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INTRODUCTION: THE DETERMINANTS OF HEALTH AND NUTRITION

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INTRODUCTION:

DETERMINANTS OF HEALTH AND NUTRITION

The following four papers discuss the impact of health and nutrition programs on health and nutrition, and also on educational, social and economic conditions of family life. This multicriteria approach to the measurement of program impact reflects our belief that the development process is highly complex as it affects the individual and family. We believe that social service programs modify the balance of the set of factors that influence the family, and it is this overall balance that conditions the quality of life for the individual and family. Consequently, we felt it necessary to study the impact of health and nutrition programs not only in terms of their explicit or nominal objectives, but also in terms of impact on the other closely linked and important objectives.

The emphasis on the family as the unit of measurement was consciously and deliberately chosen. One may discuss the impact of health and nutrition programs on the individual, family, community, region, or nation. Each focus provides unique insights and requires specific measurements and approaches. Focusing on the individual tends to direct attention to the efficacy of medical treatment and nutrition interventions. Focusing on populations - the community, region or nation - emphasizes the externalities of health and nutrition services. Emphasizing the family allows attention to be directed at both the efficacy of treatment and the externalities of community immunity and prevalence of disease, but also focus directly on the most important interpersonal interactions. It is in the family group that vital decisions are made regarding the distribution of food, the relative importance of various personal and familiar objectives, and the behavior that will encourage health or increase the vulnerability to disease.

The following paper discusses the impact of health and nutrition programs on health and nutrition. In this area we expect the clearest theoretical understanding of the relationship of program and objective, and the clearest demonstration of causality. Here is the acid test of programs; if impact on health and nutrition can not be shown comparable to investment, health and nutrition programs will be severely criticized. Historically the evaluation of health programs has been notoriously ineffective, and serious criticisms of health programs for lack of impact (1) or negative impact (2) are current. Consequently this chapter is central theme of the conference.

The evaluation of the impact of health and nutrition programs on household economy is treated in the subsequent paper. The theme is an extension of historically important work (3), (4) in health economics

relating to the investment value of health services, and to more recent work on nutrition and productivity (5). In the more modern treatment, however, it is recognized that the income redistribution and risk sharing impacts of social services must be measured directly. Moreover as health and nutrition programs are more fully integrated into a philosophy of generalized community development, health and nutrition impacts may be indirect effects mediated through familial economic changes. Finally welfare must be estimated in terms of the family's own valuation of its condition. Without an appreciation of these conceptual issues and appropriate measurements of economic variables, we feel that evaluation of health and nutrition programs will probably be partial and to some extent misleading.

It is obvious that the physical health of the family is a strong conditioning factor for the socio-economic health of the family. The social pathology caused by the death of a parent of a young family is a standard historical theme. More generally, the history, existence, or high risk of disease and disability must influence family behavior in a variety of ways, many dysfunctional in overall social context. Perhaps the strongest area of debate in this field is whether perceived high probability of death of children is a major causal factor for continued high fertility. In any case serious evaluation of the impact of health and nutrition services, discussed in the third paper, is a key element in holistic service evaluation as well as a necessity in resolving major theoretical issue in the value of health services.

Finally, the impact of health and nutrition services on social competence is treated in the last paper of this section. Strong indications exist the severe malnutrition of young children causes irremediable reduction of mental capacity. More immediately, many health and nutrition projects are undertaken specifically to improve the performance of children in school. It is also the case that health services are also often described as non-formal education, in that they educate traditional consumers as to the value of (governmental) services from the modern sector. In almost all cases, educational objectives of health and nutrition services postulate indirect causality. The result is a situation of educational objectives being important in motivation of services, but difficult to evaluate in terms of service impact.

Each of the papers presented is developed with discussion of 1) the conceptual framework linking health and nutrition programs with impacts of concern, and 2) the indices and measurements required to measure the hypothesized impacts. This focus is fundamental to approach to evaluation that the conference is intended to promulgate. Changes in the quality of life accrue from a number of sources: autonomous actions of individuals and families, direct and indirect impacts of private and public programs, changes in the environment beyond the control of man; and chance. In the evaluation of health and nutrition programs it will not suffice to measure improvements in welfare that occur during the programs. Rather, it is necessary to deal conceptually with the causability of change, and to attribute to any program only those

changes that it may reasonably be thought to have caused. For this purpose a conceptual model of causality is fundamental. The model which allows the attribution of change to programmatic vs. non-programmatic causal factors is as much a part of the evaluation method as is the measurement of the hypothesized causal factors and the measurement of the variables related to impact.

It is also the case that the conceptual model underlying the evaluation conditions the selection of variables used to measure impact, the quantitative techniques used to extrapolate from the data, and ultimately the feasibility of the evaluation itself.

The following four papers stress the impact of health and nutrition programs on various key socio-economic indicators. This focus is related to a micro-economic approach to health and nutrition planning. For a decade or more, however, there has been a growing realization of the need for a complementary macro-economic process of health planning. Demographic planners are realizing that in addition to planning for the delivery of family planning services, the impact of overall national programs of economic development on demographic trends can be predicted and manipulated. Nutrition planners are similarly going beyond food supplement and nutrition recuperation program management, to study and modify national agricultural, commercial and employment policies for nutritional purposes. Health planners in democratic countries appear to be lagging in this area, but they too are beginning to realize the potential for macro-socio-economic planning to improve health.

Historically, in most countries, improved life expectancy and increased height and weight have paralleled improved socio-economic conditions. Moreover, the improvements in health and nutrition and a fall in birth rate often preceded related advances in medical technology in North American and Europe. This is not to say that medical technology is not important. Less developed countries today generally show better indices of health than did European countries at similar stages of economic development. Rather it points to a complex causality with both socio-economic and health service (technology) factors interacting to influence health and nutrition status.

The case that socio-economic factors influence health and nutrition is quite appealing. Development of food systems generally makes food more affordable and available, contributing to increased consumption, which at least early in the process of development reduces malnutrition and its sequelae. Demographic transition, the lowering of birth rates accompanying development, results in women with high medical risk having fewer children. Fewer children per family in turn results in more family income and wealth being available for each member, in longer interchild spacing allowing more attention per child, and finally in less interfamilial contact of communicable disease. Increasing personal and familial wealth and income allow purchase of a better diet, of more adequate clothing and shelter, and of services which contribute to health. Similarly the developing infrastructure of

aqueducts and sewage systems allows better personal hygiene reducing the transmission of disease, while potable water reduces the incidence of water-born disease. Education increases the understanding of the individual and the family of disease processes and thereby leads to better capacity to prevent or treat illness. Finally, as all of these factors combine to decrease the incidence of disease, the effect becomes nonlinear. Thus generally unhealthy and poorly nourished people in a community with high disease prevalence may be both more vulnerable and more exposed to disease than their richer neighbor as well as less prepared to protect and cure themselves.

