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Investments for improving the water supplies in less developed countries have long been made on the assumption that they provide public health benefits, but this assumption has not been evaluated by well-designed research. This literature survey was conducted to assess what evidence past research offers concerning the association between improved water quality and a reduced incidence of enteric disease. The literature does not offer much evidence. More information is needed concerning health benefits that can be expected from water supply investments, what conditions beyond improved water supply are needed to realize the expected health benefits, and how diseases affected by water interact with other diseases. Findings from the literature on the epidemiology of diarrheal disease reveal that its peak incidence and fatal effects occur among preschool children, particularly those in the process of being weaned. In this age group, fatal diarrheal disease is closely associated with nutritional deficiencies. This suggests that diarrhea and malnutrition interact synergistically. Some researchers argue that water quality is not an important factor in controlling diseases of weaning children, because infectious agents causing diarrhea do not come from a single contaminated source and the most important factor is the nutritional state of the child. Several long-term studies of diarrhea in weanling children have been conducted, but none has been specifically designed to study the role of water in diarrheal disease in weanlings. Such studies should be conducted, and they should be long-term, carefully designed and planned, and accorded adequate administrative, operational, and logistic support.

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WATER SUPPLY, DIARRHEAL DISEASE, AND NUTRITION:

A SURVEY OF THE LITERATURE

AND RECOMMENDATIONS FOR RESEARCH

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SUMMARY AND CONCLUSIONS

(a) The main nonfinancial justification offered for investments in water supply projects is the expected health benefits. The literature offers little in explaining water's health impact beyond confirming the existence of a general association between improved quality and increased quantity of domestic water and a reduced incidence of enteric disease. More information is needed about the increments in health benefits that can be expected from increments in water supply investments, what conditions beyond improved supply of water are needed to realize the expected health benefits, and how diseases affected by water interact with other diseases.

(b) Findings from the literature on the epidemiology of diarrheal disease reveal its peak incidence and fatality occur among pre-school children, and particularly among those in the process of being weaned. In this age group, the incidence, severity and fatality of diarrheal disease are closely associated with nutritional deficiencies. This supports the suggestion that diarrhea and malnutrition interact synergistically, as diarrhea occurs more often and has more serious consequences among children with malnutrition, and children with marginal nutritional deficiencies can become seriously malnourished as a result of diarrhea.

(c) Some individuals writing on the epidemiology of diarrheal disease suggest that water has little role in control of the disease in weanling children. This is based on the belief that infectious agents causing diarrhea do not come from a single contaminated source and that, whatever the source and route of transmission, the nutritional state of the host is the most important factor in controlling the disease. Gordon Scrimshaw, in particular, hold this view.

(d) The interaction of diarrhea in weanling children and their nutrition has been the subject of several long-term prospective field studies. In addition, there is an ongoing field study on the effect of improved environmental sanitation, including an improved water supply on absorption of nutrients and nutrition. But none of these studies, or any others, have been designed to specifically study the role of water in diarrheal disease in weanlings, when it is recognized that the disease acts synergistically with nutrition.

(e) Several conclusions on methodology can be drawn from this paper's review of a large number of epidemiological studies of various types:

1. Long-term prospective field studies, testing well-formulated hypotheses, are to be recommended over short-term, retrospective, clinical or laboratory studies.
2. Great care should be taken in the basic design, pre-testing, implementation and analysis of a study.
3. The scope of the study, any experimental intervention, and final analysis should be limited to that which can be realistically accomplished with resources at hand.
4. It should be recognized that administrative, operational, logistic and personnel problems of field studies usually are much greater than conceptual or scientific problems.

RECOMMENDATIONS

(a) In view of the widespread belief of the crucial importance of improved water supply in control of diarrheal disease, the substantial investments envisioned by national and international agencies based on that belief, and the controversy surrounding the belief uncovered by this literature review, further research on the subject is recommended. But the research requires both a broader and a narrower approach than has been taken in the past. A study approach should be broad in that it recognizes that contaminated water is not the sole factor in diarrheal disease. Other factors, particularly cultural habits of hygiene and nutritional status, play important parts. The approach should be narrow in that it recognizes that not all individuals in a community are equally at risk to diarrhea or to its more serious consequences. The incidence and fatality of diarrhea is highly concentrated in pre-school, particularly weanling children. We recommend a study be undertaken to specifically investigate the role of water in diarrheal disease among young children, recognizing diarrhea's complex etiology, particularly its alleged synergism with nutrition and its sensitivity to household hygienic practices.

(b) The study should take advantage of the opportunity for research in Minas Gerais, Brazil, where one entity, supervised by the World Bank, will make multiple investments to initiate or improve water supply systems in communities of various sizes over several years, and where cooperation of the entity and the relevant health authorities is assured.

(c) The research should take the form of a long-term prospective field study. The objective of the study should be to discover what complex of conditions is most effective and economic in control of diarrheal disease in young children. This may require major experimental interventions in mothercraft or health education and nutrition supplementation as well as improvement in the community water supply.

(d) The main research instrument should be frequently repeated household surveys designed to record prevalance, incidence and fatality of diarrheal disease. Since the emphasis is on diarrhea as a disease entity in itself, a major reliance on clinical and laboratory examinations as well as balance studies probably should be avoided because of their inability to comprehensively measure the entire dimension of diarheal disease as it commonly exists in a community. It may be worthwhile to include in the study direct observation by a trained observer, such as a professional anthropologist, to uncover cultural influences on water usage, child care, hygiene, and infant nutrition.

(e) Before commitments are made to undertake the research described, it should be determined that an adequate capability exists to design, direct, and administer all aspects of the study, including its basic concept, its organization, its logistics, any interventions, data collection, analysis, and reporting. Individuals directing the project, both in the funding agency and in the field should be capable, and should be motivated by the study's objectives.

THE LITERATURE ON WATER SUPPLY, DIARRHEAL DISEASE AND NUTRITION

Introduction

National and international agencies have long made water supply investments in less developed countries on the faith that these investments return substantial extra-financial and nonquantifiable benefits to individuals affected and to society at large. The benefits are most often thought to lie in the field of public health. The faith is based partially on theories of the ways disease is transmitted and partially on speculation of the value of improvements in health. The theories have been subjected to little well-designed research and remain largely untested. Valuation of the benefits remains speculative due to uncertainty of just what the benefits are and a lack of consensus on a methodology of valuation.

Water Supply and Health

Two recently completed papers summarize and assess studies on the impact of water supply investments. One is IBRD's Village Water Supply and Sanitation in Less Developed Countries by R. J. Saunders and J. J. Warford (125); the other is Judith Rees' paper on domestic water supply in the Ford Foundation's Infrastructure Problems of the Cities of Developing Countries (79). Both combine extensive reviews of relevant literature with economic analysis to describe the state of knowledge about the effects of water supply and to point out inadequacies in what

is known for purposes of rational decision-taking on investments. Read together, the two are striking for their similarity in identifying issues and evaluating existing reach.

Saunders and Warford found the major nonfinancial justification offered for water supply investments in rural areas has been the expected health benefits. Improved quality and increased quantity of water are expected to affect favorably mortality and morbidity incidence of a large variety of diseases[1/].

1/

Ascariasis	Infectious Hepatitis	Encephalitis
Tribhuriasis	Leptospirosis	Fasciolopiasis
Whipworm	Typhoid Fever	Filariasis
Hookworm	Amebiasis	Loaiasis
Paratyphoid Fever	West Nile Fever	Malaria
Salmonellosis	Schistosomiasis	Onchocerciasis
Scabies	Dracontiasis	Paragonimiasis
Bacillary Dysentery	Echinosoccosis	Rift Valley Fever
Trachoma	Clonorchiasis	Yellow Fever
Typhus	Dengue	
Cholera	Diphyllocbothriasis	

Because of ease of detection or unusual importance, only a few of these diseases, mainly the diarrheal diseases, have been subjects of extensive epidemiological studies where water supply conditions entered explicitly into the research design.

Although many of the studies reviewed suffered from poor conceptualization or inadequate implementation, taken as a whole, the studies represent significant evidence that improved water supply is associated with decreased incidence of enteric disease. Further, for most diarrheal diseases and skin infections, incidence appears inversely related to volume of water used. Households that have more convenient sources of water and have more facilities for use of water (indoor latrines, showers, baths, basins) have lower infection rates. These findings confirm conclusions many have arrived at by intuition or common sense. The studies do not provide a basis for estimating incremental health benefits that can be expected from incremental investments in water supply systems. Nor do the studies give any indication of what pre-existing conditions or what complementary changes, if any, are needed to realize the expected health benefits.

Saunders and Warford review several studies which have attempted to value health improvements, including one study estimating health benefits due to improved water supply (188). Theoretical welfare economics contains little to aid these efforts. Essentially, two approaches have been chosen for lack of any better and because of their appeal to reason. One approach is to estimate the present worth of individuals' more healthful and lengthened lives. The method is to discount changes in expected lifetime earnings due to improved health. The second is to estimate costs incurred due to morbidity

and mortality. Included in these costs have been expenditures in giving birth, rearing and burying children who die before becoming productive adults; costs incurred in medically treating disease, in terms of hospital charges, drugs, medical attention, and income lost by family members caring for the ill; and income lost due to forced absence from work while sick or due to decreased productivity while working. Neither of these approaches is based on firm theoretical foundations. Nor is there a concensus on which of these is best to value human life and health. One justification of using one or the other of these approaches is a negative one: that the alternative is to conclude human life is either completely worthless or infinitely precious. The rationale for a valuation of health benefits is to be able to compare quantified benefits with the costs of improving health. The Pyatt and Rogers study made these calculations for a Puerto Rican water supply project and estimated a benefit-cost ratio that approached unity at some time over the life of the project, depending on what discount rate was used. The benefits were conservatively estimated as those resulting solely from decline in incidence of three groups of disease.

The paper on domestic water supply by Judith Rees in the Ford Foundation study differs from Saunders and Warford's mainly in its recommendations for further research. The author feels that more research is needed in the following areas:

(1) The relationship between levels of service and health benefits; much research suggests a relation between quantity of water used and improved health; but the shape of the function relating increments in health benefits to increments in water consumed is completely unknown.

(2) The relationship between real costs to users of obtaining water and demand for water; the relationship can be broken into two parts: relating increments in water used to decrements in distance water has to be carried for households without house connections; and relating increments in water used to decrements in unit price for connected households.

(3) The relationship between the provision of improved water supply and the provision of complementary improvements in public health, such as solid waste disposal or health education.

(4) The interaction of diseases directly affected by water supply with those which are not, such as malnutrition or respiratory diseases.

The author also suggests a form of research:

> "A full study would introduce different water systems in similar areas, giving families different quantities and forms of supply, while adding improvements in sewage, medical care, or education, as well as pure water."

The major conclusions to be drawn from these two studies and their review of the literature on the impact of water supply investments are:

(1) Health effect al benefits of water supply invest.....

(2) Little is known about the health effects beyond a general association between improved quality and, particularly, increased quantity of water and a reduced incidence of enteric disease

(3) For the purposes of rational investment decisions, more information is needed about the effect on health of the design of water projects and about the social, cultural, economic and educational environment for which projects are designed.

These two reviews focused their attention on water supply and the literature discussing its impact in a variety of areas. But the analysis and conclusions, especially those concerning the health effects, strongly suggest that one should venture outside the field of knowledge about water per se and take a broader look into the epidemiology of diseases thought to be affected by the supply of water. To do so places one in a vast sea of literature, mainly medical in origin. In the preparation of this paper, it became clear we would have to limit our search to areas that seemed most fruitful for later research. For reasons given below, we have concentrated on literature studying diarrheal disease and its interaction with nutrition.

The Enigma of Diarrheal Disease

Diarrheal disease is universal and ever present in human populations. It was mentioned and described in Hippocratic writings and is known to exist from the artics to the tropics and everywhere in between. Yet there is no widely accepted definition of diarrheal disease (41). The disease is a syndrome, like the common cold, with distinguishable regular symptoms, but in many cases indistinguishable infecting agents. Aside from the traditional water-related diseases caused by the bacteria, Shigella, Salmonella, and Cholera, which typically produce diarrhea, the

syndrome remains unclear (99, 153). There is no universally accepted definition of diarrhea. It is at best related symptoms (41, 94, 97). Intensive worldwide studies have produced no bacterial cause in some cases (41, 94,96,97), yet the disease acts as though it was due to some contagious agent, possibly viral as well as bacterial (153, 211). An intensive two-year study of the life history of bacterial flora of the infant's gut from birth failed to explain most diarrheal episodes (53). Antibiotics should control an infectious agent but the tropical diarrheas seem unresponsive to this treatment (5, 211, 217, 220, 221). Furthermore, the intestinal pattrology seen with diarrhea is not always specific for any particular disease of known etiology (108). On the other hand, children free of diarrhea may carry high levels of enteropathogenic organisms in their intestines (85). Infections quite remote from the gastrointestinal tract, in the middle-ear or lungs, for example, or measles often produce serious diarrhea in children (86, 131, 208, 212). The immediate cause of death in some children may be due to changes outside the intestines such as dehydration and electrolyte imbalance.

The physiology of water and electrolyte balance of the body has been studied intensively, especially in children, for many decades. Its relevance to water use and diarrheal disease is still not fully appreciated, especially in countries with rudimentary health care resources. The realization that children are not simply minature adults has not penetrated most developing countries, even where high infant and child mortality persists (4). The fluid compartments of adults and children are sufficiently dissimilar to make water loss far more serious in infants than in mature individuals (65, 81). Adults can survive about a week if deprived of water; infants about three days. Adults need not rely exclusively on oral fluids for their water requirements; they consume water-containing food and liquids

other than drinking water. Adults, furthermore, have exclusive control over what enters their mouths; infants and young children must depend on others. Children exchange about twenty percent of their body weight each day in their rapid metabolic and growth processes. Since sixty-eight percent of an infant's mass consists of body water, a relatively large amount of the fluids consumed by a child becomes incorporated as a permanent part of his substance. This central role of water for the energy-metabolic processes and for growth is crucial. An almost unrealized aspect of the water balance system is that water must be actively transported across the various membranes separating inner and outer man from his environment and this calls upon complex endocrine and physiochemical mechanisms. The active agents accompanying the movements are both simple elements such as sodium and potassium as well as complex organic compounds which must be supplied from the external environment as part of nutrition. Most of these considerations have been given brief attention in the literature reviewed.

Even though diarrheal disease is present in all populations, its incidence, prevalance, severity, and fatality vary greatly by area of the world, by level of modernization, by season, by socioeconomic status, by age group and by physiological status of the individual. In many places, especially the less developed world, diarrheal disease is the single largest cause of death and illness (96). This much is known despite woefully inadequate vital statistics on morbidity and mortality. But much remains unknown, particularly about effective and economic control of the disease.

There have been several major long-term prospective field studies of diarrheal disease in recent years: in Costa Rica (165); in the Artic (90); in India (91, 92, 94); and two in Guatemala (5, 53, 100, 155, 154, 157, 210, 212, 209, and 97, 98, 99). Perhaps the most interesting findings of these

studies, particularly of Gordon's studies in India and Guatemala, is that by far the highest incidence of diarrheal disease occurred among pre-school children of 0 to 5 years. Among those, incidence and fatality was concentrated in weanling children, usually aged six months to two years. Severity and fatality was highly associated with nutritional deficiencies. These observations have been used to support a theory of Nevih S. Scrimshaw and Gordon (218) of synergism between infection, including diarrheal disease, and nutrition.

The Malnutrition-Infection Complex

The interaction of diarrhea and infection lead to at least two separate phenomena. One is the often fatal syndrome in young children, where diarrhea is more frequent and has more serious consequences among children with malnutrition and where diarrhea turns marginal nutritional deficiencies into severe malnutrition. The other phenomenon is where diarrhea causes malabsorption of nutrients in all ages, leading to food wastage and its consequent economic loss, but seldom resulting in fatality in school-age children and adults. Great emphasis has been placed on the infection-malnutrition relationship to explain the high death rates of the weanling child in the second year of life (218, 221, 249). Though a mass of evidence is accumulated and despite detailed studies relating nutrition and infection in some causal way, there are diverse views regarding the primary problem. Furthermore, the interwoven relationship of both these factors to water and sanitation is unclear (172, 173, 250).

The interaction of infection and malnutrition has been investigated in several long-term field studies which have gained wide spread recognition and respect. Scrimshaw's and Gordon's studies in Guatemala (6, 11, 57, 106, 111, 214, 215, 216, 217, and 220) and another in India (136) have found substantial evidence to support their theory of the synergism of infection and nutrition. Nevertheless, several investigators failed to find a causal relationship between gastroenteritis and malnutrition (38, 231, 251) or change of infection rate with improved nutrition (28, 39, 196). Certainly physical occulasion of the gut with parasites will interfere with nutrition (239). But disentangling the role of parasites from other nutritional factors affecting health has not been completed (243). Frank waterborne parasites, such as hookworm or schistosomiasis, in light infections may produce no clinical malnutrition (49) or serious deficiency disease (68, 69). Certainly the weight of the evidence suggests that infection, particularly diarrheal disease, and nutrition are related in a complex way. In light of these relatively recent findings the role of water in diarrheal disease is called into question.

Water Supply versus Nutrition in Control of Diarrheal Disease

All of these studies mention water supply in one way or another and its role in diarrheal disease. Most simply mention the widespread belief that an improved water supply is important for control of infectious disease with no further analysis. Although their primary analysis and conclusions concern other things, Scrimshaw and Gordon argue that the water supply of a locality has little to do with the incidence of enteric

disease, particularly among the group most at risk, young children. They have concluded the main route of transmission is by hand to mouth and not solely by some single contaminated source such as domestic water. Further, they feel that the route of transmission is not nearly as important in the etiology of the disease as the nutritional state of the infected host. These arguments, of course, are at variance with the long-held, widespread popular belief that a plentiful, uncontaminated supply of water is necessary for the control of enteric diseases. Only one of these studies, an ongoing project in Guatemala (57) has been designed to effectively study the health impact of an improved water supply on a community. Its findings will not be available for several years. Its research strategy is to measure the existing degree of malabsorption of nutrients, how malabsorption decreases as a result of improved water and environmental sanitation, what effect increased nutrition has for workers' productivity, and what economic value these changes have. The study is not designed to specifically investigate diarrheal disease in pre-school and weanling children nor is there any special investigation of water's role in the disease among this group most at risk.

The epidemiology of any disease must consider at least three important factors: the environment of the disease, its receptivity in a host, and its route of transmission from the environment to the host. The disagreement over water's role in the etiology of diarrheal disease can be interpreted as arising from different viewpoints on which of these factors is most amenable for effective and economic control of the disease.

From one viewpoint, control requires cleaning up the environment which supplies infectious agents to their hosts. From another, it requires changing the cultural practices of hygiene which facilitate the transmission of the agents from the environment to the host. And from a third, it is necessary to fortify the the host against the invading infectious agents. Removing contaminants from the water source would be one of the steps taken in cleaning up the environment. Providing a more plentiful and convenient supply of water would be one step in encouraging better practices of household hygiene. Water would have no direct role in enabling a host to better withstand infecting agents. In many areas of less developed countries where the entire environment is heavily contaminated, where hygienic practices are inadequate, and where many individuals exist in poor health and nutritional states, it is unknown which method of attacking diarrheal disease would be most economic, or cost-effective. Intervening in a community to improve and increase the supply of water may well be much cheaper than attempting to change basic habits of hygiene or conditions of nutrition. But a better water supply without accompanying changes in habits and attitudes may have little effect on the incidence of diarrheal disease. Just what is the optimum mix of environmental, cultural, and personal changes needed for economic control of the disease is unknown and warrants further study.

DIARRHEAL DISEASE AND HOST NUTRITION

Three major field studies investigating the interaction of diarrheal disease and the nutritional state of its host have been referred to earlier. These are by Scrimshaw, et al in Guatemala (6, 11, 106, 111, 214, 215, 217, 220), Kielmann, et al in India (136), and Schneider, et al in Guatemala (57). The purpose of this section is to review these studies to elucidate their design, their methodology, and their major findings, and to see how far they take us in understanding the etiology of diarrheal disease.

First Guatemalan Study

The nutrition and infection field study by Scrimshaw and others was described and its results reported in the nine articles already cited, and in over sixty collateral articles. The field study took place in three highland Guatemalan villages from 1959 to 1964. Additional years were required for preparation and subsequent analysis. The principal investigators were epidemiologists from U.S. universities and from the Institute of Nutrition of Central America and Panama (INCAP). The villages in the study were selected for the homogeneity of their highland Indian populations, their similarity in disease occurrence, their familiarity to INCAP's staff and their similarity in size. One village served as a control village. One was a feeding village, where a daily food supplement was offered freely to children between six months and five years of age. A third was a medical treatment village where an existing clinic was expanded; health care and some public health measures were introduced on a more intensive level than in the other two villages. The segment of the populations most thoroughly

studied in all three villages were children under five. Nevertheless, censuses and some of the sample surveys collected information on other age groups as well.

