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THE PATTERNS OF NUTRITION INDICATORS
AT THE DIFFERENT STAGES OF
NATIONAL DEVELOPMENT

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ABSTRACT

This study has been conducted to find out whether nutrition indicators can assist in identifying and measuring poverty, and particularly, in finding out whether the most commonly used nutrition indicator, based on anthropometric measurements in children, is a useful proxy index of differences in socio-economic conditions in the poor.

Data on the growth of Japanese children collected over the last 25 years has been used to establish changes in nutritional status and then these patterns have been compared with other development indicators. This time sequence of change has been compared with cross-sectional data from low income groups in four South-East Asian countries (Indonesia, Thailand, Malaysia and Singapore) in 1975, and they covered a wide range of per capita GNP. A set of nutrition indicators (prevalence of anaemia, weight-for-age deficits, and 2-5 year mortality rate) have been compared with a welfare and an economic indicator. The data for nutrition indicators were from surveys which used the household as a sampling unit. The validity of an anthropometric measurement (weight-for-age) has been tested in terms of sensitivity and specificity as a screening test of the nutritional status of children.

The change in the nutritional status of children in Japan is greater during the early stage studied than in the later stages. Other development indicators also show continuous improvement over time but the rate of change differs from that shown by the nutrition indicator

at equivalent stages. The nutrition indicator demonstrates that urban-rural disparity disappeared at an early post-war period. The patterns of a nutrition indicator based on weight measurements and of other nutrition indicators from cross-country data are similar to those of the welfare indicator. However, the study shows the potential value of a nutrition indicator as a reflection of the living standards of the poor from both the cross-country and the longitudinal observation.

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CHAPTER 1

INTRODUCTION

Many views can be taken of the progress of national development, and these vary according to the development objectives with which one is concerned.

The great problems arising in poverty groups during the last few decades of development gradually shifted the focus of concern away from conventional growth orientated approaches and towards issues related to the distribution of wealth. Chenery et al (1974) have discussed a number of alternative models of development and, in particular, have attempted to use data from a number of countries to establish patterns in the relationship between the rate of growth in GNP and the changes in income distribution. Their general conclusion has been that whilst there is little evidence to support the view that redistributive policies actually reduce aggregate growth, there is equally little to suggest that 'trickle-down' of the benefits of growth will happen automatically. In fact, the inadequacy of GNP growth as the sole objective of development is well illustrated by the experience of some developing countries, where despite significant overall economic growth in recent years there has been a decrease in the share of income accruing to the poorest groups. In some cases in fact, that decrease has been sufficient to produce a decline in the absolute income of the poor groups.

In so far as government and aid agencies are concerned about these problems of relative and absolute poverty, there is a growing interest in the share received by the poor during the developmental process, and this in turn poses questions about which characteristics of the poverty groups can best be used to describe how the distribution of welfare changes during the process of development.

In other words, in order to improve the conditions of the poor, we need to be able to identify the poverty groups and to measure the degree of poverty. This desire has motivated studies on indicators in relation to social policy and planning for national development during the past twenty years.

It is regarded as a basic principle of planned development that there is a need to reduce differences in welfare between people by a process of levelling-up. To achieve this, the benefits of economic growth and the development of services, must be preferentially directed towards the most deprived. Such an objective immediately defines two important criteria for any indicator of welfare. It should be usable at a disaggregated level, revealing the existence of differentials, and it should be generally understood and accepted by administrators and politicians as a measure of some aspect of well-being (or of the lack of it).

A reflection of this concern for the problem of extreme poverty in developing countries has been the concept of a 'basic needs' approach to development (ILO, 1976). The extent of destitution has been defined in terms of the numbers of people falling below a minimum level of living standards whose description includes food, shelter and clothing as personal consumption needs, and health services, sanitation, safe drinking water, education, transportation and cultural facilities as basic public services needs.

A considerable amount of work is still being done both nationally and internationally, to devise satisfactory indicators which will be capable of responding to changing living standards of the poor and which are acceptable to administrators and politicians. A recent view of the search for the indicators of basic need fulfilment has been undertaken by Hick and Streeten (1979). In their paper, they have described and reviewed four approaches to the problems of measurement:

(1) An adjustment to GNP, which aims at capturing some of the welfare aspects of development;

(2) The use of social indicators in an attempt to define a non-monetary measure of social progress;

(3) A social accounting system which attempts to provide an organizing framework for the data from which some of these indicators are derived;

(4) A composite indicator which combines various components into a single index of human and social development.

The "adjustment to GNP" focused on attempts to improve GNP as a measure of economic welfare, and the result of the review showed that these attempts lack a logical basis and tend to result in a confusion of concepts; it also showed that research on "social indicators" have so far failed to produce an alternative which is readily accepted and comprehended though they are useful for judging some aspects of social performance. The "social accounting systems", which could integrate social indicators through some unifying concept, was not able to overcome successfully all the difficult problems encountered. Efforts to develop 'composite indices' have ranged from a search for a better measure of the physical production of goods and services, to a measure of social welfare, of satisfactions, 'happiness' and other objectives. The search for a composite index of social welfare, analogous to GNP as an index of production was not considered to be satisfactory since it proved virtually impossible to translate every aspect of social progress into money values or to some other readily accepted common denominator.

Despite the contribution of each approach on measuring fulfilment of basic need, none of the approaches satisfactorily measure the degree of the basic needs of the poor; therefore there is still a need to develop more satisfactory indicators. However, in order to identify the poverty groups and measure the degree of poverty, it is necessary to describe the distribution of the different aspects of well-being among the different populations; even though the same sources of information have been used for both purposes.

The interest in the area of nutrition has been represented by the idea that information about categories of people at risk of malnutrition in the community can be of value not only for identifying recipients of relief intervention, but also as a basis for identifying socially deprived groups, since it is invariably found that people in so-called "poverty group" have higher prevalence rates of malnutrition than the rest of the population (Levinson, 1974). This view provides an opportunity for nutritionists to assist exploring social valuation of malnutrition in the social development.

Malnutrition and Social Development

It is useful to treat the problem of malnutrition in communities as having three components, which could be referred to as 'manifest', 'risk' and 'trend' (Joy, 1980). Manifest malnutrition is the immediate and visible aspect of the problem. It might be measured by the prevalence of individuals suffering functional impairment, for whom some kind of immediate treatment or other directly targeted intervention is urgently needed. Thus, children suffering a severe degree of growth deficit might require hospitalisation and/or rehabilitation, and the mothers of such children might be given supplementary foods together with instruction on how to avoid a recurrence.

When the prevalence of manifest malnutrition is examined in relation to social and economic variables, it is generally found that people in 'poorer' families, by whatever definition, have higher prevalence rates than those in 'richer' ones. But it is also found, as a rule, that not all vulnerable individuals, even in the poorest families, are malnourished at any one time. Therefore there is a need to consider as part of the nutrition problem, the existence of categories of people or families for whom the risk of being malnourished is high, even though it may not always be manifest. For people who are primarily concerned with the relief of malnutrition, the recognition, that such factors as low income, insecure employment, bad housing, inadequate education, define high risk situations could lead to an extension of the numbers of people qualifying for targeted interventions of the kind mentioned above. However, it should also lead to an increased emphasis on reducing the risk factors themselves. Thus, information about categories of people at risk of malnutrition should not only be of value to the administrators of directly curative or supportive interventions in the health sector, but should also be used as a basis for setting priorities in the planning of social and economic development, which will ultimately prevent malnutrition from occurring.

In most developing countries however, the numbers of people at risk change over time, partly because of demographic changes, but also, in many cases, as a result of development policies themselves. Agricultural change may lead to the improvement of some people's circumstances, at the same time increasing the insecurity or the actual displacement and impoverishment of others. A comprehensive view of the nutrition problem would therefore need to include an examination of _trends_: if malnutrition is essentially a feature of poverty, we should know not only how many poor there are, and how severely they suffer from malnutrition, but also what causes their poverty and how such causes are likely to change.

The nutrition problem is of course not unique in having these three components: the same could be said of other aspects of welfare. Landlessness is immediately _manifest_ in people without access to land, but also exists as a risk which threatens a much larger class of small farmers who may be forced to sell land because of an accident of weather or illness, or because of sheer inability to support a growing family. Again, the size of the class of farmers 'at risk' of landlessness may change over time because of the long-run effects of land tenure policies, and of agricultural development and price strategies.

In view of this and of the interactions amongst nutrition, food, and social welfare, it may well be asked why nutritional status should be used as an indicator, when there are so many other variables such as income and access to land, which could be used as a basis for planning and decision making? There might be two answers to this question: the first is technical. Nutrition status measurements may well be the most reliable and cost-effective source of information to use, particularly in countries whose health and social statistics systems are poorly developed, and whose planning priorities are focused on meeting basic needs. The second reason is simply that nutrition in many countries is a sensitive issue, and it may be much easier to achieve a consensus in favour of using levels of malnutrition as a basis for comparing needs, and therefore for asserting priorities, than to use more economic measures of poverty.

It will be of critical importance to explore the nature and significance of the parameters which are measured, and the problems of constructing indicators based upon them in order to persuade development planners to include nutrition indicators in the information system for the assessment and surveillance of social welfare. This is particularly so because the process of construction of an indicator should be an integral part of the decision-making process which it is intended to serve.

From this point, the contribution of the nutritionist to the debate about economic growth and distribution issues in the process of social development is to provide technical aspects of that contribution in terms of indicator, necessary statistics and useful sources, and the method of analysis in organizing information into a more useful fashion, etc.; a change in the use of the indicator from, for example, the diagnosis and treatment of malnutrition in an individual to the quantifying of risk for families or communities, or to the analysis of trends and changes, requires a change in the definition and significance of that indicator.

It is already clear that many of these issues will become progressively more complex as we extend the area of concern to cover increasing number of interrelated variables and contributing causes. It is also clear that in considering these problems we shall need to think in terms of 'systems' or in fact of a hierarchy of systems.

Systems, State Variables and Indicators

An individual person can be regarded as a 'system', bounded by his immediate environment, and acted upon by various inputs such as food, water and disease organisms. In principle, various parameters, or state variables, of this system could be measured. Some examples of such variables are: body weight, the change in blood glucose concentration, the level of minerals in tissue fluids. If the 'system' that we are interested in is extended to include the family as a unit, with its members, their interactions and the domestic environment all considered as components, more state variables are needed to describe the system. Although they still include those parameters which describe the states of individual members, these parameters now assume a different significance as state variables describing some of the components of the larger system.

A further expansion of boundaries might define an even more complex system: a 'community' or 'nation', within which groups or classes of families would be viewed as components. If our attention is focused upon one particular level of organisation, it will generally be with the twin objectives of predicting, on the basis of current information, the likely future state of the system in terms of expected values of an agreed set of state variables. Secondly on the basis of that prediction, there is a need to justify or guide intervention. However, decisions about interventions or policies are discrete events, and therefore have to be made on the basis of particular critical levels or combinations of critical levels of the state variables. These critical points will be values which are generally agreed to be evidence of an unacceptable level of immediate or impending distress, or of adverse trends or processes. It is essentially the establishment of such critical points which distinguishes an indicator from a state variable.

The word 'indicator' itself is defined in dictionaries as 'that which serves as an indication of something'. An example frequently given is the gauge which indicates steam pressure in a boiler. Here, the 'system', or set of components, consists of boiler, firebox and engine. Steam pressure is the state variable which can be chosen to describe that system. In addition to simply measuring pressure, the steam gauge may also have certain critical points marked on the pressure scale, below which pressure is inadequate, or above which there is a danger of explosion. It is these critical points, related to specific systems, which make steam pressure an <u>indicator</u> of the state of the boiler. The points may be established from a variety of information. One point might be the pressure needed to ensure a certain minimum power output from an engine: this pressure would imply a specific temperature and flow rate of steam. Another point might be the pressure at which similar boilers have burst in the past.

A normal characteristic of an indicator is that it is used to show a number of different aspects of the performance of a system. In this particular example the situation is relatively simple because a single parameter, steam pressure, is quantitatively related in a known way to other state variables: to temperature, steam flow rate, strain in the walls of the boiler, and so on. It is therefore an indirect measure of these other state variables (all of which could be measured directly, but at greater complication and cost). In this case, steam pressure would be described as a <u>shorthand indicator</u> of boiler performance. Our confidence about the validity of using pressure as a predictor of future states is based upon past experience, not of this particular system alone, or even just of others of the same class, but of many other systems (such as laboratory experiments) which show the relationships between pressure and temperature, and pressure and strain. Whether an indicator can be described as <u>shorthand</u> or not therefore depends on the extent to which research has established confidence in causal connections between the different state variables which it represents.

In systems which include biological or social components, however, the relationships between variables are not usually so well established. We may have only statistical associations to work on. Perhaps previously in this system, or in others like it, state variables have usually assumed values which bear consistent mathematical relationship with each other, but the actual processes which happened within the system to bring this about may not be known. In such circumstances, an indicator may be generally agreed to stand as a 'proxy' for a set of state variables, or even for certain aspects of the system, which cannot as yet be precisely defined. To extend the example of the steam engine, we might be interested in a larger system which includes the person who operates the engine. Then steam pressures might be proposed as a proxy indicator of the performance of the new larger system, composed not just of the boiler, fire and engine, but also of the (human) stoker as well. In so doing, such things as rate and regularity of stoking, control of draft, cleaning of ash, and of course the stoker's close attention to steam pressure are comprised. These are the set of qualities of physical effort, skill and judgement which can be combined under the term 'performance'.

Besides classifying 'shorthand' and 'proxy' indicators, other distinctions have also been made (**Drewnowski** 1970; Culyer, 1971) between indicators of state (e.g. nutritional status), and indicators of flow (e.g. the rate of food supply). In practice, most of these classifications tend to overlap. Nutritional 'state' indicators based on anthropometry are to some extent shorthand indicators as well. Weight and size are taken as estimates of body nutrient stores, and size at a given age is regarded as a measure of the previous pattern of growth. But in addition, anthropometric indicators are most commonly used as proxies for 'nutritional status', an imprecise notion that covers the outcomes of a wide range of different processes, including the effects of different nutrient deficiencies, and non-nutritional factors such as infection. Similarly, many indicators show information about both state and flow. In the example, steam pressure can be an indicator both of the amount of steam available, and of the rate of steam supply to the engine. Nutrient intake per day is a flow measurement, but is commonly taken also as a shorthand indicator of current or likely future nutritional status.

Critical Points and Reference Values

As the above discussion suggests, the construction and application of indicators is in some degree subjective matter, and decisions about critical points and reference standards, which are applied to the measured state variables, have to involve value judgments about what matters. It is this aspect which underlies attempts to achieve consensus about which indicators shall be used as criteria for allocating resources.

In practice, indicators are often needed and proposed before there is a sound research basis for establishing the critical points. The history of the development of indicators frequently begins therefore with the establishment of normative scales. For example, in the past requirements for various nutrients were stated, despite an absence of full understanding of their physiological function. In these circumstances where the probability of specific dysfunctions in relation to various levels of intake was unknown, the distribution of observed intakes in a population, whose members show no signs of deficiency, was simply used as a reference for comparison. This provided a normative scale and indeed is still the basis of comparison such as the international FAO/WHO energy and many nutrient requirements. Intakes of other individuals or populations under study are then assessed in relation to this normative reference distribution. Similarly, biochemical or anthropometric indicators are still, in most instances, based on comparisons with 'normal' or reference populations. This approach provides both a fixed point (the mean of the reference community) and a scale for the indicator derived from the dispersion about the mean of values in the reference group. Location in the reference distribution is interpreted as an estimate of the probability of 'normality' attached to a particular value of intake, or of body measurement. By implication therefore, the probability of 'abnormality' is also being estimated. There is a danger here of loose interpretation. An individual with a high probability of abnormality, may be classified as not belonging to the reference population and may then be referred to as 'abnormal', in the sense of 'deviant'. Children whose weights or heights are more than two standard deviations below the mean of a reference distribution are classified as 'malnourished'. Yet there is, in fact, no obvious reason for those children **that** risk of physiological dysfunction is increased.

As knowledge accumulates, we should be able to move away from reliance on normative indicators. However, it is not to be expected that research will ever establish fixed and unalterable scales or reference points. Rather, it should become progressively easier to decide on appropriate operational criteria for decision-making, while at the same time promoting wider understanding and perception of the significance of the indicators when viewed within different contexts.

