge index increased, although only nutrition knowledge index became significant at .05 level. The significance of period of stay at clinic, percent of caloric requirement provided by supplementary food, percent frequency of use of food group bread and cereals, percent frequency of use of food group fruits and vegetables, percent frequency of food group milk and milk products,and nutrition practice index, decreased with increased sample size. Only the percent of calories and protein supplied by supplementary food were significant below the .05 and .10 level respectively.

The subhypothesis that malnourished children belonging to smaller households recovered in a shorter time than those belonging to larger households proved non-significant, although the significance of the model increased with increasing sample size (see Table 11).

Means of Variables Researched in Study

Table 12 shows the means of the variables considered in the hypotheses.

The means of the variables, weight for heights of children on first visit to clinic (83%), ages of children on first visit to clinic (23 months), sanitation index (2.2 and 2.3), percent frequency of use of food group bread and cereals (81%), fruits and vegetables (38%), meat and meat alternates (50%), and nutrition practice index (.34 and .32) were very similar in both the complete data set (N=43) and the entire sample (N=117). The mean period of stay at clinic, clinic attendance, percent times child was sick when attending clinic, percent caloric requirement provided by supplementary food was lower in the larger group than in the group of 43. The mean change in nutritional status, household size, food-dollars per person per week, percent protein requirement provided by supplementary food and nutrition knowledge index was higher in the larger group than in the complete data set.

Means of Variables in Complete Data Set Which Separate the Improved Group from the Unimproved Group

Table 13 shows the means of the variables of the group of children whose nutritional status had improved (Group I) and those whose nutritional status had deteriorated (Group II). It can be seen that the mean values of most variables except initial weight for height, change in nutritional status, percents of caloric and protein requirements

Table 11: Results of Linear Regression Analysis

Variable	Complete Data Set (N=43) PR > |T|	Entire Sample (N=117[a]) PR > |T|
Weight for height of children, first visit to clinic	.0001*	.0001 (N=113)
Period of stay at clinic	.37	.90 (N=109)
Sanitation Index	.71	.21
Household size	.54	.57 (N= 68)
Food-dollars per person per week	.97	.38 (N= 53)
% expected attendance at clinic	.80	.62 (N=113)
% times child was sick when attending clinic	.89	.93 (N=113)
Additional diseases	.31	.22 (N=113)
% caloric requirement provided by supplementary food	.01*	.04 (N= 97)
% protein requirement provided by supplementary food	.06*	.06 (N= 97)
% frequency of use of food group bread & cereals	.06*	.93 (N= 67)
% frequency of use of food group fruits & vegetables	.08*	.32 (N= 67)
% frequency of use of food group meat & meat alternates	.85	.91 (N= 67)

continued.......

Table 11 cont'd....

Results of Linear Regression Analysis

Variable	Complete Data Set (N=43) PR > |T|	Entire Sample (N=117[a]) PR > |T|
% frequency of use of food group milk and milk products	.72	.68 (N= 67)
Nutrition Knowledge Index	.17	.04 (N= 67)
Nutrition Practice Index	.48	.62 (N= 62)
Results of Sub-Hypothesis **		
Household size	.52	.22 (N= 68)

a Sample size varies depending on information collected from medical charts and interviews

* Variables used in Multiple Regression Analysis

** Dependent variable was length of stay

Table 12: Means of Variables Considered in the Hypotheses for Complete Data Set and Entire Sample

Variable	Complete Data Set N = 43	Entire Sample N = 117[a]
Period of stay at clinic	8.1 ± 5.5 [b] months	7.3 ± 4.9 months (N = 113)
Weight for heights of children on first visit	82.9 ± 9.9 % of std[c]	83.9 ± 10.5 % of std (N = 116)
Weight for heights of children on last recorded visit to clinic	90.4 ± 8.0 % of std	90.4 ± 12.7% of std (N = 114)
Change in nutritional status	1.2 ± .4 % of std	6.5 ± 14.5 % of std (N = 114)
Ages of children on first visit to clinic	15.4 ± 10.8 months	16.7 ± 10.6 months (N = 117)
Ages of children on last recorded visit to clinic	23.1 ± 12.0 months	23.6 ± 11.6 months (N = 117)
Sanitation Index	2.3 ± .7	2.2 ± .8 (N = 65)
Household size	8.2 ± 3.7	8.8 ± 4.7 (N = 68)
Food-dollars per person per week	5.63 ± 3.6	6.09 ± 4.2
% expected attendance at clinic	65.0 ± 26.0	60.2 ± 28.8 (N = 117)
% time child was sick when attending clinic	56.9 ± 26.9 [b]	50.8 ± 25.4 (N = 117)
% caloric requirement provided by supplementary food	33.3 ± 49.0	29.8 ± 35.9 (N = 99)
% protein requirement provided by supplementary food	107.4 ± 59.4	110.7 ± 71.0 (N = 99)

continued....

Table 12 cont'd.....

Means of Variables Considered in the
Hypotheses for Complete Data Set and Entire Sample

Variable	Complete Data Set N = 43	Entire Sample N = 117[a]
% frequency of use of food group bread and cereals	81.0 ± 31.0	81.4 ± 30.5 (N = 67)
% frequency of use of food group fruits and vegetables	39.0 ± 22.1	38.2 ± 23.0 (N = 67)
% frequency of use of food group meat and meat alternates	50.1 ± 28.4	49.5 ± 28.7 (N = 67)
% frequency of use of food group milk and milk products	86.3 ± 30.5	81.3 ± 34.3 (N = 67)
Nutrition Knowledge Index	.68 ± .3	.72 ± .3
Nutrition Practice Index	.34 ± .2	.32 ± .2

[a] Sample size varies depending on information collected from medical charts and interviews

[b] Standard deviation from mean

[c] Standard used was 50th percentile of National Centre for Health Statistics of the United States (1976)

provided by supplementary food, percent of food group fruits and vegetables are very similar and therefore could not be used to differentiate between the two groups.

Results

Table 13 shows the means of the variables considered in the seven hypotheses.

Table 13: Means of Variables Considered in the Hypotheses in Each Group of Children

Variable	Group I Improved Nutritional Status (N = 34)	Group II Deteriorated Nutritional Status (N = 9)
Length of stay at clinic	8.8 ± 8.8 [a] months	5.6 ± 4.0 months
Initial weight for height	81.0 ± 9.7 % of std	90.1 ± 7.3 % of std
Initial age	14.8 ± 10.2 months	17.4 ± 13.2 months
Final weight for height	92.0 ± 7.9 % of std	84.3 ± 5.2 % of std
Final age	23.2 ± 12.4 months	23.0 ± 11.4 months
Change in nutritional status	11.4 ± 9.9 % of std	-6.1 ± 3.6 % of std
Sanitation index	2.22 ± .8	2.35 ± .4
Household size at time of interview	8.1 ± 3.1	8.7 ± 5.7
Food-dollars per person per week	5.66 ± 3.9	5.50 ± 2.3
Percentage attendance at clinic	66.5 ± 25.0	64.9 ± 30.7

continued...

Table 13 cont'd....

Means of Variables Considered in the Hypotheses in Each Group of Children

Variable	Group I Improved Nutritional Status (N = 34)	Group II Deteriorated Nutritional Status (N = 9)
Percentage time sick when attending clinic	56.5 ± 28.7	54.5 ± 20.0
% of child's caloric requirement provided by supplementary food	35.7 ± 53.9	22.6 ± 14.6
% of child's protein provided by supplementary food	110.4 ± 59.7	95.4 ± 60.3
% of food group bread and cereals eaten by child per day	81.3 ± 31.1	79.9 ± 32.4
% of food group fruits and vegetables eaten by child per day	42.8 ± 21.1	24.6 ± 20.6
% of food group meat and meat alternates eaten by child per day	49.8 ± 26.3	50.8 ± 37.0
% of food group milk and milk products eaten by child per day	84.1 ± 33.1	94.4 ± 16.7
Nutrition Knowledge Index	0.71 ± .3	0.67 ± .4
Nutrition Practice Index	0.35 ± .2	0.31 ± .2

[a] Standard deviation from mean

[b] Standard used was that of National Centre for Health Statistics of the United States (1976)

Results of Multiple Regression Analysis

Tables 14, 15 and 16 show the results of the Multiple Regression Analysis made on the complete data set.

Table 14 shows the significance of variables in multiple regression made on the complete data set. Significant variables (below .10 level) were weight for height of children on entry to clinic, and percent of food group fruits and vegetables eaten by child per day.