In a simple model of the spread of a communicable disease, one might suggest that

$$i = c \cdot v \cdot s \cdot p$$

where: i is the incidence
 c is a contact rate between susceptibles and sources of infection
 v is the vulnerability to infection
 s is the number of susceptibles
 p is the number of persons with infections

The poor may be subjected to higher contact rates because of larger families, crowding and inadequate barriers to disease. They may be more vulnerable because of poorer health and nutrition and fewer inoculations. These factors increase incidence, increasing prevalence in turn in a vicious cycle. These arguments will be expanded in the following discussion.

Why must the impact of socio-economic development on health be discussed here in the context of evaluation of the impact of health and nutrition programs? We are after all treating in one brief exposition a topic larger than that treated in the following four papers. Moreover the following papers will discuss specific socio-economic variables and their impact on health and nutrition in the context of control variables. These reasons motivate the discussion. As planners focus more on macro policies to influence health, nutrition and population evaluation of the impact of macro policies will require such an approach. Secondly, conceptual understanding of the impact of development on health appears necessary if program impact evaluation is to be used fully. Finally, the mathematical analysis of bidirectional causal systems is different than that for more simple hierarchical or unidirectional causal systems.

Our conceptual model suggests that health and nutrition have a strong impact on family economics, education, family size, and other socio-economic factors. We also consider that these latter factors strongly influence health and nutrition. Consequently, simple techniques describing quantitative causal importance to correlations will not necessarily be appropriate.

Simple models suggest that an outcome variable is simply determined by the influence of a number of controllable and non-controllable independent variables. (7, 8, 9) We are postulating a more complex situation in which changes in each health and socio-economic variable tend to depend on all the other variables. Thus a highly complex feedback situations exists.

A set of values representing either a cross-section of communities or a history of one community will not represent a set of outcome of independent experiments. Rather it represents a set of sets of solutions to complex sets of social equations. In theory, this viewpoint suggests that two or three stage linear regressions are more appropriate than linear regressions (or simple analysis of variance techniques comparable to linear regressions).

In practice, the great complexity of interaction of health and nutrition programs and socio-economic development should lead us to great caution. The topic is among the most complex in modern society, and our theoretical understanding and measurement capacity are frail indeed. Impact evaluation in these areas is of paramount importance, but should be approached with humility, and results interpreted with caution and restraint. We suggest that the major benefit from improved evaluation programs will come as many investigations contribute information to a growing world understanding of health, nutrition, development and social service programs.

THE IMPACT OF AGRICULTURAL AND FOOD POLICIES
ON HEALTH AND NUTRITION

In developing countries the primary problem of malnutrition is not consuming enough food. Only in special groups such as children being weaned, is the quality of the diet a major problem underlying malnutrition. The fundamental requisites to resolve problems of malnutrition are that sufficient appropriate food be available, and that individuals and families have the economic power to acquire that food. If there is no food, or if people are too poor to buy an adequate diet, there will be malnutrition.

This simplistic statement has profound consequences in terms of nutrition planning. It suggests that national agricultural programming is required to assure food availability. In fact, such macro-economic planning for nutrition is being actively promulgated by international organizations. (11, 12, 13)

The variables describing food as seen by the consumer, which are major output indicators for agricultural and economic policy on the national level, are key variables in understanding nutrition. In principal, one would wish to monitor these national policies, their direct impacts on key intervening variables, and their further impacts on health and nutrition. Such a conceptual framework for evaluation would be useful for evaluation of micro or macro programs.*

Food availability may be defined as the amount of food available per person. While it may be measured in terms of amounts of different foods available per person, per unit time, it appears more useful to transform measurements into nutrient categories: calories, proteins, vitamins, minerals, etc. While as discussed in the following paper, per capita food requirements are subject to considerable uncertainty, a standardized value of availability seems appropriate. Thus, demographic information on age structure and age specific fertility of the population is needed to standardize food availability data.

The major concern in evaluating food availability is obviously the degree of disaggregation used. Availability must be disaggregated at least along three dimensions: geographic, temporal and economic. One must study the availability of food within the geographic context perceived by the target families. One must study food availability at various periods both in the outgoing of the individual and during the calendar year. One must study food availability at different costs.

*A micro-program is one composed of direct medical or food services for health or nutritional effects on individuals. A macro-program is one composed of macro-economic or socio-economic policy actions to achieve health and nutrition objectives for large groups of the society.

Agricultural production policies are the most obvious policies determining food availability.(14) Investment in land and water resources, improvement of technology, improvement of agricultural input and product markets, subsidies and excise taxes all modify the production of food. Policies implemented with sound bases such as to improve balance of trade or to maximize agricultural income, may have profound negative impacts on food availability as when farmland is devoted to high value, low nutrient productivity crops such as coffee or tea. Alternatively such policies may be nutritionally appropriate where a comparative advantage favors purchase of food grains with export earnings.

Food processing activities must also be considered. Increasing attention is being directed to the reduction of post-harvest food losses in developing countries. Such losses are an important source of reduction of availability for even food grains, but are very important for more perishable foods. Obviously, food storage and preservation is critically important in terms of seasonal food shortages. Similarly, fortification and the development of new nutrition foods offer significant potential for improving nutrient abilities at low cost.(14)

Food distribution systems also have a key role in determining food availability. Historically, famine has been a problem of the local failure of food supplies rather than of global facilities. Crop failures in large geographical areas cause almost insuperable obstacles in moving adequate stocks of food. However, even in non-critical periods the food distribution system involves relatively high costs, significant losses of perishable foods, and inescapably allows geographical variation the per capita amounts and prices of food.

The affordability of food involves the price of food relative to the income and wealth of the individual. Even in the case of the subsistence farmer, the resource costs of the food he produces must be compared with the total resources he controls. When income increases more rapidly than inflation, (principally food costs) for the poor, nutrition status tends to improve.(15) Thus, national policies that influence levels of income and wealth are of key concern. Such policies as employment, income distribution, and land reform are obviously central to Latin American concerns for food availability.

The capacity of the family to use its economic resources appropriately to acquire a good diet must also be mentioned. Where ignorance or superstition interferes with the family's

ability to acquire and prepare the most nutritious diet available within its economic means there is considerable potential for malnutrition, even in the presence of adequate food availability and affordability. Education and modernization tend to overcome informational and cultural barriers to good nutrition.

Obviously, health and nutrition are also closely inter-related. Specifically health and particularly environmental sanitation measures are often included in nutrition policies and programs. Poor health may reduce appetite, reduce the absorption of food consumed, and increase the food requirements of the individual.

It has been suggested that (national, regional and local) policies that affect agricultural productivity, processing, food distribution, per capita income, education and modernization should be monitored, related to food availability, affordability and consumption and these in turn related to changes in nutrition and health status. Practically it appears unreasonable to develop a comprehensive monitoring system for such variables, except in the context of evaluation of exceptionally ambitious national, macro-economic, nutrition program. However, in evaluation of a health or nutrition service, a diary might be maintained of important events in food or income policy, and this diary used in interpreting control variables of food price, local food availability, and family income.