Nutrition Indicators applied to Individual Screening and Intervention

There are three commonly used methods by which nutritional status of individuals is assessed, biochemical, anthropometric and other clinical assessment.

Biochemical measurements are believed to provide an ultimate objective assessment of the nutritional status of an individual. They could in theory give early warning of malnutrition, before overt clinical symptoms or signs appear. Most frequently the objective of biochemical testing of an individual is to assess the body store of particular nutrients, in order to identify those people at highest nutritional risk or in the early stages of malnutrition. But it is well known that even the least intricate biochemical test is costly and time-consuming to carry out. In all surveys, the expected value of results to be obtained by a particular method in the assessment of nutritional status must be weighed against the problems of collection, transport, laboratory analysis and interpretation. In addition, while some tests are of considerable assistance, many have yet to be precisely evaluated as indicators for less advanced forms of malnutrition, especially in young children.

Clinical assessment of the nutritional status of individuals with regard to specific nutrients is one way to assess the character and degree of nutritional problems for individuals. But the cheapness and relatively easy organisation of nutritional assessment by means of clinical examination have sometimes led to the assumption that the method is simple, quickly mastered by the beginner, and yields results that are easy to interpret. But while a few physical signs are pathognomonic of certain specific nutritional deficiency syndromes, various non-nutritional environmental influences can sometimes be responsible for identical appearances. Furthermore, it is now appreciated that almost all the signs usually recorded lack nutrient specificity. In fact, most signs of malnutrition are not specific to lack of one nutrient, and in addition can often be produced by various non-nutritional factors such as infectious illness.

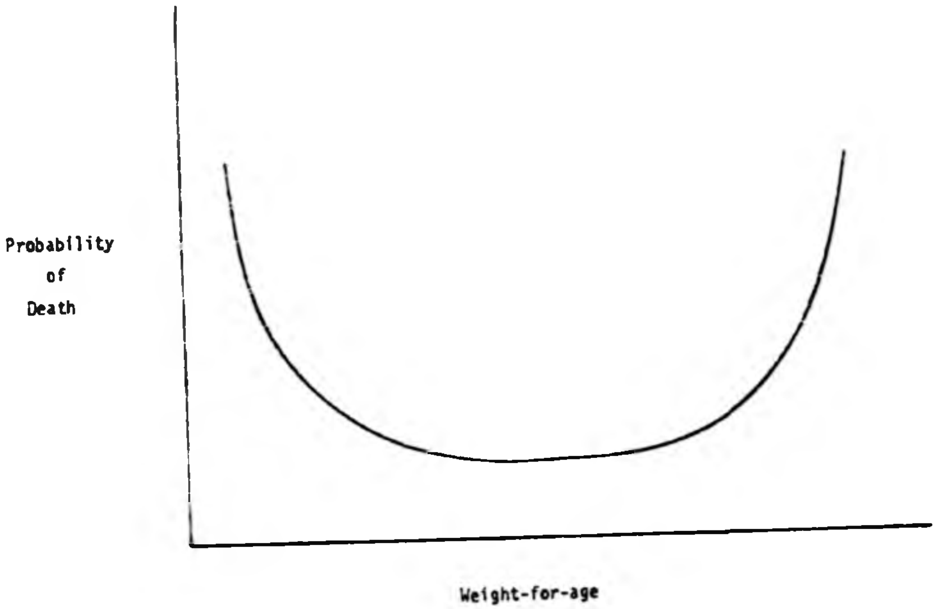
Nutritional anthropometry is concerned with the measurement of the variations of the physical dimensions and the gross composition of the human body at different ages. The methods and measurements employed in anthropometry can vary greatly in number and complexity. Obviously those chosen will depend on the purpose and objectives of the particular survey or study. For practical reason in the field, the most usual measurements are those made to assess (a) body mass, as judged by weight; (b) linear dimensions, especially height of the whole body and certain circumferences such as head and chest; (c) body composition as judged by the principal superficial soft tissue - subcutaneous fat (e.g. measured by skinfold thickness) and muscle (usually measured by mid-arm circumference).

Growth and physique can be affected by bacterial, viral and parasitic infections. These factors ideally require differentiation, but, under practical circumstances this is not as a rule possible. Anthropometry therefore is best regarded as giving evidence of the total history of nutrition and disease experienced by an individual up to the moment of measurement. Despite its relative lack of specificity however, anthropometry is likely to remain the most practical method for assessing nutritional status in individuals.

The problem of establishing scales of reference is essentially that of defining quantitatively the relationship between the measurements themselves (weight or height) and some specific aspects of function (probability of death, etc.) or well-being of the individuals or groups concerned. It is therefore necessary to demonstrate that quantitative relationships exist between body size and such things as immune competence, mental function, physical work capacity, or the likelihood of survival. Enough is now known about mortality (Chen et al, 1980) and immune competence (Reddy, 1976) in relation to growth, to suggest a general form of the relationship between weight-for-age and probability of dying during a fixed time period.

Dowler et al (1981) have illustrated the relationship in a schematic way (Figure 1.1). This shows that the relationship is non-linear and exhibits a threshold effect; that is mortality is minimal over a

Figure 1.1 Schematic Diagram of Probability of Death Versus Weight-for-age



certain range but rises steeply for extreme values both below and above the average. The relationship suggests that individuals can adapt successfully to environmental stresses over a certain range, and in so doing exhibit differences in growth performance spanning a certain range. Adaptation becomes progressively less effective, or more precarious, for individuals stressed beyond a certain point. Relationship of this kind are of course probabilistic in that they are based on groups of individuals and will always include both inter- and intra-individual variability in adaptive competence. In addition, risk will generally be related to more than one kind of functional failure. In other words, the shape of the risk curve for growth failure may well be different for lowered disease resistance from risk of mortality.

There is a further complication in the establishment of the operational cut-off point for anthropometric measurements in relation to other nutritional measurements.

To illustrate those problems, the study of Chen et al (1980) can be used to show how different scales of reference (different cut-off points) respond differently in identifying the children for treatment to prevent the risk of death; and also to show how it is possible to establish the validity of anthropometry as an assessment of nutritional status for individuals in relation to other measurements. In 1975 - 1977 Chen and his colleagues examined 2,019 Bangladeshi children aged 13 to 23 months. Cross-sectional anthropometry (weight, height and arm circumference) was conducted during 1975 - 1976 and the mortality experience of the study children was followed prospectively over 24 months.

Table 1.1: Number of children who were identified as malnourished using weight-for-age indicators and number of children who died after a certain period

Cut-off point (% of reference standard)	Number of children identified as malnourished and in need of treatment	*Number of children who died
< 60%	427	48
< 75%	1,473	92
Total population	2,013	112

* Number of children in this category who died after 24 months.

Table 1.1 shows that if we take 60% of reference standard weight-for-age as a cut-off point, there would be 427 children who would be classified as needing treatment. Of them, 48 children would theoretically thereby be prevented from dying. If, on the other hand, we take 75% reference as a cut-off point, there would be 1,473 to be treated (i.e. 3 times as many treatments), and 92 prevented from dying. Therefore, if the higher cut-off point of 75% for weight-for-age is taken to identify the malnourished children for treatment the actual number of children who would otherwise have died is greater than if the low cut-off point were used. However, because discrimination is not perfect, the higher cut-off point also means treating about 3 times as many children, in other words, the higher cut-off point chosen the more children are included as 'malnourished' who are simply lighter anyway, and not really at risk of death.

Similar observations have been demonstrated for weight-for-height, height-for-age, arm circumference-for-height and arm circumference-for-age indicator.

Some of the concepts developed by epidemiologists such as McMahon and Pugh (1970) could be adopted in order to test the validity of anthropometric measurements as indications of the risk of loss of functional capacity. In particular for screening children as malnourished in relation to the risk of subsequent mortality. This methodology referred to was originally developed to measure the validity of a screening test which was used in a particular survey, as a reflection of the situation as evaluated on the basis of other accepted criteria.

In this methodology, validity is represented by the two ratios sensitivity and specificity. Sensitivity is a measure of the ability of the screening test to recognize a high proportion of true positives (i.e. few false negatives) and specificity measures the ability of a screening test to give a result free from false positives.

If this concept of validity is adopted in our context of anthropometry as a measure of risk, the sensitivity of an indicator based on deficit in weight-for-age in screening for malnourished children is the ability of this indicator to identify a high proportion of children most likely to die (true positives). The specificity is the ability of this anthropometric indicator to exclude children who have some weight deficit but would not have died (false positives).

The data from the work of Chen et al (part of Table 1.1) can be used to calculate these ratios of sensitivity and specificity. For example, anthropometric indicators based on deficits in weight-for-age greater than 75% reference standard might be chosen using mortality as the reference test. When this cut-off point is chosen, we find that 92 children out of 1,473, whose weight was below the 75% reference standard, eventually died. If these are classified as malnourished subjects (true positives), and the other 1,381 children with the weight deficit who survived are classified as not malnourished (false negative). This result can be arranged for the calculation as follows:

Table 1.2: Arrangement for testing the validity of an anthropometric indicator as a screening test comparing a mortality indicator as a reference test

		Reference test (mortality indicator)		
		Death	Survival	Total
Screening test (Anthropometric indicator)	* Weight failure (-)	92	1,381	1,473
	* Weight success (+)	20	526	543
	Total	112	1,907	2,019

* based on cut-off point 75% of reference standard

Sensitivity of weight-for-age indicator = $\frac{92}{112}$ = .82

Specificity of weight-for-age indicator = $\frac{526}{1,907}$ = .28

If we include other calculations based on more cut-off points, the observations suggest that sensitivity increases as the cut-off point is raised but this is at the expense of specificity; that is as we raise the cut-off point level, there is an increase in the number of deaths prevented but a very big increase in the number of treatments needed, as more false positives are included. If resources are limitless this increase in treatment numbers will not matter. However, in any practical situation, resources are limited and there is a need for allocating resources more efficiently according to the priorities of criteria which are concerned.

The above discussion suggests that a unique answer cannot be found to the question of how to classify the malnourished, either in terms of what state variables to measure, or of what critical values of those measurements should be used to distinguish the 'malnourished' from the 'non-malnourished'. If the major concern is the efficient targeting of services or resources, then there must be some means of making an objective comparison of the needs of different individuals in a population in terms of an actual loss of function. It should not be supposed that selection of a better growth standard would in any way reduce this problem or the risk of future loss. The Harvard standard for weight and height was used in the above analysis, but any reference would have given similar results. In fact the only purpose a reference serves is to provide a convenient method for grouping data: this is necessary because children's ages differ, and usually both sexes are represented.

Application of Nutrition Indicators to Groups and Communities in Identifying the Differences in their Socio-economic Status

As has already been mentioned, when the prevalence of malnutrition is observed in relation to any measure of socio-economic differentials in population, it is found that malnutrition is more frequent in families in the poorer circumstances (e.g. Levinson, 1974).

The purpose of the present study is to show the basis on which nutrition indicators could be established as generally applicable measures of people as distinct from their application to individual screening, and in particular, to establish the basis for a consensus about the relevance of anthropometric measurement in children, as a useful proxy index reflecting the differences in socio-economic conditions of the poor in the community.

In order to achieve this objective, there are two criteria which have to be satisfied. First of all, the validity of anthropometry as a proxy for the other nutritional measurements has to be established. The second and perhaps a more important criterion is the establishment of anthropometry as a proxy for other welfare indicators.

The same epidemiological methodology which has been used for the validity test of nutrition indicators for screening individuals, can be adopted to quantify the relative validity of the nutritional status indicators in identifying the malnourished groups in the community. The validity of the anthropometric indicator as a proxy of nutritional status measurement in the community therefore can be quantified in relation to the whole range of the other nutritional status indicators such as biochemical and other health indicators (e.g. probability of infection, probability of death).

There have been three prospective community based studies on mortality risk and nutritional status. One was reported by Sommer and Lowenstein (1975). More than 8,000 Bangladeshi children between the age of 1 and 9 years were followed prospectively for 18 months after nutritional assessment by arm circumference-for-height (QUAC stick). Children below the 9th and between the 10th and 50th percentile experienced 3.4 and 1.5 times greater mortality risk, respectively, than those above the 50th percentile.

In another prospective study in Punjab, India, Kielmann and McCord (1978) reported similar differential mortality risk among 3,000 children aged 1 to 35 months classified according to weight-for-age (wt/age) standard. Child mortality was found to be double with each 10% reduction of wt/age below 80% of the Harvard weight median.

More recently, as already mentioned, Chen et al (1980) examined the usefulness of various anthropometric classification systems of nutritional status in prognosticating the subsequent risk of mortality among 2,019 Bangladeshi children aged 13 to 23 months.

In all these studies, the risk of mortality in relation to nutritional status based on anthropometric measurement was quantified. Therefore the relationship between the anthropometric performance of children and functional impairment in terms of mortality has been well documented. In none of these studies, however, was there an attempt to measure the relative usefulness of anthropometric indicators in relation to biochemical indicators. A comprehensive attempt to quantify the relationship between the various indicators of nutritional status (biochemical, anthropometric and health indicators) therefore, is necessary in order to validate the use of anthropometric indicators as a proxy index of nutritional status in the community. In this present study, therefore, an attempt is made to quantify these relationships in terms of relative validity (as measured by sensitivity and specificity) for anthropometric indicators in comparison with a biochemical and a health indicator.

The second criterion is rather more complicated since conceptual as well as technical problems are involved. For those concerned with welfare in a wider sense, evidence of severe problems of deprivation measured by degree of suffering in children takes on a broader significance than mere concern with treatment or intervention. The existence of malnutrition, as defined by growth deficits in children, which can be related to socio-economic groups in the community, is a reflection of the social and economic environment peculiar to those groups.

In other words, the most important distinction is that social groups in which a large proportion of the children are retarded in growth, are likely to be suffering from a whole range of social and environmental deprivation as well. Anthropometry in a sense can tell us about the general nastiness of life as well as about the health of particular individuals in the community. Therefore to identify individuals at risk, we have to include a new range of information about that individual's environment as well as his immediate state of health. This might be; information about the state of health of the mother and other family members, basic measures of living conditions, housing, levels of expenditure on food, access to land, social services and so on must be considered. In the terms we have used earlier, this implies that we are enlarging our system to include the family, and its material and social environment.

Selection and Sources of Data for the Present Study

In order to provide data to satisfy the criteria discussed above, four South-East Asian countries, whose similarity of background will be discussed later, were chosen on the basis of differences in GNP. The four countries were Indonesia, Thailand, Malaysia and Singapore. Data from each country were collected and compared.

In addition to these, a fifth country, Japan was chosen in order to provide longitudinal data. Japan was chosen partly because it has a similar cultural and ethnic background to the others and partly because it provides an Asian example of a developed country with a current high GNP and a recent rapid growth rate. Furthermore, it seems a reasonable assumption that changes in Japan over the last two decades will provide a likely pattern of development for the other four countries concerned. Finally, Japan has a peculiarly good record of data collection over the last 40 years.

In the present study, the secondary data, which originally had been collected by the different investigators in each country, were used for analysis. But the raw data for nutritional status of individual children were reselected from the original survey data. This was only possible following visits by the author to each country during 1979 to 1980.

Data on the growth of Japanese children collected between the year 1953 and 1975 has been used to establish secular time changes in nutritional status and then these patterns have been compared with other selected development indicators. This time sequence of change has been adopted so as to cover the same range of per capita GNP as found in the four South-East Asian countries in the cross-sectional study. In 1975 the range was from U.S. $220 (Indonesia) to $2,450 (Singapore). Japan's GNP at that time was $4,450.

Data for nutrition indicators were taken from surveys which used the household as a sampling unit. They were collected from the rural population belonging to an under 40% income class in these four South-East Asian countries. These particular groups have been chosen to illustrate the range of different conditions of the poor in the four countries (four communities).

The nutrition indicators are chosen as follows (justification of selection is in Chapter 2): the prevalence of anaemia as defined by the haemoglobin level; the prevalence of weight-for-age deficits; 2 - 5 (inclusive) year mortality rate. These are chosen as a biochemical, an anthropometric and a health indicator respectively.

The potential value of the nutrition indicators as a reflection of the living standard of the poor has been discussed in comparison with a composite index of development (justification of selection in Chapter 2), the Physical Quality of Life Index (PQLI). This is calculated from a combination of infant mortality, life expectancy and literacy rate and has been proposed as the basis for general comparison of quality of life between countries.