Table 14: Significance of Variables Used in Multiple Regression Equation (N = 42)[a]

Variable	PR T	Overall Significance of Model
Weight for heights of children on entry to clinic	.0001	
% of food group fruit and vegetables eaten by child per day	.006	R^2 = .30
% of food group bread and cereals eaten by child per day	.51	$F_{5,36} = 3.09$ Overall significance of model = .02
% of child's protein requirement provided by supplementary food	.096	
% of child's caloric requirement provided by supplementary food	.48	

[a] Computer print-out showed only 42 variables used.

Table 15 shows the significance of variables used in Multiple Regression for Group I. The weight for heights of children on entry to clinic was the only variable which was significant.

Table 15: Significance of Variables Used in Multiple Regression for Group I (N = 34)

Variable	PR T	Overall Significance of Model
Weight for heights of children on entry to clinic	.0007	
% protein requirement of child provided by supplementary food	.22	R^2 = .501 $F_{5,28}$ = 5.63
% food group of bread and cereals eaten by child per day	.33	Overall significance of model = .001
% caloric requirement of child provided by supplementary food	.74	
% food group fruit and vegetables eaten by child per day	.75	

Table 16 shows the significance of variables used in multiple regression for Group II. None of the variables proved significant, despite a very high R - square value (.901).

Table 16: Significance of Variables Used in Multiple Regression for Group II (N = 8)

Variable	PR T	Overall Significance of Model
Weight for heights of children on entry to clinic	.87	
% food group fruits and vegetables eaten by child per day	.69	R^2 = .901
% food group bread and cereals eaten by child per day	.36	$F_{5,2}$ = 3.63 Overall significance of model = .23
% of caloric requirement of child provided by supplementary food	.26	
% of protein requirement of child provided by supplementary food	.18	

Results of Correlations Between Variables Used in Multiple Regression

Tables 17 and 18 show the correlations between variables used in the multiple regression. There was a significant negative correlation (-.43) between the weight for heights of children on entry to clinic, and percent of caloric requirement of child provided by supplementary food for Group I (see Table 17). There were also significant negative correlations between the percent of calories and protein supplied by supplementary food and percent food group bread and cereals eaten per day by child. The highly significant positive correlation between calories and protein supplied by supplementary food was expected, since the supplementary food supplied both protein and calories.

The weight for heights of children on entry to clinic in Group II was negatively correlated with percent of calories and protein provided by supplementary food (-.53 and -.48 respectively) and food group bread and cereals (-.82), the last being significant at the .01 level (see Table 18). The percent calories and proteins provided by supplementary food was positively correlated with food group fruits and vegetables (.55 and .52 respectively).

Indication of Graphs

The relationship between length of stay of child at clinic and change in its nutritional status is shown in Figures eight and nine. Length of stay was not used in this study as an indication of change in nutritional status, however the period of time child attended clinic was seen to have resulted in deterioration in nutritional status of the child in Gp II (see Fig.9). No linear relationship was observed in Fig. 8 between period of stay of

Table 17: Correlations Between Variables of Importance in Children Whose Nutritional Status Had Improved (Group I)

Variable	IWH	PTCAL	PTPRO	PFDGRB	PFGFV
IWH[b]	1.0	-.43**	-.06	.33[a]	.10
PTCAL[c]		1.0	.53***	-.53***	.09
PTPRO[d]			1.0	-.43**	.12
PFDGRB[e]				1.0	.16
PFGFV					1.0

[a] Sig at .10 level

* Sig at .05 level

** Sig at .01 level

*** Sig at .001 level

[b] weight for height of child on entry to clinic

[c] percent caloric requirement of child provided by supplementary food

[d] percent protein requirement of child provided by supplementary food

[e] percent food group bread and cereals eaten by child per day

[f] percent food group fruits and vegetables eaten by child per day

Table 18: Correlations Between Variables of Importance in Children Whose Nutritional Status Had Deteriorated (Group II)

Variable	IWH	PTCAL	PTPRO	PFDGRB	PFGFV
IWH[a]	1.0	-.53	-.58	-.82**	-.31
PTCAL[b]		1.0	.99***	.12	.55
PTPRO[c]			1.0	.07	.52
PFDGRB[d]				1.0	.32
PFGFV[e]					1.0

** Sig at .01 level

*** Sig at .001 level

a weight for height of child on entry to clinic

b percent caloric requirement of child provided by supplementary food

c percent protein requirement of child provided by supplementary food

d percent food group bread and cereals eaten by child per day

e percent food group fruits and vegetables eaten by child per day

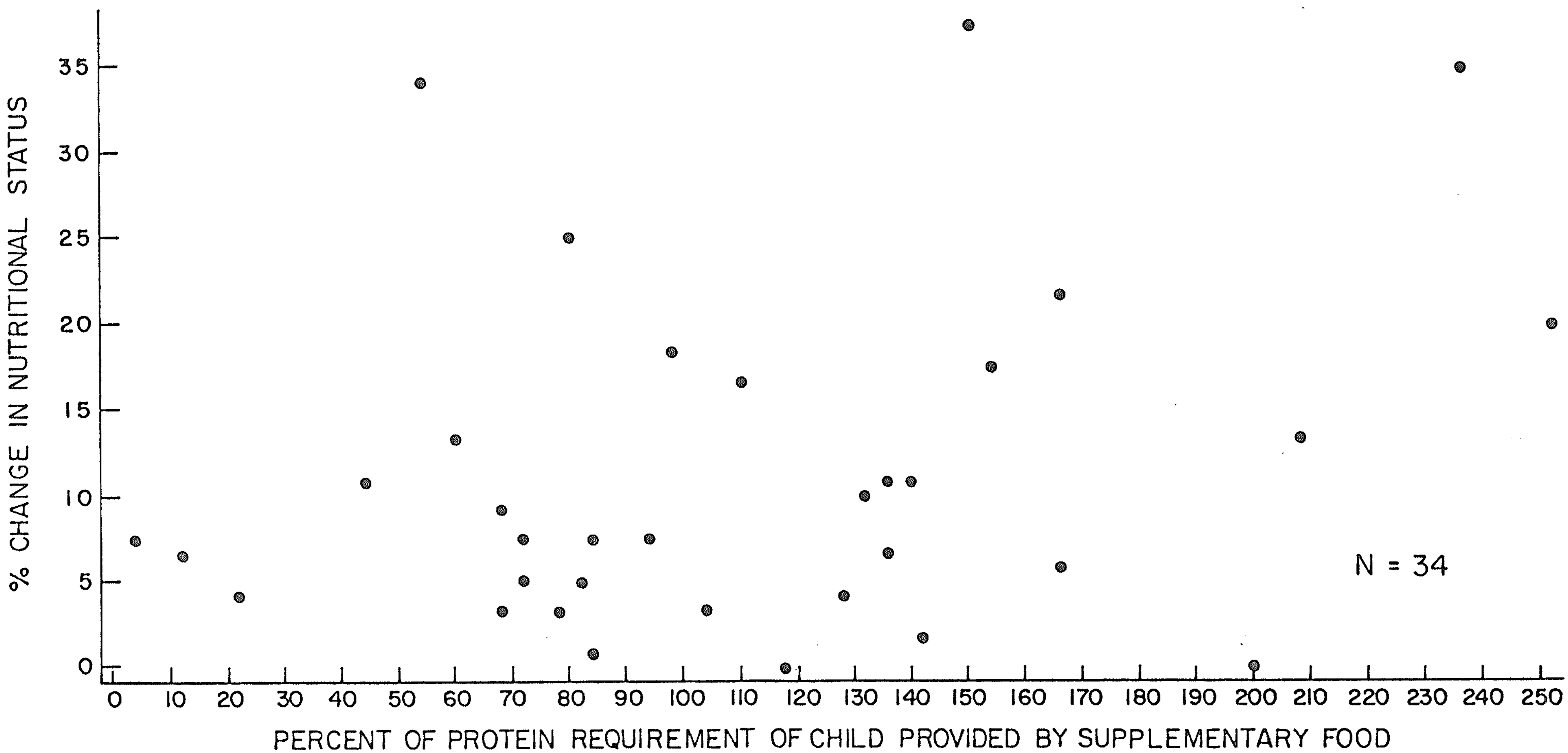


Fig. 6. CHANGE IN NUTRITIONAL STATUS OF CHILDREN IN GP. I vs PROTEIN SUPPLIED BY SUPPLEMENTARY FOOD.