The study intent was to record the effects of the two major interventions, one medical and the other nutritional. The study design was longitudinal in the sense that the health and nutritional states of the same individuals were monitored over time. It was cross-sectional in that the various levels of health and nutritional variables were measured across all three villages.

The stated objectives were:

(a) to observe and describe the interactions of malnutrition and infectious disease among infants and young children in the populations;

(b) to measure changes in nutritional status which result from food supplements to the diets of breast-fed children during weaning and thereafter and to determine the effect of such changes on the incidence and behavior of common infectious diseases;

(c) to measure the results of an integrated medical service on the frequency and behavior of infectious diseases among preschool children, and to determine the effect of the observed changes on nutritional status at those ages;

(d) to identify and evaluate the relative influence of other broad ecological factors involved in the frequency and severity of infectious and nutritional diseases of

early childhood, primarily those factors resident in environmental sanitation and in the social structure of the community.

The achievement of each of these objectives was hampered to a varying degree by events during the study. Evidence on the interaction of infection and nutrition was weak or non-existent. Poor and declining attendance and administrative problems caused inconclusive results from the feeding program. Particularly hampering was the very low participation of children under two years. Two major epidemics of diarrheal disease in the treatment village clouded the findings on the integrated health care program. Environmental sanitation improvements including an improved water supply in the village were ineffectively implemented, so no changes or lack thereof could be attributed to this factor.

Despite these problems the investigators did report some positive findings.

(a) The death rates among children from the second to the fifth year was highest in the second year. This confirmed findings in other areas of the world.

(b) Among infants, deaths in the second through the twelfth month exceeded deaths in the first month. The opposite of this is true in the more developed regions of the world.

(c) The peak incidence of infectious disease was in the second year. This study provided one of the few sources of general morbidity data on rural populations over time in less developed countries.

(d) Dietary supplementation measurably improved the nutrition of those children who participated in the feeding program frequently.

(e) Children in their second year consumed a particularly poor diet.

(f) Medical care reduced case fatality of preschool children. Morbidity due to diarrheal disease was higher in the treatment village than in the control due to the epidemic mentioned. But mortality was lower, certainly because of the prompt and intensive medical care available in the treatment village.

The investigators drew several conclusions from these findings relevant to mention here. They feel the high incidence of disease during the second year is related to the weaning of children which occurs at that time. They speculate that weaning often leads to nutritional depletion of children because solid food given during this period is inadequate to offset the declining breast milk received. Despite the lack of direct findings in this study, they further believe that the resulting malnutrition acts synergistically with the ubiquitous infecting agents in rural areas of less developed regions to cause disease with unusual frequency and severity. The receptiveness of a weanling child to infectious disease is enhanced not only by his depleted nutritional state but also by his lack of any acquired resistance to locally prevalent disease. This is due to the relative sterility of the breast milk in his diet and the absence of oral contaminants until the onset of weaning.

The investigators did mention the water supply in relation

to diarrheal disease. An improved water supply was one of the planned sanitary interventions in the treatment village. But the whole environmental sanitation program was inadequately implemented and the water supply was, in fact, little improved. Despite this, because of the observed frequency and distribution of diarrheal disease, the investigators felt water had little role in the etiology of the disease. Even though they felt an uncontaminated supply of water was important for long-term community disease control, other factors, particularly nutrition, were much more important for control of weanling diarrhea.

It should be noted that the investigators of this project do not feel that the nutritional state of a child host to diarrheal disease is the sole important consideration to the exclusion of all others. They specifically mention the importance of household hygiene and the implied need for adequate water for this purpose. In fact, the reader is left with the impression that they are arguing against the belief that the source of water is the sole important factor--that an uncontaminated water supply is sufficient for the control of diarrheal disease. They emphasize nutrition's role because that is what they were studying. Whatever their viewpoints and beliefs, their study and findings leave open the question of water's role in diarrheal disease in its interaction with nutrition.

Indian Study

A second nutrition and infection field study was carried out by the Rural Health Research Centre in Narangwal, Punjab, India. The centre has directed a large number of village studies, mainly on fertility and acceptance of family planning methods, but also on a wide variety of health-related issues. This study is an investigation in

four groups of villages on the interactions of infection and nutrition. The basic strategy was to intervene in three groups using the fourth group of villages as a control. The interventions were nutritional care, infection care, and both nutritional and infection care. The target population were children aged zero to three years. The effects of these interventions on growth, morbidity, and mortality were measured by ongoing longetudinal and cross-sectional surveys between 1968 and 1973. The report cited here is a preliminary one presented before the findings are completely analyzed. The authors feel the information is sufficiently interesting and reliable to warrant publication.

The over-all results were that children in the group of villages with both nutrition and infection care showed a larger improvement in measured mortality, morbidity, and growth than in any of the other groups. The relative improvements between groups of villages in the specific measures depended somewhat on the age of the preschool children. The health and nutritional status (as opposed to changes in status) depended significantly on the caste of the children's families.

The project did not study water in relation to diarrheal disease and its interaction with nutrition. The investigators specifically mentioned that any environmental sanitation intervention was excluded from the study's design. The study was not designed to investigate reasons for the prevalence of diarrheal disease, not even nutritional reasons. Its strategy allowed observation of whether improved medical care, improved nutritional care, or both improved the health of children the most. Not surprisingly,

the investigators found that a combination of the two was better than either one by itself.

Second Guatemalan Study

A third long-term prospective field study dealing with nutrition and diarrheal disease is currently being carried out in Guatemala under the field direction of Dr. Roberto Schneider. This study is of particular interest as it has included an improved water supply as a major experimental intervention. The study is being carried out in two coastal ladino Guatemalan villages similar in their size, in their geographic, social, ethnic, and economic characteristics, and in their prevalence of gastrointestinal disease. One of the villages was taken as a control. The other, experimental, village received an environmental sanitation program including a new chlorinated water supply piped to about sixty percent of the households. Various measurements are taken in both villages on their health, nutrition, sanitation, and economy. The investigators are specially interested in measuring malabsorption of nutrients in individuals. This is done by performing absorption tests periodically in males between fourteen and forty-five years in both villages. Later a calorie-protein supplementation program will be introduced in both villages.

The main objectives of the study are:

(a) to measure the prevalence of gastrointestinal disease, including parasitic disease, and its effect on intestinal malabsorption and nutritional status;

(b) to evaluate the prevalence and severity of intestinal malabsorption and food wastage;

(c) to determine the effectiveness of first an environmental

sanitation program and then a nutritional supplementation program in decreasing the prevalence of gastrointestinal disease, malabsorption, and food wastage;

(d) to determine the health and economic benefits of these changes by measuring the reduction in gastrointestinal disease, the economic value of a reduction in food wastage due to disease, and the value of increased physical productivity.

The findings of this study will not be known for several years. Any comments must be limited to a discussion of its design.

This study seems well-designed to capture certain of the effects of an improved water supply on health and nutrition. The investigators should be able to calculate the economic cost of food lost by malabsorption. They may be able to calculate the economic benefits of increased physical productivity of certain workers due to better nutrition. The project is designed to measure changes in malabsorption due to a decrease in enteric disease brought about by improvements in water quality and quantity. Whether or not the investigators actually are able to measure these changes depends on the significance of the changes; that is, whether or not an improved water supply decreases malabsorption in individuals in a significant and measurable way.

The emphasis of the study is the measurement of the level of malabsorption, changes in this level due to improved environmental sanitation and reduced disease incidence, and the economic value of these changes. The main target group of study is working-age males

in both villages. The study is not designed to study the broad etiology of diarrhea, its economic control, or the role of water. The link between water and diarrheal disease is assumed in this study. Because of the study's emphasis on the economic impact of the interaction of diarrhea and malabsorption, there is no special attention given to preschool or weaning children.

STRATEGY AND METHODOLOGY OF LONG-TERM PROSPECTIVE FIELD STUDIES

Basic Strategy

The epidemiological studies reviewed in preparation for this study varied greatly in their strategy. They ranged from an individual's casual observations of children playing in a village square to ambitious long-term prospective field studies involving major interventions in several sites, repeated household surveys, and extensive clinical, anthropometric, and laboratory examinations. Some studies reported on analysis of cases seen in a clinic or examinations done on convenient groups such as school children. Many were one-time status surveys where information was taken on the incidence and prevalance of infectious disease or clinical malnutrition. Although some studies, such as those in Guatemala, were well done, a feature met with surprising frequency was a lack of any hypothesis to be tested, any search for the causation of conditions found, any analysis of the findings beyond a simple statistical presentation, or any broader discussion of issues involved in the etiology of the disease and methods of control. The only conclusions that can be drawn from many of these studies is that disease exists, or malnutrition exists, among the populations surveyed.

The studies reviewed which have been valuable in answering, or at least asking, interesting epidemiological questions have been long-term prospective field studies. These have involved study in two or more sites over several years, often with an experimental intervention, such as a nutritional supplementation or improved environmental sanitation. This strategy allows comparisions between experimental and control groups and allows observations of the same group over time. These studies, like

the others mentioned above, have used household surveys, clinical and laboratory examinations, and even casual observation. But they were used over time and across populations in a way that allowed some conclusions to be drawn about the epidemiology of the disease under study. Long-term prospective field studies are to be recommended.

Methodology

Investigators in two of the long-term prospective field studies not only discussed their observations and conclusions but also examined their methodology and design in retrospect, after the project had been underway long enough for the inevitable problems to become apprent. Such an examination is rare and extremely valuable to anyone embarking on a similar study.

One of the articles reporting on the infection and nutrition field study in Guatemala was devoted to a critical examination of the study (11). He made the following important points:

(a) The study design and plan are crucial. They should make sense in their conception and appear reasonable. Any anticipated problems are likely to become real problems. They should not be left to work themselves out in the field.

(b) Chance events, such as the epidemic in one of the study villages of this project, can seriously bias results. They should be considered in as far as possible in the study design.

(c) Personnel, administrative, and logistic problems can ruin or greatly complicate even a conceptually well-designed study. Constant vigilance is required throughout the project.

(d) A good pilot study should be undertaken to test procedures, collect sample data, and train workers. The pilot study should be long enough and large enough to really test these. The natural urgency to proceed with the main study should be suppressed until the pilot study is over, its results analyzed, and any changes made.

(e) The operations of the study should be periodically evaluated and changed if required. Many problems, such as the low attendance of two-year-olds in this study's nutritional supplementation program, can be rectified if discovered early enough.

(f) Steps should be taken to assure any experimental intervention is effective. In this study, both the feeding program and the public health program were ineffectively implemented. The problem is not discerning the results of induced changes; it is inducing the change in the first place.

(g) Adequate procedures for handling the basic data of the study should be built into the design. First of all, some determination of the purposes to which the data will be put should be made while designing the study. This allows data of the appropriate kind and form to

be collected. A periodic evaluation and statistical review of the data should be carried out during the study. This allows any data problems to become apparent and be corrected early. A statistician should be involved throughout the study.

h) The budget and design of the project should make sufficient provision for analysis of the data collected. Many studies, including this one, allocated most of their funds for data collection and not enough for analysis. This results in collecting much more data than can be analyzed. Some studies may require more money and tir for analysis than for data collection.

(i) Research serendipity should be provided for. Every study reveals unpredictable but often very valuable research leads. Part of a project's justification and budget should be based on unforeseen collateral studies.

While Scrimshaw emphasized great care is required in all stages of a field study, Robert Schneider, Jaques Faigenblum, and Maarten Immink, investigators in an on-going field study in Guatemala (57), in a personal communication, stressed the need for a limited scope.

(a) The objective of the study should be simple. Trying to discover too much at the same time increases the difficulty greatly. Investigators must take into consideration how much questioning and examining informants are willing to put up with. A study must establish priorities rather than including everything somebody may think of.

(b) Good field administration is important. The project requires a full-time supervisor who is motivated by the study's objectives and who combines tact and an ability to communicate to solve field problems.

(c) The project requires several individuals with extensive experience in field administration of surveys. They need not be full-time staff members but could be consultants offering help from time to time.

(d) Any experimental intervention should be kept minimal and simple. Changing too many things at the same time makes sorting out the various effects difficult.

(e) Data analysis should be kept simple and data to be analysed should be kep to a minimum.

Conclusions

Conclusions to be drawn from these strategic and methodological considerations are:

(a) a long-term prospective field study is to be recommended over other types;

(b) great care should be taken in the design, implementation, and analysis of the study;

(c) any experimental intervention should be simple, well-designed, and effectively implemented;

(d) a good, unhurried and adequate pilot study should be undertaken;

(e) all aspects of the project should be periodically evaluated any any indicated changes made; and

(f) sufficient provision should be made for final data analysis.

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BIBLIOGRAPHY

1. Adams, R. N., "A Nutritional Research Program in Guatemala," in B.D. Paul (ed.), Health, Culture, and Community, New York, Russell Sage Foundation, 1955, pp. 435-458.

2. Adrianzen, B., et al, "The High Cost of Being Poor, Water," Archives of Environmental Health, vol. 28, pp. 312-315, June 1974.

   A longitudinal anthropometric and socioeconomic assessment was made of 127 families of children admitted to the British American Hospital in Lima, Peru, with malnutrition in 1961 to 1971. Those recruited during 1961-1966 had higher incomes and were more likely to have running water and electricity than those recruited later. Mean mid-parental heights were equal, but the children from families with water and electricity services were taller for their age. Expenditures for illumination were similar, whether for electricity or candles or kerosene, but the cost of water for families without running water was greater. The cost differences were even greater when expressed as a percentage of income or as the amount of working time to pay for water.

3. Arbeiter, A., et al, "Nutrition and Infection," Federation Proceedings, vol. 30 (4), pp. 1421-1428, 1971.

4. Aries, P., Centuries of Childhood, New York, Vintage, 1965.

5. Ascoli, W., et al, "Studies of Diarrheal Disease in Central America: VII. Treatment of Preschool Children with Paromomycin and Sulfamethosypyridazine under Field Conditions in a Guatemalan Highland Village," American Journal of Tropical Medicine and Hygiene, vol. 14 (6), pp. 1057-1061, November 1965.

   An antibiotic, Paromomycin, and a sulfonamide, sulfamethoxypyridazine, were used as an added therapeutic measure to rehydration and nursing in treatment of 535 patients (aged less than 5 years) with acute diarrheal disease (October 1960 to December 1961). Treated village program included such measures as control of water supply and building of privies, but effect or result of these measures is not listed.

6. Ascoli, W., et al, "Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964. IV. Deaths of Infants and Preschool Children," Archives of Environmental Health, vol. 15, pp. 439-449, October 1967.

   A program of supplemental feeding for children less than 5 years old was introduced into a rural Guatemalan village (Santa Catarina Barahona), population about 1,000. A second village (Santa Maria Cauque) had an integrated service of medical care, preventive medicine, and sanitary services avail-

able to all but directed primarily to preschool children. A third village (Santa Cruz Balanya) served as the control. In the course of 5 years (May 1959-April 1964) infant mortality improved in both the villages with services, and the feeding village compared with baseline experience of 9 years. Infant mortality in the control village remained unchanged.

7. Assessment of Environmental Sanitation and Rural Water Supply Programs Assisted by the UN Children's Fund and WHO, (1959-1968), E/ICEF/L, 1971, March 4, 1969. JC16/UNICEF-WHO/69.2. ARC 613.1 U58.

Section on general health improvement describes the Zaina water project as an example of health benefits derived from pure water supply. Health improvements after provision of water supplies in Japan and Brazil (Amazon area) are also discussed along with a general look at water associated diseases. Environmental sanitation in development projects is outlined and recommedations are made.

The Zaina project (Kenya) is one of the few controlled studies showing health (fewer worms, less illness) and economic (time released from water carrying) benefits four years after installation of a water supply system accompanied by latrine building. The overwhelming mass of evidence from all parts of the world supports the premise that safe water has a profound effect on the health of rural people. Surveys in 1962 in Japan showed a reduced death rate of nearly 52% in infants and young children.

8. Axelrod, A. E., "Nutrition in Relation to Acquired Immunity," in Wohl and Goodhort, Modern Nutrition in Health and Disease, Dietotherapy, 4th ed., Philadelphia, Lea and Febiger, 1968, pp. 612-622.

9. Beck, M. D., et al, "Studies on Diarrheal Diseases in Central America I. Preliminary Findings on Cultural Surveys of Normal Population Groups in Guatemala," American Journal of Tropical Medicine and Hygiene, vol. 6, pp. 62-71, January 1957.

Behar, M., et al, "Osseous Development in Children with Kwashiorkor," Federal Proceedings, vol. 23, p. 338 ff., March-April 1964.

Ossification status and thickness of compact bone of Guatemalan children with Kwashiorkor were compared to those of age-sex-matched children in two rural Guatemalan villages. Results support the concept of Kwashiorkor as acute process superimposed on chronic protein-calorie malnutrition affecting the majority of children in rural Central America.

Behar, M., et al, "Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964. VIII. An Epidemiological Appraisal of its Wisdom and its Errors," Archives of Environmental Health, vol. 17, pp. 814-827, November 1968.

12. Benelux, L., Health and Nutritional Analysis of the Province of Izmir, Turkey, (N.P.), 1968.

13. Berg, A. D., "Malnutrition and National Development," Journal of Tropical Pediatrics, vol. 14, pp. 116-123, September 1968.

Discusses the relationship of malnutrition to death from childhood disease and the probability of retardation caused by malnutrition. Enumerates the ways in which malnutrition impedes national development.

14. Berg, A. D., et al, "A New Need: The Nutrition Programmer," The American Journal of Clinical Nutrition, vol. 22 (7), pp. 893-895, July 1969.

Discusses the need for persons to address themselves to the translation of nutritional findings into acceptable, useful programs.

15. Berg, A. D., "Priority of Nutrition in National Development," Nutrition Reviews, vol. 28 (8), pp. 199-204, August 1970.

Although nutrition is typically not considered among the most important indicators of social, political, and economic development nor among the priorities for national growth, Berg argues that national development often depends on nutrition.

16. Berg, A. D., "Nutrition as a National Priority. Lessons from the India Experiment," American Journal of Clinical Nutrition, vol. 23, (11), pp. 1396-1408, November 1970.

Argues that food fortification could someday be the equivalent of a smallpox vaccination.

17 Berg, A. D., et al (eds.), Nutrition, National Development and Planning, Cambridge, Mass., MIT Press, 1973.

Proceedings of an International Conference held at Cambridge, Massachusetts, October 19-21, 1971.

18 Birch, H. G., and J. Cravioto, "Infection, Nutrition and Environment in Mental Development," in Conference on the Prevention of Mental Retardation through Control of Infectious Diseases, June 9-11. 1966, Cherry Hill, N.J., ed. H. F. Eichenwald, Public Health Service Publication 1692, Washington, D.C., U.S. Government Printing Office, 1968.

Reports on a study (partially retrospective) on growth and mental development in Guatemalan six and twelve year olds. Finds that mental development as measured by tests developed by authors differs by historical growth of subjects. Assumption made that differences in growth due to different nutritional and infectious histories.

19. Birkbeck, J. A., et al, "Nutritional Status of British Columbia Indians. II. Anthropometric Measurements, Physical and Dental Examinations at Ahousat and Anaham," Canadian Journal of Public Health, vol. 62 (5), pp. 403-414, September-October 1971.

Anthropometric (standing height, sitting height, weight, arm circumference, head circumference, triceps skinfold and radiograph of left hand and wrist), physical (examination of head, trunk, extremities and blood pressure) and dental (Green and Vermillion Simplified Oral Hygiene index and Ramford Peridontial index employed) examinations on 248 Ahousat and 266 Anaham Indians of British Columbia revealed that skeletal maturation for age in children was less than caucasian controls. Adults were also shorter and female obesity was prevalent. Physical findings were not striking, but dental and peridontal health were poor. Nutritional factors are probably of major causative significance. Methodology is described in greater detail in previous publication: Lee, M., et al, "Nutritional Status of British Columbia Indians: I. Dietary Studies at Ahousat and Anaham Reserves," Canadian Journal of Public Health, vol. 62, pp. 285-296, July-August 1971.

20. Blix, G., et al (eds.), Famine: A Symposium Dealing with Nutrition and Relief Operations in Times of Disaster, Uppsala, Almquist and Wiksells, 1971.

Suggests food distribution priorities to: (1) artificially fed infants, (2) lactating women, (3) weaning age children, (4) pregnant women, (5) pre-school and school children, (6) manual workers, (7) old people, and (8) the rest of the population. However, some studies argue that helping (service) group should be near or at the top of priorities.