In addition, this study looks at the possibility that nutritional status indicators in children can be used as a proxy index of the nutritional status of the household to which the child belongs, to support the idea of the household being used as a functional unit on the ground that nutritional status of children can be a proxy measure of environment of the household to which the child belongs. For many purposes, the household is the most useful unit for collection and present information about social conditions and levels of living (Baster, 1978). An added advantage is that we can collect the information more efficiently by reducing the size of sample from individuals to households in order to get the same information about the social group if we can assume that the state of the children of a family can represent the nutritional status of all members.

If the results from the cross-sectional country observations (Chapter 2.2) appear to demonstrate the usefulness of anthropometric indicators as a measure of socio-economic development, then one further step will have been taken towards analysing its validity on the basis of comparison with the longitudinal observation (Chapter 2.3).

The following Chapter 2 - Method and Result - therefore consists of three sections. The first section (2.1) describes the details of cross-sectional data used in examining the objectives of this study. These details included the nature of the indicator selected and the techniques involved in analysis. The second section (2.2) explores how the longitudinal data on the growth of the Japanese children has been used to establish the changes in nutritional status over a period of time, and it also explores how the other development indicators responded during the same periods. In the last section (2.3) a comparison is made between the cross-sectional and the longitudinal observations to aid further analysis of the relative validity of findings from cross-sectional observations.

In Chapter 3, discussion is concentrated mostly on the problems involved in the design of the study. The major problem in the framework arose from the difficulty in making the various comparisons in terms of 'level' or 'unit' of data due to the limitation of the data available. The incompleteness of data among indicators selected and among the sequences of observation periods were the major problems in comparing the cross-sectional with the longitudinal observations. Even within the longitudinal observations, the data required in relation to the nutrition indicators and the other development indicators, was not sufficient for comparison at the same periods of time.

CHAPTER 2

METHOD AND RESULT

2.1 Observations on Data from Four South-East Asian Countries - "Cross-sectional" Data

Objectives

a. The major objective of this part of the study is to find out whether nutrition indicators could be of assistance in measuring poverty in groups of people, and in particular to determine whether the most commonly used nutritional status indicator based on anthropometric measurement in children, is a useful proxy index reflecting the differences in socio-economic conditions of the poor in the community.

In order to achieve this objective it is necessary first to prove the validity of anthropometry as a proxy for other nutrition indicators.

The second criterion has been made by comparing the validity of the anthropometric indicator with other indicators of welfare in identifying differences in deprivation between communities. This comparison has been made through observations from the four South-East Asian countries (Indonesia, Thailand, Malaysia and Singapore); it was intended to collect the information required from the population belonging to an under 40% income class in the four countries. This particular group had been chosen to illustrate the range of different conditions of the poor in the four countries (representing four different poor communities); their selection was based on the different GNP levels in 1975.

This second criterion raises a number of problems including difficulties in comparing differing information in terms of levels of information; for example, the existing welfare indicators in those countries are only available as the national average while indicators of nutritional status come from the low income groups. Therefore great care is necessary in making the comparisons.

In order to see the differences in identifying the problem of malnutrition in those countries using different sources of information, per capita nutrient intake from household consumption survey (HCS) has been compared with per capita nutrient supply as estimated from national Food Balance Sheets (FBS); both are expressed as a national average.

b. In addition, to evaluate other aspects of the technical feasibility of the collection of data on nutrition indicators, is another important objective. In order to test the feasibility of the collection of data on nutrition indicators, we need to find out whether nutritional status indicators in children can be used as a proxy index of the nutritional status of the household to which a child belongs on the ground that nutritional status can be a proxy measure of the environment of the household. In other words, there is a need to test the household as a nutritional functional unit. A new range of information about the individual's environment as well as his immediate state of health is included in order to identify the individuals at risk; information about the state of health of the mother and other family members is used.

Selection of countries

In order to provide relevant data to test the first objective (a), four South-East Asian countries (Indonesia, Thailand, Malaysia and Singapore) have been chosen based on different income (GNP) levels in 1975. The per capita GNP was U.S. $220, 350, 760 and 2,450 for Indonesia, Thailand, Malaysia and Singapore respectively.

The four countries have been chosen on account of their similar backgrounds, including their political and free market economic systems, ethnic groups (Chinese, Malay and Thai) and their location in the tropical zone between 15° latitude north and south of the equator. These particular factors were considered in the selection of countries in order to demonstrate the differences in national development in terms of welfare status for the poor. The aim was to control as many environmental variables as possible. In the event, some factors which may or may not have had a significant bearing in differences in present welfare as may exist, such as colonial history, have been ignored.

2.1.1 Validity of an Anthropometric Indicator as a Proxy Index of Poverty

In order to test the anthropometric indicator as a proxy for the other nutritional status indicators in identifying malnourished groups in the community, a start must be made by understanding the many state variables including biochemical, anthropometric and other health variables; then the relative validity of the nutritional status indicators in the community especially the anthropometric indicator in identifying those groups must be established. Finally we need to develop appropriate operational criteria for decision making by quantifying the relative validity of the other nutritional status indicators at various cut-off points of anthropometry.

However, the criteria for the specific decision making process are not applicable to different kinds of policy issues in different systems. Nonetheless we may consider the most common priorities when we select a nutritional status indicator in the community survey. These are the identification of a high proportion of malnourished groups or exclusion of well-nourished groups.

As we have already mentioned earlier, in the case of screening malnourished individuals, the chances of identifying a high proportion of malnourished individuals increases if we raise the cut-off point level of nutritional status; but this decreases the chances of excluding well-nourished individuals. The idea of using this element of epidemiological methodology which has been previously used in testing the validity of the anthropometric indicator in screening malnourished individuals can again be used to measure the relative validity of the anthropometric indicator in identifying malnourished groups in the community.

Kielman and McCord (1976) applied a similar idea to test the validity of a single anthropometric indicator (prevalence deficit in weight-for-age) in predicting the risk of mortality in children of different ages, such as is shown in Table 2.1.

Table 2.1: Risk of death (probability) at different age groups determined by nutritional status based on weight-for-age

Age group (months)	Nutritional status (% of Harvard weight median)				
	< 60	60-69	70-79	> 80	Total
1 - 5.9	0.146	0.092	0.097	0.025	0.045
6 - 11.9	0.177	0.080	0.034	0.009	0.034
12 - 35.9	0.037	0.008	0.003	0.003	0.005
all ages	0.120	0.060	0.045	0.012	0.029

In the present study, we want to extend the investigation of the relative validity of the anthropometric indicator in identifying malnourished groups in relation to mortality (a measure of functional impairment), as well as to biochemical measurement (e.g. the haemoglobin measurement). In this way, we can establish the relative validity of the anthropometric indicator in relation to a whole range of other nutritional status measurements in the community.

An attempt was also made to extend the investigation on the relationship between these nutritional status indicators (anthropometric indicator) and the other indicators of welfare. This can be achieved by comparing the validity of the anthropometric inidcator (which is already assumed as a proxy for the other nutritional status indicators as a result of the first attempt), with other indicators of welfare in measuring differences in deprivation between communities. Thus the validity (usefulness) of an anthropometric indicator as a proxy index of welfare especially for the poor can be established.

As a result of these two analyses the relative validity of the anthropometric indicator could be established for the social group in the respect of their status of welfare.

The following nutritional status indicators and their state variables have been chosen in order to make these analyses.

2.1.1.1 Selection of indicators

Nutritional status indicators and variables

Prevalence of anaemia as defined by haemoglobin (Hb) level, prevalence of weight-for-age deficits, and the 2 - 5 (inclusive) year mortality rate have been chosen as a biochemical, an anthropometric and a health indicator respectively.

The reason for selecting these three indicators is initially to review the wide range of nutritional status indicators which cover biochemical change resulting from certain nutrient deficiencies and physical changes of differences in growth, leading progressively to functional changes of health that are due to these nutritional disorders in individuals and then apply the same criteria to identify the malnourished groups in the community. Technical feasibility and economically sound field methods at the community level, have been carefully considered in the selection of biochemical, anthropometric and health measurements of individuals.

In the early stage of deprivation, nutrient levels in body stores and tissues may be diminished long before clinical and anthropometric changes occur. Although the biochemical assessment of nutrition can be done by a variety of investigations, for example, on body tissue including liver, muscle (Waterlow and Mendes, 1957) and bone, in practice especially in the field survey, tests are usually confined to two fairly easily obtainable body fluids, blood and urine (Jelliffe, 1966). Variation in creatinine excretion in urine in a short period due to varying nutrient intake make this an unsuitable indicator with which to assess nutritional status (Vestergaard and Leverett, 1958) and the assaying of blood samples is considered to be the most useful in evaluating elemental nutritional status.

Biochemical tests on blood vary, and range from the measurement of concentration of nutrients to the measurement of metabolic changes (Sauberlich et al, 1974). The measurement of haemoconcentration of certain nutrients is the most conventional method used because of the simplicity of the technique, so that most available information for secondary analysis has been derived from these measurements. But it must be remembered that the blood level of nutrients reflects, to a large degree, recent dietary history rather than the preferred longer term nutritional status.

Robson (1972) stated in his study that to find a single biochemical test suitable either for measuring general malnutrition or specific deficiencies is clearly impossible. However, unless we are able to employ the whole range of tests for deficiencies, we have to choose a proxy measurement (such as some nutritional status measurement) of nutrient supply to the body, as reflected by levels in particular tissue or fluid, and it is blood that is most often used. Prevalence of anaemia defined as a level of haemoglobin in the blood has therefore been chosen in this study, as an index of general nutritional status of the individuals making up a community.

Anaemia can be caused by more than just deficiency of nutrient; moreover, nutritional anaemia can result from deficiency of various nutrients besides iron. Folic acid or Vitamin B_{12} can also be a cause: it may occur as a consequence of general malnutrition caused by an inadequate supply of more than one of the haemopoietic nutrients. Coward and Whitehead (1972) found out that a fall in haemoglobin level was related to reduction in the number of erythrocytes and begins with tissue wasting and the loss of body weight.

Anthropometry is the most widely used method in the assessment of nutritional status and usually consists of the measurement of growth in children. The measurements used are body mass, linear dimension and body composition. A study on the selection of the minimal anthropometric requirements needed to assess nutritional status in an epidemiological study was undertaken by Buzina and Uemura (1973); they recommended that weight, height, arm circumference and triceps fatfold be used out of the following most reliable set of measurements: weight, height, bioacromial and bicristal diameters, arm, chest and calf circumferences and measurement of at least one fatfold.

In this present study weight has been chosen as a measurement of growth in children under six for the following reasons: firstly, the weight measurement itself is easily made to a very high degree of accuracy, whereas the height measurements depend much more upon technique and upon the cooperation of the subjects. In the case of skinfold thickness, accuracy depends in addition upon the design of the calipers (Greenay et al, 1965).

Evers and McIntosh (1977) also noted that weight reflected body mass, and was influenced by dietary fluctuations. The degree of malnutrition was determined by the relationship between actual age, body weight, and theoretical weight-for-age, whereas height was considered to reflect nutrient, especially protein, intake over a considerable period of time. The present study is concerned with the single point in time so that weight-for-age has been chosen as the most useful measurement. Hiernaux (1963) also demonstrated in his study that the weight as distinct from the height of children was more dependent upon environmental factors than upon heredity.

Weight-for-height is known to be more specific than weight-for-age (Dowler et al, 1981) and Chen et al (1980) recommended the use of a combination of parameters, such as weight and height-for-age, or arm circumference and a selection of different critical values that gave increased sensitivity. Yarbrough (1974) tested validity of weight as a single index of nutritional status particular with regard to the risk of protein-calorie malnutrition. He found that body weight was a good index of nutritional status for protein-calorie malnutrition at the extremes including gross undernutrition and also overfeeding in children. Through the middle range of mild to moderate protein-calorie malnutrition, weight is not a sufficiently sensitive test of nutritional status to be used alone as an index of protein-calorie malnutrition.

Nevertheless, because of practical reasons, it is intended to test the relative validity of this most commonly used anthropometric indicator (weight) as a screening test in identifying the malnourished groups in the community, comparing it with a biochemical indicator (haemoglobin level) and a health indicator (mortality) in children under 5 years of age.

Nutritional deficiency and disorder may eventually cause sickness and death in individuals so that the extent of malnutrition in more extreme cases can be measured using morbidity or mortality rates in the community due to nutritionally relevant diseases. Morbidity based on the clinical assessment of the nutritional status of individuals with regard to specific nutrients, is one way to assess the character and degree of nutritional problems in the community. It has been well observed that non-nutritional environmental influences can sometimes be more important causes of nutritional disease than nutritional deficiency for the individuals. In fact, most signs apparently due to malnutrition are not specific signs for the lack of one or more nutrients and are often produced by various non-nutritional factors. Apart from such problems, the screening of individuals concerning the interpretation of clinical signs, and the practical value of morbidity measurements in terms of the quantitative estimation of the prevalence of morbidity in the community, remains to be determined.

Although the infant mortality rate has long been used as an indicator of the health of a community it was realised that 1 - 4 year mortality rate is of greater value in assessing the nutritional status of children in a community (Uttley, 1963). But even when the 1 - 4 year mortality rate showed a decline with improvements in socio-economic conditions, the infant mortality often rose sharply when development was accompanied by rapid urbanization. This increase is generally blamed on nutritional problems brought about by the substitution of breast feeding for inadequate bottle feeding (Sandre et al, 1971). Nevertheless, according to a study of death below 5 years in 18 areas of Latin America undertaken by Puffer and Serrano (1975), in more than 50 per cent of cases, malnutrition was an underlying or associated cause.

In the present study the 2 - 5 year mortality rate has been chosen instead of a 1 - 4 year mortality rate since an initial tabulation of prevalence of weight-for-age deficits (Table 2.2) showed that the prevalence of 2 - 5 year weight-for-age deficits was higher than that of the 1 - 4 year group (Appendix 1 - prevalence of weight-for-age deficit at three different cut-off points). It is advantageous to compare the greater prevalence of the weight-for-age deficits with the prevalence of malnutrition based on biochemical and mortality measurement. So that data on the prevalence of anaemia and on the mortality rate were used from this group for the sake of comparing the relative validity of these indicators with that of weight-for-age deficits.

Table 2.2: Accumulated prevalence of weight-for-age deficits in four South-East Asian countries based on the cut-off point of the 70% Harvard weight median

Country	Age group	
	1-4 years	2-5 years
Indonesia	74.1%	93.0%
Thailand	56.2%	52.4%
Malaysia	28.3%	28.3%
Singapore	3.6%	3.6%

Other development indicators

One of the composite indicators, "Physical Quality of Life Index (PQLI)" was chosen as a development indicator. The PQLI was developed in response to the need for a non-income measurement to supplement GNP. It was proposed by the Overseas Development Council (ODC) in 1977 as complementary to GNP per capita in evaluating economic-social welfare of countries.

PQLI combines the following three indicators: infant mortality, life expectancy and literacy, into a single composite indicator. It is particularly supposed to assess the rate of progress made in meeting various aspects of "basic human needs". It was originally calculated by a cross-sectional comparison of 150 countries.

Larson and Wilford (1979) have criticised PQLI on the ground that the three component variables were closely correlated and that in any case it ranked countries in approximately the same manner as the GNP per capita ranked them so it was not able to perform the expected function.

Despite such criticism, PQLI has been chosen amongst the other indicators of welfare in this study as a measure of the progress of well-being for the populations observed in the four South-East Asian countries, for the following reasons: (1) the PQLI is a non-income proxy measure of welfare, which is the same kind of function as the nutrition indicator eventually we wish to validate; (2) the three component variables of PQLI are indicators of state (as are nutritional status indicators) rather than those of flow.

2.1.1.2 Material used

2.1.1.2.1 Nutritional status indicators

Selection of sample surveys

In each of the four countries, one sample survey in each country was chosen: in Indonesia, Kardjati et al (1977), in Malaysia, Kandiah and Boo (1976), in Thailand, Harinasuta et al (1976) and in Singapore, Institute of Health (1979) in 1975. These surveys had similar sample frames based on rural populations that belonged to the under 40% income class (Gupta, 1977; Council for Asian Manpower Studies, 1978; Ramakrishnan, 1977; Manton et al, 1978). The estimated range of income of the population sampled in the survey in each country is shown in Table 2.19.