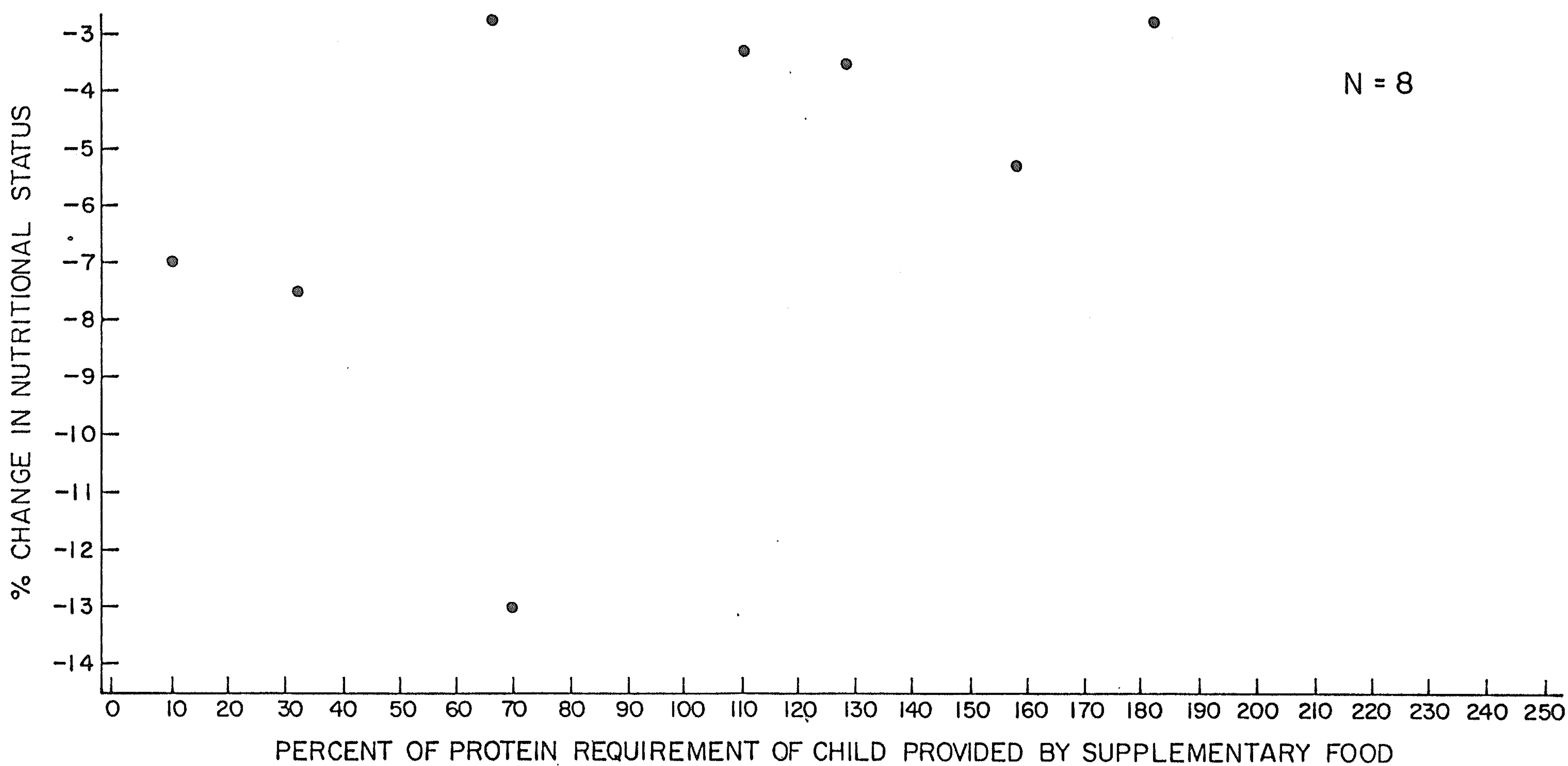


Fig. 7. CHANGE IN NUTRITIONAL STATUS OF CHILDREN IN GP. II vs PROTEIN SUPPLIED BY SUPPLEMENTARY FOOD.

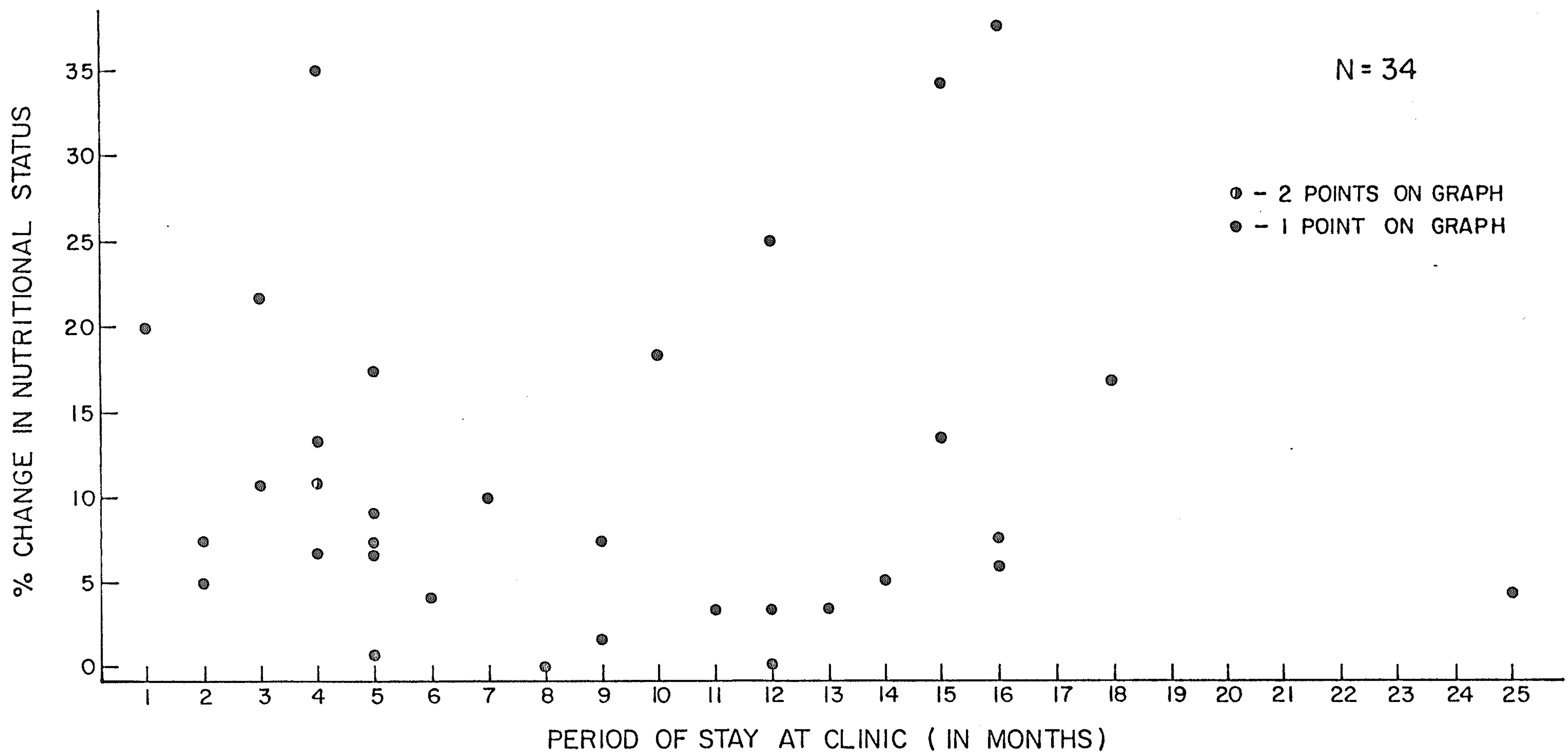


Fig. 8. CHANGE IN NUTRITIONAL STATUS OF CHILDREN IN GP. I vs PERIOD OF STAY AT CLINIC.