Food sanitation practices should also be monitored. Public health practices normally includes monitoring of quality of milk and milk products, water, meat, and restaurants. Obviously, as contaminated food causes disease, and disease in turn influences nutritional status, strong direct influences are possible. Often in Latin America, extensive sanitary inspection, activities by sanitarians are undertaken and provide input data for such analyses.

Lactation and weaning may be identified for special attention because of the extreme vulnerability of the young child. Ideally, child development in Latin America would involve an extended period of breast feeding with an appropriately timed gradual transition to high quality weaning foods. Breast feeding is advised for immunologic, food quality and sanitary reasons. Food marketing policies(16), public policies regulating advertising, and nutrition education can all influence breast feeding and weaning behavior.

The Impact of Population Policies on Health and Nutrition

A population policy relates overall social programs to key demographic objectives--the rate of population growth, the demographic profile of the population, the geographical distribution, etc. Direct programs include the provision of family planning services, motivational and educational programs, and may extend to direct governmental incentives or disincentives to the family to have additional children.(17) Indirect, socio-economic programs are also generally conceded to influence demographic trends.(17) Such programs would include education and employment programs, especially those favoring women, income redistribution, etc. Generally it is perceived that these developmental programs which increase the social competence and economic well-being of the poor (who have high birth rates), will result in smaller families.(18)

The notion of a population policy may prove useful even in those countries in which no explicit policy exists, or in which policy is pro-natalist rather than anti-natalist. The conceptual framework emphasizes that certain direct and indirect societal and government actions closely identified theoretically with socio-economic development, influence the procreation behavior of the family.

The principal macro-economic rationales for reduced population growth have obvious repercussions at the level of familial health:

a) Reduced population growth allows sustained growth in GNP to be transmitted to higher per capita income growth. Thus, both the rapidly increasing per capita product and the policy instruments used to control population growth should improve the poor families socio-economic status, allowing improved health and nutrition.

b) Improved (increased) ratios of wage earners to dependents allow the per-capita productivity of the society to increase. This, in turn, reflects in the family where, on the average, the number of dependents per wage earner should decrease and well-being should increase.

c) As family size decreases, then the number of persons on the average dwelling and eating together in close proximity should decrease. Since the highest rate of transmission of communicable disease is within close

familial households, decreasing average size of the household should decrease incidence and prevalence of disease.

d) As child bearing is reduced, it may be confined more nearly to the optimal period in the life of the woman, and child spacing may be increased. These effects both reduce biological strain and risk for the mother and child. (19,20,21,22)

In addition to these mechanisms obviously changing age, fertility and sex structure has profound impact on health. These demographic characteristics are very strong predictors of morbidity by cause. Specifically, as the population becomes older the relative importance of heart disease and tumors increases and those of infectious diseases and diseases of childhood decrease. Consequently, changes of disease prevalence and use of medical services must be considered in light of demographic changes in the community.

The conceptual framework postulated for discussion of procreation activities suggests that the family has offspring according to attitudes as to the best number of children, information and means available for controlling fertility, the costs of raising children, the economic alternatives open to having children and for the childrens' lives, and other factors.

Many of these factors are related to the status and role of women. As women have more education and status they have more earning power. The earning power increases the opportunity cost of bearing children. It also decreases many incentives to early or repeated marriages. Similarly, as social competence and income increases it may be postulated that couples have more opportunity and capacity to use health and family planning services, and are less prone to fatalistic reasoning and behaviors. On the other hand, as economic incentives increase outside the home there may be a tendency to reduce child care. Reduced child care may in turn cause nutritional problems and increased disease prevalence in children.

A number of indices are available in many countries describing the characteristics of sexual activity. These include estimates of the age of menarche, initiation of sexual activity, marriage, birth of first and last children, and estimates of fertility and fecundity. Often such estimates are available not only on the basis of ten

year census data, but for intermediate dates from sample surveys. Similarly marriage, divorce, legitimacy and illegitimacy rates are often available.

Indicators of the coverage and effectiveness of direct family planning programs are well-known. They range from indicators of attitudes, knowledge and practice of family planning obtained through field surveys, to records of numbers of contacts, acceptors and persons in control for family planning services, to age-specific birth rates and estimates of births averted. Program statistics are often available for education and motivation programs, for family planning programs by type of contraceptive, and for key incentive or sanction activities.

Indirect population policy instruments are often more difficult to measure. There appears to be no single convincing indicator for the status of women in the society which would predict procreational activity. Employment, wages, literacy, educational attainment and differentials between men and women in all of these indices are commonly available and useful.

Where national plans include a population policy, or where population impact analyses of national plans have been prepared it may be possible to predict and monitor these variables in the framework of health and nutrition program evaluations. This will normally not be the case, especially since it will be rare to find control data available at the level of disaggregation needed for health and nutrition project evaluation. Given the conceptual framework, however, it should be possible to maintain a diary of major initiatives in population policy or in socio-economic policy that might influence health and nutrition through demographic mechanisms. Sample surveys or the addition of key population policy indicators to existing instruments may also be considered.

THE IMPACT OF INCOME AND EMPLOYMENT
ON HEALTH AND NUTRITION

This section deals with two principal sets of variables: those relating to income (or, more broadly, economic well-being) and those concerning employment. Perhaps the scope of those factors is captured by the term "household economy." It must be realized, as suggested in passages above dealing with "bidirectionality," that income and employment have a two-way relationship with health and nutrition. For example, it is obvious that improved health and nutrition lead to higher levels of income through a more productive work force, while more income in turn can yield better health and nutrition status. Here, we treat only the second direction of causality, the one that runs:

Income and Employment —→ Health and Nutrition.

Income and Wealth

As Sharpston of the World Bank has written, "there has been a growing realization in the development community as a whole that gross national product (GNP) per capita alone is not an adequate measure of development and of its effect on human welfare." (23, p. 24) A logical outcome of this realization for the Bank and others has been "increased attention to income distribution and to the social sectors." (23, p. 24) This focus includes a renewed concern with employment (discussed separately in sub-section "B" below). An important reason for this modification of view was the accumulation of evidence for the 1960's that "many countries experience rising per capita incomes, but the lives of the people did not improve at all. Indeed, it seems to be the case that in the early stages of per capita income growth, the lot of the poor deteriorates." (24, cited in 25, pp. 18-19)

Obviously, additional measures of economic level are needed. Some of these would simply carry on, and perhaps extend, the long search for an ideal index of degree of income equality or inequality within a population. Others would elaborate the concept to embrace "socio-economic status," going beyond the scope of this section. Still others could make the useful distinction between "income" (a flow of funds or resources within a given period of time) and "wealth" (a stock of assets at some point in time). There even have been attempts to incorporate the value of leisure available to a typical family into a measure of its situation.