The sample surveys had been chosen from among 52 nutrition surveys carried out in those countries during 1975. The four surveys were selected as they contained the following information: haemoglobin value (Hb), weight and mortality rate for children aged 2 - 5 years. Haemoglobin and weight measurements on the children were done in accordance with the WHO standard technique for field surveys (WHO, 1972; Jeliffe, 1966). The other most important factor in selecting these sample surveys was the characteristics of the population surveyed such as the low income class (under 40%) living in rural areas.

Collection of raw data for analysis

Information about the individuals analysed in this present study was collected for the three nutritional status measurements in the four selected sample surveys by means of questionnaire, which was sent by post to each institute responsible, during early 1979. (The three different questionnaire forms with instructions are shown in Appendix 7.) The suitability for analysis of the information about individuals was confirmed by the author on her visit to each country during 1979 to 1980 (the itinerary is in Appendix 8). The different field conditions at the time of collection of data in each country were also checked by field trips during the visits.

2.1.1.2.2 Development indicator: PQLI

Unlike the data on nutritional status, the data on PQLI from the population belonging to the under 40% income class in each country were not available. Data on PQLI as a national average for the year

1975 in each country were therefore substituted and these have been drawn from the Annex Note from ODC's Agenda (1979). Because the PQLI has been measured as the national average for the countries observed so that it is not an indicator of well-being in the poor alone (in the strict sense) but is rather an indicator reflecting the differences in the living conditions of the countries as a whole, the PQLI is designed to reveal the extent to which the basic needs of the population in a country have or have not been met; the PQLI as a national average therefore can be used in making comparisons between the countries observed since the PQLI is supposed to reflect the standard of living of the poor to some extent by the nature of the indicator.

2.1.1.3 Size of samples

From the four sample surveys one in each country, information about only 1,230 children aged 2 - 5 years was suitable for the analysis of nutritional status in the present study (see the criteria for the selection of nutrition indicators in Section 2.1.1.2.1).

Table 2.3: Number of children aged 2 - 5 used in analysis of biochemical, anthropometric and mortality indicators; selection from sample surveys

Country	No. of children
Indonesia	856
Thailand	211
Malaysia	35
Singapore	130
Total	1,230

Table 2.3 shows the number of the selected children from each country. The differences in numbers of children used in analysis in the four countries make it imperative to use great caution in interpreting the results; the analysis therefore is made on the basis of devices such as ranking order wherever this is appropriate.

2.1.1.4 Analysis

The nutritional status indicator was initially analysed in terms of the ranking order of countries in comparison with a welfare indicator (PQLI), using the ascending order of GNP between the four countries as a basis. An underlying assumption in comparing the ranking order of the various indicators of welfare (e.g. nutritional status indicator and PQLI) in relation to that of the GNP of the countries, is that if income (GNP) is equally distributed among the population within a country the ranking order of other indicators such as the welfare and nutritional status indicators, tends to follow that of the GNP. In this way we can also test the potential value of the nutritional status indicator as a measure of welfare comparing the ranking order between the countries using another indicator of welfare (PQLI). Another reason for adopting the ranking order system in this analysis is that nutrition indicators are drawn from the under 40% income class while the PQLI represents the level of welfare for the population as a whole at the national level. In otherwords, in order to overcome the difficulties in comparing differing information in terms of aggregated level of population, the ranking order system has been adopted in the analysis because it facilitates the necessary comparison between the various indicators in the countries observed.

Besides the above two reasons, the methods of ranking order in comparing the countries has been chosen as the numbers of children used in the analysis from each country are very different and a more cautious comparison than direct comparison between the absolute values in the indicators is needed.

The next step is quantification of the relative validity of the nutritional status indicators (which include a whole range of nutritional status indicators such as biochemical and health indicators) in relation to the anthropometric indicator in the community.

As has been mentioned earlier, the same epidemiological methodology used in testing the validity of anthropometric indicators in identifying malnourished individuals has been adopted. The relative validity therefore has been measured by sensitivity and specificity using the biochemical and the anthropometric indicator as reference tests, in order to demonstrate the relative validity of the two indicators compared with that of the mortality indicator. As a result of these estimations, the relative validity of a whole range of nutritional status indocators at the progressive cut-off point of the anthropometric indicators could be established.

Definition of terms in this context is adopted from epidemiological terminology of validity test for the screening test (McMahon and Pugh, 1970) in identifying malnourished groups in the community. Validity is represented by two ratios, sensitivity and specificity:

a) Sensitivity is a measure of ability of the screening test of a nutritional status indicator to identify a high proportion of true positive groups (identified as malnourished subjects by the screening test as well as by the reference test).

b) Specificity is a measure of ability of the screening test of nutritional status indicator to give a result that does not include false positive groups (identified as malnourished subjects by the screening test but not by the reference test).

Firstly, an attempt was made to measure the relative validity of the screening test using the anthropometric indicator, by comparing it with the reference test of biochemical measurement (see Table 2.4.a).

The reason underlying this first attempt is that the biochemical indicator has been known to be the most objective measurement of the nutritional status of an individual, before overt clinical symptoms or signs appear (Sauberlich et al, 1974), thus the relative validity of the anthropometric indicator needs to be compared with that of the reference test. Secondly, an attempt was made to measure the relative validity of the mortality in 2 - 5 (inclusive) year old children as a screening test in comparison with a reference test using an anthropometric measurement (see Table 2.4.b for the arrangement). These two attempts were made in order to establish the comparative validity of a whole range of nutritional status indicators (including biochemical and health indicators chosen) in relation to the anthropometric indicator in identifying the malnourished groups in the community.

Basic information used in testing the validity of the biochemical indicator (prevalence of anaemia) and the anthropometric indicator (prevalence of deficit in weight-for-age) is shown in Tables 2.5 and 2.6.

Table 2.4.a: Arrangement for testing the validity of the anthropometric indicator as a screening test comparing it with the biochemical indicator as a reference test

		Reference test (Biochemical indicator)		
		*"Hb-"	"Hb+"	Total
Screening test (Anthropometric indicator)	** "weight-"	a	b	a+b
	"weight+"	c	d	c+d
	Total	a+c	b+d	

Note: 1.* "Hb-" and "Hb+" based on 10 mg Hb as a cut-off point (Sauberlich, 1974).
(i.e. "Hb-": children whose Hb is lower than the cut-off point.
"Hb+": children whose Hb is higher than the cut-off point).

** "Weight-" and "weight+" based on < 80%, < 70% and < 60% Harvard Standard (Stuart and Stevenson, 1959).

The sensitivity of screening test $= \frac{a}{a + c}$

The specificity of screening test $= \frac{d}{b + d}$

2. The distribution of anaemia in the three South-East Asian countries at all ages is shown in Appendix 2.

Table 2.5: Distribution of *anaemic children ("Hb-") aged 2 - 5 (inclusive)

Country	No. of children examined	No. of children with anaemia
Indonesia	856	143
Thailand	211	16
Malaysia	35	5
Total	1,102	164

*Based on < 10 mg Hb.

Table 2.6: Distribution of "weight failure (-)" in children aged 2 - 5 (inclusive)

Country	Degree of "weight failure (-)"					
	+ (> 90% Harvard Standard)	G1 (80-89)	G2 (70-79)	G3 (60-69)	G4 (< 60)	Total
Indonesia	96	246	308	163	43	856
Thailand	42	73	70	20	6	211
Malaysia	12	13	8	2	0	35
Total	150	332	386	185	49	1,102

Note 1. The weight of the children was classified into five groups, > 90%, 80-89%, 70-79%, 60-69% and < 60% Harvard weight median. This classification was adopted in order to compare the prevalence of progressive "weight failure (-)" with the other nutritional status indicators.

2. The distribution of "weight failure (-)" of the children at each age at all cut-off points for the four countries is shown in Appendix 1.

In order to measure the relative validity of the mortality measurement as a screening test in comparison with a reference test using the anthropometric measurement, data on the weight of the deceased children are essential to the analysis. But this study is a retrospective study and there is no way of ascertaining the weight of the deceased children; therefore these have been estimated on the assumption that the weight of the deceased child is the same as that of the living child in the same household whose age is the same as that of the deceased child when it died. Thus in the case of Indonesia, a ratio between "weight failure (-)" and "weight success (+)" of the dead child was indirectly estimated from the "weight failure (-)" rate of the living child, in the same household, whose age was the same as that of the deceased child when it died. As the study covers children between 2 and 5 years old, the youngest living child was chosen could be not less than 2 years old when it died. This attempt is only possible if a household is proved to be a nutritional functional unit.

The Indonesian nutrition survey (Kardjati, 1977) provides the "weight failure (-)" rate of the youngest child and can be seen in Table 2.7.

For the second attempt, the arrangement for the validity test for the 2 - 5 year mortality rate indicator was set out based on the result of Table 2.7 as shown in Table 2.4.b overleaf.

Table 2.7: Distribution of "weight failure (-)" and child deaths within the same family - the case of Indonesia

	Classification of weights of living children					
	+ (> 90% Harvard Standard)	G1 (80-90)	G2 (70-79)	G3 (60-69)	G4 (< 60)	(Total)
No. of living children aged 2 - 5	64	179	232	127	36	(638)
No. of households having a dead child aged 2 - 5	20	36	50	33	9	(148)

Table 2.4.b: Arrangement for testing the validity of the mortality indicator as a screening test compared with the anthropometric indicator as reference test - the case of Indonesia

		Reference Test (Anthropometric measurement)		
		*"weight-"	"weight+"	Total
Screening test (2 - 5 year mortality rate)	Death	92	56	148
	Survival	395	243	638
	Total	487	299	786

* Based on cut-off point at 80% Harvard Standard.

The sensitivity of 2-5 year mortality rate = $\frac{92}{487}$ = .1889

The specificity of 2-5 year mortality rate = $\frac{243}{299}$ = .8127

2.1.1.5 Result

The result of the initial analysis of the comparison between the nutritional status indocator and other development indicators is shown in Table 2.8. It is expressed in terms of ranking order as well as in actual value.

Table 2.8: Comparison between three sets of indicators

2.8.a: Economic Indicator. 1975 (1-4): ranking order

Selected Indicator	Country Indonesia	Thailand	Malaysia	Singapore
Per capita	220	350	760	2,450
GNP (US $)	(1)	(2)	(3)	(4)

Data from the World Bank Atlas 1976.

2.8.b: Welfare Indicator: PQLI

Selected Indicator	Country Indonesia	Thailand	Malaysia	Singapore
Physical quality of life index	48 (1)	78 (3)	68 (2)	83 (4)

Data from ODC's Agenda 1979: The United States and World Development on PQLI and DRR.

Table 2.8.c: Nutrient (Calorie) supply and consumption measurements

(unit: Kcal per caput)

Source	Country				
	Indonesia	Thailand	Malaysia	Singapore	(Japan)
* Supply as estimated in FBS	2126 (1)	2360 (2)	2589 (3)	2812 (4)	(2824) (5)
** Intake from HCS	1832 (1)	2037 (2)	2085 (3)	-	(2188)

* Based on national Food Balance Sheets (FBS) published by Food and Agriculture Organization (FAO).

** Based on data from the household consumption surveys (HCS) in each country.

Table 2.8.d: Nutritional status indicators

Selected Indicator	Country				Cut-off point
	Indonesia	Thailand	Malaysia	Singapore	
1 Biochemical Indicator					
Anaemia prevalence rate (%) (age 2-5)	16.6 (1)	7.4 (3)	13.2 (2)	6.4 (4)	< 10 mg
2 Anthropometric Indicator					
"weight failures" rate (%)					
a) Age 2-5	60.1 (1)	45.3 (2)	40.4 (3)	8.6 (4)	< 80% H.S.
	24.8 (1)	13.6 (2)	6.4 (3)	1.0 (4)	< 70% H.S.
	4.8 (1)	3.2 (2)	0.0 (3)	0.0 (3)	< 60% H.S.
b) Age 1-6	60.1 (1)	39.9 (2)	38.1 (3)	6.8 (4)	< 80% H.S.
	22.8 (1)	11.9 (2)	8.3 (3)	0.4 (4)	< 70% H.S.
	4.0 (1)	2.1 (3)	2.4 (2)	0.0 (4)	< 60% H.S.

H.S. = Harvard Standard.

Indicators in Table 2.8 have been derived from two different levels of information: the economic, welfare and nutrient measurements are taken from the aggregated national average, while the nutritional status indicator comes from the data for the population belonging to the under 40% income class. These two different levels of information make it difficult to compare actual values directly.

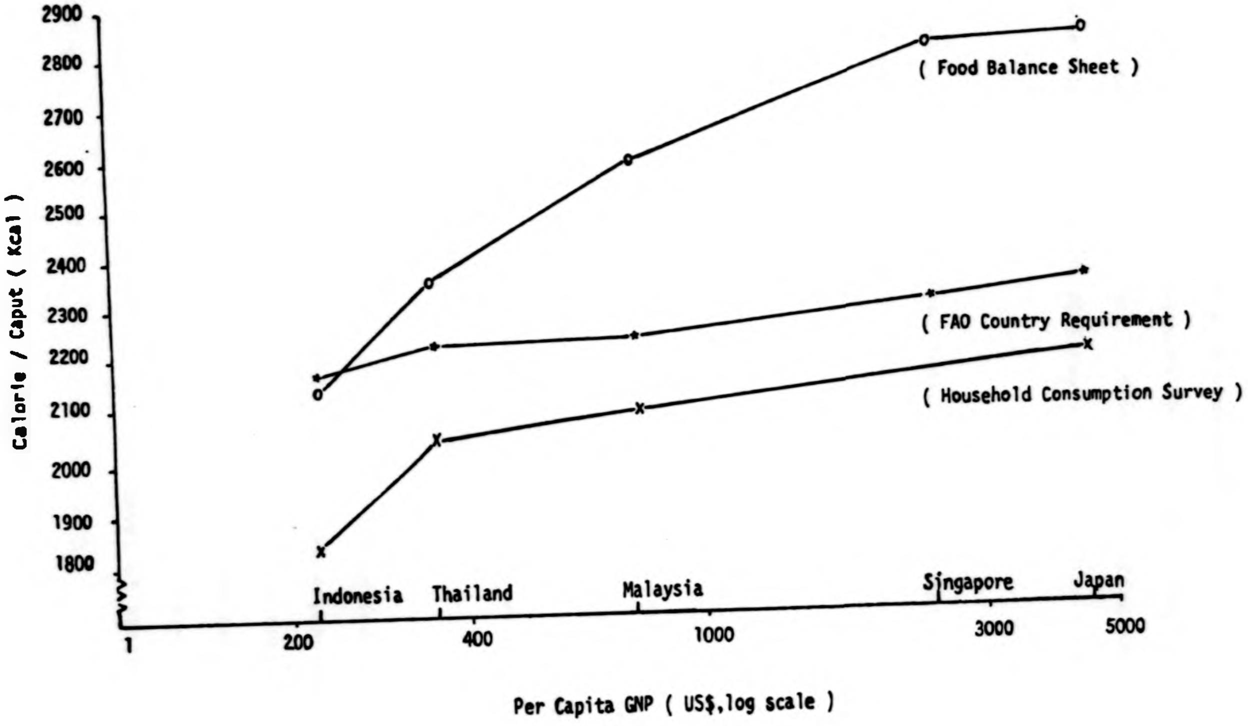
The validity of using aggregated calorie consumption from household consumption surveys and calorie supply as estimated in national Food Balance Sheets as a basis of indicator of nutritional differences between countries, is questionable. Table 2.8c shows that both the consumption and supply rank the countries in the same rank as the GNP did in contrast it has given by the nutritional status indicator and PQLI. Moreover, it has been common practice to use supply figures in FBS as an indirect estimate of energy consumption of population by comparing the value with the requirement. This estimate has been commonly interpreted in such a way as to provide an alternative measurement to the more direct measurement of nutritional status in the individual, in order to classify people as adequately or inadequately nourished, and it has even been used for assessing the magnitude of the consumption or supply deficit in the country by aggregation.

From Table 2.8.c doubt arises about the validity of such figures as indicators of nutritional differences between the countries. If we arrange those values in sequence according to average per capita income (per capita GNP), the result (in Figure 2.1) shows that not only is the FBS estimate always higher than the household assessment, but the discrepancy increases with increasing GNP. This observation may suggest that there is a relationship between the national food supply estimate from FBS and intake from the HCS, but the relationship is not constant between the different countries. The fact that the relationship changes with GNP, suggests that the discrepancy between supply and intake increases as the economic system becomes more extensive and more complex.