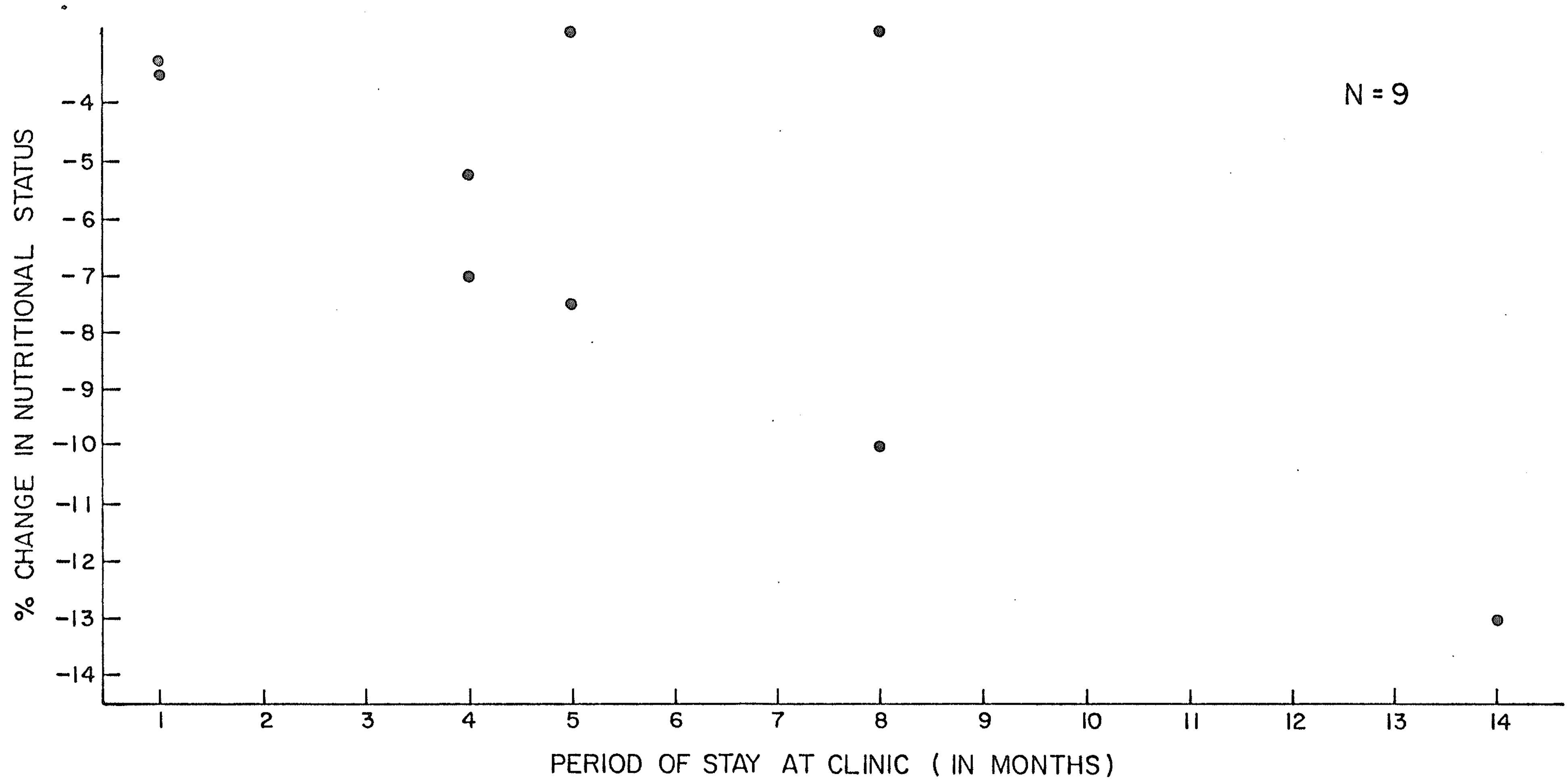


Fig. 9. CHANGE IN NUTRITIONAL STATUS OF CHILDREN IN GP. II vs PERIOD OF STAY AT CLINIC.

child at clinic and improvement in its nutritional status.

The change in nutritional status versus percent protein supplied by supplementary food show no definite linear relationship in children belonging to Group I or Group II although percent protein supplied by supplementary food was found to be associated with change in nutritional status in the linear regression analysis. It was also found to be the second most important factor which contributed to improvement in nutritional status (see Table 15).

Results of Discriminant Analysis

A discriminant analysis using variables x_1, x_2, x_3, x_4 and x_5 of the Multiple Regression Analysis was performed on the two groups of children. However, the $F_{5,36}$ value of 1.17 was not significant even at the .10 level, thus these variables cannot be used to differentiate between the two groups or predict which children will improve their nutritional status. However, a discriminant analysis performed using variables weight for height of child on entry to clinic, sex, and age of child was significant between the .05 and .10 level ($F_{3,39} = 2.71$) and it is probable that if the sample size had been larger, the discriminant analysis may have differentiated between the two groups.

Discussion

Weight for height was used as a measure of nutritional status to incorporate height as well as weight into the assessment of nutritional status. It can be used as a measure of acute malnutrition, since changes in weight would be more rapidly seen than changes in height. Initial analysis of the data using weight for age as a measurement of mutritional status showed no trends or associations between factors investigated and nutritional status. This may be because the United States standards does not reflect the growth pattern of Guyanese children under five years of age since the growth spurt of the Guyanese children may accur at a later age. In the United States, only three percent of population would probably fall under the third percentile, whereas more than three percent of Guyanese children would probably fall under the third percentile of the United States standards, since the range of weight for age in the Guyanese children would probably be wider and more children would be at the lower end of the spectrum.

1. Food Availability

Four indicators of food availability, namely, average income spent on food per person, household size, variety of the child's diet and use of supplementary food by the child, were used to assess improvement in nutritional status. Of these, use of supplementary food by the child was found most important to the improvement of a child's nutritional status. Variety of the child's diet proved to be of some importance, especially the frequency of use of bread and cereals, and fruits and vegetables. The other two factors were not significant (see Table II).

Income Spent on Food

The average income spent on food per person per week was not found to be associated with improvement in nutritional status. The mean income spent on food in the group of children whose nutritional status had improved was similar to that spent on food in the group of children whose nutritional status had deteriorated, $5.66 and $5.50 respectively (see Table 13). The non-significance of this factor in explaining improvement in nutritional status may be due to the homogeneity of the food income in the households of subjects investigated.

The mean income spent on food per household per week was seen to be approximately $45.00 in the total sample (see Table 12). This estimate is much lower than the $67.20 estimated by the Nutrition Association of Guyana to maintain minimum nutritional status in a five-member household in 1976. Since 1976, the cost of consumer goods and food have risen tremendously and the amount of $45.00, inadequate to meet maximum nutritional requirements for a household of five in 1976, would be less effective in maintaining minimum nutritional status in a larger household of eight or more in 1979.

Characteristics of fathers, both in the complete data set (N=43) and other interviews (N=28) in Table 9, show that a low percent of fathers lived at home, 52 and 36 percent respectively. The percent of fathers who did not live at home, but helped to support their children, was also small in both groups, 42 and 32 percent respectively. This lack of financial support by fathers may be an important factor in the etiology of malnutrition, since in most cases the mothers/guardians had only a primary school education and earned small incomes.

It is interesting to note that the National Food and Nutrition Survey of Guyana (1976) p.33 found the nutritional status of African children (most of the subjects investigated were of African origin), was greater when the father was non-resident. Non-resident fathers were thought to contribute to the up-keep of the child. The difference in findings of the two surveys may possibly be due to two factors viz. that the results of the National Food and Nutrition Survey of Guyana was representative for the entire country, whereas the results of this study may be peculiar to the subjects investigated whose selection was not random; the nutritional status of the child was measured by weight for age, not weight for height as used in this study.

The lack of income spent on food has been agreed by many workers to be a major determinant in the etiology of protein-energy malnutrition. (FAO, 1971; Gokulanath and Verghese, 1969; Jansen et al, 1977; Jelliffe, 1973; Kanawati and McLaren, 1973; Khan and Gupta, 1977).

Household Size

Large household size has been found by many workers to be an important factor in the etiology of malnutrition (Alleyne et al, 1977, Chap. 2; Grantham, McGregor et al, 1977; Spalding, Rutishauser and Parkins, 1977; Wray and Aguirre, 1969). The association between household size and improvement in nutritional status proved unimportant in both the complete data set (N-43) and the total sample (N=117), having a significance of .57 and .54 respectively (see Table Il). This non-significance may be due to the homogeneity of the sample, which was comprised mainly of large households (see Table 12).