It appears that in practice there is no single satisfactory alternative to per capita GNP (or a similar average income figure) for our needs. Nevertheless, attention should be directed to a promising attempt by Weisbrod and Hansen in a wealthy country to measure "economic welfare." (26) Their indicator of the level and distribution of welfare "is based on a combination of current income and current net worth (assets minus liabilities)" (26, p. 1315), with net worth being converted into an annual income stream by treating it like a lifetime annuity. Applying their new measure to illustrative (1962) data for families in the United States, they found that the degree of inequality worsened when net worth was considered in contrast to income alone. It would be hazardous to generalize this finding to other periods and to other countries--especially in view of the differences among them in importance of non-market income--but specific new applications appear worth considering for those concerned with distributional questions, as many health and nutritional specialists are.

Whatever the exact selection of the indicator of economic status, analysts might wish to consider the challenge of identifying the value of income or other economic level that denotes the cut-off point of ill health or malnutrition. Of course, such a value will depend upon one's notion of health or nutrition problems, and it probably will vary among populations. Still, there could be policy uses of findings as to the approximate "poverty line" (or range) related to a problem set.* In principle, this could be identified for ill health of one sort or another. In practice, there probably has been a closer approach to application of the concept as it relates to nutritional deficiencies.

Without establishing an income cut-off, Swanberg and Shipley obtained suggestive data from two areas within the same rural region of Colombia.(27) We cannot do full justice to their experiment here, but can identify their conclusions of chief interest in our context as follows:

- (1) Incomes are probably not as important as other factors (perhaps, disease and unsanitary living conditions) in affecting overall health status (e.g., height and weight of preschoolers);

*Among others, F. James Levinson has suggested this; interview of February 6, 1977.

- (2) "Protein and calorie intake were found to be more highly correlated with expenditure and income than were calcium, vitamin A, or riboflavin."
(27, pp. 123-124)

Their work provides a step towards a poverty line and, at the same time, contains several useful cautions for future investigators, including the need to distinguish in studies among various nutritional problems and in policies among various areas or regions of a country.

A commonly cited concept regarding economic variables and health and nutrition is the "income elasticity of demand" for a product, such as a type of health service or food. It refers to the relationship between percentage change in quantity of product demanded (implying ability as well as willingness to buy) and the corresponding percentage change in income of the demanders in question. An elasticity coefficient greater than one would denote a greater than proportionate increase in demand as income rises. Elasticity is greater than one for luxuries and less than one for necessities. (See also Section II on agriculture and food.)

It is far easier to define the concept and to theorize on its values than it is to estimate it empirically, especially in poorer countries with weaker data bases. There has been enough field research to indicate income elasticities for various foods, with important nutritional implications, but the values for health services are not well established. Among the reasons for that are the limitations of field survey instruments and the high random element in health care utilization (not so true of food).^{*} A measuremental problem that must be acknowledged is the likelihood that demand data available will be in terms of monetary expenditures instead of product quantities (as required technically for elasticities). In that case, price movements can confound apparent demand variations as income changes.

Among the diverse items of evidence or even just suggestions regarding income elasticity values, two might be cited--mostly to point to additional work ahead in the health and nutrition fields:

- (1) Working from admittedly imperfect data from 13 well-developed countries, Newhouse decided that

^{*}We are indebted to George Poyner for some of these comments; interview of March 24, 1977.

"both cross-nation and time-series (within nation) data support the conclusion that the income elasticity of national medical care expenditure is greater than one."(28, p. 16) The applicability of this to developing countries is open to serious question.

- (2) A recent review of 1971 cross-sectional consumer expenditure data in Colombia yielded no consistent income elasticities for urban or rural areas for a variety of possible reasons (29, p. 33, based on preliminary work by Corporacion Centro Regional de Poblacion of Bogota); more important findings of the same project were the differences in patterns of health service utilization by different income classes in Colombia and in Santo Domingo, Dominican Republic.(29, pp. 33, 42-43)

Employment and Occupational Health

There are many well-established indicators of employment or labor activity in a country, including ones for the proportion of adult population participating in the labor force, level of employment, and level or percentage of unemployment. Less settled, but highly important, measures exist to estimate job vacancies and also the degree of "underemployment" or under-use of human resources. We leave the general topic of employment measurement to other authors, with the warning that the crucial problems concern the quality of data for those indicators, still a matter of concern to several international agencies.

This section will deal also with occupational health; there, too, there are fairly well accepted ways to measure it--or its converse, ill health, as through industrial accident rates and time lost from work due to health problems. Admittedly, data needs remain great, especially in obtaining broad-based information on population health status and in separating the effects of job-related problems from others.

Before examining the main ideas concerning employment and health, we might make one lesser, but nevertheless useful, observation. Employment opportunities can distort the delivery of health and, perhaps, nutritional services by affecting the location of providers of care. That is, providers' earnings opportunities are likely to affect their choice of location of practice. Those opportunities, in turn, are associated with local employment (and overall economic) conditions. Whether the impact of the economy on

the geographical distribution of services has any important effects on health status is a variant of a basic outcome question of this conference: What really affects health and nutrition?

For our purposes the most notable fact in the present context, besides the obviously positive effect of employment on income, is the perverse relationship, at least in the short run, between employment opportunities and health. (The role of nutrition here is not so clear.) Put differently, increased chances for employment might worsen the health level of the affected population in the near run (of several years). There are two types of reasons for this seemingly strange situation. One is illustrated by the familiar experience of several countries that the development of new regions has led to a rise in certain diseases, like malaria. Development projects, such as dams, might have aggravated other threats, like schistosomiasis. Of course, an increase in exposure of the population to disease threats, already existing in a region or aggravated by development, is involved in such cases.

The second type of reason for the perverse short run relation of employment to health consists of occupational health hazards. The nature of industrial accidents and of job-related sicknesses is well known.(30) With or without good statistics on these problems, we can note their importance in poorer, as well as more highly developed, nations. Agriculture--the backbone of a typical developing country's economy--is notoriously unsafe, especially as mechanization increases. But the bodily threats multiply as industrialization proceeds. A body of information is accumulating through the efforts of agencies like the International Labor Organization and from case studies in developing countries. (31, reviewed in 32; 33)

Health problems related to growing employment opportunities point to several needs for future work. One is to develop better data on some aspects of this, such as industrial sicknesses. Another is to devise programs or interventions to ameliorate the difficulties. By way of illustrating the challenge here, we point to the fruitful possibilities for combining market incentives (such as insurance contribution rates for companies) and governmental regulations to attack occupational health problems. The payoff to such policies--clarified with better data on health impacts--can be great in the form of decreased absenteeism, increased productivity, lowered labor turnover, lessened disability and mortality, and medical services avoided.(33, p. 40)

IMPACT OF INFRASTRUCTURE DEVELOPMENT POLICIES
ON HEALTH AND NUTRITION

Aside from the income and employment effects of infrastructure developmental policies on health and nutrition, the type of infrastructure invested in has varying impacts on health. An example may be useful at this point. Health planners would not ordinarily equate the same value to prevention of pertussis (whooping cough) as to treatment of a child sick with pertussis. Prevention is obviously superior both with respect to lower cost in most instances and a preferred health effect. Frequently the same planner, however, will make no distinction between types of water supply systems, although their health effects may vary markedly and may be much more important than the results of vaccination programs.