21. Bradfield, R. B., "Some Characteristics of the Health and Nutrition Status of California Negroes," American Journal of Clinical Nutrition, vol. 23 (4), pp. 420-426, April 1970.

A review of the Berkeley, California studies (neither clinical) and statistics from several other states show that the nutritional status of the American Negro has not been investigated thoroughly and that there is no information on the nutritional status of the preschool Negro child in California. Limited health statistics suggest that the California Negro may have less than adequate nutrition. Further study is needed to determine the nutritional status of preschool children of low income Negro families to provide a basis for applied nutrition programs.

22 Brown, J., et al, "Participant Intervention in Providing Domestic Water," Comparative Studies of Cultural Change, Department of Anthropology, (mimeo), Cornell University, Ithaca, 1964.

Describes the work of an anthropologist in Puerto Rico to encourage and help a small community (25 houses) to build a water supply system (La Cuesta).

23. Brown, M. L., et al, "Health Survey of Nepal. Diet and Nutritional Status of the Nepalese People," American Journal of Clinical Nutrition, vol. 21, pp. 875-881, August 1968.

Although sanitation and disease data were collected in the course of the study the present report is concerned only with the nutritional status of the Nepalese population as determined by dietary data and clinical examination.

During 1965-1966, a population thought to comprise a good geographic sampling (18 villages and 1 urban site; 6,321 persons from 957 households) was surveyed with 79% of these examined physically. The 24-hour recall method was used to obtain household food consumption. The diet of the Nepalese people is clearly superior to many other areas of the Far East but is generally lacking in sufficient high quality protein, calcium, vitamin A, riboflavin and ascorbic acid. Iron, thiamine, and niacin intakes are adequate to high, due to consumption of large amounts of unmilled rice. Although the clinical nutritional status of the population is generally satisfactory, the high mortality rate among children under five suggests that marginal malnutrition exists, which, coupled with constant exposure to a contaminated environment, is a major factor implicated in child deaths in Nepal.

24. Brozek, J. (ed.), "Proceedings of a Conference on the Role of Body Measurements in the Evaluation of Human Nutrition, Sponsored by the Committee on Nutritional Anthropometry of the Food and Nutrition Board of the National Research Council, Cambridge, Massachusetts, June 17-18, 1955," Human Biology, vol. 28 (2) pp. 109-273, 1956.

A detailed outline is presented for use of body measurements to standardize collection of such data in measuring nutritional status in adults and children as agreed upon by the participating members of the committee.

Eleven articles: "Physical and Nutritional Status of Men" (Brozek), "Body Build and Body Weight in 25-year-old Army Men" (White), "Variable Factors in Skeleton Weight" (Trotter), "Skinfold Measurements in Young American Males" (Newman),

"Correlations between Thickness of Skinfolds and Body Density in 88 Soldiers" (Pascale, et al), "The Canadian Weight-Height Survey" (Pett and Ogilvie), "Anthropometry and Nutritional Status of Adult Women" (Ohlson, et al) "Obesity and Disease" (Rion), "Body Weight: Facts from Life Insurance Records" (Marks), "Fat Thickness and Growth during Infancy" (Garn), "Allometric Growth of Body Composition in Man and Other Mammals" (Hunt and Giles) are published here.

25. Bruch, H. A., et al,"Studies of Diarrheal Disease in Central America. V. Environmental Factors in the Origin and Transmission of Acute Diarrheal Disease in Four Guatemalan Villages," American Journal of Tropical Medicine and Hygiene, vol. 12, pp. 567-579, July 1963.

26. Bruvold, W. H., et al, "Consumer Assessment of Water Quality and the Cost of Improvements," Journal of American Water Works Association, vol. 63, pp. 3-5, January 1971.

The authors, from the University of California at Berkeley, School of Public Health, illustrate how a consumer survey could be used to document the nature and extent of water quality. The use of such surveys to deal with four general issues involved in improving water quality was discussed and an interview schedule proposed. The final instrument was divided into two main parts: one dealing with consumer assessment of water quality and the other with the cost of the local water, the possible need for improving water quality, and the cost of such improvements. Tabulated data included structure ratings for water in general and taste, reasonable and highest increase and water rates.

27. Buck, A. A., et al, Health and Disease in Chad: Epidemiology, Culture, and Environment in Five Villages, Baltimore, Johns Hopkins Press, 1970.

Reports on a large scale epidemiological survey of health conditions in Chad.

28. Burgess, H. J., et al, "Results and Appraisal of a Nutrition Survey in Malawi," Tropical and Geographical Medicine, vol. 25 (4), pp. 372-380, December 1973.

A nutritional status survey utilizing a combination of anthropometry, clinical examination, and simple analysis of blood and stool samples of under-fives and their families and a

household dietary survey were carried out in ten villages in the south of Malawi in 1970. Mild to moderate protein-caloric malnutrition was found in about 30% of under-fives. Infant mortality was high. Malaria and anaemia were common at all ages. Household diets were generally low in total energy with this accompanied by some low protein, iron and vitamin A intake. The article asks for (1) further research on recent morbidity, (2) a more quantitative appraisal of what the agricultural plans of each family would imply in terms of energy and nutrient intakes, and (3) more information about the communities' value system in relation to illness, food and services.

29. Buskirk, E. R., et al, "Comparison of Two Assessments of Physical Activity and a Survey Method for Calorie Intake," American Jounal of Clinical Nutrition, vol. 24 (9), pp. 1119-1125, September 1971.

Attempts to compare habitual physical activity (measured by questionnaire and interview) with the daily caloric intake (measured by dietary survey) of 198 men between the ages of 40-59. A scheme for determining the relative activity level yielded values unrelated to those for average daily caloric intake determined from 7-day dietary records.

It appears that direct observation or the completion of an activity diary or both may yield better information about physical activity that the questionnaire and interview process.

30. Campbell, Eugene P., and Mildred A. Morehead, "Health as a Factor in Economic Development, Brazil," Serviceo Especial de Salude Publica Bulletin, No. 2, 1952.

Calculates productive potential through man-years saved by control of epidemics. Measures to lessen mortality include safe drinking water, improved hygiene, and better nutrition.

31. Canosa, C. A., "Ecological Approach to the Problems of Malnutrition, Learning, and Behavior," in N. S. Scrimshaw and G. E. Gordon (eds.), Malnutrition, Learning, and Behavior, Cambridge, Mass., MIT Press, 1968.

32. Cesario, F. J., et al, The Economics of Malnutrition, vols. I and II, Columbus, Battelle Memorial Institute, 1970.

Include a 53 page and 50 page bibliography.

33. Chase, H. P., et al, "Nutritional Status of Pre-school Mexican-American Migrant Farm Children," American Journal of Diseases of Children, vol. 122 (4), pp. 316-324, October 1971.

Evaluates the nutritional and medical problems of 300 Mexican-American pre-school children of migrant workers in the spring of 1969 in Colorado. Outstanding in the history was the high infant mortality of 63 deaths per 1,000 live births. Frequent findings in physical examination included low height attainment, upper respiratory tract infections, skin infections, dental caries, hypertrophied tongue papillae, conjunctival difficulties. Biochemical testing showed low vitamin A levels in 159 children, low alkaline phosphate levels in 120, and low total serum proteins in 28. The relationship between nutrional and health problems was apparent.

34. CIBA Foundation Study Group No. 31, Nutrition and Infection, ed. G. E. W. Wolstenholme and M. O'Connor, London, J. and A. Churchill, Ltd., 1967.

Contains the following articles of interest.

a. Mata, L. J. et al, "Effect of Infection and Diet on Child Growth: Experience in a Guatemalan Village," which reports on Santa Maria Cauque (Guatemala) and a group of 45 babies from birth to two years of age by means of weekly visits by an MD and nurse. Fecal specimens were studied and dietary surveys taken, growth measurements, severity of infection and number of illness days could not be determined accurately. A correlation between deficient diet, high morbidity and poor growth was found suggesting a synergism between infection and malnutrition. Infection makes malnutrition worse by impairing absorption of nutrients.

b. Hendrickse, R. G., "Experience in Nigeria," which reviewed 1,685 pediatric deaths in 1964-1966. Seventy percent are due to infectious diseases, aged 1-5 years 73%, 20% with severe marasmus or PCM.

. Vahlquist, B., "Malnutrition and Infection in Ethiopia," which studied 2,830 children in five field stations aged 0-10, and includes some longitudinal studies with children over 4 years old. Article provides weight data, ESRS, antibody patterns, parasites. Notes increased gamma globulins and high prevalence of skin infections, co-existence of widespread moderate and high frequency of specific and non-specific infections.

35. Coelho, R. de B., et al,"Aspectos Etiopatogenicos e Morfologicos da Sindrome Pluricarencial da Infancia no Recife (Pe.), Brazil," Revista Brasileira de Malariologia e Doencas Tropicais, vol. 15, pp. 67-129, January-March 1963.

"Sindrome Pluricarencial" is the Brazilian term for kwashiorkor. The article reviews basic papers on the subject (1934-1960) and claims to be the first exhaustive study of this syndrome in NE Brazil. The study surveys 236 children aged 0-3 years in addition to 80 autopsies, dietary surveys and stool cultures. Findings include (1) a high intake of starches,)2) all children underweight (3) almost all organs hypotrophied, and (4) fatty de-

generation of the liver as the major pathology. There were marked organic changes in the intestinal tract not correlated with bacterial findings. The pancreas also showed degenerative changes.

36. Coelho, R. de B., et al,"Socio-Economic Survey of Patients at the Recife University Hospital (Northeast Brazil)," Revista Brasileira de Malariologia e Doencas Tropicais, vol. 15, pp. 673-692, October-December 1963.

A socio-economic survey including information regarding the dietary pattern, behavior, and reactions of individuals to their community made among patients of University Hospital in Northeast Brazil (Recife). Tables and graphs illustrate. (Portuguese and English summary)

37. Coin, L., "A Current Review of the Problem of Water in General Epidemiology in France," International Conference on Water for Peace, vol. 3, pp. 725-730, ARC 333.51 I61b v.3.

Sources of contamination include: watered vegetables (26%), shell fish (18%), wells (23%), ponds, springs, rivers (7%), treated water lines (2%), and water tanks (2%).

Total water source:	60%
Total food source:	29%
(epidemics) human contamination:	11%
	100%

38. Collis, W., et al, "On the Ecology of Child Nutrition and Health in Nigerian Villages," Tropical and Geographical Medicine, vol. 14, pp. 201-229, September 1962.

Reports on a health, nutritional, agricultural, medical and dietary survey in five villages in western Nigeria. After comparing findings of this study with other studies, the authors conclude that infection rates (diarrheal disease especially) are not greatly affected by nutritional status.

39. Collis, W., et al, "Transverse Survey of Health and Nutrition, Pankshin Division, Northern Nigeria," West African Medical Journal, vol. 11, pp. 131-154, August 1962.

A rapid field survey of cropping and dietary patterns of Vodni (Jas Plateau, Nigeria) was carried out on September 29 to October 10, 1961. Two main cultural groups were surveyed (Moslems and non-Moslems). Calorie and protein requirements are satisfied by both diets except that protein is, on the average, marginal in the non-Moslem food mixture. Simple goiter is fairly widespread, but low iodine in drinking water does not completely explain the incidence. Still, the general nutritional status is good; the diet being above the FAO calorie and protein intake. Height and weight curves of children are very much better

than those of children of Forest Belt in the western region and after 4 years tend to approximate those of the optimum group curves of the well-to-do children at University College, Ibadan (previous study). Blood albumen levels confirm excellent nutritional status of the group.

Strangely, mortality and morbidity of the children are in great contrast to the nutritional findings (54% child mortality in the sample taken).

40. Commissao Nacional de Alimentacao, Shank, R. E., Relatorio Preliminar: Inquerito de Nutricao Realizado no Nordeste do Brasil, Rio de Janeiro, 1963.

41. "Comparability in International Epidemiology. V. Diarrheal Disease," The Milbank Memorial Fund Quarterly, vol. 43 (2), pp. 215-258, April 1965.

"The large number of variables invalidates the usefulness of epidemiological studies in the diarrheal diseases and more attention might be given to (animal studies)." The study notes, however, that (1) weanling diarrhea resembles cholera epidemiologically, (2) intensive longitudinal studies should be encouraged, (3) stress (psycho-physiological) reactions may be important in infantile diarrhea, (4) oral polio vaccine seemed to reduce seasonal peaks of LA country diarrhea, and (5) an intensive 4 year study in Scotland shows that the majority of cases of diarrhea have no acceptable bacterial cause. It goes on to say that there is still no universally accepted definition of diarrhea.

42. Contente, J. J., "Clinico-Nutritional Study of Minors in the City of Manaus, I. Districts of Sao Raimundo and Bombeamento," Revista da Associacao Medica Brasileira, vol. 9, pp. 169-180, May 1963.

43. Cook, R., "Ankole, Pre-School Protection Programme," Journal of Tropical Pediatrics Monograph, vol. 2, p. 13 ff., 1966.

44. Cook, R., "The Financial Cost of Malnutrition in the Commonwealth Caribbean," Journal of Tropical Pediatrics, vol. 14, pp. 60-65, June 1968.

Categories of financial loss due to malnutrition in the Commonwealth Caribbean are identified as: (1) costs incurred in connection with treatment of the clinically malnourished; (2) costs of child-life wastage; (3) child wastage as a major influence working against the successful application of family planning programs in developing countries; (4) possible physical

handicap in survivors of malnutrition; (5) retardation of mental development in survivors of malnutrition; (6) loss of efficiency in learning in poorly nourished school children; and (7) earning productivity loss in adult workers through inadequate nutrition.

Two factors (cost of in-patient treatment and cost of child wastage) are quantified by estimates made for certain territories and extended to the rest of the area on basis of population size.

45. Cook, R., "The Cost of Malnutrition in Jamaica," Ecology of Food and Nutrition, vol. 1 (1), pp. 61-66, November 1971.

Identifies economic losses caused by malnutrition. Financial costs of child wastage and treatment of malnutrition in Jamaica are estimated to be US$ 1.5 million. Increasing nutritional intake may raise productivity and increase GNP by ½ of 1%. Evaluation of the costs requires further study and examination.

46. Cordeiro, N. V., et al, "Water Resources and Development. Hydrological Resources. Brazil," International Conference on Water for Peace, vol. 1, pp. 313-323. ARC 333.51 I61b v.1.

Pleas for greater population density and sees shortage of technicians.

47. Correa, H., et al, "Contributions of Nutrition to Economic Growth," American Journal of Clinical Nutrition, vol. 23 (5), pp. 560-565, May 1970.

Estimates effects of increased calorie consumption on the productivity capacity of the labor force and, therefore, on the economic growth of 18 countries from 1950 to 1962. For nine Latin American countries, increased calorie consumption accounted, on the average, for almost 5% of the growth of national product. This was nearly as great as the contribution of education. Increased calorie consumption had a negligible effect on the economic growth of nine advanced countries. It probably causes a substantially larger fraction of growth in out-put per capita than of the growth in total out-put in poor countries. Also, its effect is probably greater in very poor countries than in the Latin American group.

48. Costopoulos, J. M. "Water Supply and Public Health, Greece," International Conference on Water for Peace, vol. 8, pp. 952-956. ARC 331.51 I61b v.8.

A discussion of Greece's water supply problems from early post-war years to the present. Partial solutions reached and further recommendations outlined. Provides charts and graphs of water distribution by rural-urban and whether from river, carted, well or piped supply; relates water supply to public health. Because

of high incidence of so-called water-borne diseases in early post-war years, mass vaccinations were provided in areas where reliable water supplies were defective. Reported typhoid cases dropped from 4,599 in 1950 to 1,306 in 1962 (case rate decline from 60.3 to 15.4 cases/100,000 population). At the same time, about 1,200 public health dispensaries were established. This report shows clearly that changes in disease patterns must take into account a number of causal-related factors to explain trends.

49. Coutinho-Abath, E., et al, "Alimentary Patterns in the Endemic Areas of Manson's Schistosomiasis in the Northeast of Brazil," Revista Brasileira de Malariologia e Doencas Tropicais, vol. 16, pp. 553-589, October-December 1964.

A baseline dietary survey of 494 families (2,339 people) in three villages and one town with high infection rate (over 50%) of schistosomiasis mansoni. The diets were surprisingly good (beans, cassava, corn, dried meat, sugar, bread, and vegetables) and except for calcium deficiency produced no clinical signs of malnutrition. Perhaps the high calcium carbonate content of the waters of NE Brazil made up for this lack. Iron deficiency disease was not noted despite high prevalence of several parasitic diseases.

50. Cramer, E. R. et al, "Action of the Social Security Nutrition Service Diet on the Health of Industrial Workers in the State of Guanabara," (Preliminary Note), Revista Brasileira de Medicina, vol. 19, pp. 189-194, April 1962. (In Portuguese with English summary)

A nutrition service of Brazil's Social Security (SAPS) tries to improve workers' nutrition through restaurants and research. One hundred workers are studied, 25-55 years old, from thirteen industries. They are to eat at institution restaurants only. The purpose is to measure change in work capacity. There are no conclusions yet.

51. Cravioto, J., et al, "Nutrition, Growth, and Neurointegrative Development: An Experimental and Ecologic Study," Pediatrics, vol. 38 (2), pp. 319-372, August 1966.

An early key article attempting to show that protein deficiency may result in "structural lesions" of the young child's nervous system. Notes that except for Rao's 1959 field survey, few large scale studies are available to provide reliable nutrition status data.

In this study of a Guatemalan village (Magdalena), 323 children under five years are compared with urban children as controls testing "intersensory integrative development." Height for age is used as measure of previous malnutrition. Results showed: (1) no significant association between the test, financial status, housing or diet expenditures, (2) weak inverse correlation with father's education, (3) no correlation with conditions of personal cleanliness, (4) correlation with mother's education.

The author postulates that a malnourished child is less responsive to his environmnet and thus loses learning time, critical experience, motivation, and personality changes. They note that at the time of birth, the human brain is growing at a rate of 1 - 2 mg./minute and that nutrient shortage at this time may interfere with both staging and timing of brain development and behavior.

52. Cvjetanovic, B., et al, "Diarrheal Disease: International Cross-Sectional Studies," The Milbank Memorial Fund Quarterly, vol. 43, pp. 240-257, April 1965.

A WHO Diarrheal Disease Team, studied children under 2 - 3 years old in six countries: Mauritius, Sudan, Egypt, Ceylon, Iran, East Pakistan. The leading cause of death in 1961 among 1 - 4 year olds in Mauritius, UAR, Columbia, Costa Rica, Guatemala, Mexico, Panama, and Portugal were those classified under disease rubric B36 (diarrhea). Author concludes (paraphrase): Better nutrition and rehydration centers will reduce case mortality but controlling incidence of diarrhea requires economic changes and better long term community hygiene. It is not useful to differentiate pathogenic from non-pathogenic infantile diarrheas. It is the dehydration and electrolyte imbalance which causes death and we should report "dehydration syndrome" rather than diarrhea a cause of death to alert governments and doctors to take proper steps.

53. Dale, D. C., et al, "Studies of Diarrheal Disease in Central America: XI. Intestinal Bacterial Flora in Malnourished Children with Shigellosis," American Journal of Tropical Medicine and Hygiene, vol. 17, pp. 397-403, March 1968.

Examines five pre-school children from a children's convalescent hospital in Guatemala City, all convalescent carriers from preceding acute diarrheal disease and ten other children living in the rural village of Santa Maria Cauque, part of a group studied since birth for progressive colonization of the intestinal tract. Organisms present are identified and quantified.

54. Daniel, Mann, Johnson, and Mendenhall, "Master Plan and Feasibility Study of the Lagos Water System Expansion," vol. I, March 1965, 3325 Wilshire Blvd., Los Angeles, Ca., ARC NI 628.1 D184.

Consultant's report with a detailed discussion and data on waterborne diseases in Lagos, mostly derived from official, hospital, and clinic reports. Between 11-15% of all cases were attributed to inadequate water supply. The authors then go on to suggest that health care savings would accrue as a secondary benefit of improved water supplies, what per capita work loss of one person per year could save, and that extension of the water system would stimulate the local economy.

55. Dean, A. G., et al, "Seasonal Gastroenteritis and Malabsorption at an American Military Base in the Philippines. I. Clinical and Epidemiologic Investigations of the Acute Illness," American Journal of Epidemiology, vol. 95 (2), pp. 111-127, February 1972.