Sub-hypothesis

The sub-hypothesis, that malnourished children from a smaller household recovered in a shorter time than those belonging to a larger household, proved non-significant (see Table 11), although the significance increased with increased sample size. These results are surprising, since other researchers such as Spalding et al, 1977, in the Gambia and Wray and Aguirre, 1969, in Colombia discovered a significant association between malnutrition and large family size. The difference in findings may be due to the environment in which the children lived, i.e. the subjects studied came from an urban environment, whereas those in the Gambia and Colombia were chosen from a rural environment. The National Food and Nutrition Survey of Guyana (1976), p. 26, which is representative for the entire country, found that, in a household over the size of six, the income did not increase with household size. Thus, the non-significance of household size to nutritional status may be peculiar to the subjects investigated.

Variety of the Child's Diet

The variety of the child's diet was measured by the frequency of use of the four basic food groups, milk and milk products, meat and meat alternates, bread and cereals, and fruits and vegetables. The frequency of use of milk and milk products and meat and meat alternates was not found associated with improvement in nutritional status, both in the complete data set (N=43) and entire sample (N=117). The significance for milk and milk products was .72 and .68 respectively, and for meat and meat alternates .85 and .91 respectively (see Table 11). The frequency of use of bread and cereals and fruits and vegetables was found to be significant in the complete data set (.06 and .08 respectively), but not in the total sample. The association between these two food groups and improvement in nutritional status may be peculiar to the complete data set.

Children whose nutritional status had improved (Group I) showed a higher frequency of use of fruits and vegetables than those whose nutritional status had not (see Table 13). This difference between the two groups, however, did not prove an important factor associated with change in nutritional status in the two groups when multiple regression analyses were made (see Tables 15 and 16), since they contributed the least significance to change in nutritional status. It is probable that the low frequency of use of fruits and vegetables, 43 percent in Group I and 25 percent in Group II (see Table 13), may be responsible for its low association. The highly significant association in the complete data set (.006) between change in nutritional status, frequency of use of fruits and vegetables (see Table 14) and non-significance when the two Groups were separated, (see Tables 15 and 16), cannot be explained.

The unimportance of milk and milk products (excluding supplementary food) to nutritional status found in this study, is contrary to the findings of Grantham-McGregor et al, 1977, in Kingston, Jamaica. This may, however, be a result of the fact that this present study investigated factors which explained improvement in nutritional status whereas Grantham-McGregor et al investigated factors important in the etiology of malnutrition.

Bread and cereals contributed equally to the change in nutritional status of both groups I and II having a significance of approximately .34 (see Tables 15 and 16). The equal contribution of this food group to the nutritional status of both groups of children may be a reflection of the fact that rice and bread are the staple foods in Guyana, in addition to being the cheapest, and are therefore frequently used.

A discriminant analysis using weight for height of child on entry to clinic, use of supplementary food and frequency of use of the two food groups bread and cereals, and fruits and vegetables, was not able to differentiate between groups I and II. Thus, factors which lead to the improvement in nutritional status could not be identified.

Use of Supplementary Food

Martorell et al (1976) opines that the relative contribution of calories or protein in supplementary food to growth of children, depends upon which nutrient is limited in the home diet.

The percent of child's caloric and protein requirement provided by the supplementary food in this study was found to be significantly associated with the change in nutritional status of the child, in both the complete data set (.01 and .06 respectively) and the entire sample (.04 and .06 respectively)(see Table 11). It is interesting to note that other studies which were done in rural areas of different countries agree with the findings in this study. Baertl et al (1970) in Northern Peru and Edozien et al (1976) in Nigeria, noted a constant improvement in the heights and weights of children given supplementary food.

The mean percent of caloric requirement of the child supplied by supplementary food was 33 and 30 percent in the complete data set and entire sample respectively (see Table 12), with over 70 percent of children receiving less than 30 percent of their caloric requirement from supplementary food (see Appendix B, Table 15). On the other hand, the mean protein requirement of the child provided by supplementary food was greater than 100 percent (see Table 12), with over 80 percent of the protein requirement being provided by supplementary food in over 60 percent of the subjects (see Appendix B, Table 16).
The greater significance of calories compared to protein in the improvement in nutritional status shown by linear regression analysis may indicate a greater deficiency of calories in the children's diet. However, low intakes of protein may have occurred in the subjects since over 80 percent of children interviewed drank some form of bush-tea or porridge (plantain or flour) which may have been prepared with water or diluted milk. The findings of the National Food and Nutrition Survey of Guyana, p. 45, indicate that nearly 60 percent of urban children drank bush-teas such as sweet-broom, tezum, buck-cotton and daisy or porridge (mainly plantain) prepared with water or diluted milk.

Results of the Multiple Regression (Tables 15 and 16) indicate that protein provided by supplementary food contributed most to the improvement in nutritional status other than weight for height of children on entry to clinic. It would thus seem than the nutrient most limited in the children's diet was protein. From the above discussion, it could be assumed that both calories and protein are lacking in the subjects' diets. This lack of a clear-cut relationship between protein and improvement in nutritional status could be observed in Figs. 6 and 7 which show the change in nutritional status versus percent protein requirement provided by supplementary food. Despite the results of the Multiple Regression Analysis, these graphs do not show a distinct relationship between change in nutritional status and percent protein requirement provided by supplementary food.

The protein and caloric contribution of supplementary food to the diets of children whose nutrition status had improved (Group I) was higher than the contribution to the diet of children whose nutritional status had not improved (Group II). Calories seemed to be more limited in Group II than Group I (see Tables 15 and 16), since the percent of caloric requirement of children provided by supplementary food contributed more to the children's nutritional status in Group II, despite the fact that the percent of total requirement satisfied was less in Group II than in Group I, being 23 and 36 percent respectively (see Table 13). It could thus be concluded that supplementary food may be an important factor in the improvement of nutritional status of malnourished children.

A negative correlation was found in Group I between the percent caloric and protein requirement of children supplied with supplementary food and frequency of use of bread and cereals. This could point to displacement of bread and cereals from the diet by supplementary food. Despite differences in environment between this study and Guatemala (urban vs rural), Valverde and coworkers (1979) in rural Guatemala found that supplementary food in the form of high-protein cookies, given to family members, displaced corn and wheat products, and also beans and eggs from the family's diet.

It thus seems that guardians who gave the supplementary food to their children may have reduced the children's intake of bread and cereals.

The supplementary food, mainly dried skimmed milk (DSM) and corn-soya milk (CSM) may thus have provided more protein and possibly more calories than bread and cereals. This assumption would be consistent with improvement in nutrition status shown by children in Group I.

2. Sanitation Index

Sanitation index which measured the personal hygiene of mothers/ guardians and child and sanitation of the environment (see Table 5) was not found to be significantly associated with the change in nutritional status of the children, either in the complete data set (N=43) or total sample (N=65). The mean sanitation index for both the complete data set and total sample are similar in value 2.3 and 2.2 respectively (see Table 12) which may suggest that subjects investigated had a similar hygiene and environmental conditions.

It is also probable that the indices themselves were not precise enough to measure any small difference in sanitation between the subjects, which may have affected their nutritional status.

3. Use of Available Medical Services

Individual measures of use of available medical services, by percent attendance of child at clinic and percent times child was sick when attending clinic, proved non-significant in the complete data set (.80 and .89 respectively), and in the entire sample (.62 and .93 respectively)(see Table 11).

Despite differences in sampling methodology and measurement of nutritional status between the two surveys, the findings of this study agree with those of the nationally representative Food and Nutrition Survey of Guyana (1976), p. 102, which found no significant association between nutritional status and use of clinic by the child. This is contrary to the findings of Grantham-McGregor et al (1977) in Jamaica, where clinic attendance was discovered to be inversely associated with malnutrition in children under 12 months of age.

4. Nutrition Education of the Guardian

Nutrition education of mothers/guardians of the children measured by two indices of nutrition knowledge and nutrition practices proved non-significant in both the complete data set and the total sample, except nutrition knowledge which became significant (.04) with increasing sample size (see Table 11).

The nutrition practice indexes of guardians of the children were much lower than their nutrition knowledge indices in both the total sample and complete data set, indicating that nutritional practices of guardians lagged behind their nutrition knowledge. This finding is consistent with the literature.

The means of the nutrition knowledge index and nutrition practice index for the complete data set and entire sample indicate that nutrition knowledge and practices were quite similar in both groups and may be common to guardians of malnourished children. The low nutrition practice indices .34 and .32 in the complete data set and entire sample respectively, may suggest that guardians of malnourished children have poor nutrition practices. Jelliffe (1973) in reviewing nutritional practices of mothers in developing countries,and Khan and Gupta (1977) in Lusaka, Africa, have also noted poor nutrition practices to be an important factor in the etiology of malnutrition.