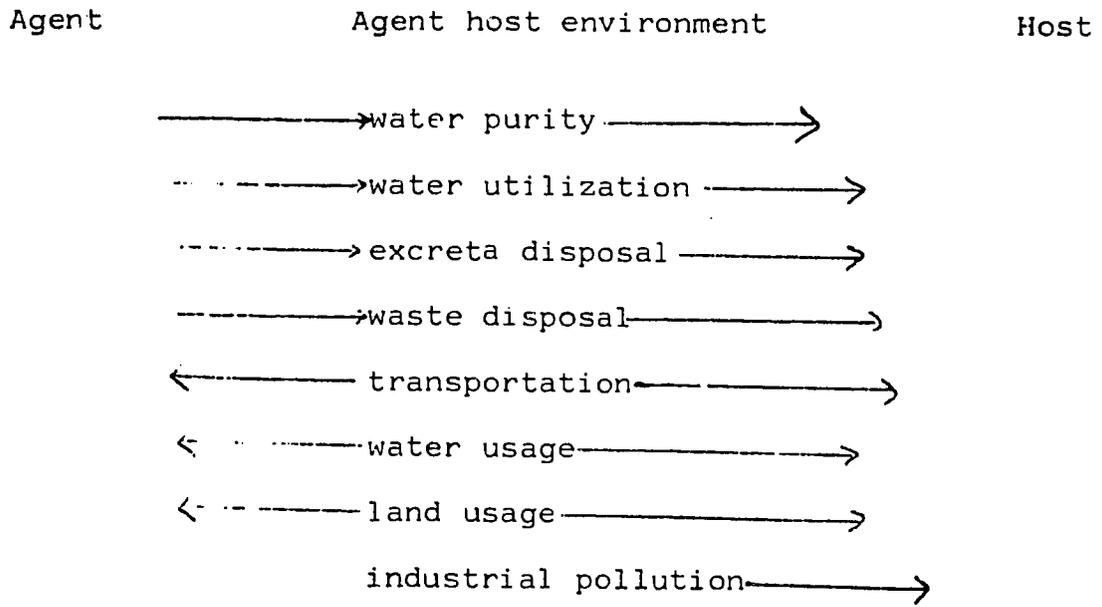
The major health and nutrition impacts to be considered are outlined in diagram 1 on the following page.

From the perspective of the major health and nutrition impacts of the variables involved, most serve to alter the environment within which the agent and the host interact. In a lesser number of instances, toxic agents are a direct by-product of investments or health and nutritional variables have a direct result on outcome of activities in other sectors.

Environmental sanitation facilities perhaps form the most conceptually important area of infrastructure development from the perspective of their impact on health and nutrition. There are several ways in which this impact is achieved. They are: A) Water can serve as a vehicle for bacteriological or toxic substances which cause ill health upon ingestion of contaminated water. This was most vividly portrayed by John Snow's (34) incrimination of the Broad Street pump as a source of cholera in 1851.

Despite the nature of such incidents, they are relatively infrequent when viewed from the perspective of total water related diarrheal case load. Although a few water borne epidemics continue to be identified, (35) the currently most frequent type of health impact by ingestion of contaminated water supplies is that due to metals and chemical pollution (36) of the water supply. B) The utilization of water as a cleansing and dilutional factor to diminish contact between the host (man) and biological agents. This is obviously the mechanism whereby the health improvement from sanitary sewers is realized but also, and perhaps

Diagram I



more importantly, is the mechanism whereby potable water has its greatest impact. Several studies have indicated that the major impact of potable water is dependent upon its adequate utilization. The utilization of greater amounts of water goes for more frequent bathing, washing of hands, household cleanliness, cleaner eating utensils, etc.

C) The third type of sanitation infrastructure investment is that of a mechanical separation of biological agents or toxins from the host (man). This includes garbage disposal and latrines as well as the disposal of toxic waste substances.

The impacts on health and nutrition of the various biological, metallic, and chemical toxic agents are specific to the agent but also their effect on the host is conditioned both by other factors in the host's environment and by host factors.

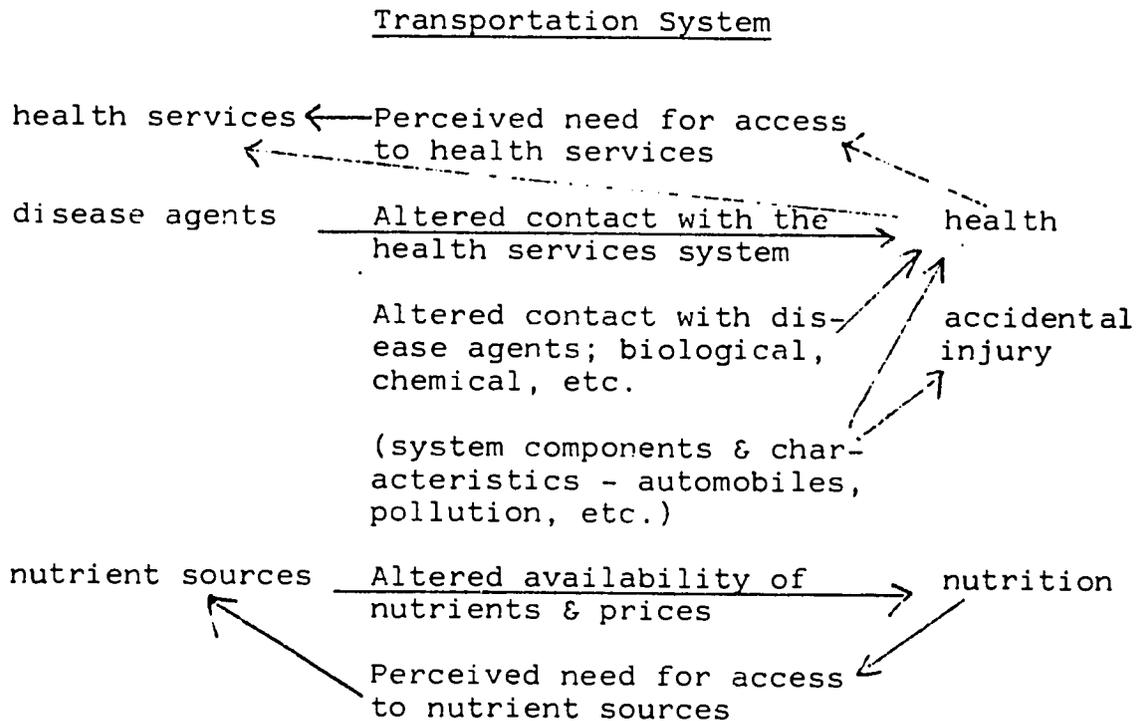
The most important host factors are physiological and dietary. Physiological conditioning factors include age, body size (immunological competence), level of nutrient intake and presence of other debilitating factors. The most important set of factors to account for appears to be those associated with the diarrheal disease-malnutrition complex which will be discussed in other papers.