Seasonal epidemics of acute gastroenteritis affecting 5,000-6,000 of 36,000 Americans occur annually at Clark Air Base. In 1969 the illness was unusually acute, with nonbloody diarrhea, abdominal cramps, constitutional symptoms and sometimes vomiting. One-fifth (1/5) of the patients had symptoms lasting more than two weeks, often with accompanying intestinal malabsorption. The epidemic, lasting five months, occurred during the hottest season of the year but before the heaviest rainfall. The incidence of disease was uniform on and off base, and among men, women and children. The secondary attack rate in families was not significantly greater than the over-all attack rate. Among Americans, previous attacks or higher rank (greater age) were not protective, but local Filipinos working on the base had a significantly lower incidence. The illness was not confined to new arrivals. Sources of meals, recent trips, consumption of water, soft drinks, milk

and locally made beer did not seem causally related. The water supply appeared to have been well chlorinated and free of coliform bacteria.

No microscopic cause for the epidemic was found but the suggestion is made that a waterborne, temperature dependent agent may be responsible.

56. De La Torre, J. A., "Mortality from Infectious Diarrhea in Hospitalized Children under Two Years of Age," Boletin Medico del Hospital Infantil de Mexico, vol. 13, pp. 785-792, August 1956.

The mortality rate from infectious diarrhea for the years 1948, 1949 and 1950 was 283/1,000 in 1,318 children under two years of age admitted to the Hospital Infantil.

57. "Design and Methodology for the Project on 'The Development and Evaluation of Measures to Reduce Food Waste Caused by Intestinal Disease,'" University of North Carolina, Chapel Hill and Institute of Nutrition of Central America and Panama, Guatemala City, Decembe 18, 1972.

Describes the design of the UNC-INCAP-AID Guatemalan Study. AID Contract No. CSD-2959.

The hypothesis is that a population living under unsanitary conditions and poor nutrition will have a greater prevalence of diarrhea disease and parasitism than a population living in a more sanitary environment. Repeated incidence of diarrheal diseases and parasitosis should lead to an increase in malabsorption in populations living under unsanitary conditions. Food wastage is a consequence of malabsorption. The study hopes to identify and measure this food waste.

58. "Development Assistance Programs of U.S. Non-Profit Organization in Brazil," Technical Assistance Clearing House, American Council of Voluntary Agencies for Foreign Service, Inc., 200 Park Avenue, New York 10003, mimeo, 69pp., June 1974.

Report describes the assistance programs for Brazil of 83 U. S. organizations including voluntary agencies, missions, foundations and their non-profit organizations working in health education and community development. This is an expansion of part II of the TAICH 1971 Directory.

59. DIACONIA, "Nutrition Project Pernambuco. Conclusion," mimeo, Rio de Janeiro, January 31, 1971.

Reports on an integrated nutrition supplementation, mother and child care education program, and several nutritional and socio-economic surveys in several sites in Pernambuco.

60. Dublin, Louis I., and Alfred J. Lotka, The Money Value of a Man, New York, The Ronald Press Co., 1930.

The classic work estimating the economic value of life.

61. Dubos, R. J., et al, "Nutrition and Infection," Journal of Pediatrics, vol. 55 (1), pp. 1-14, July 1959.

The nutritional state can affect infectious processes through many unrelated mechanisms modifying either the multiplication and activities of infectious agents, the susceptibility of the host to their toxic manifestations, or the immunologic and histochemical response to infection. There is evidence that a given dietary factor can be beneficial, indifferent or deleterious depending upon the type of infectious process under consideration as well as the genetic constitution, age, past history and physiologic state of the infected individual.

The effect of a given dietary factor on infection cannot be predicted from its effect on the growth rate of the uninfected host. In fact, resistance to infection, as to other forms of stress, may be highest under nutritional conditions which do not favor growth. The ability to resist infections and their associated stresses is the expression of nutritional criteria different from, and supplementary to, those usually considered by nutritionists.

62. Economic Evaluation of Federal Water Resource Projects, U. S. Government Report to the Committee on Public Works, House of Representatives, 82nd Congress, Second Session, by Mr. Jones of Alabama from the Subcommittee to Study Civil Works, U. S. Government Printing Office, Washington, D.C., 1952.

This publication lists and defines benefits and costs used for economic evaluation of water projects. It describes various methods and procedures utilized by bureaus in computations on the value and cost of their respective projects.

63. Edibam, H. H., et al, "Endemic Goitre in the Narmada Valley in Broach Districts, Gujarat," Indian Journal of Medical Sciences, vol. 26 (4), pp. 216-220, April 1972.

In Nandod Taluka of Broach District, Gujarat, 1374 persons (31% of total population) were examined. Affected were 36.7% of the sample population, 8.6% with grade II or III goitre. The 6-11 age group was most affected. A diet survey showed a semi-starvation level. No goitro-geneous food was consumed, and water supplies showed low iodine content. In one village, it

was evident that the more polluted water source was associated with a greater prevalence of the disease than the less polluted one. Recommendation for iodized salt distributed through the licensed ration shop was made.

64. "Extension of Methods for Incorporating Nutrition in Planning, Progress Report, Community Systems Foundation, May 19, 1974, USAID Contract No. AID/CM/TA/-C-73-45.

A progress report consisting of (1) notes on the classification of nutrition planning, (2) a list of persons interviewed and approaches taken, (3) a discussion of diffusion research and its contribution to nutrition planning, (4) instructions for carrying out a search and review of the applied nutrition literature, (5) a description of the Papagos three level model of political process and health improvement, and (6) a bibliography related to nutrition planning.

65. Falkner, F., (ed.), Human Development, Philadelphia, W. B. Saunders Co., 1966.

Source of body water data and norms.

66. Farooq, M., "Medical and Economic Importance of Schistosomiasis," Journal of Tropical Medicine and Hygiene, vol. 67, pp. 105-112, May 1964.

Review article noting occurence of approximately two million cases of s. mansoni (Pinto and de Almeida, 1945) in Brazil while Pessoa, et al (1955) note areas with prevalence rates of 40%. Also provided are economic losses due to lower man-days and work productivity ranging from $3.50 to $105.00 per year per patient.

67. Faust, R. J., et al, "Evaluation Report on Community Water Supply Programs in Pakistan for UDHE-PHS and AID," November-December 1967, ARC 333.9109549 F267.

The team's visit lasted four weeks. Their estimates are: 50% of all illness due to water-related diseases: morbidity and mortality statistics so incomplete that it is not included in the report. (Recent PH statistical study on all illness reports 68.2% due to water-borne diseases.)

68. Fernandez, N. A., "Nutritional Status of People in Isolated Areas of Puerto Rico: Survey of Barrio Mavilla, Vega Alta, Puerto Rico," American Journal of Clinical Nutrition, vol. 17, pp. 305-316, November 1965.

Describes a nutrition survey carried out in the rural area of Mavilla, Vega Alta, Puerto Rico during the period of February 8 to 15, 1963. Three hundred and six (306) subjects were examined clinically, and biochemical studies were done on 97% of the subjects. A dietary survey of families representing 27% of the total population using the 24-hour individual

weighted intake method was carried out. Feces were examined for ova and parasites.

Diet was deficient in calories, vitamin A and calcium. Protein, iron, ascorbic acid and thiamine were adequate. Fat intake was low and mostly saturated.

Skin xerosis and hyperkeratosis grossly associated with vitamin A deficiency and retardation of growth were found, suggesting that there exists a problem of under-nutrition in the realm of borderline cases manifested by unspecific signs and symptoms. A considerable number showed low serum, vitamin A and carotene. Serum proteins and ascorbic acid values were satisfactory. Hemoglobin levels were higher than expected. Hypochromia was observed, usually in family groups. Excretion rates of thiamine per gram of creatinine were adequate. N-methyl-nicotinamide was low in 15% of subjects studies, and 28% had deficient excretion rates of riboflavin. Intestinal infestation with helminth parasites was highly prevalent and severe cases were the exception rather than the rule.

While water supply is not specifically [illegible] the introduction does state that "[illegible] a good means of communication as well as with facilities such as electricity, potable water and waste disposal."

69. Fernandez, N. A. et al. "Nutrition [illegible] Puerto Rican Communities." Boletin Asociacion [illegible] de Puerto Rico, vol. 61 (2), pp. 42-52, February 1969.

A summary report of five nutrition surveys (not individually) done in isolated, poor Puerto Rican communities from 1963 to 1965. Subjects, 2137 (94% of total population), were surveyed; 2110 (98.7% of examinees) were subjects of biochemical tests, 479 persons in 86 families were subjects of a dietary survey. Found some indication of [illegible] malnutrition but no serious deficiency [illegible] nificant [illegible] by height and weight for age. Also noted [illegible] Trichuris and hookworm intestinal infection. [illegible] nutritional status survey with no intervention or monitoring, but the mentioned presence of investigators probably biased dietetic survey.

70. Fernandez, N. A., et al, "Nutritional Status of the Puerto Rican Population: Master Sample Survey," American Journal of Clinical Nutrition, vol. 24, pp. 952-965, August 1971.

Summarizes a 1966 island-wide nutrition survey of a representative stratified sample of the Puerto Rican population including collection of socio-economic, dietary, clinical and biochemical data. Interviewed 877 families at home. Clinical and biochemical test (633 and 655 subjects respectively) were done on 142 families. Some comparisons are made to findings of a 1946 nutritional survey of Puerto Rico. Concludes that higher economic standards do not necessarily improve nutritional value of diet.

Although 20% of the population used flush toilets in 1946 compared with 50.5% in 1966, no relation is drawn to this improvement in sanitation.

71. Fioravante, I., "The Food Requirements of Children in Brazil, (General View)," Revista Brasileira de Medicina, vol. 18, pp. 561-566, September 1961.

Author reviews a variety of nutrition related field studies and reports major findings which show serious incidence of malnutrition in young children in major population centers in Brazil. The various studies used a variety of techniques, including anthropometric measurements. They generally found anaemia, calcium and vitamin deficiency. (Article is not complete in journal.)

72. Flores, M., et al, "The Nutritional Status of Children of Pre-School Age in the Guatemalan Community of Amatitlan.1. Comparison of Family and Child Diets," British Journal of Nutrition, vol. 14, pp. 207-216, 1960.

Thirty-five (35) pre-school children and their families in the semi-rural town of Amatitlan, Guatemala were studied in 1955 to determine calorie and nutrient intake. The dietary intake of most of the children was inadequate; quantitative tables are given. The most marked deficiencies occurred between one and two years of age. The diet of the family as a whole was generally better than that of the children. The money spent on food was insufficient to purchase an adequate family diet, and that spent on the feeding of the young child was particularly unsatisfactory. Dietary, clinical and biochemical information was obtained.

It is mentioned that the supply of water is inadequate and its purity undependable.

73. Flores, M., "Dietary Studies for Assessment of the Nutritional Status of Populations in Non-modernized Societies," American

Journal of Clinical Nutrition, vol. 11, pp. 344-355, 1962.

4. Flores, M., et al, "Annual Patterns of Family and Children's Diet in Three Guatemalan Indian Communities," British Journal of Nutrition, vol. 18, pp. 281-293, 1964.

Reports on dietary surveys lasting 3 days taken annually in three Indian towns for 4 years. Main finding is the constancy of diet over time, family to family and child to child.

Sample included 20-30 families, 20-30 individual children aged 1-5 in each town.

5. Flores, M., et al, "Food Intake of Guatemalan Indian Children, Ages 1-5," Journal of the American Dietetic Association, vol. 48, pp. 480-487, June 1966.

Three hundred children ages 1-5 were studied in Santa Maria Cauque, Santa Cruz Balanya and Santa Catarina Barahona, rural villages of Guatemala for three consecutive days to assess nutritive value of diet, especially protein intake. Inadequate food intake was noticeable among all children studied. Santa Catarina Barahona showed better intake, especially of protein, due to a supplementary feeding program of dry skim milk and INCAP vegetable mixture. Although Santa Maria Cauque had improved sanitary facilities, there is no reference in the paper to any relationship of nutrition to sanitation. Tables listing dietary intake for each village are given.

6. Flores, M., et al, "Diet of the Preschool Child in Rural El Salvador," Archivos Latino-Americanos de Nutricion, vol. 22 (2), pp. 205-225, June 1972.

Food intake measured in children 0-5 from a sample of families in rural El Salvador. Food intake varied widely among these preschool children, but average intake was low for every age. Most severe deficiency in 1-3 year olds was in calories, retinol and iron; in 4 and 5 year olds, retinol and riboflavin. Adequacy of diet influenced by economic level of families. Information from anthropometric, clinical and biochemical studies corroborate the diet deficiency found.

7. Food and Agriculture Organization, Malnutrition and Disease, Freedom from Hunger Campaign--Basic Study No. 12.

8. Food and Agriculture Organization, Documentation Center, Food and Nutrition: Annotated Bibliography: Author and Subject Index, FAO Publications and Documents (1945-1972), Rome, 1973.

79. Ford Foundation, Infrastructure Problems of the Cities of Developing Countries, B. Bernstein (ed.), International Urbanization Survey, July 1971.

Pages 13-97 contain a discussion on domestic water supply. The discussion is partially a critical survey of the literature on suggested goals for water supply in less developed countries, health benefits, economic growth benefits, demand studies, water supply technologies, investment appraisal criteria, management topics, financing and pricing. Needed research is pointed to in several areas. Bibliography contains 91 citations.

80. Frazao, M., "Resume of Organiations in Brazil Working in Programs to Combat Malnutrition," USAID/Brasilia, mimeo, April 1974.

The author, nutrition advisor to USAID/Brazil, compiled this listing as a service to English speaking visitors wanting contact with mass-feeding and other nutrition-related programs. About 70 organizations are identified including private, voluntary, state and federal agencies.

81. Gamble, J. R., Chemical Anatomy Physiology and Pathology of Extracellular Fluid, Cambridge, Mass., Harvard University Press, 1960.

A 10 kg. infant loses 250 cc water daily from skin and lungs. Dehydration always means an accompanying loss of electrolyte especially with diarrhea.

82. Garn, S. M., et al, "Catch-up Bone Development during Treatment of Kwashiorkor," Federation Proceedings, vol. 23, p. 338 ff., March-April 1964.

A pilot series measured compact bone formation in the second metacarpel of 71 kwashiorkor patients upon admission and after therapy. Results show reduction in compact bone is an additional characteristic of kwashiorkor and its increase another means of judging the effectiveness of therapy.

83. Garn, S. M., et al, "Compact Bone Deficiency in Protein-Calorie Malnutrition," Science, vol. 145, pp. 1444-1445, September 1964.

An INCAP study of x-rays of ninety-five infants and children hospitalized in Guatemala City compared with two villages with infant populations of 694 during period 1959-1963 using chi-square test. Results showed bone-ages were comparable between

acute protein-calorie malnutrition in city infants and Indian village children on customary (deficient) diets but that the acutely malnourished children had "marked deficiency in compact bone." It was suggested therefore that acute bone loss accompanies marasmus as well as failure in linear growth.

84. Garn, S. M., et al, "Continuing Bone Growth throughout Life: A General Phenomenon," American Journal of Physical Anthropology, vol. 26, pp. 313-317, May 1967.

Cross-sectional data on 2,799 subjects (adult) from 5 different populations (St. Louis, Mo., Ohio, Guatemala, El Salvador and Nicaragua) and longitudinal data on 113 older adults indicate continuing adult bone growth in the second metacarpal. Similar 6-decade increases in the size of the cranium confirm continuing bone growth as a general phenomenon not necessarily related to weight bearing or flexion stress and representing an increase of about 10% in skeletal volume concomitant with the major age-associated decrease in skeletal mass.

Comparative tables of populations studied are given.

85. Gaurdiola, R., et al, "Studies on Diarrheal Diseases. II. Survey on the Incidence of Enteric Organisms in the Pediatric Population of Two Isolated Communities in Puerto Rico," American Journal of Tropical Medicine and Hygiene, vol. 13 (3), pp. 417-424, May 1964.

Presents microbiological findings of July 1961 in 276 children under six years of age from Manzanilla and Cialitos, two isolated communities in Puerto Rico. Enteropathogenic bacteria were recovered from 31% (M) and 19% (C) of the cases studied. Viral agents were recovered from 2.1% of the Cialitos children. A serologic response against cytopathogenic agents was obtained in 3/4 of these cases. Serum survey studies showed previous exposure to certain enteroviruses.

The high rate of infection among non-diarrheic children indicates the importance of existing foci of infection within a population from which infectious agents may be transmitted to susceptibles.

86. Gokulanathan, K. S., et al,"Sociocultural Malnutriton. Syndrome of Nutritional Imbalance, Growth Disturbances and Chronic Infection," Clinical Pediatrics, vol. 9, pp. 439-442, August 1970.

A brief article noting the "deterioration of infant nutrition" accompanying urbanization and "factors other than poverty and lack of . . . food" which are termed "sociocultural malnutrition" or "dysnutrition" occurring among normal children with minor upper respiratory infections and "gastrointestinal troubles" in OPDS nad MD offices. Studied were 390 children aged 1-6 years from educated, high and middle socioeconomic group in "South India agrarian community on the threshold of industrialization."

No data was presented except for a graph from another article.

87. de Gonzalez, M. L. S., "Breast-Feeding [illegible] and Nutritional Status," Journal of Pediatrics, vol. 62, pp. 5[illegible]8[illegible] April 1963.

The [illegible] breast feeding and [illegible] studied [illegible] as well as [illegible] Latin [illegible] breast-feeding becom[illegible] [illegible] become more urbanized and [illegible] more available.

88. de Gonzalez, [illegible] S., et al, "Pattern[illegible] Sickness in a Black Carib Community," Psychosomatic Medicine, vol. 15, pp. 422-430, December 1963.

A general description of the feeding habits of black caribs in Guatemala along with an extended discussion of the Carib's magical explanation of disease. Black Caribs are healthier and better nourished than other rural low-income groups of Central America. Among other dietary habits is one feeding to infants of other foods along with breast milk as soon after birth as possible.

89. de Gonzalez, [illegible] S., et al, "Infant Feeding and Nutritional and Health Status," Milbank Memorial Fund Quarterly, vol. 44, pp. 77-96, April 1966.

Discussion of the ways in which cultural [illegible] dietary and child rearing practices affect [illegible] traditional Mayans and poor Latinos in Guatemala. [illegible] practices are discussed in detail. Recommendations are made for educational programs. Practices taught must fit the existing conditions if they are to be utilized.

90. Gordon, J. E., et al, "Acute Intestinal Disease in the Arctic," American Journal of Public Health, vol. 49, pp. 1441-1453, November 1959.

Reports on a field survey in three areas of the Arctic over three years to determine prevalence of diarrheal disease. Discovered high incidence and suspect main mode of transmission of infecting agents is through contact spread. Incidence rates determined mainly by the habits, customs, occupations, and food sources of Arctic populations.

91. Gordon, J. E., et al, "Field Studies in Population Dynamics and Population Control," American Journal of the Medical Sciences, vol. 240, pp. 361-386, September 1960.

Describes the Ludhiana, Naringwal, field study which identified what has become known as weanling diarrhea.

92. Gordon, J. E., et al, "Death Rates and Causes of Death in Eleven Punjab Villages: An Epidemiological Study," Indian Journal of Medical Research, vol. 49, pp. 568 ff., 1961.

Field study to measure death rate and causes of deaths which are compared to inaccurate published statistics.

93. Gordon, J. E., et al, "Studies on Diarrheal Disease in Central America. II. Community Prevalence of Shigella and Salmonella Infections in Childhood Populations of Guatemala," American Journal of Tropical Medicine and Hygiene, vol. 11, pp. 389-394, May 1962.

94. Gordon, J. E., et al, "Weanling Diarrhea," American Journal of the Medical Sciences, vol. 245, pp. 345-377, 1963.

"Weanling diarrhea is not a specific clinical or etiologic entity but a syndrome varying greatly in its manifestations and due to a variety of agents, most of them infectious."

Data from seven Punjab villages are provided in detail as part of a broader demographic study by means of household survey and morbidity and vital registration. Statistics were collected for four years (1955-1959) on approximately 775 infants through monthly visits. The breast fed infants (95.3%) had an infant mortality rate of 120/1,000 per year while the artificially fed died at a rate of 950/1,000. The disease is most severe between ages of six months and eighteen months of age and is associated with: (1) exposure to potential pathogens from foods other than breast milk, (2) weaning which makes the child more susceptible to infection through nutritional deficiency, and (3) diarrheas themselves which produce further nutritional deterioration.

A large bibliography (269 references) is included.

95. Gordon, J. E., "Field Epidemiology," American Journal of the Medical Sciences, vol. 246, pp. 354-376, September 1963.

A discussion of what epidemiology is and what it is not. Stresses that epidemiology is the study of disease in its natural, human environment.

96. Gordon, J. E.,"Acute Diarrheal Disease," American Journal of the Medical Sciences, vol. 248, pp. 345-365, September 1964.