The non-significance of these two indices may also be due to the indices not being precise enough to differentiate between the knowledge and practices of guardians of children whose nutritional status had improved and those whose nutritional status had not.

5. Presence of Additional Diseases in Child

Investigation of the total sample of 117 shows that approximately 50 percent of the children who were classified as malnourished using the Gomez classification, also suffered from some other disease on entry to the malnutrition clinic. Gastroenteritis does not seem to be prevalent in subjects investigated (1.7% prevalence). It is interesting to note that the results of this study,despite differences in methodology, is in keeping with the findings of the National Food and Nutrition Survey of Guyana (1976), p. 36, which discovered that only 2.1 percent of 0.5 - 5 year old children had an alimentary infection.

The prevalence of respiratory diseases (15%) was much lower than that of the nationally representative Food and Nutrition Survey of Guyana (1976) which found a prevalence of 41 percent in children under five years of age. This may be due to the criteria for selection of children who are referred to the Malnutrition Clinic.

Skin diseases were found to be more prevalent in the subjects in this survey than in the National survey, which is consistent with other findings that show malnourished children to be more susceptible to skin infections. (Chanda, 1977; Edelman, 1977; Faulk, Paes and Mango, 1976; Gordon and Schrimshaw, 1970).

The additional diseases present in children on entry to clinic were not found to be significantly associated with the improvement of nutritional status, having a significance of .31 in the complete data set and .22 in the total sample. This could be explained by the fact that medicines were prescribed for any additional diseases present in the child.

6. Initial Nutritional Status of Child

The mean change in nutritional status was larger in the total sample than in the complete data set, 6.5 percent compared to 1.2 percent (see Table 12). This may probably be due to the fact that a larger number of children were below 80 percent of the standard in the total sample compared to the complete data set (see Appendix B, Table 1). It is reasonable to assume that the lower the initial nutritional status of the child, the greater will be the magnitude of improvement in nutritional status.

The weight for heights of children on entry to clinic was found to be significantly associated with their improvement in nutritional status (.001), see Table 11. The high contribution of weight for height on entry to clinic to changes in nutritional status may be due to the composition of this dependent variable, weight for height on entry to clinic being an inherent part of the dependent variable. However, since weight for height on entry to clinic was significantly associated with changes in nutrition status in the Multiple Regression Analysis only in the group of children whose nutritional status had improved, (see Tables 15 and 16), it is reasonable to assume that "catch-up" growth also played a part in the improvement of nutritional status. The supplementary food may have contributed to the "catch-up" growth in these subjects.

Correlations between variables used in the Multiple Regression Analysis show a significantly negative correlation (-.43) in both Group I and Group II, between the weight for heights of children on entry to clinic and percent of caloric requirement of children supplied by supplementary food (see Tables 17 and 18). This finding is probably a reflection of the practice of the clinic where the more undernourished child is provided with a greater amount of supplementary food.

The highly negative significant correlation in Group II between weight for heights of children on entry to clinic with the use of bread and cereals (-.8) shown in Table 18, indicates that as the frequency of bread and cereals increases, the weight for heights of children on entry to clinic decreases. This finding could point to the influence of decreasing variety of the child's diet as implied by a higher use of bread and cereals.

Implications of the Regression and Discriminant Analyses

Results of the linear regression analysis illustrate a trend in many cases towards significance with increasing sample sizes (see Table 11).

The results of the Multiple Regression Analysis indicate that the factors considered in the analysis contributed significantly to the overall model (.02), although the R-square value was only 30 percent (see Table 14). In the children whose nutritional status had improved (Group I), these factors were shown to be more important than in the overall model, since the R-square value was 50 percent and the overall significance of the model was greater (.001) (see Table 15). The factors could therefore be said to account for 50 percent of the improvement in nutritional status.

In children whose nutritional status had deteriorated (Group II), the factors weight for height, use of fruits and vegetables, bread and cereals, percent caloric and percent protein requirement of the child provided by supplementary food, explained 90 percent the deterioration of nutritional status (R-square value = 90%). The overall model however, was not significant. This non-significance may probably be due to the small sums of square error in the model. The distribution described by the $F_{5,2}$ value is skewed and the F value would have to be larger than 9.3 to indicate significance even at the .10 level.

The discriminant analysis technique may be used to differentiate between children with improved nutritional status and those with deteriorated nutritional status, since it could identify potential failure to thrive of children who enter the clinic. The non-significance of the discriminant analysis using factors identified as being important in the linear regression analysis may be due to the small sample size in both groups, especially that of Group II.

Recommendations for future Research

It is recommended that the following points be taken into consideration in further research of factors into the etiology and improvement of Protein-Energy Malnutrition:-

(1) A control group of well nourished children under five years of age be used to compare their social and economic conditions with those of the malnourished children.

(2) Ages of children should be included in statistical analysis investigating factors affecting recovery from Protein-Energy Malnutrition, since this study appeared to show a deterioration of nutritional status in older subjects.

(3) The Discriminant Analysis technique of statistical analysis be used to distinguish between malnourished children and a control group of well nourished children in order to identify factors important in the etiology and/or improvement of malnutrition.

Conclusion

Factors used to test the seven hypotheses showed no significant association with improvement in nutritional status, except for the use of supplementary food by child, weight for heights of children on entry to clinic, frequency of use of food groups bread and cereals and fruits and vegetables by the child.

Information used to assess nutrition knowledge and practices, by the indices, showed a trend towards guardians with poorest nutrition knowledge and practices having children with lowest nutritional status. However, nutrition education of guardians did not prove to be significantly associated with improvement in nutrition status of the subjects.

The results of both the linear and multiple regression analyses show the importance of use of supplementary food to improvement in nutritional status. Mutiple regression analysis indicates that protein in the supplementary food probably contributed to the growth of children whose nutritional status had improved. A similar trend could be seen in children whose nutritional status had deteriorated implying that the protein in the supplementary food provided to the child probably resulted in a decrease in the rate of deterioration of nutritional status in these children. The weight for heights of subjects on entry to clinic proved to be important only in children whose nutritional status had improved. Other factors not identified, seem to be important in the deterioration of nutritional status.

Summary

A study investigating the factors affecting the recovery of preschool children suffering from protein-energy malnutrition was performed in Georgetown, Guyana. One hundred seventeen subjects were chosen from the Malnutrition Clinic of the Georgetown Hospital, and information was elicited via Personal Interview Technique and perusal of the children's clinic charts. Complete information was collected on fourty-three subjects.

Factors investigated were availability of food to subjects, personal hygiene of mothers and child and sanitation of the environment, use of the available medical services, nutrition education of the mother/guardian, additional diseases present in the child, and weight for heights of children on entry to clinic.

Analysis of the data found that use of supplementary food, ~~initial~~ weight for heights of children on entry to clinic, frequency of use of bread and cereals and fruits and vegetables, were significantly associated with improvement in nutritional status. Information collected on nutrition education suggested that nutrition knowledge was not necessarily reflected in good nutrition practices. For example, children were being bottle fed at less than one month of age, although most mothers considered breast milk to be the best kind of milk for a young child. Despite these trends, however, nutrition knowledge and practices were not found to be significantly associated with improvement in nutritional status. Mothers/guardians of the subjects investigated were found to have poor nutritional practices.

The non-significance of factors other than weight for height of child on entry to clinic, use of supplementary food by the child, and

frequency of use of bread and cereals and fruits and vegetables may have been due to the homogeneity of the sample and/or the rather small sample size. The results of this study are compared to results of researchers in Guyana and other countries.

The Malnutrition Clinic of the Georgetown Hospital seemed to have been effective in improving the nutritional status of some subjects, apparently through provision of supplementary food.

APPENDIX A:

Interview Schedule and Recording Sheet Used in Personal Interviews

Interview Schedule

Hello, my name is Sandra Plummer, and I am working with Dr. Harry at the Georgetown Hospital Malnutrition Clinic. I would like to ask you some questions about your child (name child). First of all, I would like to ask some questions about the child's health.