The conditioning factors which can exist in the host-agent environment and confound the measurement of impact are almost limitless. The causative agents of diarrheal disease are only infrequently identified and include factors entirely unrelated to sanitation.(38) The specific host-agent environmental changes produced by utilization of adequate amounts of potable water are almost never identified.

The impact measurement problems, therefore, appear to be inversely proportional with the directness of the contact between the host and the agent. In the case of waterborne epidemic diseases or direct human contact with toxic materials impact measurements are relatively simple. In the case, however, of sanitation measures which alter the environment of the host-agent contact, impact measurement and the specification of causality becomes enormously complex. Take the example of utilization of adequate amounts of potable water. Water can influence the environments of food preparation, personal cleanliness, waste disposal, clothing, household cleanliness, and many other factors which we have little knowledge concerning their impact on diarrheal disease and all of which vary markedly with climate, social, cultural, economic, and educational levels of households involved.(39)

Bidirectional causality is one of the major themes of this paper. In the specific area of environmental infrastructure this aspect is not of much import. Health and nutritional status, per se, have very little impact on the development of environmental infrastructure.

Transportation investments also potentially influence health and nutrition in several ways. They alter the host agent environment by changing the rapidity of contact between individuals and altering the time required to expose an individual or group of individuals to an infectious or toxic agent. They incorporate new agents which directly effect the health of man and they also are associated with changes in host characteristics as well. Some of the relationships are diagrammed below:



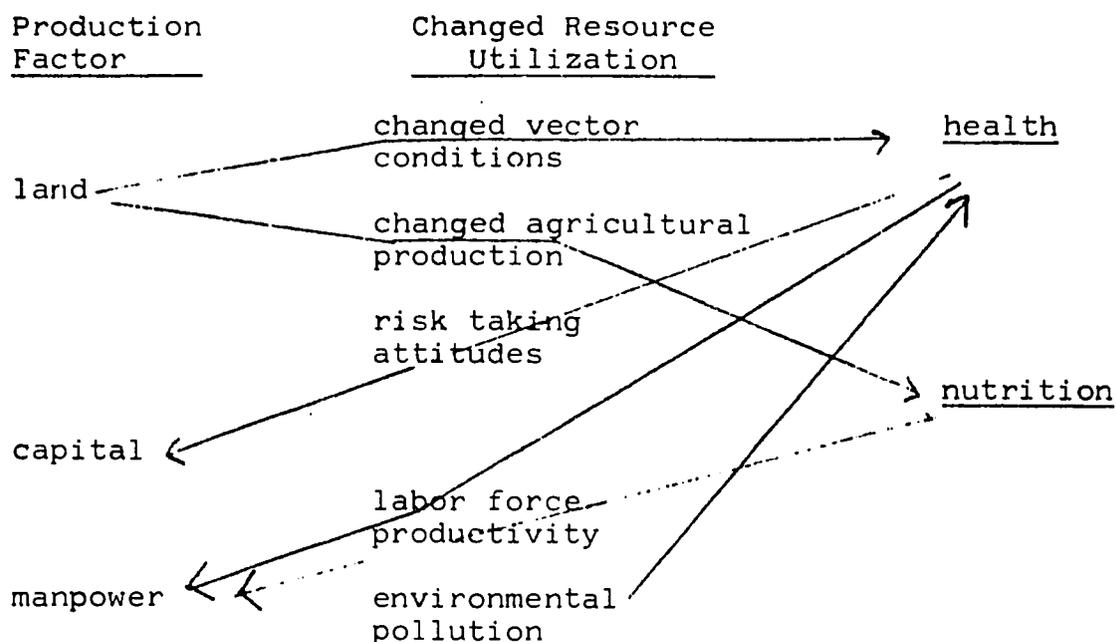
Transportation system configuration and components have a very important direct effect on health. In many societies they form the largest single cause of death in the young adult population.(40) Factors like the use of seat belts, speed limits, the use of public buses or trains instead of private automobiles, pedestrian overpasses in urban areas, etc.; all have a significant impact on accidental injury and death rates.(41)

A second area of potential impact is that of the alteration of patterns of spread of infectious disease determined in part by the probability of introduction of the disease agent into the population susceptible to the disease and the subsequent frequency of person to person contact among the population. Improved transportation systems both increase the probability of introduction by transporting a large number of individuals into a region from a wider source area outside the region and by increasing the frequency of contact between individuals.(42) The literature cites many examples of the introduction of communicable diseases into previously unexposed populations.(43) These examples are becoming more infrequent with greater social mobility, improved transportation, etc. They continue to occur in some instances like the incidence of cutaneous leishmaniasis (44) in workers on the Trans-Amazonian highway.

A more frequent occurrence at the current time is the more constant reintroduction of common communicable diseases into the child population. This frequently implies a higher mortality rate and complication rate than would otherwise be the case.

Transportation and communication systems have a major impact on relative prices for foods, health services and nutrient distribution services. Frequently transportation of food stuffs costs as much as the food itself with a resultant marked impact on family diets. Also, travel costs both in real payment for transport and in time lost due to slow or non-existent transport facilities, impacts on the frequency of utilization of health services. Reduction of real costs or travel time will be expected to have a marked impact on demand for services as relative cost decreases. Although the extant literature cites many examples of health problems influencing the construction of transport systems, this aspect presents fewer problems today.

Programs with a major environmental impact constitute another area of impact of infrastructure development policies on health and nutrition. The diagram below identifies some of the relationships involved.



Various examples are cited in the literature.(45) The major areas of impact appear to be: 1) the changes in disease and disease vector patterns due to changed environmental features; 2) the direct impacts of health and nutrition; and 3) the impact of health and nutrition on the utilization of resource factors.

The alteration of land and water use patterns in tropical countries frequently alters disease patterns. Frequently cited examples are malaria, trypanosomiasis, onchocerciasis, and schistosomiasis.(46) In most of the diseases, alteration is due to the changed habitat of the intermediate vector.

The changed utilization of land, manpower, and capital resources and other natural resources results in changed availability of goods to the population. The two major examples are altered availability of food stuffs as agricultural production patterns change and secondly, the alteration of the environment due to changed patterns of industrial and agricultural pollution. The most important areas to be considered are water contamination, discussed earlier in this section and air pollution. The variety of potentially detrimental air pollutants is quite large but the most important ones from the health perspective are hydrocarbons, sulfur dioxide and carbon monoxide. (47) Rather difficult measurement problems exist when calculating the impact on the environment outside the industrial plant due to the effect of climatic variation on pollutant density.