"As a killing disease, the diarrheas far overshadow upper respiratory illnesses . . ." and "in large parts of the world diarrheal deaths outnumber any other single cause."

Although acute diarrheas lack definable infectious agents, they behave like an infectious process. In diarrheas of early childhood, synergism between malnutrition and diarrhea is an outstanding feat , but "poor sanitation has an equally important part." Highe seasonal prevalence is in hot dry periods. Index case is u lly a young child through direct contact with adult carrier "Water for hygienic uses in adequate amount and ready acc ibility has more significance for this age group (less t two years old) than provision of a potable supply." Dietary supplements plus environmental sanitation are the main considerations in diarrhea control programs.

97. Gordon, J. E., et al,"Acute Diarrheal Disease in Less Developed Countries: I. An Epidemilogical Basis for Control," Bull. WHO, vol. 31, pp. 1-7, 1964.

Argues that acute diarrheal disease is a clinical syndrome, much like the common cold, where few of the cases have identifiable infecting agents but most do not. Syndrome is called acute undifferential diarrheal disease. Epidemiological measures for prevention are feasible and desirable.

98. Gordon, J. E., et al, "Acute Diarrheal Disease in Less Developed Countries: II. Patterns of Epidemiological Behavior in Rural Guatemalan Villages," Bull. WHO, vol. 31, pp. 9-20, 1964.

The pattern of acute diarrheal disease, which accounts for a large share of general morbidity and mortality, indicates that highest incidence occurs to pre-school children (0-5) and particularly to weanlings (6-25 months). The pattern in the four Guatemalan highland villages indicates recurring epidemic rather than sustained endemic incidence. Data indicate that spread is largely by personal contact rather than a single infecting source (e.g. water supply). Incidence and severity of

diarrheal disease is strongly associated with degree of malnutrition. Severe malnutrition was frequent in these four villages. Viewing weanling diarrhea as an epidemiological entity, control must rely on better maternal and child health practices, with strong emphasis on nutrition, on health education and on medical care of patients. Environmental measures will be less effective for this age-group but are considered necessary for long-term community control.

99. Gordon, J. E., et al, "Acute Diarrheal Disease in Less Developed Countries: III. Methods for Prevention and Control," Bull. WHO, vol. 31, pp. 21-28, 1964.

Argues for more emphasis on personal hygiene, better nutrition, better maternal and child health education as means for control of the most prevalent and most severe form of diarrheal disease--that is, weanling diarrhea. Environmental measures--building latrines, improving water supplies, pasteurizing milk--may be important in general community control of disease but do not effect weanling malnutrition much because they do not attack its specific transmission route. Authors feel one-shot field surveys have been overdone; surveys should be repeated in order to have much value. Most useful would be a long-term prospective study of a fixed population which would compare results with similar studies done in India, Guatemala and the Arctic.

100. Gordon, J. E., et al, "Studies of Diarrheal Disease in Central America: VI. An Epidemic of Diarrhea in a Guatemalan Highland Village, with a Component due to Shigella dysenteriae, Type I," American Journal of Tropical Medicine and Hygiene, vol. 14, pp. 404-411, March 1965.

This is an INCAP study incidental to a larger prospective field study of interaction of nutrition and infection in three rural Guatemalan highland villages (this one Santa Maria Cauque). It has a total Indian population of 1,025 with two local resident field workers visiting all homes bi-monthly to maintain illness and death records on all 0-4 year old children with annual nutrition survey and quarterly stool examination (bacteriology) and a clinic provided with resident nurse and daily visit of a physician. The study covers the period from 1959 to 1962. There were 1,212 cases of acute diarrheal disease with seasonal peak in late spring or early summer and progressive lesser frequency as rainy season began. Classification of diarrhea was: mild--less than three days; moderate--more than three days; severe--blood or mucus in stools.

0-4 year olds:
age-specific mortality = 15.1/1,000 pre-school children diarrheal disease
deaths all causes = 60.4/1,000 pre-school children diarrheal disease
proportionate mortality
diarrhea/all deaths = 25.0 %

carrier rate and pathogen = no bacterial pathogen / 82.6% of 997 cases examined

There were 30 cases of shigella dysentery. Eighty percent of all cases (1,212) occurred in 0-4 year olds. Annual mortality rate = 9.5/1,000.

101. Gordon, J. E., et al, "Measles in Rural Guatemala," Journal of Pediatrics, vol. 66, pp. 779-786, April 1965.

"There can be no question that health problems of lesser developed countries relate mainly to deficient environmental sanitation, an undue frequency of infections, and inadequate nutrition."

102. Gordon, J. E., and N. S. Scrimshaw, "Nutrition and the Diarrheas of Early Childhood," Comparability in International Epidemiology, New York, Milbank Memorial Fund, 1965, pp. 233-239.

103. Gordon, J. E., "Weanling Diarrhea: A Synergism of Nutrition and Infection," Nutritive Review, vol. 22, pp. 161-163, June 1964.

In observing weanling diarrhea in India and Guatemala, growth and development of infants conformed to an accepted standard for the first 6 months, while breast milk continued to be adequate. As weaning began and nutritional deficiency appeared, attack rates and death rates from diarrheal disease increased sharply. High infant fatality rates and excessive incidence of diarrhea are to be attributed to the synergistic interaction of diarrhea and malnutrition. Control programs should focus on the highly vulnerable weaning age by plans for rehydration, health, education and provision of adequate diet. Improved environmental sanitation must also be planned for long term control.

104. Gordon, J. E., "Ecologic Interplay on Man, Environment and Health," American Journal of the Medical Sciences, vol. 252, pp. 341-356, 1966.

105. Gordon, J. E., et al, "The Second Year Death Rate in Less Developed Countries," American Journal of the Medical Sciences, vol. 254, pp. 357-360, September 1967.

An excellent review with good bibliography and data not available elsewhere and collected into one source. Scope is worldwide. Suggests second year of life (more than 1 year, less than 2 years) as best internationally suitable indicator of biologic and environ-

mental health conditions measuring infectious disease and malnutrition and is a specific index of community malnutrition. Survey difficulty is good datum source, original local records or field surveys must be done to collect reliable data. Notes that Wills and Waterlow suggest use of ratio: death rates age 1-4/infant death rates (less 1 year) as an index of nutritional state in a community.

106. Gordon, J. E., et al., "Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964. VI. Acute Diarrheal Disease and Nutritional Disorders in General Disease Incidence." Archives of Environmental Health, Vol. 16, pp. 424-437, March 1968.

107. Gordon, J. E., "Social Contributions to Infectious Disease: Causality, Behavior, Aftereffects," in H. F. Eichenwald, (ed.): Proceedings of a Conference on Prevention of Mental Retardation through Control of Infectious Disease, June 9-11, 1966, Cherry Hill, Public Health Service Publication 1692, Government Printing Office, Washington,D.C., 1968.

Article states a few of the basic findings of three prospective field studies in the Arctic, in India, and in Guatemala supporting the conclusion of a synergism between infection and nutrition.

108. Gupte, S. P., "Chronic Diarrhoea and Marasmus," Lancet, vol. 2, p. 725 ff., October 3, 1970.

Small gut biopsies of 29 children with marasmus revealed non-specific changes similar to those seen in coeliac disease and endemic tropical sprue and were not reversed by glutenfree diet, tetracycline and/or folate.

109. Guzman, M. A., et al, "Growth and Development of Central American Children: I. Growth Response of Rural Guatemalan School Children to Daily Administration of Penicillin and Aurecmycin," American Journal of Clinical Nutrition, vol. 6, pp. 430-438, July-August 1958.

110. Guzman, M. A., et al. "Osseous Growth of Guatemalan Children Fed a Protein-Calorie Supplement," Federation Proceedings, vol. 23, p. 338 ff. March-April 1964.

The osseous status and development were compared on a matched-pairs basis for age, sex and year in 215 children of 2-6 years fed on Incaparena-milk supplement providing 30 g. of protein daily and 217 unsupplemented children from 2 control villages. Ossification status improved systematically in the supplemented village after 1959 but did not change in the control villages. By the fourth year (1963) dramatic increase in ossification centers (development) was seen in the supplemented children who also showed superior compact bone mineralization and a reduced tendency for ossification to occur as multiple foci in the developing epiphyses.

111. Guzman, M. A. et al, "Nutrition and Infection Field Study in Guatemalan Villages, VII. Physical Growth and Development of Preschool Children," Archives of Environmental Health, vol. 17, pp. 107-118, July 1968.

112. Gyorgy, P., et al, (eds), Malnutrition is a Problem of Ecology, White Plains, N. Y., S. Karger, 1970

Contains papers presented at a conference on world-wide nutrition problems, October 1-7, 1968 sponsored by the International Union of Nutritional Sciences, and the Rockefeller Foundation. Papers are wide-ranging including epidemiological studies and calls for action.

113. Hamilton, H. R., et al, Bibliography on Socio-Economic Aspects of Water Resources, Columbus, Battelle Memorial Institute, March 1966.

114. Hankin, J., "Dietary and Disease Patterns Among Micronesians," American Journal of Clinical Nutrition, vol. 23, pp. 346-357, 1970.

Twenty-four hour dietary recall of 379 migrating islanders.

115. Hansen, J. D. L., et al, "The Relationship of Diarrhea to Nutritional Disease: Cause and Effect," Proceedings of the Nutritional Society of Southern Africa, vol. 3, pp. 35-39, 1962.

116. Hansen, J. D. L., et al, "Evaluating the Synergism of Infection and Nutrition in the Field," in N. S. Scrimshaw, and J. E. Gordon, (eds.), Malnutrition Learning and Behavior, Cambridge, Mass., MIT Press, 1968, pp. 438-455.

117. "The Health and Nutritional Status of Alaskan Eskimos: A Survey of the Interdepartmental Committee of Nutrition for National Defense - 1958." American Journal of Clinical Nutrition, vol. 11, pp. 31-76, July 1962.

118. Hojer, B., et al, "Health Survey of a Rural Elementary School in Ethiopia," Ethiopian Medical Journal, vol. 11 (1), pp. 75-92, January 1973.

A field study to gather baseline data for planning a local school health program in Gute (Ethiopia), a rural community using locally existing resources. Four hundred ninety (490) of 630 students (every fifth boy and every second girl) selected to provide final sample of 106 students. Besides a dietary survey, study documented weight, height, arm circumference, triceps fatfold, hearing, vision, dental and physical examinations, hemoglobin, stool examination and BCG and smallpox immunization status. Fifty percent of the sample had skin infections, 11% organic heart murmurs, 60% had ascaris and 45% hookworm infections, 17.5% thyroid enlargement and 50% conjunctivitis. A natural selection process (namely a four hour walk to and from school) meant that healthier children attended school but the investigators concluded that long-standing malnutrition was the prevalent situation.

119. Hollister, A. C., Jr., et al, "Influence of Water Availability on Shigella Prevalence in Children of Farm Labor Families," American Journal of Public Health, vol. 45 (3), pp. 354-362, March 1955.

"A study of shigellosis in migratory labor camps in Fresno in 1955 suggested that water as a diluent might reduce the prevalence of shigellosis. The present study has shown that shigella prevalence was associated with availability of water for personal hygiene. Other measured environmental variables did not account for the differences seen." "The finding implies that control of shigella infections may be significantly improved through a single practical modification of the environment - provision of easily accessible water for personal hygiene."

120. Ianini, M. J., "Salary Levels and Nutrition in the State of Minas Gerais, Brazil," Revista Brasileira Malario Doencas Tropicas, vol. 22, pp. 461-467, April-December 1970. (in Portuguese with English Summary).

Analysis of number of work hours at minimum salary to purchase one liter of milk and one kilo of beef in Minas Gerais, Brazil compared with other countries. Discusses relationship of salary and amount spent on food by a family of five with a low cost diet.

121. Ingram, V., et al, "Diarrhea in Children of West Pakistan: Occurrence of Bacterial and Parasitic Agents," American Journal of Tropical Medicine & Hygiene, vol. 15(5), pp. 743-750, September 1966.

122. Institute of Development Studies, University of Sussex, Annotated Bibliography of Village Nutrition Surveys, i, Africa 88 pp.; ii, Latin America 78 pp.; iii,India 64 pp.; iv, S.E. Asia 33 pp.; v, Middle East 30 pp.; vi, Oceanea 30 pp., 1973

123. Interdepartmental Committee on Nutrition for National Defense, Nutrition Survey, U.S. Government, Washington, D.C.

a. Bolivia, ICNND, June 1964.
Studied were 5787 military and civilians including 364 children under five years. Water control in nearly all parts of Bolivia is a problem since "drinking water must be carried for miles in many localities."

b. NE Brazil, March-May 1963, ICNND, May 1965.
Surveyed were 5538 individuals of which 963 were less than five years. Certain clinical and laboratory examinations were done on a subsample. Surveyed individuals were selected in a non-random way that could have introduced a significant bias to all findings. Major findings were general protein calorie deficiencies and inadequate vitamin A in most diets. Parasitism was almost universal and diarrheal disease was frequent particularly among infants and children below five years.

c. Union of Burma, October-December 1961, ICNND, May 1963.
The report blames rain for diseases, found village sanitation levels low and sewage disposal lacking.

d. Republic of China, September-October 1960, ICNND, December 1961.

e. Colombia, May-August 1960, ICNND, December 1961.
Surveyed were 3700 military men, 4818 civilians and 1263 children.

f. Ecuador, ICNND, July 1960.

g. Ethiopia, ICNND, September 1959.

Survey of the nutritional status of almost 6,200 men, women and children examined at 52 sites in 11 major geographic, ethnic or dietary regions of Ethiopia and Eritrea from 19 September to 5 December 1958. Of the 1,679 examined in detail, 624 blood and urine samples analyzed, 320 dietary pattern food questionnaires answered, 18 one-day aliquots dietary intake composited for chemical analysis, 1,100 detailed examinations of teeth and gingival tissues were made. Results indicate overall nutritional status of Ethiopians was somewhat lower than required for their level of activity. Evidence of protein malnutrition and inadequate intakes of vitamin A and C was found in some segment of the population.

Weight relationships were compared to the Medico-Acturial standard and expressed as a percentage of this reference standard represented by the average weight of Ethiopians examined. Twelve percent of the population was below 70% of standard weight so calculated. Cases of kwashiorkor, growth retardation of children, endemic goiter, and mild rickets were identified.

Intakes of thiamine, riboflavin niacin, calcium and iron are adequate. High levels of iron (100 to 500 mg. per day) were found present in the diet.

Widespread infestation among all age groups was revealed by parasitologic studies.

Incidence of dental caries was very low. Peridontal diseases were present and major destruction of the gingival tissues was common.

It is noted that weather conditions during 1957-1958 resulted in one of Ethiopia's poorest harvest in years previous to the study and that Ethiopian agriculture has potential to provide sufficient food for the population if transportation and storage facilities are improved.

Recommendations for nutritional education programs, collection of reliable production data and coordination of transportation, marketing and storage improvements are made.

(Attention is directed to further development of water resources for agricultural purposes.)

"Nutrition Survey on Infants and Preschool Children in Jordan," ICNND Jordan, November 1962-October 1963.

Baseline study reporting the nutritional condition of 2,843 children 0-5 years of age from the various regions of Jordan. Definite presence of malnutrition, especially as revealed in the weight and height patterns, dietary patterns, low vitamin A and carotin levels, low riboflavin excretion, anemia, and the presence of clinical cases of marasmus, prekwashiorkor and kwashiorkor and high levels of excretion of thiamine is reported. Recommendations for feeding and diet improvement programs as well as further research to find proper levels of growth for healthy children of Jordan are made.

i. Libya, ICNND, December 1967.

j. Federation of Malaya, ICNND, September 1964.
During September-October 1962, 8172 military and civilians were examined. City water supplies excellent: rural supplies deficient.

k. "Nutrition Survey, Republic of Nigeria," Nutrition Section of Office of International Research, NIH-PHS, March 1967.

Survey made in February-April 1965. Found communal source of water was usual custom; sanitary facilities lacking or inadequate in most visited communities.

l. "Nutrition Survey, Republic of Paraguay," U.S. Department of Health, Education and Welfare, Public Health Service, August 1967.

A randomly selected, representative sample of 7,440 civilians from 1,424 households were surveyed in thirty-three (33) geographical locations of Paraguay from May to August 1967. Included in the sample were four special groups: two colonies of Mennonites, Japanese emigrants and indigenous Indians. Recommend more specific research as well as institution of preventive procedures such as iodizing salt to combat widespread goiter.

"Poor water supplies...and sanitary facilities contribute... to (suboptimal) nutrition."

Ninety-five percent of rural families have privies and 66% had well or spring water.

Asuncion, the capital, has a modern water treatment and supply facility. It is chlorinated and fluoridated.

m. Peru, ICNND, December 1959.
Reports acute diarrheal disease as chief cause of illness. Improved sanitary controls needed.

n. Spain, ICNND, 1958.

o. Venezuela, ICNND, June 1974.
Reports advanced water and sewage systems.

p. Republic of Vietnam, ICNND, July 1960.
Study of 7336 military and civilian individuals. Water and sanitation mentioned as a basic health problem.

124. Manual for Nutrition Surveys, Interdepartmental Committee on Nutrition for National Defense, National Institutes of Health, Bethesda, Maryland, 1963.

Sets standards widely used to insure conformity in nutritional surveys.

125. International Bank for Reconstruction and Development, "Village Water Supply and Sanitation in Less Developed Countries," Research Working Paper Series, P.U. Report RES-2, Washington, D.C., March 1974.

126. "Iron Deficiency Anemia and the Productivity of Adult Males in Indonesia," Staff Working Paper 175, prepared by S. S. Basta and A. Churchill, CPS, IBRD, Washington, D.C., April 1974.

Reports of a field testing of nutritional intervention by administering iron tablets (and placebo) to anemic (and non-anemic) rubber plantation workers in Ind[illegible] Results show highly significant work productivity increase when [illegible] administered to anemic workers. Calculates a very high benefit-cost ratio (260:1) when benefits are measured as current market price of increased latex production and costs are costs of iron tablets only.

127. Iutaka, S., "Social Status and Illness in Urban Brazil," Milbank Memorial Fund Quarterly, vol. 44, pp. 97-110, April 1966.

Claims to be one of the first attempts at health sociology in Brazil in a district of Rio. Uses questionnaire.

128. Jelliffe, D B ,"Infant Nutrition in the Sub-tropics and Tropics," WHO Monograph Series, No. 29, World Health Organization, Geneva, 1955.

Notices that an infectious disease, usually acute diarrheal disorder, commonly preceded the appearance of the severe protein deficiency, kwashiorkor, by 3-6 weeks.

129. Jelliffe, D. B., et al, "The Children of the Lugbara. A Study in the Techniques of Paediatric Field Survy in Tropical Africa," Tropical and Geographical Medicine, Vol. 14, pp. 33-50, March 1962.

130. Jelliffe, D. B., "The Assessment of the Nutritional Status of the Community," WHO Monograph Series, No. 53, World Health Organization, Geneva, 1966.

A monograph principally directed to the field worker and medical officer, the nutritionist and the public health nurse faced with the practical problems of attempting the assessment of the nutritional state of a community in a less developed tropical country.

131. Jelliffe, D.B., et al, "Nutritional Status of Infants and Pre-School Children: A Review of Surveys since 1960," West Indian Medical Journal, vol. 20, pp. 145-149, September 1971.

A compilation of nutritional surveys in West Indies (Jamaica, Barbados, St. Vincent, Trinidad-Tobago, St. Lucia-St. Kitts, Nevis-Anguilla).

Conclusions: modal malnutrition age 6-18 months, marasmus was more common than kwashiorkor, principal infections in GI and respiratory tracts, 30% of children had moderate to severe malnutrition.

132. Kajaba, I., et al, "Health and Nutritional Status of Children in an Industrialised and Agricultural area of Eastern Slovakia. 1. Dietary Pattern and Health Status," Review of Czechoslovak Medicine, vol. 14, pp. 118-26, 1968.

133. Kapikian, A. Z., et al, "Reovirus agent in Stools: Association with Infantile Diarrhea and Development of Serologic Tests," Science, vol. 185, pp. 1049-1053, September 20, 1974.

134. Keeler, Emmett, "Models of Disease Costs and their Use in Medical Research Resource Allocations," Rand Corp., Santa Monica, California, 1973.

135. Keusch, G. T., "Nutrition and Infectious Disease in the Mekong Basin: The Impact on Individuals," Presented at the Seminar on Nutrition and Public Health in Mekong Development Planning, Asia House, New York, August 1972, ARC. FEA 613.2, K43.

Discusses the synergism of vitamin A, thiamine, and moderate protein deficiency, which are widespread in the Mekong rural areas, and infection as documented by Gordon and Scrimshaw. Summarizes data pertaining to the complex effects of low serum iron and iron-binding protein on infections and points out the effects of asymptomatic maternal infection with and without intra-uterine infection of the fetus upon birth weight, both leading to intra-uterine growth retardation and the effects on the child afterbirth.