1) How is your child today?
2) Does your child catch cold easily?
3) How often in the past month did he have a cold?
4) What kind of treatment do you use for a cold?
5) Do you use home remedies when the child has a cold?
6) What kind of home remedies do you use?
7) Does your child get diarrhoea?
8) How often in the past month did he get diarrhoea?
9) What kind of treatment do you use when the child has diarrhoea?
10) Do you use home remedies when the child has diarrhoea?
11) What kind of home remedies do you use?
12) How often in the past month did the child have a fever?
13) What kind of treatment do you use when your child has fever?
14) Do you use home remedies when your child has fever?
15) What kind of home remedies do you use?
16) Does your child have worms?
17) How often in the past month did he have worms?
18) Since last year this time, how often did your child have worms?
19) What kind of treatment do you use when your child has worms?

Appendix A

20) Do you use home remedies when your child has worms?

21) What kind of home remedies do you use when the child has worms?

22) Is there any type of medical service in your district?

23) If yes, what kind of medical service is it.

24) How far away from home is it?

25) Which do you use more frequently, home remedies or the medical service?

26) Do you find home remedies satisfactory?

I would now like to ask you some questions about yourself and when the child was an infant.

27) When you were pregnant with ___________, were there any particular foods you ate more of?

28) If yes, what kind(s).

29) Were there any particular foods that you did not eat?

30) If yes, what kind(s).

31) Was the child breast-fed?

32) If yes, was the child put to the breast immediately after delivery?

33) If no, how long was it before the child was put to the breast?

34) Why was breast-feeding delayed?

35) When you were breast-feeding _________, were there any particular foods you ate more of?

36) If yes, what kind(s)?

37) Was the child bottle-fed?

38) Do/did you boil the bottle each time before feeding the child?

39) Did you give the child any other kind of milk in addition to breast milk?

40) How old was the child when he was given this other kind of milk?

41) Why was this other kind of milk given?

42) How do/did you prepare this milk?

43) Do/did you give the child milk (skimmed or other) collected from the clinic?

44) For how long did you use the milk from the clinic?

45) What kind of milk do you think is best for the child?

46) How does breast milk compare to the other kinds of milk?

47) How often is the child given the following beverages:

a) Bush-tea

b) Porridge

I hope you don't mind if I now ask you some questions about yourself and your household.

48) Did you go to school?

49) Which class or form were you in when you left school?

50) Who usually looks after the child?

51) Is there anyone else who looks after the child? Who? How often?

52) Do you read magazines, newspapers or books? What kinds?

53) Does the child's father live at home?

54) If no, does he help support the child?

55) Are there any other members in the household who contribute to household expenses?

I would now like to ask you some questions about the foods you usually eat.

56) How often in the past week have you served the following foods:

a) Milk and cheese b) Meat, chicken, fish, eggs c) Rice & bread

d) Provisions e) Legumes f) Other vegetables g) Fruits

Appendix A

57) How often in the past week did the child eat the foods above?

58) How old was the child when he first started eating from the family pot?

59) At thatt time, was there any particular food that you specifically gave the child?

60) Were there any particular foods that you did not give the child? (If no protein foods were mentioned, ask about what age the child was given protein foods; name them.)

61) Do you get any advice on the kinds of food that the family should eat?

62) If yes, from whom do you get the advice?

63) What kind of advice do you get?

64) Do you serve beef at mealtimes?

65) If not, why not?

66) Do you serve pork at mealtime?

67) If not, why not?

68) Are there any particular foods that you do not eat because they are your kinna?

69) What are your kinna foods?

70) Do you have a vegetable garden?

71) If yes, what kinds of vegetables do you grow?

72) Do you serve only the vegetables that are grown in your garden?

73) Do you "mind" chickens?

74) If yes, do you use only your own eggs and chickens as food?

75) When you share out food for the main meals, who gets the biggest share?

76) How many times a week do you shop for foodstuff?

Appendix A

77) On your last big marketing day, what kinds of foods did you buy?

78) How do you keep your meat from spoiling?

79) About how much do you spend on food per week?

I would now like to ask you some questions about your house and household.

80) How many persons are there in your household?

81) What kind of water supply do you have?

82) Where do you bathe the child?

83) How often do you bathe the child?

84) What type of toilet do you have?

Appendix A

Recording Sheet

Reg. No.

1) How is your child today?

2) Does your child catch cold easily?

3) - 22)

	Frequency Last Month	Frequency Last Year	Treatment: Medical Treatments	Home-Cures Comments
a) Cold				
b) Diarrhoea				
c) Fever				
d) Worms				

23) - 24)	Medical Facility in District Yes	No	Kind of Facility	Distance from Home

Appendix A

25) Which do you use more frequently, home-cures or medical service?

26) Do you find home-cures satisfactory?

27) When you were pregnant with ___________, where there any particular foods you ate more of?

28) What kind?

29) Were there any particular foods not eaten?

30) What kind?

31) Was the child breast-fed?

32) Was the child put to the breast immediately after delivery?

33) If not, how long was it before the child was put to the breast?

34) Why was breast-feeding delayed?

35) Did you eat any extra kinds of foods when you were breast-feeding?

36) If yes, kind of food eaten.

37) Was the child bottle-fed?

38) Do/did you boil the bottle each time before feeding the child?

39) When breast-feeding, did you give the child any other kind of milk?

40) How old was the child when other milk than breast milk was given?

41) Why was this other milk given?

42) How do/did you prepare the other kind of milk?

43) Do/did you give the child the skimmed milk collected from the clinic?

44) What kind of milk do you think is best for the child?

45) How does breast milk compare to other kinds of milk?

46) Is the child given anything to drink other than milk?

47) If yes, how often is child given the following beverages:

	Frequency	How Much
a) Bush-tea		
b) Porridge		

Appendix A

48) - 49)

	Yes	No
Went to school		
Left school after		

50) - 51)

	Person who looks after child	Amount of time spent looking after child	Comments
1)			
2)			

52) Do you read magazines, newspapers or books?

Types of magazines

Types of newspapers

Types of books

53) Does the child's father live at home?

54) If no, does he help support the child?

55) Are there any other members of the household contributing to the household expenses?

56) - 57)

	Qu. 59	Qu. 60
a) Milk and cheese		
b) Meat, chicken, fish, eggs		
c) Rice and bread		
d) Provisions		
e) Legumes		
f) Other vegetables		
g) Fruits		

Appendix A

58) - 60)

Age child ate from family pot	Special foods given	Foods not given

61) Do you get advice on the kinds of foods that the family should eat?

62) If yes, from whom do you get advice?

63) What kind of advice do you get?

64) - 67)

	Yes	No	Reasons
Pork			
Beef			

68) Are there any particular foods that you do not eat because they are your kinna?

69) Kinds of kinna foods.

70) Do you have a vegetable garden?

71) Kinds of vegetables grown?

72) Do you serve only the vegetables that are grown in the garden?

73) If no, is the rest bought or given to you?

74)

	Yes	No	If Supplemented	Comments
Poultry				
Eggs				
Chicken				

Appendix A

75) When you share out foot for the main meals, who gets the biggest share?

76) How many times a week do you shop for foodstuff?

77) On your last marketing day, what kind of foods did you buy?

78) How do you keep your meat from spoiling?

a) In a refrigerator

b) Buy meat every day

c) Does not eat meat

d) Parboil it

e) Other; please specify

79) About how much money do you spend on food per week?

80) How many persons are there in your household?

81) What kind of water supply do you have?

a) Piped in house — Distance from house

b) Piped in yard

c) Piped in street

d) Trench

e) River

f) Other

82) Where do you bathe the child?

83) How often do you bathe the child?

84) What type of toilet do you have?

Appendix A

Information from Charts

Child

Code No. _________ Birth Date ____________ Race ___________ Sex _______

Date of Admission ____

Date of Discharge __________________________________

Length of Stay (months) ____________________________

Birth Order ____

Address ____

____

Nutritional Status of Child

	On Admission	On Discharge	At time of survey
Grade of Malnutrition			
Other diseases			
Weight (lbs)			
Length (cm)			
Hb Status (if recorded)			

Main Guardian

Relationship to child _____________ Formal Education ________ Age ______

Household

No. of persons in household _______________ No. of rooms _______________

Appendix A

Environmental Sanitation

Type of garbage disposal ______________ Type of toilet ___________

Type of water supply __________________ Water boiled _____________

Observation Schedule

Mother/Guardian	Comments
Cleanliness of clothes	
Kemptness of hair	
Cleanliness of fingernails	

House and Surroundings

Cleanliness of house

Cleanliness of yard

Target Child

Cleanliness of target child

Cleanliness of fingernails

Kemptness of hair

APPENDIX B:

Distributions of Variables Investigated in the Study[a]

Table 1: Distribution of Initial Weights for Height of Children on Entry to Clinic

% of Std[a]	Complete Data Set N = 43	Total Sample N = 117
50 - 60	2.3%	0.9%
60 - 70	9.3%	4.3%
70 - 80	25.6%	35.3%
80 - 90	37.2%	35.3%
90 - 100	23.3%	18.1%
100 - 110	2.3%	3.4%
110 - 120	0 %	0.9%
120 - 130	0 %	1.7%

[a] Std used was National Centre for Health Statistics (1976) of the United States

Table 2: Distribution of Final Weights for Heights of Children on Entry to Clinic

% of Std	Complete Data Set N = 43	Total Sample N = 117
40 - 50	0 %	1 %
70 - 80	11.6%	15.0%
70 - 90	34.9%	32.0%
90 - 100	46.5%	38.0%
100 - 110	7.0%	11.0%
110 - 120	0 %	3.0%
170 - 180	0 %	1.0%

[a] Sample size in the 19 tables varies depending on the amount of information available for each variable.