Health and nutritional status also have frequent impacts on the use of manpower resources.(48) A malnourished or an ill labor force results in a different mix of factors of production than would be the case otherwise. The import of this impact on labor force productivity is very difficult to measure as it is subject to long-term adjustments in expected labor force productivity and levels of unemployment.

Another aspect which is not well understood is the impact on savings-investment decisions of expected illness or mortality.(49) Theoretically the issue is that the level of savings and investment is reduced as the expectation that the investor will be alive and healthy to realize the returns from that investment decreases.

As obvious from the foregoing discussion, the variety of potential linkages between health, nutrition and environmental infrastructure is quite broad. The relative magnitude of the linkages and the difficulty of measurement are important to estimate prior to the development of impact measurement programs. Unfortunately, as is usually the case, it appears that the variables most important to measure are also the most difficult to measure accurately. In the authors' opinion the most important linkages are the impact of water utilization, excreta disposal, transportation, and health and nutrition services demand and the health effects of water and land usage. All these factors have multiple causalities and operate through several intermediate variables.

Impact of Education on Health and Nutrition

Formal and non-formal education are considered in terms of their impacts on health and nutrition. While recognizing again that causality is bidirectional, we emphasize here the cases in which health and nutrition are dependent variables. That focus is in contrast to the one, also important, which sees health and nutrition as independent variables, affecting education (see following papers).

A. Cultural Constraints to Good Health and Nutrition - -

Before considering formal education and non-formal acquisition of skills and knowledge, as related to health and nutrition, we must take note of the pervasive role of cultural factors in our fields. It is apparent to most students of health in the developing world that basic variables like income and education are not sufficient to explain the use and non-use of services, and particularly to interpret differences in utilization behavior among different populations. Social scientists have attempted to apply "health beliefs" models and other conceptualizations to elucidate such behavior in prosperous countries. Anthropologists have used their tool kits to explain it, often in highly specific (or micro) situations in poorer nations.

The continued use of "traditional" (i.e., non-"modern") health services and foods in less well developed countries suggests serious cautions for analysts in examining conventional variables and drawing policy conclusions from their assessment. It is for others to select more expansive or eclectic models than those often used and to operationalize new or refined cultural variables for studies of health and nutrition.

B. Impact of Formal Education - -

With the limitations of this section clearly stated, we may proceed to discuss certain relationships and impacts briefly. It is often pointed out that education is positively correlated with health status. A simplified indication of this is the high (negative) coefficient of simple correlation between literacy and infant mortality rates from a world-wide cross-sectional UN study (25 pp. 24, 26). While users of such results should be properly cautious about the interpretation of that in the absence of control for other variables (with the knowledge that education and income are intercorrelated), they would be encouraged by research in the United States that seems to demonstrate "a strong positive correlation between health and length of schooling . . . after allowing for the effects of such other variables as income, intelligence, and parents' schooling" (50, p. 46).

The natural question that follows such findings is: "Why?" Unfortunately, surprisingly little is known about the causal mechanisms behind these associations. Speculation over the reasons for the impact of formal education, via schooling and literacy, on health and nutrition

has included at least the following: encouragement of better personal hygiene; improvement of child rearing; increase in safety practices; adoption of better diets and other living habits; and ability to comprehend lessons from health education (23, p. 27; 25, p. 26; 50, pp. 46-47; 51, p. 4). Clearly, the subject is wide open for additional research on outcomes, and their explanations of the development of many social and economic skills as well as mental agility.

Education one may suggest permits a closer description of health deficiencies, diagnoses of (certain) causes, and suggestion of (partial) remedies.

Educational institutions can play roles besides those of schooling the population and developing (even supporting) researchers. In many countries, they fill the additional role of provider of health services. School health programs including inoculation, screening and first aid are common in Latin America. Similarly health personnel extend services as part of their training in many medical schools. More ambitiously, an institution can operate its own community health and nutritional service programs (again linked to educational objectives). Out of the many examples which can be found, we might cite: the widely-publicized experience of Universidad del Valle, Colombia, with its health center-hospital in Candelaria, along with other outreach activities (52, 53, 54); and the neighborhood health center movement, with involvement of institutions like Massachusetts General Hospital and Harvard Medical School (55). Such programs offer interesting challenges to operational researchers -- for example, the separation (through time studies) of medical and nutritional services from educational functions in order to isolate the costs of delivering care (54, 55).

C. Impact of non-Formal Education - - -

Properly conceived, education extends to non-formal activities that potentially develop a wide range of economic and social skills. Their breadth is so great that analysts must be selective in order to use a few tractable independent and dependent variables for applied research.

Customary manpower training programs and many systems of extension services resemble formal education in their possible effects on health and nutrition. For one thing, they have potentialities for affecting human behavior -- as in the case of use of health services. For another, they, too, can offer external benefits in the form of direct service activities as part of the training or related process. Even more, they can affect the availability and perhaps deployment of specialized manpower, with important nutritional and health impacts (56, 57).

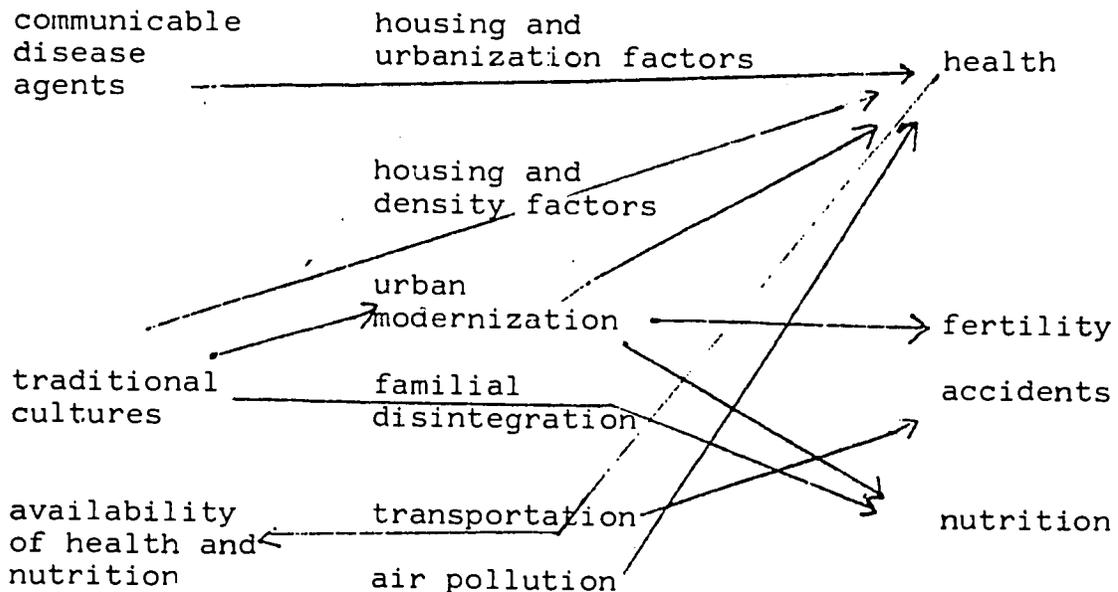
A rather different facet of non-formal education comes in the form of public campaigns to enlighten would-be users of services. "Health education" -- better labelled "education of consumers in the use of

services" -- can have important effects on nutritional practices and on utilization of medical care and environmental and other public health services. Behavioral differences exist among individuals and entire populations to suggest the relevance of these campaigns. It seems wise at this point to defer to health education specialists to explore the massive area. We close by noting that innovative delivery systems -- possibly integrating health, nutritional, and other services -- draw on the training programs mentioned above in order to obtain auxiliary health personnel of various skills who can spread their "message" while offering care to people (56, 57, 58).