136. Kielmann, A. A., et al, "The Narangwal Experiment on Interactions of Nutrition and Infection," AID/NESA 435, no date, no place, mimeo.

Early report on major prospective field study on interactions between malnutrition and infections carried out in Narangwal, in the Punjab, India from 1968 to 1973. The experimental design included interventions in separate groups of villages: nutrition control, infection control, and both infection and nutrition control. A fourth group of villages served as a control. Measurements were taken on morbidity, anthropometry, and vital statistics by ongoing longitudinal and cross-sectional surveys. The general findings were that health by all measures of pre-school children (target group) was best in group where the intervention was both nutrition and infection control. The health and nutrition status (as opposed to changes in status) depended on social status (caste). The superiority of statistics from the village with both infection and nutrition control depended somewhat on the specific ages of the pre-school children.

137. King, M., Medical Care in Developing Countries, Oxford University Press, Nairobi, 1968.

Stresses the need for rehydration treatment of diarrheal disease.

Major causes of death among children under five in west African village (Imesi):

Diarrheal disease	12%
Pneumonia	12%
Protein Calorie Malnutrition	12%
Malaria	8%
Pertussis	8%
Measles	8%
Tuberculosis	8%
Smallpox	5%
(Other conditions mostly neonatal	30%)

138. Klipstein, F.A., et al, "Nutritional Status and Intestinal Function Among Rural Populations of the West Indies. II. Barrio Nuevo, Puerto Rico," Gastroenterology, vol. 63 (5), pp. 758-767, November 1972.

Dietary intake, nutritional status and intestinal structure and function were evaluated in 96 representative adult residents of a rural barrio in Puerto Rico. Observations indicate that the mildly compromised intestinal function found present in nearly 1/2 of the subjects evaluated does not, in most instances result in the development of deficiency states in the presence of an adequate diet.

139. Krishnaswami, S. K., "Health Aspects of Water Quality," American Journal of Public Health, vol. 61 (11), pp. 2259-2268, November 1971.

Water quality control "medical emphasis" is wrong since it is based on single-cause factor of disease.

"There is no evidence that bacterial, enteroviral and other microbial diseases are frequently transmitted to man by water that meets the relatively stringent bacterial disinfection and chlorine residual standards for drinking water."

Swimming in sewage-polluted seas carried negligible risk to health. Recreational health hazards are:
1. water borne and associated enteric infections
2. upper respiratory eyes and ear infection
3. ingestion toxic algae, fungi, etc.
4. ingestion toxic chemicals Hg, As
5. dermatitis - schistosomiasis
6. physico-chemical eye irritation
7. accidents due to impaired visibility

Health implications of trace elements are not understood. "Nutritional significance of water constituents has received very little consideration." Suggests that FDA acts include drinking water as a food so that "additives" may be regulated.

140. Labarthe, D., et al, "Health Effects of Modernization in Palav," American Journal of Epidemiology, vol. 98 (3), pp. 161-174, September 1973.

Analysis of study results showed consistent associations between modernization and health-related factors, with the most modern area having the least desirable health attributes, especially in regard to blood pressure, serum lipids and obesity.

141. Larson, L. B., et al, "Nutritional Status of Children of Mexican-American Migrant Families," Journal of American Dietetic Association, vol. 64 (1), pp. 29-35, January 1974.

A nutrition status of 351 children from 0 to 8 years old including dietary, biochemical, clinical and socioeconomic factors for period 1970 to 1972 (3 years) using "nutrition aides." Vitamins A and D

intake was inadequate. Iron intake was low, but protein intake was twice the recommended allowance. The study concluded that one-third to one-half of the children suffered from vitamin deficiency.

142. Lauria, D. T., "Planning Small Water Supplies in Developing Countries, AID/TA/H, (AID/esd-2494), Dept. of Environmental Sciences and Engineering, University of North Carolina, Chapel Hill, N.C., 1972, ARC 628.72 L384.

Model building in water supply planning using mixed integer programming (MIP) and branch and bound algorithm (Shareshian, 1969) concerned with water-economic and social benefits. Notes that until the health effects (benefits via shadow health costs) and direct health costs are studied with long term prospective studies - model building will suffer from inadequate data input.

143. Le Bosquet, M., "Health Aspects of Water Resources Development," International Conference on Water for Peace, vol. 6, pp. 922-927. ARC 333.51 I61b, v.6.

Discusses WHO role re: health aspects, prevention of water-related diseases, malaria, schistosomiasis, onchocerciasis, filariasis, trypanosomiasis, leptospirosis, dracontiasis.

144. Lees, R. E. M., "Malnutrition: The Infant at Risk," West Indian Medical Journal, vol. 15, pp. 211-216, December 1966.

Household survey by a single public health nurse of 42 families from north third of St. Lucia. The study is part of Save the Children nutrition program (education) to find what socioeconomic factors might be responsible for the persistence (of infant deaths due to malnutrition) No evidence other than the fact that the investigator-interviewer was "well experienced in handling cases of malnutrition" is given for diagnosis. Data is all based on recall of respondent (usually mother) of deaths. In addition to income, diet, breast feeding, protein intake, number of siblings, literacy, father and mother's age and occupation, number of rooms and water supply and latrine facilities, there were subjective impressions of poverty, overcrowding.

Although 66% had incomes less than $15/week this was not considered poverty level. Seventy percent of mothers worked and left child care to others. Although 69% of mothers were literate - in 16 families with under 2 year deaths - 87% were illiterate.

	literate	illiterate	total
families with under 2 yr. deaths	2 (13)	14 (87)	16 (100)
all families	13 (31)	29 (69)	42 (100)

Eighty-one percent of under 2 year deaths were due to malnutrition. Forty-two mothers bore 189 children of whom 40 (21%) died before age two. Breast feeding "appeared adequate" (? in duration) but was "infrequent" and of "poor quality". The "at risk child" factors were, 1. maternal illiteracy, 2. working mother, 3. previous history of malnutrition death. One or more of these factors operated in 85.6% of series, all three in 33.3%, two in 23.8% and one 28.5%. "Patient individual tutoring" is only solution and the "at risk" criteria helpful for case prevention.

145. Leim, T. T., et al, "Health, Development, and Nutritional Survey of Preschool Children in Central Java," American Journal of Clinical Nutrition, vol 20, pp. 1260-1266, December 1967.

146. Lewin, K., et al, "Patterns of Aggressive Behavior in Experimentally Created Social Climates," Journal of Social Psychology 10:271, 39.

147. Logan, J. A., "Water Supply and Wastewater Disposal in Developing Countries," in W. B. Pescod, et al (eds.), Proceedings of a Water Supply and Sanitation Seminar, Bankok, January 19-23, 1970, Asian Institute of Technology, Bankok, January, 1971. ARC 628 W324.

Discussion of water supply in relation to economic growth. The impact of water supply on developing countries moving toward industrial development is discussed. Points out that the high proportion of working group in U.S. (55%) is due to past investments in public health - including water supplies estimated at $5/capita/yr. for health services and $8-30/yr. for public water supplies.

148. Losee, G. J., "Influence by Industrialization on the Health of Workers in the Community of Ivangrad," Report of Consultation provided June 21 to July 2, 1966, Belgrade, Yugoslavia on Research Project NCHS-Y3. ARC YU 614.7 L879.

Outlines the plan for a study, the objectives of which are to establish a method for measuring the impact of rapid industrialization on the health of a population, to obtain measurements of various factors affecting mental and physical health and to assess the role and importance of these factors.

149. Lowenstein, F. W., "Nutrition and Health of School Children in a Brazilian Amazon Town," The Journal of Tropical Pediatrics, vol. 8 (4), pp. 88-96, March 1963.

Examined 2111 children of school age in the Amazon town of Castanhal during August-September 1955. One hundred forty-eight (148) of these had a second examination in March-April 1956. These children were on the average of small stature with a fairly "normal" weight distribution for height and age. Nearly all were infected with necator, ascaris and trichocephalus, but the degree was mild to

moderate in the majority. Associated was a moderately severe anemia probably of the iron deficiency type. Inquiry was made on breast feeding and weaning practices and consumption of 'protective' foods (eggs, cheese, vegetables, fruits and meat or fish) and showed a lack of vegetables, eggs and cheese in the children's diet. A clean, safe, water supply system had been built in the area without exact date given but presumably it was in conjunction with a health center established in Castanhal in 1945.

150. Luche, T. C., "A Report on the Feasibility of Initiating Pilot Rural Health Activities as an Adjunct to a Rural Water Supply Project in the Yemen Arab Republic," International Voluntary Services, Inc., Washington, D.C., January 15, 1974.

A general discussion of the advisability of low-cost (estimated $25,000 per year) non-curative health activity pilot program to be attached to a rural water supply program. A woman's program (nutrition and health practices) and a men's program (sanitation facilities and practices) are recommended. The general approach is one of great flexibility in the pilots to determine what works and what does not.

151. Luckey, T. D., et al, "A Holistic Approach to the Interruption of the Diarrhea - Malabsorbtion - Malnutrition Cycle," American Journal of Clinical Nutrition, vol. 25, pp. 612-614, June 1972.

Suggests "poor environmental management" innoculates humans with harmful germs. Suggests using antibiotics to break the cycle and "positive innoculation" with normal gut bacteria. Suggests laboratory and field experiments using chronic antibiotic therapy, innoculation, nutrition and better "management" should be undertaken.

152. Martins, I. S., "Study of the Socio-Economic Situation and the Consumption of Nutrients in Communities of Vale do Ribeira, Sao Paulo, Brazil," Revista de Saude Publica, vol. 6 (2), pp. 199-209, June 1972.

153. Mata, L. J., "Agentes Causales de las Diarreas," Revista Colegio Medico de Guatemala, vol. 15, pp. 64-71, June 1964.

This is a review article with references.

Shigella, salmonella and enteropathogenic with coli account for approximately one-third of causes of diarrhea but even when virus is taken into account, 70% of the diarrheas cannot be explained and other conditions or agents must be taken into account such as easily upset GI tracts with or without large quantities of intestinal flora, introduction of non-pathogens, non-inhabitants, germs in aberrant locations and endotoxins.

154. Mata, L. J., et al, "Prevalence of Shigella, Salmonella and Enteropathogenic Escherichia Coli in Six Mayan Villages," American Journal of Public Health, vol. 55, pp. 1396-1402, September 1965.

A rectal swab study of Shigella, Salmonella & EE coli in 712 children, age 0-9 in six highland (population N=1000-5000 each village) Mayan villages. Infection rates peak under 3 year olds. Pathogens range 11-20%.

Population is highly illiterate and latrines rare and improperly used. Water is obtained from public fountains and reservoirs.

A random block sample to yield 150 subjects per village was taken.. The criterion for diarrhea is more than four stools the previous day.

Age-specific diarrhea prevalence rates:

Age	%
<1	18.7
1	20.4
2	22.2
3	15.3
4	4.2
5-9	3.1
N = 712	10.5

155. Mata, L. J., et al, "Studies of Diarrheal Disease in Central America: IX. Shigella Carriers Among Young Children of a Heavily Seeded Guatemalan Convalescent Home," American Journal of Tropical Medicine and Hygiene, vol. 15, pp. 632-638, April 1966.

156. Mata, L. J., et al, "Effect of Infection and Diet on Child Growth: Experience in a Guatemalan Village," in G. E. W. Wolstenholme and M. O'Connor, (eds.), Nutrition and Infection, Ciba Foundation Study No. 31, London, J. and A. Churchill, Ltd., 1967, pp. 112-126.

157. Mata, L. J., et al, "Diarrheal Disease in a Cohort of Guatemalan Village Children Observed from Birth to Age Two Years," Tropical Geographical Medicine, vol. 12, pp. 247-257, December 1967.

A cohort of children in Santa Maria Cauque, Guatemala was followed from birth to age two, to study the frequency of diarrheal disease and of viruses, bacteria and parasites as determined in fecal specimens collected every week. Attack rates increased with age reaching the highest level at the end of the first year and throughout the second. Twenty percent (20%) of cases were chronic. No difference in frequency of infectious agents was observed in the acute or chronic form. Potentially pathogenic agents were more

frequent in cases than in matched controls. No agents were found in 40% of cases.

Water supply is mentioned (spring water is piped to a central reservoir and to public faucets; then carried in earthen jars. Few houses have an individual water supply. Disposal of feces and other wastes is inadequate.) but no relationship is discussed.

158. Mata, L. J., et al, "Influence of Recurrent Infections on Nutrition and Growth of Children in Guatemala," American Journal of Clinical Nutrition, vol. 25 (11), pp. 1267-1275, November 1972.

The study revealed a high frequency of fetal growth retardation and deficient growth in postnatal life. Both phenomena were associated with infection as well as nutritional deficiency.

159. May, J. M., The Ecology of Malnutrition in Middle Africa; Ghana, Nigeria, Republic of the Congo, Rwanda, Burundi, and the former French Equatorial Africa, Studies in Medical Geography, vol. 5, New York. Hafner, 1965.

A general description of each country investigated, an inventory of food grown, dietary surveys, and some discussion of nutritional status of middle Africans.

160. Mayberry, R. H., et al, "A Survey of Chronic Disease and Diet in Seminole Indians in Oklahoma," American Journal of Clinical Nutrition, vol. 13, pp. 127-134, September 1963.

Information was taken on height, weight, blood pressure, Hb, and cholesterol levels, incidence of diabetes, dietary habits, and causes of death of three groups: Seminole Indians in Florida, in Oklahoma, and whites in Oklahoma. Subjects were selected in a variety of non-random ways. Indians were shorter and heavier than whites. Indians' reported causes of death more frequently mentioned hypertension, stroke, and diabetes; less frequently mentioned coronary artery disease.

161. Migasena, Panata, "Nutrition, Health Status, and the Impact of Development in the Lower Mekong Basin," South East Asia Development Advisory Group Papers: Problems of Development in South East Asia, 1972. ARC FEA, 614.0959, M634.

The nutritional and health status of the population enumerated and discussed in light of a recommended development project. Article outlines needed research as a basis for planning.

"It is understood that the ecology and the epidemiology of endemic diseases would be changed after the construction of dams. Nutritional status, in other words, may not improve even though the production of food is increased, unless the endemic diseases,

especially intestinal parasites, are eradicated and prevented. Therefore, both environmental sanitation and epidemiological control of endemic diseases should be planned in parallel with other aspects of Mekong development. To achieve this goal pertinent basic data should be collected."

162. Miller, A. P., Water and Man's Health, April 1962, Reprinted July 1967, 91 pp. Community Water Supply Section, AID/Washington. ARC 614.772, M647.

The relationship and importance of water to man's health is analyzed. Discusses water's use in preventing disease as well as its relationship to diseases, particularly cholera, leptospirosis, paratyphoid fever, tularemia, typhoid fever, dracontiasis, echinococcosis, schistosomiasis, amebiasis, infectious hepatitis, diarrheal diseases, pleurodynia, and poliomyelitis. A bibliography of 164 items on these diseases appears on pp. 52-58. Chemical characteristics of drinking water are noted.

163. Miller, H. W., "Plan and Operation of the Health and Nutrition Examination Survey," Vital Health Statistics, vol. 1, pp. 1-77, February 1973.

164. Monckeberg, F., "Factors Conditioning Malnutrition in Latin America," Biblioteca Nutrio et Dieta, vol. 14, pp. 23-33, 1970.

Comparative international chart using 1-4 years mortality, literacy, water, sewage, protein and a combined living condition index with U.S. as standard (100) (best) and Guatemala 23 (worst).

165. Moore, H. A., et al, "Diarrheal Disease Studies in Costa Rica:"
"I. Plan and Methods of Investigation," American Journal of Public Health, vol. 56 (2), pp. 276-286, February 1966.
"II. The Prevalence of Certain Enteric Organisms and Their Relationship to Diarrhea," American Journal of Public Health, vol. 56 (3), pp. 442-451, March 1966.
"III. Morbidity and Mortality from Diarrhea," American Journal of Epidemiology, vol. 82 (2), pp. 143-161, September 1965.
"IV. The Influence of Sanitation upon the Prevalence of Intestinal Infection and Diarrheal Disease," American Journal of Epidemiology, vol. 82 (2), pp. 162-184, September 1965.

166. Morris, J. N., The Uses of Epidemiology, Edinburgh, E. and S. Livingstone Ltd., 1957.

"The main use of epidemiology is to discover populations or groups with high rates of disease and with low, in the hope that causes of disease and of freedom from disease can be postulated."

Multiple causality is important to the concept.

167. Munford, R. S., et al, "Spread of Meningococcal Infection Within Households," Lancet, vol. 1, pp. 1275-1277, June 22, 1974.

A recent and carefully controlled household study in Sao Paulo, Brazil during an epidemic. The infection (meningococcal) is usually introduced into families by adults, spreads to other family members and usually reaches infants after there is a relatively high "density" of infection in the family.

168. McJunkin, F. E., "Community Water Supply in Developing Countries," Office of International Health, USPHS PHS/OIH, AID/WHO, Chapel Hill, N.C., 1969. ARC 628.1 M152.

Quotes E. P. Campbell (1959) as source of widely accepted data that each year 500 million people are affected by incapacitating water related illness and 10 million (half of them infants) die. Worldwide, 25% of hospital beds are occupied by patients ill with these diseases. Gives historic review of water related illnesses. Gives typhoid fever graph (Greece and Mass.) and WHO data showing inverse relationship of infant mortality to proportion of population served by water.

169. McLaren, D. S., "The Great Protein Fiasco," Lancet, vol. II for 1974, pp. 93-96, July 13, 1974.

Malnutrition is not always due to protein deficiency and does not always express itself as kwashiorkor.

170. McLellan, D. L. (or U.S. Department of the Army, Office of the Chief of Research and Development), The Ecology of Malnutrition in the Caribbean, Studies in Medical Geography, vol. 12, New York, Hafner, 1973.

171. Nivaldo, J., "Economic, Social and Alimentary Aspects of Refugees from the Drought in Ceara," Revista Brasileira de Medicina, vol. 17, pp. 720-724, August 1960. (Portuguese)

172. "Nutrition and Infection," Medical Journal of Australia, vol. 1, pp. 589-590, April 2, 1966.

An editorial discussing "Nutrition and Infection," report of a WHO Expert Committee, Technical Report Series No. 314, 1965.

But we must not lose sight of fact that behind improved nutrition and better management of infection there must be a sound public health service and intensified mothercraft and child care.

"The nature of the interaction" (between nutrition and infection) "have not been demonstrated by unequivocal scientific research" and lingers in the community as folklore including the scientific

folklore that famine is related to epidemics of tuberculosis, leprosy and measles. Other devastating changes in the environment including breakdown in sanitation, overcrowding and failure of civic services are probably equally or more important. The WHO Committee reports "relatively little scientific experimentally based information and a surprising lack of specific information on this subject." But "sufficient material is available to sustain the long-held belief that there is a close relationship..."

173. Nutrition Reviews, "Survival of Starvation by Germfree Mice," review of article by W. F. McNulty and R. Linares, vol. 24, p. 313 ff., 1966.

Four groups were studied:
1. germfree - born and reared
2. conventional - animal room mice reared in same environmental conditions
3. "conventionalized" - born germfree but contaminated with cecal contents of open animal room
4. contaminated - born germfree but fed E. Coli contaminated water

Findings:
1. germfree mice could not survive starvation as long as other groups
2. longer surviving starved mice lost more weight
3. drinking water did not prolong survival
4. body composition (percent water, protein, calories) no difference between groups
5. diarrhea developed a few days before death in all animals but "may have been more severe in germfree animals"

No energy and electrolyte studies were made.

174. Nutrition Reviews, "Seasonal Hunger in Underdeveloped Countries," review of: Hunter, J. M., Platt, B. S., Hathaway, M. L. and others in various periodicals, vol. 26 (5), pp. 142-145, May 1968.

Points up importance of seasonal variation in food and water supplies and its effects on very young ("cultural practices allocate food first to the farmer," ref: M. C. Latham, Nutrition in Tropical Africa, p. 8, FAO, Rome, 1965).

Emigration, rainfall, type of crops are all important. Nutritional status studies should take account of seasonal variation. "An intriguing question that has not been asked by anyone...what happens to a water supply during the dry season?"

175. de Oliveiro, J. E., et al, "Nutritional Studies on a Group of Children from Ribeirao Preto, Brazil," Journal of Tropical Pediatrics, vol. 10, pp. 17-26, June 1964.