However, such an observation must be considered very carefully while even comparing the different levels of information, such as estimated national averages (e.g. GNP, PQLI) and the actual observation values from populations belonging to the low income groups (e.g. nutritional status indicators). Therefore in this study the comparison has been expressed in terms of favourable ranking order between the countries in order to facilitate the necessary comparison of nutritional status indicators from the low income groups, with the other development indicators as a national average.

The welfare indicator and the nutritional status indicator (especially the biochemical indicator), show a different ranking order from the economic indicator based on GNP per capita in the case of Thailand and Malaysia. This may imply that the first indicator reflects differences in the living standards of the population as a whole while the nutritional status indicator reflects the differences in the living standards of the poor in the two countries.

Figure 2.1 Calorie Supply (FBS) and Calorie Consumption (HCS) Versus GNP
- Cross Country Comparison in 1975 -



The difference between the PQLI in the two countries may be partly due to the difference in the living standard of the poor. This may imply that higher standard of GNP in Malaysia as compared with that of Thailand was distributed less fairly between the peoples of Malaysia, the poor receiving less than their share. However, the affected group has not been identified as the PQLI represents only the country as a whole.

As shown in Table 2.8.d, the biochemical indicator and the anthropometric indicator based on the weight of children at 60% Harvard Standard (age 1 - 6), seems to be the relevant indicator to reflect the differences in the living standard of the poor in this observation; however, in practice there is the well-known difficulty in collecting and analysing the biochemical data, and as the anthropometric measurements are more easily obtained they are more commonly used. Because of this practical point the following analysis is intended to test the relative validity of the anthropometric indicator as a screening test, compared with biochemical measurements as a reference test in the countries observed (see Table 2.9).

The estimated sensitivity and specificity of the screening test (in this case of the anthropometric indicator) have also been expressed in terms of ranking order between the countries observed. The rationale underlying this attempt is that ranking order facilitates the necessary comparison between the countries observed even when the differences between pairs of absolute values do not reach high level of statistical significance.

Table 2.9: Validity of the anthropometric indicator as a screening test, compared with the reference test using biochemical measurement

Country	Different cut-off points of the anthropometric indicator (weight-for-age)								
	< 80% Harvard Standard			< 70% Harvard Standard			< 60% Harvard Standard		
		*Se	*Sp		Se	Sp		Se	Sp
Indonesia	(1)	70.63	42.08	(1)	34.97	78.23	(1)	9.09	95.79
Thailand	(2)	31.25	53.33	(3)	12.50	76.92	(2)	0.00	98.97
Malaysia	(3)	20.00	70.00	(2)	20.00	96.67	(2)	0.00	100.00

* Se and Sp are sensitivity and specificity respectively as a percentage.

The sensitivity of the anthropometric indicator in the community as a screening test compared with the biochemical indicator to identify the malnourished groups, decreases with a descending cut-off point from 80% standard (G1) to 60% standard (G4). A converse effect is shown in the case of the specificity value. These findings are similar to that shown by anthropometry in identifying the malnourished individuals, for example, when we raised the cut-off point level of the anthropometric indicator for individual screening, the sensitivity of the anthropometric indicator increased and also a converse effect was shown in the case of the specificity value. These findings support our attempt of applying the same epidemiological methodology in testing the validity of the anthropometric indicator in identifying malnourished individuals to in testing the validity of the anthropometric indicator in identifying malnourished groups in the community.

The sensitivity also changes from one country to another. A high value is always shown in the case of Indonesia where malnutrition is most prevalent. Indonesia is also the poorest of the three countries as based on the GNP.

In the case of Thailand and Malaysia, there are variations in ranking order according to the different cut-off points, the ranking order being the same as that of the PQLI, which is supposed to reflect the fulfilment of basic human needs, especially at the cut-off point of 70% Harvard Standard. It may imply that the anthropometric indicator is still sensitive as a proxy index of socio and environmental measurements up to a certain cut-off point.

It might also be inferred that the 70% Harvard Standard (H.S.) is a more useful cut-off point than the 80% H.S. in order to identify the differences of deprivation between the groups observed in this study.

Table 2.10 shows the validity of the 2 - 5 year mortality indicator as a screening test compared with a reference test, using the anthropometric indicator in the case of Indonesia. The sensitivity and specificity do not respond dramatically to the descending cut-off point of the anthropometric indicator. However, one must consider the fact that in the case of the anthropometric indicator, the weight of the deceased child was regarded as the same as that of the youngest child in the household.

In order to describe the complete series of relationship between the three nutritional status indicators (biochemical, anthropometric and mortality indicator), it is essential to establish first of all the relationship between biochemical and mortality data. Unfortunately, direct data for this observation was not available (haemoglobin measurements for the dead children were not available) therefore the relationship has been indirectly estimated. It has been calculated simply by multiplying the

Table 2.10: Validity of the 2-5 year mortality rate as a screening test as compared with a reference test using the anthropometric measurement

Country	Different cut-off points of the anthropometric indicator (weight-for-age)					
	< 80% Harvard Standard		< 70% Harvard Standard		< 60% Harvard Standard	
	Se	Sp	Se	Sp	Se	Sp
Indonesia	18.89	81.27	20.49	81.76	20.00	81.24

Table 2.11: Comparison of validity of the nutrition indicators at the biochemical index of 100 in the case of Indonesia

Indicator	Different cut-off points of the anthropometric measurement (weight-for-age)					
	< 80% Harvard Standard		< 70% Harvard Standard		< 60% Harvard Standard	
	Se	Sp	Se	Sp	Se	Sp
Biochemical indicator	100.00	100.00	100.00	100.00	100.00	100.00
Anthropometric indicator	70.63	42.08	34.97	78.23	9.09	95.79
2-5 year mortality rate	13.34	34.20	7.17	63.96	1.82	77.82

sensitivity and specificity of biochemical in relation to anthropometric indicators (Table 2.9) by the sensitivity and specificity of anthropometric in relation to mortality indicators (Table 2.10).

As a result of this calculation, the whole range of relative validity of the nutritional status indicators has been established and it has been presented in Table 2.11 using the biochemical index set as a value of 100.

For the sake of comparison, the biochemical index is used as a basis even though the growth and development of children can be retarded before other changes appear, such as the appearance of anatomical and biochemical deficiencies and height and weight retardation that may indicate subclinical malnutrition (Jelliffe, 1966). Nevertheless, the biochemical measurement is regarded as the most objective assessment of nutritional status of an individual, as it frequently provides pre- or subclinical information (Sauberlich, 1974).

A complete set of the required information was obtained in the case of Indonesia, but unfortunately, was not available in the case of Thailand, Malaysia or Singapore. However, Table 2.9 shows that the validity (e.g. sensitivity) of the anthropometric indicator reveals the same trend as the welfare indicator up to a certain cut-off point (70% standard), in comparing Thailand with Malaysia.

Even though a complete set of required data for all four countries was unavailable, the above findings demonstrate the quantitative relationship between nutritional status indicators at all different cut-off points of the anthropometric indicator, and may also suggest the potential value of the anthropometric indicator as a proxy index of welfare measurement for the poor up to a certain cut-off point.

These findings may also provide a rational basis for the choice of a nutritional status indicator depending on purpose of a survey; this may be to identify correctly a high proportion of malnourished groups in the community or to allocate resources more efficiently by excluding well-nourished groups (or individuals).

2.1.2 Other Aspects of the Value of Nutrition Indicators; the Household as a Functional Unit

2.1.2.1 Method

In order to test the household as a nutritional functional unit, the nutritional status of the mothers and children from an Indonesian survey (Kardjati, 1976) has been adopted as a relevant source of data.

The haemoglobin (Hb) value for mother and child has been chosen as a measure of nutritional status based on the assumption that the biochemical measurements have more nutritional significance than the anthropometric measurements in adults. It was also the only comprehensive observation on the mothers and children in terms of data completeness.

The present study has been designed to examine the relationship between the haemoglobin values for mother and child by two different sampling schemes. One scheme has been based on the random selection of both mothers and unrelated children (simple random sampling scheme), while the other scheme has been based on the household, that is on the selection of the mother and her own child (household sampling scheme).

The mothers and children selected in each scheme came from a nutrition survey in the same population. The original survey (Kardjati, 1976) had investigated haemoglobin values of 1,800 samples from mothers and children.

Two aspects of relationship have been observed; one was the association between the mothers' and children's haemoglobin values and this has been expressed as a linear regression. The other was the correlation coefficient of the Hb value between the mothers and children. The analysis of variance (ANOVA) for linear regression has been employed for the significance test. The significance of the correlation coefficient has been checked by the t test.

The 122 sample size has been determined based on the statistical consideration of maximum level of t value for significance ($p < 0.05$). The sampling of the 122 cases in each sampling scheme has been carried out from 900 mothers and children in each case from the original samples.

2.1.2.2 Result

The relationships between nutritional status in mother and child are different in each sampling scheme: from the individual sampling scheme, the linear regression between mother and child (X: mother, Y: child) is $Y = 0.04 X -0.06$; and from the household sampling scheme it is $Y = 0.08 X + 0.03$ (Table 2.12). The analysis of variance (ANOVA) to test the significance of the two regression lines indicates that the individual sampling scheme does not show enough association between the nutritional status of the mother and child ($p > 0.05$); in the case of the household sampling scheme the regression line shows highly significant association ($p < 0.01$).

The household sampling scheme shows that the haemoglobin (Hb) level in the mother and her own child have a correlation more than five times

Table 2.12: Comparison of relationships between nutritional status in the mother and child from two different sampling units

Relationship	Individual Sampling Unit	Household Sampling Unit
1. Measuring the association		
a) linear regression	$Y = 0.04 x -0.06$	$Y = 0.28 x +0.03$
b) significance test of linear regression	The analysis of variance for linear regression	

Source	Ssq	d.f.	Msq	VR	Source	Ssq	d.f.	Msq	VR
Regression	2.19	1	2.19	0.55	Regression	61.15	1	61.15	17.83
Residual	75.43	120	3.96		Residual	412.18	120	3.45	

(at $P = 0.01$ $F_{1, 120} = 6.85$)

(at $P = 0.05$ $F_{1, 120} = 3.92$)

	Individual Sampling Unit	Household Sampling Unit
	$\therefore P > 0.05$	$\therefore P < 0.01$
2. Measuring the correlation		
a) correlation coefficient	$r = 0.068$	$r = 0.36$
b) significance test of correlation coefficient	The significance test for the correlation coefficient	
	$t = 0.747$	$t = 4.23$

(at $P = 0.01$ $t_{120} = 2.68$)

(at $P = 0.05$ $t_{120} = 1.98$)

	Individual Sampling Unit	Household Sampling Unit
	$\therefore P > 0.05$	$\therefore P < 0.01$

stronger than that of the individual sampling scheme (the correlation coefficient is 0.36 and 0.067 respectively). The significance test for the correlation coefficients in both the two schemes is seen in Table 12. The individual unit scheme shows an insignificant ($p > 0.05$) correlation between the haemoglobin level of the mother and child. The strong relationship between the haemoglobin level of mother and child obtained from the household sampling scheme seems to support the usefulness of the household unit as a nutritional functional unit.

This finding may suggest the agreement with our assumption that the nutritional status indicator in children can represent the nutritional status of the household to which the child belongs. Thus we may in addition support the idea of the household as a nutritional functional unit on the grounds that thenutritional status in children can be a proxy measure of the environment of the household to which the child belongs.

Moreover, the collection of information for the nutritional status indicator can be done much more easily and cheaply by reducing the size of the sample to that of one individual child per household.

2.1.3 Summary of the Results from Cross-sectional Observations

Anthropometric indicators based on the weight of children, vary in their validity as single indices of nutritional status of deprived groups in the community, according to the cut-off point chosen on the weight-for-age scale. A lower cut-off point of the anthropometric stronger than that of the individual sampling scheme (the correlation coefficient is 0.36 and 0.067 respectively). The significance test for the correlation coefficients in both the two schemes is seen in Table 12. The individual unit scheme shows an insignificant ($p > 0.05$) correlation between the haemoglobin level of the mother and child. The strong relationship between the haemoglobin level of mother and child obtained from the household sampling scheme seems to support the usefulness of the household unit as a nutritional functional unit.

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In general there is a tendency for the sensitivity of the anthropometric indicator to decrease as countries become richer.

However, the anthropometric indicator shows the same trends between the countries observed as that shown by an indicator of welfare (PQLI), which is supposed to reflect the fulfilment of the basic human needs of the poor. This finding suggests that anthropometry is of potential value as a proxy of socio and environmental measure in the community.

In addition, the result of testing the household as a functional unit in the community suggests that the nutritional status indicator obtained from one child in a family, can be used to represent the nutritional status of all the family members.

2.2 Observations from the Japanese Longitudinal Data

2.2.1 Objective and period observed

The purpose of this particular part of the exercise is to explore how various development indicators respond differently during the same periods and then to estimate the value of nutrition indicators in helping to describe the process of national development.

This can be done by establishing the changes in nutritional status over certain periods in Japan and then comparing the patterns with other development indicators during the same periods.

The period of observation was chosen in an attempt to cover the same range of per capita GNP as that which existed in 1975 among the four countries used in the cross-sectional study (summary in Table 2.13)

Table 2.13 Time Sequence Between Longitudinal and Cross-sectional Observation

1. GNP per capita 1975 (US dollars)	220	350	760	2,450	4,450
2. "Cross-sectional" countries chosen	Indonesia	Thailand	Malaysia	Singapore	Japan
3. "Equivalent" year in Japan	1953	1958	1964	1972	1975
4. Stages of development in symbols	I	II	III	IV	V

Nutrition data were studied at the end of each year. Only 3 periods (1950, 1960 and 1970) were studied for other development indicator since there was not sufficient information for all the equivalent years.

2.2.2 Indicators selected

Nutrition indicators

As already mentioned, the design of this part of study was linked with that of the "cross-sectional" part. Because of the need to make comparisons in the two observations at equivalent periods, there was very little latitude in selecting nutrition indicators. For example, weight-for-age was the only anthropometric measurement (as a nutritional status measure) among other measurements such as height, skinfold thickness and weight which had been included in the original National Nutrition Survey (NNS) by the Japanese Ministry of Health and Welfare (1948-).

In addition to weight-for-age,′intake of nutrients (calories and protein) was also selected as a basis for nutrition indicator. This data is of particular interest since separate figures for rural and for urban populations were available while the anthropometric data was undivided after the year 1964 so this data was analysed in relation to the nutritional status of children.Per capita nutrient intake (calorie and protein) from the national nutrition survey (NNS) which used the household as a consumption unit, was compared with average per capita calorie supply as estimated in the national Food Balance Sheets (FBS) published by FAO (Food and Agriculture Organization) in order to compare usefulness of the two sources of information to assess changes in the nutritional condition of populations over a period of time.

Ideally, a biochemical indicator, prevalence of anaemia as defined by the haemoglobin level, would also have been included in the data collected from Japan; thus, comparison could then have been made between the indicators in the cross-sectional and the longitudinal data at the equivalent periods. However, it was decided not to include it as data here only available from 1969, so that the series would have been incomplete.

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Other development indicator

The same composite index as chosen in section 2.1, "Physical Quality of Life Index (PQLI)", has been selected as a single index of measurement showing the changes in living standard of population over a period of time in Japan.

2.2.3 Materials used

Nutrition indicators

The National Nutrition Survey (NNS), which uses households as sampling units, has been carried out every year since 1948 by the Japanes Ministry of Health and Welfare. The sample size averages 6,000 households and about 20,500 individuals are measured each year. The sampling frame covered the whole population in terms of children and adults of both sexes, living in rural and urban areas. The same sampling frame was maintained throughout the period observed, and was adjusted for demographic changes in terms of population size in the rural and urban areas according to the latest cenus. The survey items included food consumption and anthropometric measurements such as weight, height and skinfold thickness.

The present study used only the results of weight-for-age measurements for children under six and the nutrients intake for analysis. The aggregated data at the national level for the years 1953, 1958. 1964, 1972 and 1975 were used for analysis in the present study.

Data on the growth of children in urban and rural areas were available for the years 1953, 1958, and 1964. But such separate urban and rural data for 1972 and 1975 were unavailable.

Other development indicator

Complete data on PQLI were not available for the actual years 1953, 1958, 1964, 1972 and 1975, so data from three periods with ten year intervals beginning in 1950 were used: 1950, 1960 and 1970.