IMPACT OF HOUSING AND URBANIZATION
ON HEALTH AND NUTRITION

For more than a century there has been an active interest in and study of the relationships of health, urbanization and housing. Historical perspective indicates that in early industrialized societies increased communicable diseases resulted in a marked deterioration of health status.(59) With advances this century in the technology for prevention and treatment of communicable diseases, the magnitude of the health implications of urbanization and housing has markedly decreased. Still, there remains a significant problem related with urbanization in the least developed countries.(60)

There exist a variety of potential relationships, however.. They are diagrammed in the following table.



There are, therefore, a variety of modes whereby housing and urbanization influences health and nutrition. The three major mechanisms appear to be: 1) the consideration of housing and urbanization as environmental factors in which the relationship between man and disease agents is altered;(61,62) 2) urbanization directly produces certain factors deleterious to health such as transportation, accidents and air pollution; and 3) urbanization frequently is influenced by health and nutrition factors which lead to increased urbanization in order to increase accessibility to health and nutrition services.

The density and the quality of housing exerts potential influence on health and nutrition. This influence is exerted in a variety of ways. Density increases the probability of effective contact with communicable disease agents.(63) Probably the two most important aspects of density are the larger the size of the contact pool and crowding within the household, school, or neighborhood.(64)

Housing, per se, has various aspects other than density of inhabitants which exert influence on health and nutrition. General household sanitation secondary to utilization of adequate amounts of potable water was discussed in the previous section. Other aspects are related to safety such as propensity for accidental falls (the most frequent accident causing disability in most countries) and fire hazards. Other aspects relate to type of flooring and roofing materials, cooking, and food preparation surfaces, sanitary facilities, etc.

Urbanization also results in breakdown of traditional cultural and familial factors. Some of these are beneficial to health but some are detrimental such as increased alcoholism, drug abuse, and mental illness.(65) The major causitive factors are probably the breakdown in familial responsibility patterns and the increased likelihood of contact with a broader set of behavior patterns in urban areas. Urbanization is also associated with changes in fertility, which in turn has secondary effects on notation and disease.(66)

Urban areas are frequently characterized by more readily available social services of all types. Specifically--health, nutrition and water supply services are almost invariably more available to inhabitants of urban areas. This factor probably accounts for some of the improved health of urban population and almost certainly accounts for some of the improved health of urban population and almost certainly accounts for some decisions for urbanization.(67)

Lastly, the urban environment introduces new disease agents such as alternative infant foods to breast milk, air pollution, and new hazards from accidental injury or death such as occupational hazards or transportation accidents.

The two major impacts of those outlined in this section appear to be those of the new health hazards characteristic of an urban environment and the tendency toward urbanization produced by the greater availability of health, nutrition and environmental services.

Quite different measurement problems arise with regard to these two principal aspects. The new health hazards of the urban environment can be measured directly and compared to hazards implicit in the rural environment. The extent to which the availability of health services influences decisions of urban migration is very complex, however. Many other determinants effect the urbanization decision and multivariat analytical procedures are required to measure the health and nutrition services impact.

CONCLUSIONS

We have presented very quickly an enormously complex view of a large number of national policy instruments, which interact among themselves, and which are thought to impact on health and nutrition through a large variety of direct and indirect mechanisms. An enormous quantity of literature deals with these hypotheses(68,69) but, given the complexity of the subject, it appears fragmented and confusing. Not only are we not sure of all the mechanisms to include in a conceptual framework, but we are uncertain of the magnitude and even the direction of the major effects.

Consequently, the focus on intersectoral measures for the measurement of health and nutrition programs is enormously complex. It implies a concern for many areas in which few or no generalizable statements concerning program impact can be made. It also includes many areas of concern which are so interrelated that empirical research into program impacts becomes very difficult and expensive, or requires further conceptualization to be feasible at all. On the other hand, however, there is the general impression that in some instances intersectoral measures may have a greater impact on health and nutrition than do health and nutrition programs.(70)

The combination of the two factors of importance and complexity require that particular attention be paid to the development of appropriate evaluation techniques for intersectoral programs. This brief paper does not allow for an in-depth treatment of methods which could be utilized, instead one example is briefly described. It is labeled incremental measurement. This implies a stepwise progressive approach to measurement of program impacts. Initially, a few of the many potential causal variables must be selected. For this purpose intuition and best judgement are probably superior to the gleanings from scientific literature. The process whereby such intuition and best judgement is expressed and formalized becomes important. It is suggested that a multidisciplinary group of individuals knowledgeable in health, nutrition and the other particular sectors involved, be convened and charged with the following tasks: 1) identification of potentially important intersectoral impacts; 2) development of impact measurement criteria; 3) development of exogenous weights to be applied to varying types of impacts; and 4) by an appropriate group process techniques specify the most important impacts to be measured. Subsequently, variables would have to be grouped and their probable magnitude of relationship estimated by a similar process.

Following this stage of variable specification, measurement programs can be established. Given the greater uncertainties of approaching impact measurement in the way described above, it is preferable to develop the measurement processes in a modular fashion. That is, initially design the measurement procedures such that they can be added to and made more complex in the future if it proves feasible and useful to do so.

An underlying factor necessary to understand is that activities which take place in other sectors are not homogeneous. They include a wide variety of alternatives which vary markedly in their impact on health and nutrition variables. The importance of impact measurement is mainly due to this variety. Education or infrastructive investments can be made in different ways if it can be shown that there are significant differences in impact. Research, and especially evaluation research on the impact of national policies on health, nutrition and fertility is fundamental if Latin America is to develop the theoretical tools to make macro-economic planning for health possible and effective.

In the evaluation of specific health and nutrition projects it will seldom be feasible to study the impact of development policies on health and nutrition formally or in detail. However, we reiterate the importance of reviewing the experience of the project with this conceptual framework, and particularly the importance of maintaining a record of socio-economic and other policies and events of potential major importance. Simply relating such events to trends on key health indicators through graphs may also be informative.

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