A survey was made on the feeding habits and nutrition status in children attending a day care institute of Ribeirao Preto, Sao Paulo, Brazil. Hygienic practices are taught at the school and three meals are given per day. Attendance is not constant. Low intake of protein, calcium and calories were noted. Physical status was better than expected. Few signs of specific malnutrition were found though children were below weight and height averages. Taking the economic situation into account, recommendation is made to increase intake of protein, calcium and calories through soya bean products enriched with vitamins and minerals.

176. Osancova, K., et al, "Nutrition and its Reflection on the Health Status of the Population," Review of Czechoslovak Medicine, vol. 14, pp. 101-117, 1968.

A nutritional survey of a representative sample in the West Bohemian region of Czechoslovakia revealed that nutritional advances had been made (higher animal protein, mineral and vitamin intake) compared to an earlier study in a similar region. But also excessive caloric and fat intake are now present. Obesity was prevalent as was high cholesterol. The results indicate that under favorable conditions of food supplies a number of nutritional problems persist in Czechoslovakia.

177. Passmore, R., "Energy Balances in Man," Proceedings of the Nutrition Society, vol. 26 (1), pp. 97-101, 1967.

"Field studies in which neither dietary intake nor the physical activities of the subject can be controlled or measured with precision by the investigator are liable to so great an error that they are not likely to throw much light on the nature of the controls...accuracy is not compatible with the freedom of normal life (and) can only be achieved... in the metabolic ward of a hospital or in a well-equipped research laboratory."

Small body weight changes do not reflect body composition changes but usually body water.

Error in assessing calorie intake with dietary surveys is not "less than 10% and often much greater." Estimating daily energy expenditure under field conditions has an error of at least 10%.

178. Paulini, E., et al, "A Simple Graphic Method for Evaluating and Comparing Results of Nutrition Surveys," Revista Brasileira de Malariologia e Doencas Tropicais, vol. 15, pp. 629-634, October-December 1963.

179. Pierce, V., et al,"Studies on Diarrheal Disease in Central America. III. Specific Etiology of Endemic Diarrhea and Dysentery in Guatemalan Children." American Journal of Tropical Medicine and Hygiene, Vol. 11, pp. 396-400, May 1962.

180. Plough, I. A., et al, "Relations of Clinical and Dietary Findings in Nutrition Surveys," Public Health Reports, vol. 75(8),. pp. 699-706, August 1960.

Selected data nutrient intakes from 58 surveys in 57 military messes in 8 nations are compared with the clinical and average biochemical findings in troops from the same locations. Clinical and biochemical findings relating to vitamin C nutriture correlated well with dietary intakes. Urinary excretion rates of thiamine, riboflavin and N'methyl-nicotinamide correlated roughly to intake. However, the clinical findings widely held to reflect an insufficiency of these vitamins showed scarcely any correlation with dietary intakes. No apparent correlations in vitamin A or calorie nutriture were found between the three survey approaches although there was an apparent negative correlation between fat intake and serum cholesterol. Paper identifies and discusses sources of error in interpretation of the findings.

181. Pollack, H., et al, "The Factor of Disease in the World Food Problems, Journal of the American Medical Association, vol. 212, pp. 598-603, April 27, 1970.

Using some ingenuity, authors calculate the total calorie lost cost of three diseases, respiratory tuberculosis, malaria and dysentery, in selected Latin American and African countries. Concludes the per capita cost is significant (.10-1.27) and represents benefits to any program that reduces disease and/or malnutrition incidence.

182. Pollack, H., "Nutritional Problems as Part of the Total Economy," American Journal of Clinical Nutrition, vol. 19, pp. 285-290, October 1966.

General outline of world's major nutritional problems linking their solutions to the total economy of the specific country or area. Recommends looking at totality of an area in attempting solution. Helpful in showing the status of general nutritional knowledge after 31 years of WHO and FAO.

183. Popkin, B. M., et al, "Economics as an Aid to Nutritional Change," American Journal of Clinical Nutrition, vol. 25, pp. 331-334, March 1972.

Survey of types of economic benefits associated with nutritional improvement as part of the "health spectrum" consisting of demographic, socio-cultural, economic, environmental and medical factors.

Improved nutrition is a "merit want" in economics. Economic (efficiency) benefits to improved nutrition may include:

1. physical performance - can raise capacity, productivity, and nutrition
2. mental performance - improves learning and concentration
3. morbidity - synergism of infection and nutrition - leads to disability and debility
4. mortality
5. structural development - (questionable)
6. mental health
7. fertility decline - (questionable)
8. external effects - prevention of food theft (questionable) - less communication of infections
9. intergenerational effects - better parents, better children
10. associated benefits - lower demand for medical care, lower funeral benefits

184. Price, D. P., et al, "The Economic Value of Human Life," American Journal of Public Health, vol. 57 (11), pp. 1954-1966, November 1967.

Calculate the value of human life by age, sex, color and educational qualification (8, 12, 16 years of study) using what seems to be a sound methodology. Uses the present value of future income streams (no deduction for consumption). Reviews other attempts by a variety of professions (e.g. life insurance companies, education studies, health studies) to calculate same value.

185. Prior, I., "A Health Survey in a Rural Maroi Community, with Particular Emphasis on the Cardiovascular, Nutritional and Metabolic Findings," New Zealand Medical Journal, vol. 61, pp. 333-348, July 1962.

A cross sectional study of 491 natives of all ages suffering from ills of civilization: caries, gout, obesity, hypertension, diabetes, coronary artery disease, etc.

186. "The Problem of the Evaluation of Nutritional Conditions," Revista Brasileira de Malariologia e Doencas Tropicas, vol. 15, pp. 277-290, April-June 1963.

187. Puffer, R. R., et al, "Patterns of Mortality in Childhood," PAHO / Who Scientific Publication No. 262, 1973

Thirteen project sites in Latin America (8 countries) were studied (hospital records, autopsies) in order to isolate the major underlying cause of death for 10,052 of the 35,095 deaths of children under five years of age. The study concludes that nutritional deficiency was the most serious health problem uncovered in the investigation since 57% of the children who died under 5 years of age had immaturity or nutritional deficiency as the fundamental or associated cause of death. In many children there was a history of repeated diarrheal

disease episodes combined with nutritional deficiency, and because of the reciprocal implications it is difficult to know which of the conditions should be the basic cause. However, analysis of the multiple causes of death (using evidence obtained from clinical and autopsy records, interviews in the homes of deceased children combined with data from medical certificates of death) implicates nutritional deficiency as the most important contributor to the excessive mortality in Latin America.

The study also noted that (1) the level of a mother's education was a valuable socioeconomic indicator and (2) there existed an inverse relationship between post-neonatal deaths and homes with piped water supply.

188. Pyatt, E. E., et al, "On Estimating Benefit-Cost Ratios for Water Supply Investments," American Journal of Public Health, vol. 52 (10) pp. 1729-1742, October 1962.

Using concepts from Wiesbrod (1961) and Dublin (1930), an attempt is made to express benefits in terms of additional worker income resulting from reduced morbidity and mortality following construction of public water systems.

189. Rao, K. S. J., et al, "Protein Malnutrition in South India," Bull. WHO, vol. 20, pp. 603-639, 1959.

A 1959 field survey of nutrition of 4000 rural children under 5 years of age.

190. Rao, K. S. J., "Evolution of Kwashiorkor and Marasmus," Lancet, vol. I for 1974, pp. 709-711, April 20, 1974.

Author suggests that kwashiorkor and marasmus are two advanced forms of protein-calorie malnutrition - the same disease but altered by failure of adrenal cortex response in kwashiorkor.

191. Reh, E., "Report to the Government of Brazil on Training of Personnel in Dietary Survey Techniques," FAO, ETAP Report No. 1438, Rome, 1961.

192. "A Report of Background. Considerations and Recommendations on the Water for Peace Program," Interdepartmental Committee on Water for Peace, March 1967. ARC 333.91 I61

Discusses the problems correctable by pure water supplies, their dimensions and the guiding principles for providing supplies.

Of 1.1 billion rural people, 800 million had no water service in 1964, and less than 300 million had public outlet service. In an urban population of 140 million, 40% had no water service, and 90 million had public outlet service. In sum, more than 900

million were without any kind of public water service, 365 million relied on public outlets, and only 170 million or one person out of nine had water piped to his home.

193. Report of the Panel of Expert Consultants to the ICA on Community Water Supply Development Program, Washington, D.C., April 12--14, 1960. ARC 628.1 I61.

Overview of economic benefits through better health provided by pure water supply. Recommendations for development of cost-benefit ratios and meetings of persons from various disciplines.

194. Report on a Water Supply System for the Metropolitan Area of San Jose, Costa Rica, Rader and Associates, Miami, Florida, April, 1959. Job No 3658 ARC CR 628.1 R127.

Chapter three outlines the problem of water-borne diseases. Tables are provided showing morbidity and mortality rates for different areas of San Jose and typhoid morbidity rates for various American countries. Rates are widely different even within the metropolitan section of San Jose.

195. Reutlinger, S., "Nutrition Policy Research Issues and Approaches: A Perspective for the Bank's Involvement," IBRD, Washington, D.C., March 15, 1974.

Following a helpful recapitulation of the economic effects of various levels of nutrition, Reutlinger reviews and criticizes various approaches to nutritional research. He identifies priority areas for Bank support of research and suggests that the Bank's role should largely be evaluative of research done by other, better equipped institutions but should cooperate with others, both in formulating research policy and advising from Bank experience. It should do its own research when there are direct implications for Bank operations.

196. Richardson, B.D., "Studies on Nutritional Status and Health of Transvaal Bantu and White Pre-school Children," South African Medical Journal, vol. 47, pp. 88-98, April 1973.

Part of a medical school thesis: A study of protein calorie malnutrition of South African Bantu (2486 children age 1-6) and 467 whites.

No obvious differences in home environment or diet were found in children with or without kwashiorkor although 5% were severely malnourished and 75% (Bantu non-nursery school) were mild to moderately so. The small food supplement in nursery school seemed to prevent malnutrition and promoted a 10% growth increase.

197. Robson, J., "The Ecology of Malnutrition in a Rural Community in Tanzania," Ecology of Food and Nutrition, vol. 3, pp. 61-72, 1973.

An epidemiologic assessment by an interdisciplinary team who attempted to "alleviate malnutrition in a remote area of Africa," Ngoni of Songea district (pop. 150,000, 1948 census estimate). Questionnaire and 24-hour diet recall allowed the study of crop yield estimates, livestock census, quantitative nutrition estimates and calculations from food survey, study of weaning habits, food taboos and food consumption patterns of 378 sample population of all ages from representative areas. No measurements (anthropomorphic or laboratory), or morbidity or mortality rates were taken.

The annual precipitation is 40 inches. The area is well wooded and watered with "clear free running streams." "In the midst of these very favorable conditions...the presence of...malnutrition...apparently caused by food inadequacy was surprising."

Administrative, legislative and political measures, change of leadership and land tenure, better agricultural methods, increased availability of animal foods and economic incentives are needed rather than food supplementation. "The causes of inadequate (food) supplies are numerous and often obscure."

198. "Rural Sanitation in El Salvador: A Proposed Approach to its Problems," Servicio Cooperativo Inter-Americano de Salud Publica, November, 1961.

Discusses existing rural sanitation projects and notes their progress ("health has been improved and life made a little bit easier in the communities that have been favored with these works") and their shortcomings (lack of maintenance in several cases, health education has not been adequate). Recommendations for an accelerated program are made and costs are estimated. Mortality rates from 1955 to 1958 for causes which may be related to environment are given.

199. Sabaugh, G., et al, "A Comparison of Different Survey Techniques for Obtaining Vital Data in a Developing Country," Demography, Population Association of American, vol. 4 (2), pp. 758-772, 1967.

An estimate of sources and extent of observation errors in three rounds of a multi-purpose sample survey of Morocco. Conclusions are:
1) vital data collected with single rounds retrospective procedure - gross error (over plus underenumeration) is equal to 17% for births and 36% for deaths, with net error of 3% (births) and 9% (deaths);
2) a two round study (household composition plus retrospective mortality questionnaire) would eliminate overenumeration and reduce underenumeration.

Most remaining errors of underenumeration may be due to: 1) infants born and died between rounds and missed; 2) matching failures caused by absent adults in first round; 3) matching errors

Stratified problem sample - 750 villages, rural universe of 300,000.

Rounds taken exactly one year apart.

200. Salomon, J. B., et al, "Studies of Diarrheal Disease in Central America. X. Associated Chickenpox, Diarrhea and Kwashiorkor in a Highland Guatemalan Village," American Journal of Tropical Medicine and Hygiene, vol. 15 (6), part 1, pp. 997-1002, November 1966.

201. Salomon, J. B., et al, "Malnutrition and the Common Communicable Diseases of Childhood in Rural Guatemala," American Journal of Public Health, vol. 58, pp. 505-516, March 1968.

Presents a series of case histories taken in conjunction with Guatemalan four village study showing nutritional and diarrheal interactions with common communicable diseases of childhood - measles, whooping cough, mumps, rubella and chickenpox - and presented as reasons for the high degree of severity and mortality of these childhood diseases.

202. Samuelson, G., "An Epidemiological Study of Child Health and Nutrition in a Northern Swedish County. I. Food Consumption Survey," Acta Paediatrica Scandinavica, (Supplement), 214, pp. 5-44, 1971.

Reports on a general nutritional survey of 1401 children in a northern Swedish county. In an urban area, 4, 8 and 13 year olds and in a rural area 8 and 13 year olds were studied by a survey using 24-hour recall technique. Found little overall under-nutrition although found many children eating inadequate breakfasts and a few cases of iron anemia among 13 year old girls.

203. Samuelson, G., "An Epidemiological Study of Child Health and Nutrition in a Northern Swedish County. 3. Medical and Anthropometrical Examinations," Acta Paediatrica Scandinavica, vol. 60 (6), pp. 653-665, November 1971.

Reports the medical and anthropometric examinations of the 1401 children surveyed in the first of these articles. Found no undernutrition.

204. Santasiri, S., et al, "A Study on the Pattern of Socioeconomic and Health Status in relation to parasitic diseases in the inhabitants around Ubolratana Dam in NE Thailand," Southeast Asian Journal of Tropical Medicine and Public Health, vol. 4 (3), pp. 421-434, September 1973.

A cross-section base-line study in May-July 1972 of three villages on newly created lake. Noted were house mapping, census, medical history, environmental sanitation, fecal smears and stool counts (eggs/gm. feces), Hb, serum protein, malaria smears, snail and fish examination. Sample was N=1088/1169 (93.1%) of all ages. Water source is sub-soil dug pools. There are no latrines. Found were prevalence of intestinal parasites=52.2%, no major significant

anemia, normal to high serum proteins (associated with parasites), (most eat raw fish), no malaria, no amoebic dysentery. The under 7 year age group not as infected as adults; ova counts not as high as in total population.

Study done because other investigations show spread of endemic water borne diseases (including meningitis, malaria, and nutritional disorders) following dam construction (Harinasuta, SEA Journal of Tropical Medicine and Public Health, 1:530, 1970, and Migasena, SEADAG Papers on Problems of Development in SE Asia, Asia Society, 1972).

205. "Sao Paulo Basic Urban Plan," Urban Services, vol. 5, FINEP-USAID. Consortium: Asplan, Daly, Montreal, Wilbur Smith. ARC BR 301.364 E96, vol. 5.

A general services and urban services public opinion (interview) survey in Sao Paulo Metropolitan Area in 1968 showed that city residents rate street cleaning and lighting above sanitary sewerage. They rate pavement maintenance next and water supply fifth, but rated water supply and sewers third in importance (above public health and education) in general service necessity during a home interview survey.

206. Schliessmann, D. J., "Diarrheal Disease and the Environment," BULL. WHO., vol. 21 (3), pp. 381-386, 1959.

A review article presenting references and some data to show "that diarrheal morbidity rates varied significantly with the quantity of water available for personal hygiene." Presents a summary table of studies in California, Guatemala, Georgia and Kentucky of shighella infection rates related to sanitary facilities showing that infection rates of children in houses with outside water supplies were twice those of homes with inside taps. He notes too that homes with inside toilets are likely to have handwashing and bathing facilities which also contribute to disease transmission reduction.

207. Schneider, H. A., et al, "The Way It Is," Nutrition Reviews, vol. 31 (8), pp. 233-237, August 1973.

Review with comments of A Study of Health Practices and Opinions, National Analysts, Inc., 1972, a report contracted by U. S. Food and Drug Administration to conduct a large national survey of adults in the summer of 1966 to investigate the nature and prevalence of fallacious or questionable health beliefs and practices in the U. S. and susceptibility to them. Review deals with the part of the survey dealing with attitudes on vitamins and nutritional supplements, health foods and weight reduction. Other areas surveyed were self medication practices and diagnosis and treatment of arthritis, rheumatism, cancer,

etc. The study presents a valuable estimate of the complexities of human beliefs and actions in the field of health. Faulty health practices appear to have no single or simple basis which education could set to right but appear to be based on irrational and contradictory elements of the human psyche. The survey concluded that the sole effective action available is by means of government regulation.

208. Scrimshaw, N. S., et al, "Interactions of Nutrition and Infection," American Journal of Medical Sciences, vol. 237, pp. 367-403, March 1959.

Basic review article citing much laboratory and animal work and repeated in WHO Bulletin No. 57.

Interactions were classified as to whether they were antagonistic or synergistic. States the interaction, particularly the synergism, of nutrition and infection had been inadequately recognized.

209. Scrimshaw, N. S., "Nutrition and Infection," Journal of American Medical Women Association, vol. 17, pp. 422-426, May 1962.

Brief account of nutritional and infectious synergism.

210. Scrimshaw, N. S., et al, "Studies of Diarrheal Disease in Central America: IV. Demographic Distribution of Acute Diarrheal Disease in Two Rural Populations of the Guatemalan Highlands," American Journal of Tropical Medicine and Hygiene, vol. 11, pp. 401-409, May 1962.

Reported diarrheal death rates for ages 1-4 exceed other causes. Frequency of diarrhea and severity coincided with ages at which kwashiorkor is most common. Prospective study from official death records of two rural highland villages for 28 months.

211. Scrimshaw, N. S., "Ecological Factors in Nutritional Disease," American Journal of Clinical Nutrition, vol. 14, pp. 112-122, February 1964.

Review article notes that INCAP study Santa Maria Cauque, Guatemala providing safe drinking water, privy for each house, fulltime sanitary inspector, clinic with MD and nurse after three years produced "no recognizable decrease in diarrheal disease in children under five" when no associated nutritional measures were taken or changes in food preparation and handling within the home were made. Spread of the diarrheal disease was shown to be by contact within the family group, not by water or flies. A similar village with dietary supplement alone without medical or sanitary help had decreased diarrheal disease.

Discusses host agent environment factors.

212. Scrimshaw, N. S., et al, "Studies of Diarrheal Disease in Central America: VIII. Measles, Diarrhea, and Nutritional Deficiency in Rural Guatemala," American Journal of Tropical Medicine and Hygiene, vol. 15, pp. 625-631, July 1966.

Measles in rural Guatemala is a serious disease mainly in the first three years of life, with acute diarrhea as most frequent complication. Children given extra food supplements (15 grms. protein, 450 calories) did not succumb to the illness. Neither village had local medical service. Case fatality in control village was 6.8%, in the feeding village 4.3%. Total cases were 136. No statistical tests of significance done.

213. Scrimshaw, N. S., "The Effect of the Interaction of Nutrition and Infection on the Preschool Child," in Pre-School Child Malnutrition, Washington, D.C. National Academy of Sciences-National Research Council, Publication 1282, 1966, pp. 63-73.

214. Scrimshaw, N. S., et al, "Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964. I. Study Plan and Experimental Design." Archives of Environmental Health, Vol. 14, pp. 657-662, May 1967.

215. Scrimshaw, N. S., et al, "Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964. II. Field Reconnaissance, Administrative and Technical; Study Area; Population Characteristics; Organization for Field Activities," Archives of Environmental Health, vol. 14, pp. 787-801, June 1967.

216. Scrimshaw, N. S., et al, "Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964. III. Field Procedure, Collection of Data, and Methods of Measurement," Archives of Environmental Health, vol. 15, pp. 6-15, July 1967.

217. Scrimshaw, N. S., et al, "Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964. V. Disease Incidence Among Pre-School Children under Natural Village Conditions, with Improved Diet and with Medical and Public Health Services," Archives of Environmental Health, vol. 16, pp. 223-234, February 1968.

218. Scrimshaw, N. S., et al, "Interactions of Nutrition and Infection," WHO Monograph Series No. 57, Geneva, 1968.

The standard background work on interaction of nutrition and infection. Major conclusion:

> In man, interactions between malnutrition and infection are regularly synergistic. Infections are likely to have more

serious consequences among persons with clinical and subclinical malnutrition, and infectious diseases have the capacity to turn borderline nutritional deficiencies into severe malnutrition.