For the years 1960 and 1970, the PQLI were drawn out of the Annex note from the ODC's Agenda 1979. For the year 1950, the PQLI has been calculated from raw data; infant mortality per 1000 live births, life expectancy at age one and literacy rate. These were available in the Japanese Annual Statistical Year Book published by Bureau of Statistics from the Prime Minister's Office (Appendix 3 shows the sources used and the estimation procedure). Summary of the calculation is as follows: each of the component has been indexed according to the estimation of PQLI devised by ODC using a scale which runs from zero (the most unfavourable performance in 1950 among the 150 countries; when the infant mortality rate was 229 in Gabon, life expectancy was 38 in Guinea and literacy was 0) to 100 (the best performance expected by the end of the century which is projected to be infant mortality 7, life expectancy 79 and literacy 100). Then the PQLI has been calculated by averaging the three indices, giving equal weight to each of them.

2.2.4 Analysis

In order to see the general trends and changes in nutritional status over the periods observed and to compare these with per capita GNP, firstly, it was assumed that the rate of change (improvement of nutritional status) would be related to that of the increasing GNP (e.g. Table 2,14). Accordingly, in a graphical presentation, the X scale represents the changes in per capita GNP using a log scale (see Figure 2.2 and 2.3). Then the average weight-for-age of the children living in urban and rural areas were analysed in order to find out any disparity between these two populations, and protein and calorie consumption from the two areas of populations were observed and compared with the growth patterns of children in the two areas during the periods selected.

2.2.5 Findings

2.2.5.1. Differences in changes of nutritional status between the periods.

(based on weight-for-age of children under 6 - Appendix 4)

There are three patterns of change in the figures for the nutritional status between the five periods of time (1953, 1958, 1964, 1972 and 1975) observed in all ages. The first period 1953-1958 shows the greatest change at age 1, 5 and 6. The second period (1958-1972) shows a slow change, wheras the third period (1972-1975) shows again a great change, even though it is smaller than that of the first period (Table 2.14). Figure 2.2 shows these trends.

In general, the changes in the nutritional status of children were greater during the early stages (period) studied than are those in the later stages.

Table 2.14 Rate of Change in Weight of Japanese Children at the Different Periods

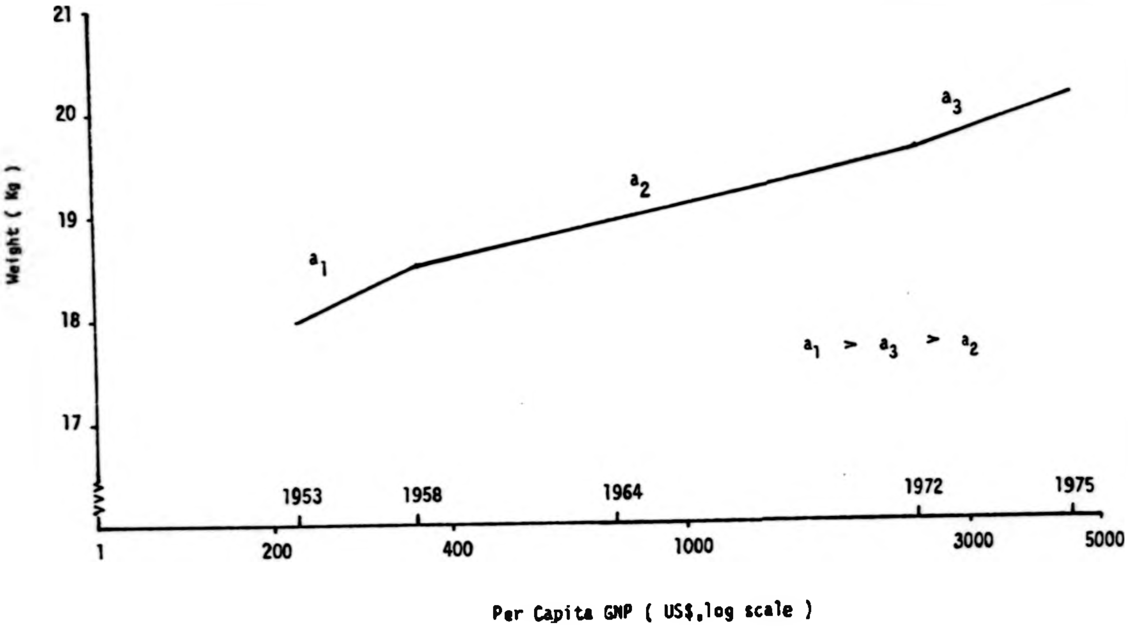
Unit: weight increase in Kg per year every GNP increase in dollar

Age (Years)	PERIOD I (1953-1958)	II(1958-1972)	III (1972-1975)
1	$4.6\text{x}10^{-4}$	$3.4\text{x}10^{-5}$	$6.6\text{x}10^{-5}$
2	0	$3.4\text{x}10^{-5}$	0
3	0	$3.1\text{x}10^{-5}$	$-(9.5\text{x}10^{-5})$
4	$-(3.1\text{x}10^{-4})$	$3.1\text{x}10^{-5}$	$5.0\text{x}10^{-5}$
5	$3.1\text{x}10^{-4}$	$4.4\text{x}10^{-5}$	$8.3\text{x}10^{-5}$
6	$6.2\text{x}10^{-4}$	$4.1\text{x}10^{-5}$	$5.0\text{x}10^{-5}$

2.1.5.2 Urban-rural disparity according to changes in nutritional status

The importance of making a distinction between rural and urban sectors in national development analysis has long been stressed by both economist

Figure 2.2 Weight of Japanese Children at Age 6 in relation to Per Capita GNP during 1953-1975



and other development analysists.

Differences between rural and urban areas are considerably more pronounced in developing countries than in the already industrialized and economically complex societies.

From the Figure 2.3 it can be seen that urban-rural disparity disappears at an early post-war period in Japan taking into account the growth of children, especially that based on weight-for-age (Appendix 4). Table 2.15 summarize the weight of the children of rural and urban populations at all ages during the periods observed.

A study on the distribution of household income by Mizoguchi (1975) described the income changes in the rural sector in post-war Japan (1954-1971). According to this author, the number of households in the rural sector fell from 23 percent in 1958 to 16 percent in 1971. In the process of rapid economic growth many farmers became part time farmers earning their living not only in agriculture but also through wage income from regular employment in the non-agriculture sector. As a result, the average income of the rural household grew at the same rate as that of urban employees. The improvement in the household income of those in the rural sector was affected by two factors: The increase of non-agricultural income and the price support policies of the government. Considering the primary income and its two components (agricultural and non-agricultural) by quintile grouping in the rural sector, the distribution of the income from agriculture tended to be more equal before 1967.

This experience of economic changes is related in changes in growth of children in the rural and urban population (Figure 2.3) during the same period. In other words, the disappearance of the disparity in the

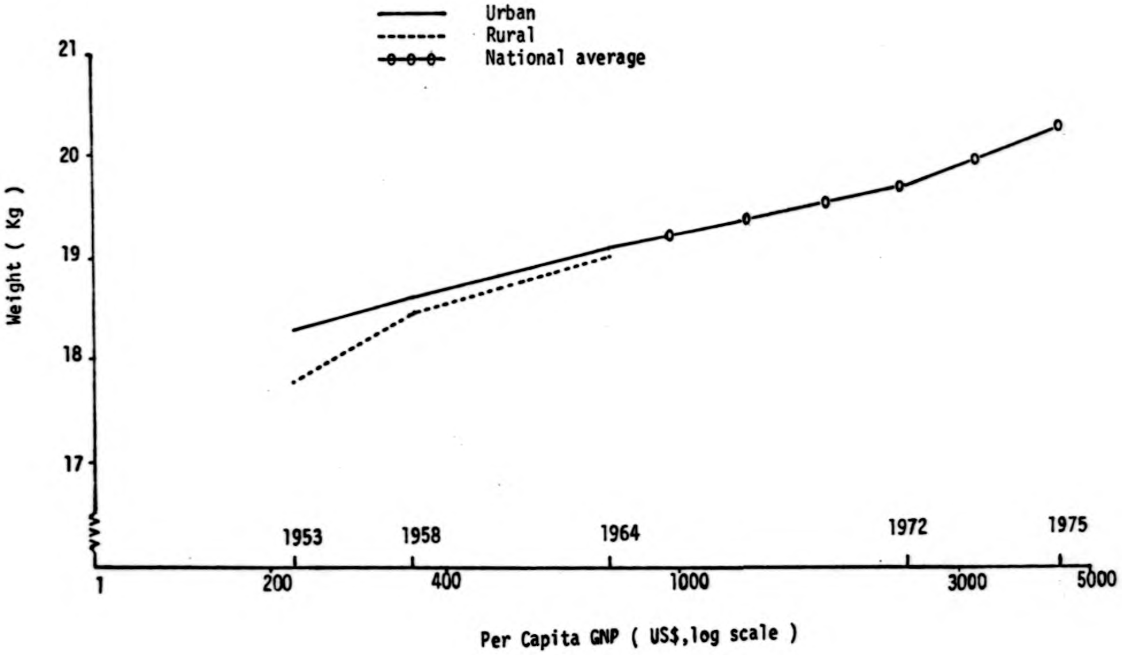


Figure 2.3 Weight of Japanese Children at Age 6 in Urban and Rural areas in relation to Per Capita GNP during 1953-1958

Table 2.15 Weight of Children of Rural and Urban Population

Sex combined, Unit (Kg), Values in brackets is the size of samples in each case.

Age (years)	Area	YEAR				
		1953	1958	1964	1972	1975
1	Urban	9.6±1.6 (370)	10.0±1.5 (459)	10.3±1.4 (358)	10.8±4.0 (478)	11.2±7.6 (341)
	Rural	9.4±1.4 (306)	9.5±1.4 (367)	10.0±1.3 (302)		
2	Urban	11.8±1.5 (392)	11.9±1.9 (379)	12.3±1.4 (346)	12.7±2.6 (485)	12.7±3.8 (404)
	Rural	11.4±1.5 (379)	11.5±1.5 (308)	12.2±1.4 (339)		
3	Urban	13.6±1.7 (512)	13.7±1.8 (488)	14.1±1.5 (368)	14.6±2.9 (557)	14.0±1.8 (369)
	Rural	13.3±1.6 (398)	13.7±1.7 (369)	14.1±1.6 (354)		
4	Urban	15.0±1.7 (545)	15.3±1.8 (427)	15.6±1.9 (405)	16.1±2.3 (485)	16.4±5.9 (389)
	Rural	14.9±1.8 (374)	15.1±1.7 (408)	15.6±1.8 (387)		
5	Urban	16.6±2.0 (566)	16.8±2.1 (499)	17.2±2.2 (414)	18.0±3.3 (524)	18.5±6.1 (252)
	Rural	16.4±1.9 (443)	16.6±1.9 (435)	17.3±2.3 (404)		
6	Urban	18.3±1.9 (543)	18.6±2.4 (538)	19.0±2.6 (423)	19.7±3.4 (374)	20.3±5.0 (394)
	Rural	17.8±1.9 (342)	18.4±2.2 (416)	18.9±2.5 (328)		

Significance of difference between the weight of children at age five in the rural and urban area

Area	Standard error in % weight in each year		
	1953	1958	1964
Rural	0.06	0.07	0.09
Urban	0.07	0.08	0.09
significance level of urban and rural disparity	$p>0.05$	$p<0.05$	$p<0.01$

nutritional status between the rural and urban population coincides with the experience of economic change between the two sectors. The balanced development between the urban and rural sector in Japan is unique in that it has differed from the pattern found in most of the developing countries.

2.1.5.3 Relationship between nutrition indicators with special reference to growth and nutrient intake.

Despite the fact that the rural-urban disparity based on the growth of children has disappeared during the early post-war period, protein consumption for rural populations did not rise. In fact, the gap between protein consumption in the rural and urban groups increased during the same period (Table 2.16.b). The Figure 2.4 shows this between the year 1958 and 1964.

However, the calorie consumption of rural population was higher than that of urban populations during the same period. This evidence from Japan suggests that reconsideration of the emphasis on protein requirements for children during their growth period (WHO/FAO Expert committee, 1973) is necessary. This data suggests that protein consumption has less effect on the growth of children than calorie consumption in Japan during the periods observed.

The per capita calorie intake from the National Nutrition Survey (NNS) has also been compared with the average per capita calorie supply as estimated in the Food Balance Sheet (FBS); Table 2.17 summarises the comparison. Figure 2.5 shows the result, plotted against GNP (US dollars) on a log scale. It shows that average calorie intake from the NNS changed very little over the period. But the per capita calorie supply figures from FBS rose rapidly as GNP increased especially after 1958 when the GNP increased rapidly. This observation suggests that the relation-

Table 2.16 a Calorie Consumption in Rural and Urban Populations

Unit: Kcal per caput, values in brackets ( ) is the number of individuals surveyed.

Area			YEAR		
	1953	1958	1964	1972	1975
Urban	2002 (12,615)	2044 (14,586)	2168 (58,681)	2260 (23,336)	2171 (18,562)
Rural	2131 (7,898)	2232 (6,461)	2336 (16,410)	2357 (4,445)	2261 (3,457)

Table 2.16 b Protein Consumption in Rural and Urban Populations

Unit: g per caput

Area			YEAR		
	1953	1958	1964	1972	1975
Urban	69 (12,615)	71 (14,586)	76 (58,681)	83 (23,336)	80 (18,562)
Rural	68 (7,898)	70 (6,461)	71 (16,410)	84 (4,445)	81 (3,467)

Table 2.17 Comparison of Calorie Intake from the National Nutrition Survey (NNS) with Calorie Supply as Estimated in Food Balance Sheets (FBS)

Unit: Calorie per caput

Source			YEAR		
	1953	1958	1964	1972	1975
Intake from NNS	2068	2118	2223	2279	2188
Supply in FBS	2130	2210	2566	2832	2824

Figure 2.4 Nutrient Consumption Patterns in Urban and Rural Populations in Japan during 1953-1975