Table 3: Distribution of Ages of Children on Entry to Clinic

Age (in months)	Complete Data Set N = 43	Total Sample N = 117
0 - 6	16.3%	14.5%
7 - 12	27.9%	23.0%
13 - 18	34.9%	30.8%
19 - 24	9.3%	15.4%
25 - 30	0 %	6.8%
31 - 36	2.3%	3.4%
37 - 42	2.3%	2.6%
43 - 48	7.0%	1.7%
49 - 54	0 %	0.9%
55 - 60	0 %	0.9%

Table 4: Distribution of Ages of Children on Last Visit to Clinic

Age (in months)	Complete Data Set N = 43	Total Sample N = 117
0 - 6	0 %	3.4%
7 - 12	14.0%	12.8%
13 - 18	30.2%	23.1%
19 - 24	16.3%	19.7%
25 - 30	16.3%	17.1%
31 - 36	9.3%	10.3%
37 - 42	4.7%	5.1%
43 - 48	4.7%	5.1%
49 - 54	2.3%	1.7%
55 - 60	2.3%	1.7%

Table 5: Distribution of Sanitation Indices of Children

Sanitation Index	Complete Data Set N = 43	Total Sample N = 65[a]
0 - 1	4.3%	12.3%
1 - 2	23.3%	24.6%
2 - 3	67.4%	63.1%

Table 6: Distribution of Period of Time Children Attended Clinic

Attendance (in months)	Complete Data Set N = 43	Total Sample N = 113[a]
ϕ - 6	53.3%	57.5%
7 - 12	23.3%	25.5%
13 - 18	20.9%	13.3%
19 - 24	0%	1.8%
25 - 30	2.3%	0.9%

Table 7: Distribution of Household Size to Which Subjects Belong

No. of Members in Household	Complete Data Set N = 43	Total Sample N = 68
0 - 6	32.6%	33.8%
7 - 12	58.1%	51.5%
13 - 18	7.0%	8.8%
19 - 24	2.3%	4.4%
25 - 30	0 %	1.5%

Table 8: Distribution of Change in Nutritional Status of Subjects

Change in Nutritional Status	Complete Data Set N = 43	Total Sample N = 113
20 - 40%	14.0	9.7
0 - 20%	65.1	62.8
-20 - 0%	20.9	24.8
(-40)-(-20)%	0	1.8

Table 9: Distribution of Food-Dollars per Person in Households Under Investigation

Food-Dollars per Person per Week	Complete Data Set N = 43	Total Sample N = 53
0 - 2	9.3%	5.7%
2 - 4	32.6%	32.1%
4 - 6	23.3%	16.4%
6 - 8	16.3%	15.1%
8 - 10	9.3%	7.5%
10 - 12	4.7%	5.7%
12 - 14	0 %	0 %
14 - 16	0 %	0 %
16 - 18	4.7%	5.7%
18 - 20	0 %	1.9%

Appendix B

Table 10: Distribution of Scores of Nutrition Practices for Mothers of Subjects

Nutrition Practices Index Score	Complete Data Set N = 43	Total Sample N = 62
0	20.9%	24.2%
0.25	25.6%	32.3%
0.50	48.8%	37.0%
0.70	4.7%	6.5%
1.0	0 %	0 %

Table 11: Distribution of Scores of Nutrition Knowledge for Mothers/Guardians of Subjects

Nutrition Knowledge Index Score	Complete Data Set N = 43	Total Sample N = 67
0	9.3%	7.5%
0.50	41.9%	40.3%
1.0	48.8%	52.2%

Table 12: Distribution of Children's Attendance at Clinic

% Clinic Attendance	Complete Data Set N = 43	Total Sample N = 117
0 - 10	2.3%	3.4%
11 - 20	4.7%	12.0%
21 - 30	2.3%	5.1%
31 - 40	2.3%	5.1%
41 - 50	7.0%	11.1%
51 - 60	23.3%	14.5%
61 - 70	9.3%	8.5%
71 - 80	25.6%	11.1%
81 - 90	4.7%	11.1%
91 - 100	18.6%	17.9%

Table 13: Distribution of Use of Medical Services

% Time Sick When Attending Clinic	Complete Data Set N = 43	Total Sample N = 117
0 - 10	4.7%	7.7%
11 - 20	7.0%	6.0%
21 - 30	7.0%	6.8%
31 - 40	9.3%	16.2%
41 - 50	14.0%	17.9%
51 - 60	9.3%	7.7%
61 - 70	7.0%	11.1%
71 - 80	20.9%	15.4%
81 - 90	13.9%	7.7%
91 - 100	6.9%	3.4%

Table 14: Caloric Requirement of Children Provided by Supplementary Food

% Caloric Requirement of Child Satisfied	Complete Data Set N = 43	Total Sample N = 99
0 - 10	7.0%	14.1%
11 - 20	30.2%	27.3%
21 - 30	32.6%	33.3%
31 - 40	11.6%	5.1%
41 - 50	11.6%	10.1%
51 - 60	0 %	1.0%
61 - 70	4.7%	3.0%
71 - 80	0 %	4.0%
81 - 90	0 %	0 %
91 - 100	0 %	0 %
321 - 330	2.3%	1.0%

Table 15: Protein Requirement of Children Provided by Supplementary Food

% Protein Requirement of Child Satisfied	Complete Data Set N = 43	Total Sample N = 99
0 - 10	4.7%	3.0%
11 - 20	2.3%	2.0%
21 - 30	2.3%	3.0%
31 - 40	2.3%	6.1%
41 - 50	2.3%	7.1%
51 - 60	4.7%	4.0%
61 - 70	7.0%	5.1%
71 - 80	11.6%	7.1%
81 - 90	7.0%	5.1%
91 - 100	4.7%	9.1%
101 - 150	30.1%	29.3%
151 - 200	14.0%	12.1%
201 - 250	4.7%	7.1%
251 - 300	2.3%	0 %
401 - 450	2.3%	1.0%

Appendix B

Table 16: Distribution of the Frequency of Food Group Bread and Cereals Eaten by Children Per Day

% Use of Bread & Cereals by Child Per Day	Complete Data Set N = 43	Total Sample N = 67
0 - 20	9.3%	9.0%
21 - 40	4.7%	6.0%
41 - 60	4.6%	4.5%
61 - 80	14.0%	12.0%
81 - 100	67.4%	68.6%

Table 17: Distribution of the Frequency of Food Group Fruits and Vegetables Eaten by Children Per Day

% Use of Fruits & Vegetables by Child Per Day	Complete Data Set N = 43	Total Sample N = 67
0 - 20	20.9%	22.3%
21 - 40	32.5%	32.8%
41 - 60	32.6%	28.4%
61 - 80	16.3%	14.9%
81 - 100	0 %	1.5%

Table 18: Distribution of Frequency of Food Group Meat and Meat Alternates Eaten by Children Per Day

% Use of Meat & Meat Alternates By Child Per Day	Complete Data Set N = 43	Total Sample N = 67
0 - 20	18.7%	17.9%
21 - 40	9.3%	9.0%
41 - 60	46.5%	44.7%
61 - 80	11.7%	14.9%
81 - 100	14.0%	16.4%

Table 19: Distribution of Frequency of Food Group Milk and Milk Products Eaten by Children Per Day

% Use of Milk and Milk Products by Child Per Day	Complete Data Set N = 43	Total Sample N = 67
0 - 20	7.0%	10.4%
21 - 40	4.6%	4.5%
41 - 60	7.0%	10.4%
61 - 80	0 %	0 %
81 - 100	81.4%	74.6%

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