Monograph written to "sift the vast amount of epidemiological, clinical and experimental evidence already available" regarding the effects of infection on nutrition status, effects of malnutrition on resistance to infection and interaction between nutrition and infection. Claims that diarrhea is rarely fatal to a well-nourished child.

"Emphasis has been too much on the obligations and duties of public health agencies, with too little appreciation of the fact that much of the control rests in what people must do for themselves. . . ."

Bibliography contains 1500 citations.

219. Scrimshaw, N. S., and Gordon, J. E., (eds.), Malnutrition, Learning, and Behavior, Cambridge, Mass., MIT Press, 1968.

220. Scrimshaw, N. S., et al, "Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964, IX. An Evaluation of Medical, Social and Public Health Benefits, with Suggestions for future Study" Archives of Environmental Health, vol. 18, pp. 51-62, January 1969.

221. Scrimshaw, N. S., "Synergism of Malnutrition and Infection; Evidence from Field Studies," Journal of American Medical Association, vol. 212 (10), pp. 1685-1692, June 8, 1970.

Warns against the epidemiological study which rushes into a definitive field study without proper groundwork identified in stages of: conceptual idea, field reconnaissance, exploratory study, pilot study, definitive study and analysis and interpretation. The remainder of the paper summarizes a series of field studies in Guatemala over a period of ten years (the main study in 1959 to 1964) which illustrate the synergistic interaction of malnutrition and infection which characterizes the occurrence of both in pre-school children of developing countries.

The main study based on concepts arising from earlier studies was conducted in three highland Guatemalan villages and was designed to test the extent to which nutritional improvement alone or medical care and environmental sanitation measures alone would improve nutritional status, lower morbidity and mortality rate, and promote growth in pre-school children. Three villages of about 1,000 inhabitants each were used. The program in the feeding village (Santa Catarina Barahona) was shown to decrease mortality and morbidity significantly and slightly but significantly to increase growth and development. It was clear, however, that feeding alone, while helpful was not enough since

mortality and morbidity remained shockingly high. The program in the treatment and sanitation village failed to influence disease morbidity. Diarrheal disease in particular was apparently not affected by either the sanitation or drug treatment of all cases. It is concluded that satisfactory correction of the high morbidity and impaired growth and development in these populations was not susceptible to a single factor approach but rather that malnutrition and infection needed to be combated concurrently.. Study also concludes that many conventional, even sacred, public health activities may not in themselves be the best way to utilize limited resources.

222. Selowsky, M., et al, "The Economics of Malnourished Children: An Example of Disinvestment in Human Capital," Economic Development and Cultural Change, vol. 22 (1), pp. 17-30, October 1973.

A very interesting study of the effects of infant nutrition on later earnings. The link is through improved IQ (and some cross-effects of increased schooling) on later employment and earnings. Authors calculated a 20% rate of return (at a 10% discount rate) on supplying infants enough milk to make up nutritional deficiencies.

Sample size of 33 malnourished children with a control (well nourished) group of seven. Analysis was econometric and rule-of-thumb. Methodology seems good. Carried out in Chile in 1970. Main survey technique was measuring other socioeconomic information of household.

223. Sloan, F., Survival of Progeny in Developing Countries: An Analysis of Evidence from Costa Rica, Mexico, East Pakistan and Puerto Rico, AID/CSD-2533, Rand, 1971.

Data from published sources are analyzed to identify several potential determinants of regional differences in infant and pre-school child mortality. Among the determinants considered, female literacy and nutrition, definitely have an impact on mortality of children less than five. The roles of female labor force activity and medical care emerge less clearly. Sanitation variables and variables that characterize the housing stock of the region explain none of the variation in mortality rates.

Recommends the extension of analysis grounded in a theory of household decision making, to be conducted on the level of the household. New surveys merit attention and should collect data on vital events, morbidity record of family members, consumption of foods and services relevant to health, income, occupation, educational attainment and time budget data.

"Sound reasons can be given for including several measures of environmental variables (including water supply) and housing...

as in most previous investigations, no evidence to support such relationships is found in this study."

Author applies multiple regression analysis to data from four countries to discover determinants of regional variation in infant and child mortality. Finds mortality data and rates of female literacy highly associated. Discovers some association between child mortality and a variety of proxies for nutrition. Other variables, including piped water and biological purity of water, not significant as independent variables in his equation.

224. Smith, C. H., et al, "The Rate of Secretion of Breast Milk," American Journal of Diseases of Children, vol. 24, p. 413 ff., 1922.

Baby Weight	Quantity of Milk Obtained by Infants at Single Breast for Ten Minutes	
6-9 lbs.	3.4 oz.	
9-12	4.0	(90% water)
12-15	5.3	

225. Sornmani, S., et al, "A Study on the Pattern of Socioeconomic and Health Status in Relation to Parasitic Diseases in the Inhabitants Around Ubolratana Dam in Northeast Thailand," Southeast Asian Journal of Tropical Medicine and Public Health, Vol. 4 (3), pp. 421-434, September 1973.

226. Studwick, R. H., et al, "The Zaina Environmental Sanitation Scheme, A Pilot Project in Rural Africa," WHO/Env. San./135, June 19, 1962.

Describes in detail the conception and construction of the gravity fed Zaina project and accompanied sanitary facilities. In 1961 surveys (including personal health, pathological examination of stools, urine, sputa, bloods and Heaf testing, housing and sanitation, economic level, nutrition and an estimation of mean heights and weights of children from birth to school leaving age) were conducted in the service area and in a similar area uneffected by the soon to be functionable pure water supply. The 'before' survey results do not differ greatly between the service area and the control area. An 'after' survey was planned for two years later. Results of the before survey are given in detailed tables.

227. "Summary Results of the Eight Regional Nutrition Surveys Conducted in the Philippines by the Food and Nutrition Research Center, NIST, NSDB, Quebec," Philippine Journal of Nutrition, vol. 22 (2) pp. 61-101, April-June 1969.

From 1957 to 1967, baseline nutrition surveys were conducted in the ten regions of the Philippines. Diet ratings were computed to determine their correlation with factors of household size, education level, per capita food expenditure. Biochemical findings are presented in table form as are clinical results. Total calorie intake (weighted mean) was found inadequate, amounting to three-quarters (3/4) recommended levels. The suggestive signs of nutritional deficiency observed were of vitamin A, riboflavin, niacin, vitamin C, thiamine and iron. Pregnant and nursing mothers had a higher incidence of enlarged thyroid than the general population. Average incidence of parasitism was 88.5% with ascaris most common.

228. "Survey Report of a Special Health Education Project in Central Java, Indonesia," Djakarta, Indonesia, 1961. ARC ID 614 0991 U58.

A 1961 report of a continuing health education and sanitation project in Banjumas, Central Java. At this time the project had been in operation, off and on for twenty-eight years. Progress in the first years was impeded because individuals and families disliked being singled out to be educated; the health center, an unattractive hut, failed to inspire pride or respect; the health workers, living in conditions similar to the people's did not set an example; thus, exposing people to knowledge was not enough. The people, moreover, resented being told to cooperate. It is believed by the reporters that unfamilier ideas can be more stimulating than familiar ideas. In this vein, a new cooperative water supply, better trained health workers and group discussions seemed to speed progress in 19(

229. Szalai, A. (ed.), The Use of Time. Daily Activities of Urban and Suburban Populations in Twelve Countries, Publications of the Vienna Centre No. 5, The Hague, Mouton, 1972.

Thirty thousand time budgets give a multidimensional description of daily life (96 specific activities).

No similar study available for developing countries.

230. Tabrah, F. L., et al, "Some Aspects of Health and Nutritional Status, Awo Omamma, Nigeria," Journal of the American Dietetic Association, vol. 43, pp. 321-326, October 1963.

A study of an Eastern (Ibo) Nigerian community using various ad hoc sources concerning external signs of infection and malnutrition.

231. "The Tamil Nadu Nutrition Study," Sidney M. Cantor Associates, Haverford, Pa. 19041, 1973. AID/NESA - 399, ARC IN 641.1 c232a vol IIe.

CSM feeding program had no effect on infection rate, Hb levels or height gains. Studied were 602 children in seven test villages, 516 in control village, preschoolers age 6 to 30 months.

Parasite infestation rate is low.

232. Tan, A. C., "A Study of Health, Hygienic and Sanitary Conditions," Community Development Research Council, University of the Philippines, Diliman, Quezon City, Philippines, 1960.

A baseline survey of existing conditions of the rural towns of Bay and Los Banos in Laguna, Philippines conducted in 1959. Sanitary conditions, level of education, water supply and morbidity rates are provided in table form. Recommendations are made for progress against very unsatisfactory conditions.

233. Tandon, B. N., et al, "Nutritional Survey in Rural Population of Kumaon Hill Area, North India," American Journal of Clinical Nutrition vol. 25 (4), pp. 432-436, April 1972.

A nutritional survey in rural area 150 miles southeast of Delhi of 177 families, 1070 family members. Measures taken included one day's food to be prepared for consumption, height, weight, and other anthropometric measures. Also, 268 stools were examined. The authors found both a significant degree of nutritional deficiency and enteric disease.

234. Taylor, F. B., et al, "Economic and Social Benefits from Improving Health by Provision of Safe Drinking Water Supplies," Water for Peace, vol. 7, pp. 107-116. ARC 333.51 I616 v. 7.

It is argued that: (1) "the provision of safe water supplies is a tremendous factor in combating certain communicable disease" (cholera diarrheal disease, shigella and ascaris); (2) since "the control of communicable disease has been the greatest single factor in increasing life expectancy in developed countries...increasing life expectancy is a reasonable indication of the control of communicable disease in developing countries"; (3) life expectancy at birth is a good index of the general level of a country's health. Therefore, "the great economic benefit of providing safe water supplies can be demonstrated through utilization of this index (expectancy at birth) of national health."

A statistical relationship between per capita income and life expectancy at birth is shown. Data is presented to show that where expectancy of long life is greatest lower rates of population growth occur. This is seen as a social benefit of providing safe water supply.

235. Tennessee Valley Authority, Benefit-Cost Analysis for Water Resource Projects: A Selected Annotated Bibliography, Division of Navigation Development and Technical Library, Knoxville, Tennessee, October 1967.

236. Tie, L. T., et al, "Health Development and Nutritional Survey of Preschool Children in Central Java." American Journal of Clinical Nutrition, vol. 20, pp. 1260-1266, December 1967.

About 2000 children under five years of age were examined clinically as part of field trial of palm oil for treating vitamin A deficiency in five villages. Iron and serum albumin and anthropometric measurements were taken. Chronic undernutrition was noted.

237. Tropical Health. NAS-NRC, Publication No. 996, Washington, D.C., 1962.

Survey of 169 countries and 15 "great diseases of the tropics."

238. Urutia, J. J., et al, "Childhood Diarrhea in Rural Guatemala," Archivos Latino Americanos Nutricion, vol. 19, p. 173 ff., 1969.

A cohort of 387 children under two years of age in rural Guatemala were studied from birth in order to observe the pattern of intestinal flora, parasites and viruses and the relationship to diarrheal disease. Diarrhea was more common between three and twelve months of age, and the diseases most commonly associated with diarrhea are respiratory diseases and conjunctivitis.

239. Venkatacholan, P. S., et al, "The Role of Ascaris lumbricoides in the Nutrition of the Host: Effect of Ascariasis on Digestion of Protein," Transactions of the Royal Society of Tropical Medicine and Hygiene," vol. 47, pp. 169-175, 1953.

Reports on a balance study of nine poorly nourished children heavily infested with ascaris before and after de-worming. Found less nitrogen excreted after de-worming than before. Suggests synergism between nutrition and ascaris infestation.

240. Wagner, C.J., "Benefit - Cost Analysis: A Method to Demonstrate the Importance of Water Resources Development," International Conference on Water for Peace, vol. 8, pp. 189-193. ARC 331.51 I606 v.8.

Presents a benefit-cost method of developing a program plan for water supply system in nine steps:

1. Community status must be identified;
2. Community must establish health goal expressed in quanitifiable terms;
3. Determination must be made of community attitudes, resources and conditions;
4. Health problems must be analyzed in terms of causes and factors contributing to these causes concurrent with analysis of all other major problem areas. This must include quantification of health problems in respect to health status;

5. Alternate plans developed to eliminate or modify health problem factors;
6. Benefit-cost studies on alternate plans;
7. Establishment of total community objectives and plans of actions on short and long range basis;
8. Analyze all problem areas using benefit-cost and cost effectiveness studies to develop trade-offs to result in integrated program with major impact on established goals;
9. Institution of continuing program evaluation process.

A 1955 project by the Division of Indian Health of the Public Health Service is used as an example of benefit-cost planning. Medical treatment for preventable disease and lost productivity due to premature death produced an annual liability of $11.2 million. This figure over a 30 year period is used as a basis for benefit-cost planning.

241. Wagner, E. G., et al, "Anticipated Savings in Venezuela Through the Construction of Safe Water Supplies in the Rural Areas," Orgono Oficial de la Asociacion Interamericano de Ingenieria Sanitaria, Ano 1, No. 4, pp. 381-389, April 1948.

Calculates the national economic loss due to the great amount of water-borne diseases and estimates the net gain from potable water supplies. Consideration is given to (1) per capita production, (2) the present cost to the nation of sickness and death from water-borne diseases as well as the cost of present inadequate, contaminated water supplies, (3) cost of providing water to 2 million people in small towns, and (4) extra benefits not readily calculable but which result from safe water supply. Calculates return of 8 per one unit invested.

242. Walker, A. R., "The Problem of Seeking to Assess the Handicap Imposed by Parasitism on Certain Aspects of Health," International Review of Tropical Medicine, vol. 2, pp. 1-25, 1963.

Basing his discussion mostly on the Bantu population of South Africa, Walker discusses the problems of determining the influence of parasitism on health and distinguishing between parasitism and other factors (malnutrition) as the cause in the effect of ill health.

243. Warford, J. J., et al, "Economic Analysis and Municipal Water Supply in Developing Countries," in Transfer of Water Resources Knowledge Proceedings of the First International Conference on Transfer of Water Resources Knowledge, September 1972, Fort Collins, Col., (ed.) E. Vlachos, U. S. Water Resources Publications, Fort Collins, Col., P. O. Box 303, 80521. ARC 333.91 v. 865.

"Another way of measuring benefits is the estimation of the public health benefits of a safe, dependable water supply. This is an area where data on changes in mortality and morbidity from water-borne and water associated diseases are very sketchy and consumer behavior is an unreliable guide . The highly complex task of trying to

determine the impact of water supply is worth the effort, in view of the billions of dollars that are spent on this activity in the name of public health . . . . One reason why economics is frowned upon by those concerned with public health matters is the belief that its use is necessarily at odds with humanitarian principles. This is clearly not so, but this viewpoint is one more obstacle that has to be overcome if economic analysis is to be taken seriously in the water supply field in developing countries.

244. Waterlow, J. C., et al, "Protein Malnutrition in Brazil," FAO Nutrition Study No. 14, Rome, 1956.

245. Watson, E. H., et al, Growth and Development of Children, 5th ed., Chicago, Year Book Medical Publishers, Inc., 1967.

An average adult takes in and excretes about two liters of water daily representing 5% of total body weight or 14% of his extracullular volume.

The infant exchanges 600-700 cc daily or 20% of his body weight or nearly 50% of his extracellular fluid. Daily excretion of water by an infant is about one liter and normally half of that is reabsorbed.

A term infant is 68% water, an adult 60%. One to three year olds need 125 cc/kg daily water.

Weight 1 year = 10 kilo = 7 kilo water
2 year = 13 kilo = 9 kilo water

Body and brain triple weight between birth and one year - 65% water.

246. Webb, K. E., "Geography of Food Supply in Central Minas Gerais," National Academy of Sciences, National Research Council Publication 642, Washington, D.C., 1959.

247. Whittman, W., et al, "Malnutrition, Infection, and Socioeconomic Status," South African Medical Journal, Nutrition Reviews, vol. 26 (4), pp. 100-103, 1967.

Study designed to evaluate relationship between nutritional status and infection dividing the groups by socioeconomic status. "The study does not succeed in defining the relative importance of malnutrition and of infection in childhood morbidity but strongly concludes that there is a close association between these factors and socioeconomic circumstances." Increasing economic level rather than nutrition or public health is the "optimum mode of attack."

Place: housing estate on Cape Peninsula, South Africa; all families with piped water. Population: four strata of 30 children each racially segregated "coloreds."

Families of these 120 children were visited every two weeks by a pediatrician and social worker for one year. Heights, weights, blood, serum protein, stools and socioeconomic data were collected at beginning period point and end.

The incidence and severity of diarrhea among the poorest stratum was greatest - 75% requiring hospital treatment and 50% repeated admissions. Parasitic infection was common in all groups. The fathers' education and job are related to socioeconomic status. There is no difference in the number of working mothers between groups. Both diarrhea and protein calorie malnutrition are very closely linked to socioeconomic status.

Good nutrition and an unknown "protective factor" guard against diarrhea. This factor is more important than nutritional status except among the very deprived. Below a certain level of hygiene and child care, frequency of infection is probably mainly responsible for recurrent diarrhea. "The relative importance of malnutrition and infection in child morbidity remains undefined."

The panacea is increased family income. The reviewer suggests instead, education, family planning and job training.

248. Whittmann, W., et al, "An Evaluation of the Relationship between Nutritional Status and Infection by Means of a Field Study," South African Medical Journal, vol. 41, pp. 664-682, July 1967.

A field study in Cape Town housing estate with 4,368 children less than three years. The random sample N=120, aged three months to three years in four income strata, was visited weekly for one year by two investigators. Clinical, biochemical and bacteriological tests were done; social, environmental, anthropometric and dietary data collected.

Findings are: (1) one-third below poverty level and below Boston standards for height and weight; (2) diarrhea and morbidity correlated with low income, family size, crowding and social disorganization; (3) good weight for age protected against diarrhea.

249. Wills, V. G., et al, "The Death-Rate in the Age-Group 1-4 as an Index of Malnutrition," Journal of Tropical Pediatrics, vol. 3 (4), pp. 167-170, March 1958.

The infant mortality rate is widely used as an index of the state of public health because it is based on a period of life when danger of deaths is relatively high. The authors argue that the period of greatest danger is not necessarily the same in all countries and all environments. It is suggested that malnutrition tends to raise morbidity and mortality predominantly in the age-group 1-4 years. The mortality rate in this age-group might therefore be useful as an index of the nutritional status of a country.

World Health Organization

250. "Nutrition and Infection," World Health Organization Expert Committee on Nutrition and Infection, Technical Report Series 314, WHO, Geneva, 1965.

A report of a WHO Expert Committee discussing existing evidence of interactions of nutrition and infection. N. S. Scrimshaw was chairman of committee and restated major findings of his other work.

251. "Report of a Survey of Diarrheal Diseases in Mauritius, 1960," WHO Diarrheal Diseases Advisory Team.

On a cross-sectional basis, several samples of children and their families were physically examined and rectal swab cultures were taken. The following were among the conclusions of the examinations: a) greater diarrheal infection rates were found among those who had a less readily available water supply, b) there was less diarrhea among those using municipal water, c) occurrences of malnutrition and gastroenteritis were independent and d) diarrhea occurs in children both over and under the average height and weight.

252. WHO - Water Supply Feasibility Study, Monrovia, Liberia, Alvord, Burdick and Howson, Chicago, Ill., January, 1964. ARC LB 628.164 A476a.

Description of the problem of the Monrovia water supply installed in 1953 and 1958. Discussion of health problems related to failure of chlorination program. Water was more contaminated during wet season than during dry season. Even with hospital care available from a company plantation, infant mortality was 50%, 10% due to diarrhea.

253. Wyon, J. B., et al, The Khanna Study: Population Problems in the Rural Punjab, Cambridge, Harvard University Press, 1971.

254. Yekutiel, P., "Epidemiological Methods Used in the Study of Infantile Diarrhea in Israel," Bull. WHO, vol. 21 (3), pp. 374-381, 1959.

Preliminary methods-report of a survey of approximately 1000 children under three years of age for seventeen months in five small communities. Questionnaire forms are given showing collection of data for sanitary conditions, type of feeding, handling of food utensils, weights, diarrhea data. Water supply was individual house tap or outside tap serving two houses, and either water-carrying lavatories or earth latrines. Bacteria and parasite stool examinations were done every two weeks, rainfall was measured (diarrhea was more prevalent during hot and dry spells), and certain demographic data collected either in the home or the MCH clinic.

All cases of diarrhea were seen at home by the nurse and a diarrhea register maintained. The results were not analyzed or reported because of a shortage of statistical help, and it is planned to publish the results sometime in the future.