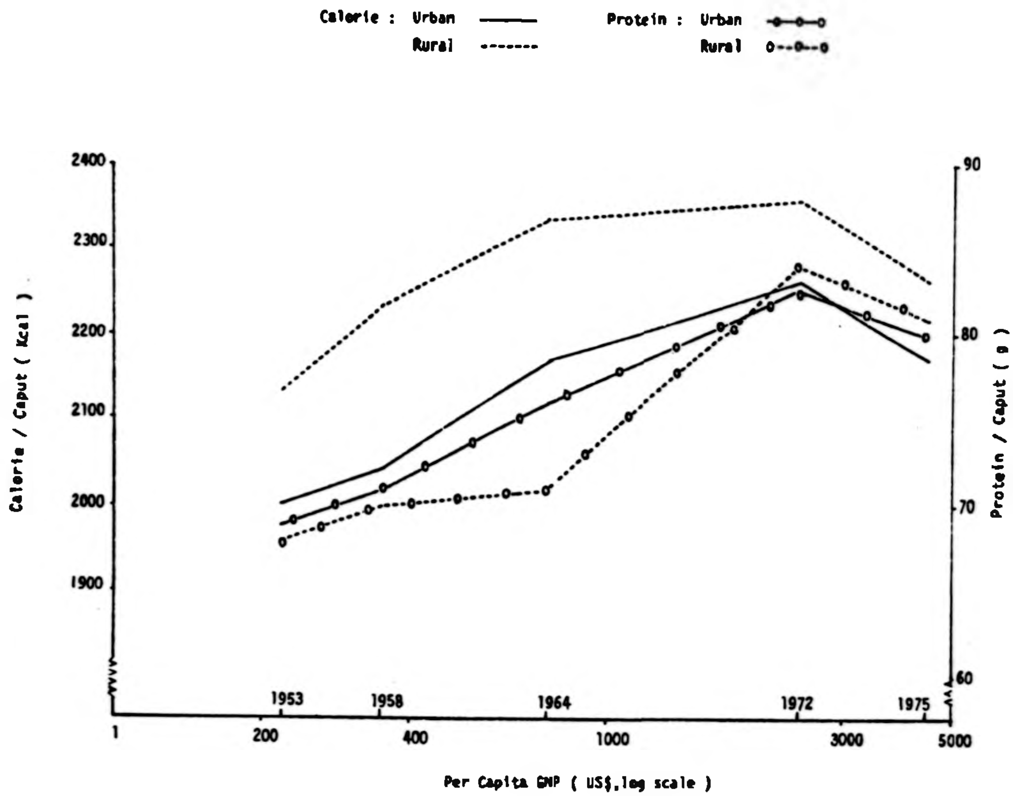
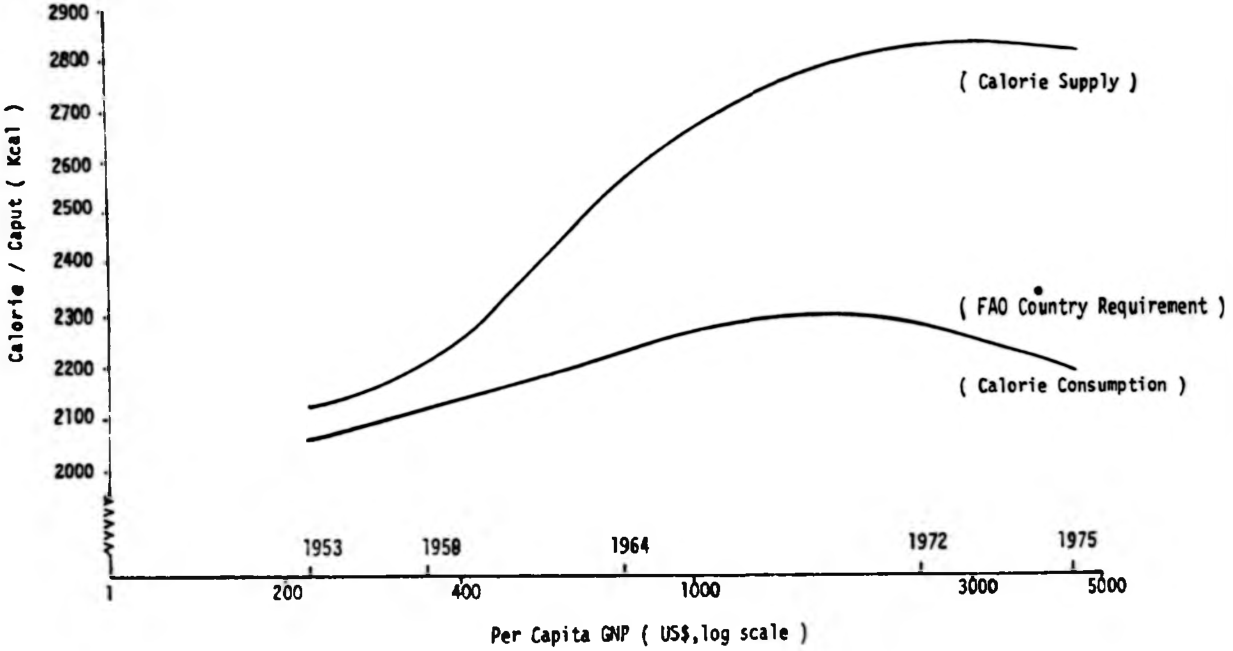


Figure 2.5 Comparison of Per Capita Calorie Consumption from the National Nutrition Survey with the Calorie Supply as estimated in Food Balance Sheet in Japan



ship between food consumption (NNS), and food supply in a country which experiences increasing income, is quite complex, and changes with the level of income. The use of FBS data to assess differences in the nutritional condition of populations or to infer changes over time is of doubtful validity.

2.2.5.4 Comparison of changes in nutritional status of children with that of other development indicators.

Changes over time in the weight of children run parallel to improvements in GNP and PQLI (Table 2.18). The improvement in PQLI during the earlier period may also be contributed by increasing equality between rural and urban area during the riod. However separate information about the PQLI in the two sectors is not available at the moment.

While the overall improvements in per capita GNP, welfare (PQLI) and nutritional status, the overall income equality as measured by the Gini coefficient has deteriorated from 0.31 to 0.41.

2.2.6 Summary of the results

The relationship between the patterns of changes in nutritional status of children and other development indicator observed in Japan varies over a period of time (1953-1975). The pattern of changes in nutritional status are different from those shown by Gini coefficient during the same period. But it shows similar trends as those shown by GNP and a welfare indicator (PQLI).

The improvement of nutritional status coincides with the period which the rural and urban disparity disappeared. Changes in nutritional status of children therefore is able to demonstrate the unique developmental pattern in Japan, that is the disappearance of disparity between the

Table 2.18 Change Over Time in Measurements of GNP, PQLI, Income Distribution and Nutritional Status in Japan (1950-1975)

Year	GNP[1] Per Capita (US $)	PQLI[2]	Measurement Weight of 4 year old children (kg)[3]	Gini coefficient[4] (Index in bracket)
1950		78.3		
1951				
1952				
1953	230		15.0	
1954	250			
1955	270			
1956	300			.3130(100.0)
1957	340			
1958	350		15.2	
1959	390			.3568(114.0)
1960	460	88.9		
1961	570			
1962	620			.3819(122.0)
1963	700			
1964	820		15.6	
1965	900			.3766(120.3)
1966	1,020			
1967	1,190			
1968	1,400			.3800(121.4)
1969	1,630			
1970	1,920	95.7		
1971	2,130			.4069(130.0)
1972	2.320		16.1	
1973	3,630			
1974	4,040			
1975	4,450		16.4	

Sources:
1. OECD National Account (1953-1975).
2. Annex Note from ODC's Agenda 1979 (1960 and 1970) and estimation from the present study (1950).
3. Annual Report on the Japanese National Nutrition Survey by Ministry of Health and Welfare (1953-1978).
4. Richard O. Wada's work (1975) on Impact of Economic Growth in the Size Distribution of Income: The Post-war Experience of Japan.

urban and rural sectors during the early post-war period.

The disparity between the growth of children in the urban and the rural population has disappeared despite the gap between protein consumption in the rural and urban populations has increased during the same period.

2.3 Comparison Between Nutritional Status in the Longitudinal and the Cross-sectional Observations.

2.3.1 Objectives, indicators and materials used.

Having established the validity of the anthropometric indicator as a potential proxy index of social and environmental welfare (from the result of the section 2.1), we can now pursue a further analysis.

Even though the previous section suggests positive finding, the observations have been based on cross-sectional data and therefore their uncertainty remains as to their value in describing developmental changes over time. The intention in this section, therefore, is to test the reliability of findings from cross-sectional data, by comparison with the data on the longitudinal Japanese observations. The nutritional status measured by average weight-for-age from the two sets of data has been compared.

Data on the weight of children from the same source as that used in section 2.2 has been used again for longitudinal observation, and the same cross-sectional data on weights of children as used in section 2.1 have been analysed for the comparison.

2.3.2 Analysis

Data on the average weight-for-age of children from four South-East Asian countries have been compared with that from Japan for the equivalent years (Table 2.13). The same time sequence and development stages of the four countries based on per capita GNP has been used.

It is intended to carry out a comparison between the under 40% income class both in the cross-sectional and in the longitudinal observations. But in fact, the data on weight for the children from the under 40%

income class was not available, therefore in the case of longitudinal observations on the weight of Japanese rural children coming from all income classes have been substituted for the equivalent periods (Figure 2.6 and Table 2.21). Thus we must take into account the fact that the weight of Japanese rural children shown here could be higher than the weight of children from the under 40% income class in Japan when interpreting the results.

Table 2.19 shows the changes in household income for the last 23 years in Japan and that of the four South-East Asian countries in 1975.

Table 2.19 Estimated Household Monthly Income for the Under 40% Income Class in Japan and that in the Four South-East Asian Countries in 1975.

Unit: U.S. dollars

Stages of development in symbols	Year in Japan	Income in Japan	Income in "cross-sectional" countries (1975)	
I	1953	<53	<26	(Indonesia)
II	1958	<72	<50	(Thailand)
III	1964	<172	<122	(Malaysia)
IV	1972	<472	<336	(Singapore)
V	1975	<633	<633	(Japan)

The sources and the estimation are described in Appendix 5.

In analysing cross-sectional and longitudinal data, weights for the rural children in Japan have been compared with those for the rural children in the four South-East countries, at the equivalent periods. As has already been mentioned, the data on the weight of Japanese children came from all income classes in the rural population while that of the South-East Asian children came from the rural population belonging to the under 40% income class therefore this must be borne in mind in making the comparisons.

Two linear regressions on nutritional status at different stages in relation to household income from the longitudinal and the cross-sectional data have been calculated.

The regression line from the cross-sectional data has been extrapolated beyond the actual values to a point at the same income level as that which obtained in Japan in 1975. This is a very rough attempt to estimate the expected value of nutritional status when these countries reach the same level as Japan in terms of income. Of course this assumes that these four countries represent stages in the same general pattern of development.

2.3.3 Result

The nutritional status of children in Japan reached a higher standard in the early post-war period than it did in the South-East Asian countries at the equivalent periods. Table 2.20 summarizes the changes in weight of children in the longitudinal and the cross-sectional observations at the equivalent periods.

The longitudinal patterns showing the nutritional status of children in Japan has revealed not only a higher standard than in the cross-sectional countries but the gap between the "cross-sectional" pattern and the longitudinal pattern at the equivalent periods (within square line in Figure 2.6) has also been maintained; for instance, in the case of Malaysia and Thailand, the gap between the longitudinal and the cross-sectional observations shows that Malaysia has a bigger gap than Thailand; (just such an adverse ranking between the two countries was also shown in the

Table 2.20 Weight of Children in the Longitudinal and the Cross-sectional Observations.

Unit: Kg., ( ): No. of children examined.

Age (years)	Observation	Stages of development in symbols				
		I	II	III	IV	V
1	Cross-sectional	8.4±1.3 (167)	8.6±1.2 (68)	8.8±1.2 (24)	10.1±1.5 (45)	
	Longi-tudinal	9.4±1.5 (676)	9.5±1.5 (826)	10.3±1.4 (660)	<10.8±4.0> (478)	<11.2±7.6> (341)
2	Cross-sectional	9.7±1.3 (151)	10.0±1.4 (62)	10.9±1.8 (10)	<11.2±1.8> (60)	
	Longi-tudinal	11.6±1.5 (771)	11.7±1.7 (687)	12.3±1.4 (685)	<12.7±2.6> (485)	<12.0±3.0> (404)
3	Cross-sectional	11.3±1.7 (238)	11.7±1.5 (75)	12.6±1.3 (16)	<13.5±1.8> (28)	
	Longi-tudinal	13.4±1.7 (910)	13.5±1.8 (857)	14.1±1.5 (722)	<14.6±2.9> (557)	<14.0±1.8> (369)
4	Cross-sectional	12.7±1.7 (228)	13.3±1.7 (53)	13.3±1.3 (9)	<16.2±1.9> (34)	
	Longi-tudinal	15.0±1.8 (919)	15.2±1.8 (835)	15.6±1.9 (792)	<16.1±2.3> (485)	<16.4±5.9> (387)
5	Cross-sectiona-	14(0±1.9 (278)	15.7±2.1 (31)	14.9±1.5 (12)	<17.2±2.8> (8)	
	Longi-tudinal	16.5±1.9 (1,009)	16.7±2.0 (934)	17.2±2.2 (818)	<18.0±3.3> (524)	<18.5±6.7> (352)
6	Cross-sectional	15.4±2.0 (201)	18.0±2.4 (47)	16.5±2.0 (13)	<19.6±2.1> (75)	
7	Longi-tudinal	18.0±1.7 (795)	18.4±2.3 (954)	19.0±2.5 (751)	<19.7±3.4> (374)	<20.3±5.0> (394)

Note:

1. The cross-sectional data came from the rural population belonging to the under 40% income class in the four South-East Asian countries (Indonesia, Thailand, Malaysia and Singapore) in 1975.

2 The longitudinal data came from Japanese rural population in all income classes and values in brackets represent the average value from rural and urban populations.

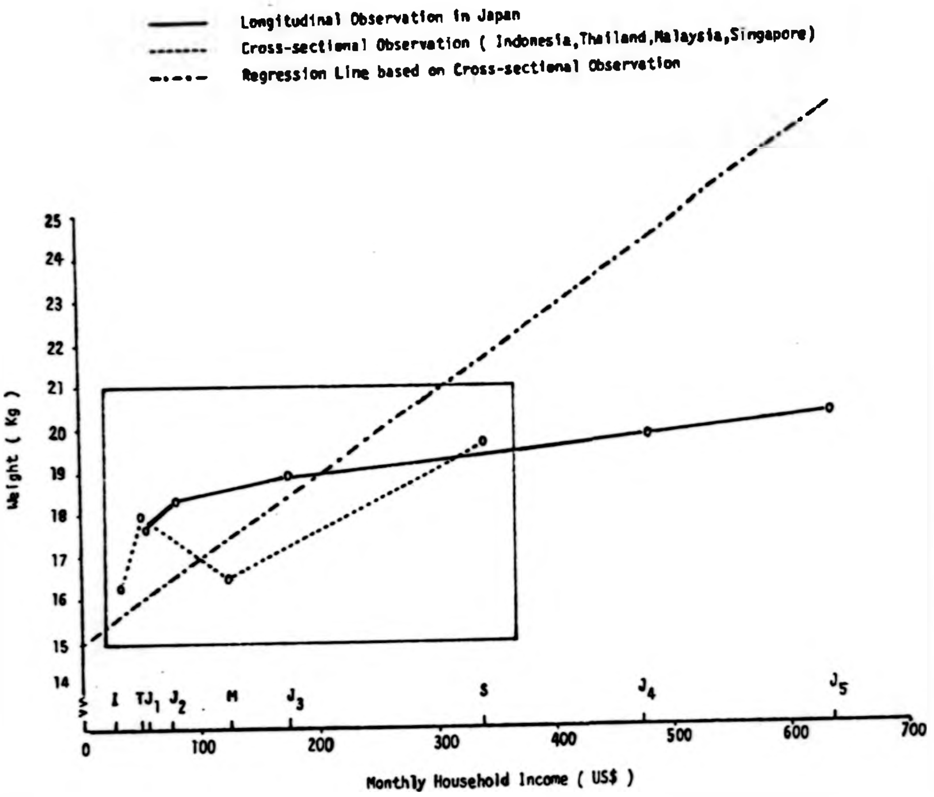
3 Stages I.II, III, IV and V represent Indonesia, Thailand, Malaysia, Singapore and Japan respectively in the cross-sectional observation in 1975, and the equivalent periods in Japan (1953, 1958, 1964, 1972 and 1975).

cross-sectional country observations in the previous section).

Throughout the periods observed, Japan maintains a higher standard of average weight-for-age in children than that found in the four South-East Asian countries at the equivalent periods. But the expected weight of children in the South-East Asian countries estimates from the extrapolated regression line based on the present performance of the four countries (see Figure 2.6), was higher than that of Japan when they reached the same income level as Japan did in 1975. This may not be a realistic arrangement for comparison since the rate of change in weight within the four South-East Asian countries may have been different from that of Japan during the last 25 years. It therefore may suggest that faster growth in children can not be explained simply by increases in income and more environmental factors may be involved.

Even though the longitudinal patterns of weight for children in Japan are not the growth pattern of children (in a strict sense) since those are not cohort observations of the same children. It might suggest a more realistic growth pattern for children than that of the cross-sectional data. However, one has to be careful to interpret such a finding from the extrapolated rgression line which is not based on real observations. We can therefore only state that the present rate of change in the nutritional status of children in the four South-East Asian countries is higher than that found in Japan for the last 25 years (1950-1975) at the equivalent periods.

Figure 2.6 Weight of Rural Children at Age 6 in the Longitudinal and the Cross-sectional Observations at the Equivalent Periods in relation to the Household Income



CHAPTER 3

DISCUSSION

A major objective of the study has been to test the vaildity of an anthropometric indicator as a proxy index of social and environmental welfare.

Three important stages in analysis have been explored. The first stage has involved a discussion of the complete range of nutrition measurements which could be used as a basis for defining nutrition indicators. The second stage has examined the relationship between the various nutritional status indicators and has discussed the validity of choosing an anthropometric indicator in children as a proxy for the nutritional status of community in general. The third stage has explored the basis for regarding nutritional status of the community as an acceptable proxy indicator for general socio and environmental well-being.

Of course the idea of using anthropometry in children as a general measure of socio-environmental conditions is not a new idea, however ther have been very few formal attempts to establish the basis for such a relationship. It is a major feature of this subject area that it combines together the need for a scientific examination of the causal relationships between measurements and variables, and application of this knowledge to decisions about welfare of human populations.

Whether in the last analysis decision makers are prepared to accept one particular measure of nutritional status as a proxy for general social welfare will depend upon their confidence in the scientific analysis but also upon their willingness to accept the much less precise social values contained in the proposition.

3.1 Assessment of Study Design

3.1.1 Original study design

The whole of this research has been based on an attempt to assemble as comprehensive a set of data as possible covering nutritional, economic and social measurements for a group of four countries at different stages of economic development, and to compliment this with longitudinal data for one country to provide a historical perspective for the changes which take place during economic growth.

It seemed desirable, in addition, to choose the countries with similar cultural and ethnic backgrounds. On the basis of these requirements and because it seemed likely to offer the most complete series of data, the four following countries, Indonesia, Thailand, Malaysia and Singapore were selected for the cross-sectional, and Japan for the longitudinal study.

The original study design was intended to make comparison as outlined in Figure 3.1

The selected set of indicators were: the prevalence of anaemia; the prevalence of weight-for-age deficit and the 2-5 year mortality rate. Economic and social indicators were GNP, Gini coefficient and Physical Quality of Life Index.

In making inter-country comparison, the gross national incomes of the four South-East Asian countries have been matched against the Japanese data at dates for which the GNP values correspond.

Figure 3.1 Original Study Design for the Longitudinal and Cross-sectional Observations.

Longitudinal observation (Japan)		Cross-sectional observation (Indonesia, Thailand, Malaysia and Singapore)
1st stage analysis: relationship between nutritional status indicators 1) biochemical indicator 2) anthropometric indicator 3) Health indicator	⟷	1st stage analysis: relationship between nutritional status indicators 1) biochemical indicator 2) anthropometric indicator 3) health indicator
2nd stage analysis: anthropometry as a representative of community nutritional status	⟷	2nd stage analysis: anthropometry as a representative of community nutritional status
3rd stage analysis: community nutritional status compared with economic and social indicators over period during 1953-1975	⟷	3rd stage analysis: community nutritional status compared with economic and social indicators over GNP ranged U.S. $ 220-2,450 in 1975

3.1.2 Available data and modification of study design

In practice, the data sets from all these countries were not complete. Table 3.2 shows the summary of data that were actually obtained.

Table 3.1 Data Available as a Result of the Search for Raw Material (1979-1980).

Cross-sectional observation in 1975

Development stages in symbols	Country	Nutritional status indicator	Welfare indicator
I	Indonesia (I)	BI (O) AI (O) HI (O)	PQLI I (Δ)
II	Thailand (T)	BT (O) AT (O) HT (X)	PQLI T (Δ)
III	Malaysia (M)	BM (O) AM (O) HM (X)	PQLI M (Δ)
IV	Singapore (S)	BS (Δ) AS (O) HS (X)	PQLI S (Δ)

Longitudinal observation in Japan (J)

Development stages in symbols	Years	Nutritional status indicator	Welfare indicator
I	1953	BJ (X) AJ (Δ) HJ (Δ)	PQLI (1950)
II	1958	BJ (X) AJ (Δ) HJ (Δ)	PQLI (1960)
III	1964	BJ (X) AJ (Δ) HJ (Δ)	
IV	1972	BJ (X) AJ (Δ) HJ (Δ)	PQLI (1970)
V	1975	BJ (X) AJ (Δ) HJ (Δ)	

Note:

1. B,A and H stand for biochemical, anthropometric and health indicator respectively.
2. Δ; only available as the national average
   X; not available
   O; available from the lowest income section of the population who receive a share of low 40% of the total national income.

The Table 3.1 shows the major problems were encountered in the longitudinal data. Only one nutritional status measurement (average weight-for-age for children) was available. Japanese data could not be disaggegated to give prevalence of deficit below a reference growth standard. Therefore the stage 1 and 2 analysis were impossible. In addition, the nutritional status measurements could not be exactly matched with economic and social measurements at all points on the same scale.

3.2 Assessment of Validity of the Analysis and Results

3.2.1 Cross-sectional data

The relationship between three nutritional status indicators have been summarized in Table 2.11. This table shows that there is a relationship between the three. And the second stage of analysis which is intended to justify anthropometry as representing nutritional status in general is supported by the high value of specificity which is seen when a low (less than 60%) cut-off point is used to classify weight-for-age.

Evidence that measurements of nutritional status in individual children can provide useful information about status of other members in the same family comes from two sets of data. Firstly from the strong relationship between mortality and anthropometric indicators from sibling children. Table 3.2 shows the specificity of under weight-for-age as a predictor of mortality in siblings in the Indonesian survey is as high as that found by Chen et al (1980) in propective studies in which subsequent mortality of measured individuals was determined. Secondly, Table 2.12 shows that there is a significant relationship between haemoglobin status in children and their own mothers.

Table 3.2 Comparison of the Specificity of Weight-for-age Indicator as a Screening Test for Mortality Rate from the Study by Chen at al with that from the Present Study at the Different Cut-off Points of the Anthropometric Indicator

Chen et al		Present study	
Cut-off point	Specificity of Weight/age	Cut-off point	Specificity of Weight/age
50% H.S.*	95.9 %	60% H.S.	94.4 %
62% H.S.	75.2 %	70% H.S.	74.5 %
71% H.S.	41.3 %		
78% H.S.	16.6 %	80% H.S.	38.1 %

* H.S. stands for Harvard Standard.

However, Table 2.9 shows that the validity of anthropometry as a general measure of the nutritional status of communities, varies from one country to another. There is a general tendency for sensitivity to decrease as the country becomes more rich. For example, Indonesia was the poorest, and always shows the highest sensitivity. The converse effect has been shown in the case of specificity.

The third stage of analysis relies very much upon ranking order between the countries as a means of comparing the various indicators of nutrition and welfare. Its objective was to demonstrate the potential value of nutritional status indicators as a proxy for general socio-economic and environmental well-being. Table 2.8 shows biochemical indicator of nutrition gives the same ranking order for the four countries as does PQLI. However, the anthropometric indicator shows this ranking order only when cut-off point of less than 60% reference standard is used (as will be discussed later), this lack of total consistency may be due to problems of sampling and sample size connected with Malaysian data.

In addition to the nutritional status indicators, nutrient consumption and food supply information were available for these countries. It is often suggested that food consumption or aggregated supply could be used as a basis for indicator of extent of under nutrition of population. In order to do this it would be necessary to establish some reference levels, for example, for calorie consumption or supply which would provide cut-off points to distinguish adequacy or inadequacy of nutritional status. Table 2.8c shows figures of average consumption (based on national sample household survey) and supply (as estimated in National Food Balance Sheets). The Table 2.8c and the Figure 2.1 shows that both supply and consumption give the same ranking order as does GNP in contrast to the order given by the prevalence of under nutrition and PQLI. Also as the Figure 2.1 shows average energy consumption in all countries is less than average requirement calculated by FAO. In addition, the food supply estimates are always in excess than consumption and the magnitude of this discrepancy increases with rising GNP. It seems that we have no basis therefore for interpreting consumption figure in relation to requirement and supply estimates can not be assumed to have a consistent and known relationship with consumption. It seems therefore there is not simple relationship between level of food supply; level of food consumption; and the observed levels of malnutrition of population in the four countries.

3.2.2. Longitudinal data

As has been already mentioned in the previous section, only the third stage of analysis was possible for the Japanese longitudinal observations.

The summary table 2.18 indicates that the nutritional status of children shows the same patterns of change over time as does PQLI and GNP. This observation is particularly interesting when another economic indicator, the Gini coefficient, is introduced. The table shows the Gini coefficient followed an opposite trend to that of nutritional status. However, it has to be remembered that Gini coefficient is an attempt to present information about the distribution of income as a single figure. It is possible therefore that significant changes in income distribution could take place without perceptible changes in the Gini coefficient. In particular, a country such as Japan, urban rural differences may have changed drastically without significant change in Gini coefficient.

In fact, the Japanese nutrition status data can be separated into rural and urban component. Table 2.15 and Figure 2.3 show that disparity in average weight-for-age in children in those two sectors were very marked during early 1950s, disappeared around 1964. Separate data for these two sectors ceased to be available after 1964. The improvement in nutritional status which took place at the national level between 1953 and 1964 despite a worsening of overall income distribution, was probably due mainly to the disappearance of rural and urban disparity. This is a good demonstration of the value of nutrition status measurements in providing disaggregated information.

3.2.3 Comparison between the longitudinal and the cross-sectional data.

A summary of all the cross-sectional and longitudinal data is shown in the following Table 3.3.

Table 3.3 Comparison of Various Measurements in Longitudinal with that of in Cross-sectional Observation

			MEASUREMENT				
Development stages in symbols	Country/Year	Sources of observation	GNP (US $)	PQLI	Average weight of 4 year old children (Kg)	Prevalence of anaemia (%)	Gini co-efficient
I	Indonesia	C*	220	48	12.7	16.6	0.377
	1953	L**	220	78	15.0		0.313
II	Thailand	C	350	78	13.3	7.4	
	1958	L	350	89	15.2		0.357
III	Malaysia	C	760	68	13.3	13.2	0.506
	1964	L	760		15.6		0.382
IV	Singapore	C	2,450	83	16.2	6.4	0.411
	1972	L	2,450	96	16.1		0.380
V	Japan						
	1975	L	4,450		16.4		0.407

*C = Cross-sectional

**L = Longitudinal

In Japanese data, GNP, PQLI and average weight of 4 year old children all show continuous trend towards improved values over time in contrast to Gini coefficent which shows trend towards reduced income equality. Cross-sectional data shows similar trends except for anomalyexhibitedby the Malaysian data which is consistent in suggesting that this country has poorer levels of nutrition (prevalence of anaemia) and general welfare (PQLI) than would be consistent in its positon in the ranking order of GNP. The very high level of Gini coefficient suggests a high degree of income inequality. The anthropometric data for Malaysia do not perhaps fit so well with this sequence but source of this data was by far the least satisfactory of the whole series and may well reflect errors due to small sample sizes.

3.3 Possible Contribution of the Findings in this Study

Apart from that nutritional status data is relatively cheap and practicable as a measurement for inclusion in survey, perhaps its greatest advantages lies in its possibility of using it to distinguish between relatively small population groups. Thus if it can be established and generally accepted then anthropometry can represent the socio-economic and environmental health condition of population groups. Such data offers considerable advantages over other socio-economic indicators such as PQLI, Gini coefficient and GNP since these by their nature can not be disaggregated. The possibility of having a welfare indicator capable of continuous assessment of relatively small population groups is of particular significance to the execution of policies and programs which aim to give priority in development to the blems of poverty or policies which are intended to cover a basic need orientation.

The analysis of cross-sectional data suggests although the numerical values of various nutritional and social indicators remain in fairly constant relationship with each other, the biological significance of anthropometry changes as countries change their general level of development; for very poor countries anthropometry in children seems to be more directly related to specific nutritional factors whereas for richer countries these measurements are influenced by a wider range of environmental and social factors.

Analysis of relationship between nutritional status of single child member of household and status of other members of the same household has not only added strength to the concept of using child nutrition as an indicator of larger groups and communities it has also provided further validation for the use of households as a functional unit in the collection of survey data.

3.4 Further Lines of Study

During the past 30 years, increases in calorie consumption seem to have contributed more to the improved growth of Japanese children than did increased protein consumption. The fact is revealed by the study of growth and consumption changes in urban and rural communities. This is in contradiction to the traditional view that protein intake is an important determinant of growth of children. Although a few studies have been made recently, for example, Davis et al (1978) and Hegstead (1978) have been concerned with the relationship between protein-calorie ratio in the diet and the degree of growth retardation, most of these work has been used small samples and laboratory condition. A better understanding of the relationship between growth and energy intake and dietary quality will depend upon more data collected from longitudinal studies carried out over substantial period of time on children living normally in communities in well defined situations.

An interesting question arises from the comparison of calorie consumption from household surveys and calorie supply as estimated in national Food Balance Sheets. These two values exhibit a changing relationship with respect to GNP. The discrepancy between consumption and the supply values becomes progressively larger as GNP increases. It does not seem likely that this discrepancy is due simply to increasing domestic waste with increasing affluence. It is important to know in some detail, the causes of this discrepancy. Until this is properly understood, it will not be possible to use Food Balance Sheet data as a basis for predicting the number of people in a country who are underfed or to calculate the overall deficit in food supply.

Some of the relationship by this study between nutritional status and social indicator must clearly still be regarded as tentative and whilst it is hoped that this study will materially contribute to the growth of concensus it has to be admitted that there is still a great need for further research based uopn a larger and more comprehensive sets of data. This will in turn depend upon the willingness of governments and other institutions to conduct well-organized collaborative studies and to make the basic data more readily accessible than is currently the case.

REFERENCES

Baster, N. (1978). Social Indicator and Social Statistics in the Context of FAO's Concerns. ESS/MISC/78-5. FAO, Rome.

Buzina, R. and Uemura, K. (1974). Selection of the minimum anthropometric characteristics to assess nutritional status. In: "Nutrition and Malnutrition". Roche, A.F. and Falkner, F. (eds.). New York: Plenum Press.

Chen, L.C., Chowdhury, A.K.M.A. and Huffman, H. (1980). Anthropometric assessment of energy-protein malnutrition and subsequent risk of mortality among pre-school-aged children. Amer. J. Clin. Nutr. 33/8; 1836-1844.

Chenery, H., Ahluwalia, M.S., Bell, C.L.G., Duloy, J.H, and Jolly, R. (1974). "Redistribution with Growth". London: Oxford University Press.

Council for Asian Manpower Studies. (1978). Income Distribution: Economic Growth (Thailand). Council for Asian Manpower Studies Discussion Paper Series No. 77-15.

Coward, W.A. and Whitehead, R.G. (1972). Changes in serum β-lipoprotein concentration during the development of kwashiorkor and in recovery. Brit. J. Nutr. 27 /2: 383-393.

Culyer, A.J., Lavers, R.J. and Williams, A. (1971). "Social indicators: Health". In : "Social Trend" No. 2 : 31-42. Central Statistical Office. London: H.M.S.O.

Davis, D.R., Apley, J., Fill, G. and Grimaldi, C. (1978). Diet and retarded growth. Brit. Med. J. 1 : 539-542.

Dowler, E.A., Payne, P.R., Seo, Y.O., Thomson, A.M. and Wheeler, E.F. (1981). Nutritional status indicator: their interpretation and place in policy making. (In Press).

Drenowski, J. (1970). Studies in the measurement of levels of living and welfare. United Nations Research Institute for Social Development Report No. 70-3. Geneva.

Evers, S. and McIntoch, W.M.A. (1977). Social indicators of human nutrition: measures of nutritional status. Social Indicators Research 4: 185-205.

Garzuel, M. (1978). Redistribution of Income, Patterns of Consumption and Employment: The Case Study for Malaysia. World Employment Program Research Working Papers No. 71. ILO, Geneva.

Gebre-Medhin, M. (1977). Initial experience of a consolidated food and nutrition information system-analysis of data from the Ogaden area. J. Trop. Paediat. & Envir. Childh. 23: 29-36.

Gomez, F., Galvan, R.R., Frenk, S., Munoz, J.C., Chavez, R. and Vazquez, J. (1956). Mortality in second and third degree malnutrition. J. Trop. Paediat. 2 / 2 : 77-83.

Greenway, R.M., Littell, A.S., Houser, H.B., Lindan, O. and Weir, D.R. (1965). An evaluation of the variability in measurement of some body composition parameters. Proc. Soc. Exp. Biol. & Med. 120 / 2 : 487-492.

Gupta, S. (1977). "A Model for Income Distribution, Employment and Growth - Case Study of Indonesia". World Bank Staff Occasional Papers No. 24. Baltimore: John Hopkins University Press.

Harinasuta, C., Sornmani, S. and Migasena, P. (1976). "Studies on Nutrition and Some Related Parasitic Diseases Arising from Water Resource Development in the Lower Mekong Basin.

Dowler, E.A., Payne, P.R., Seo, Y.O., Thomson, A.M. and Wheeler, E.F. (1981). Nutritional status indicator: their interpretation and place in policy making. (In Press).

Drenowski, J. (1970). Studies in the measurement of levels of living and welfare. United Nations Research Institute for Social Development Report No. 70-3. Geneva.

Evers, S. and McIntoch, W.M.A. (1977). Social indicators of human nutrition: measures of nutritional status. Social Indicators Research 4: 185-205.

Garzuel, M. (1978). Redistribution of Income, Patterns of Consumption and Employment: The Case Study for Malaysia. World Employment Program Research Working Papers No. 71. ILO, Geneva.

Gebre-Medhin, M. (1977). Initial experience of a consolidated food and nutrition information system-analysis of data from the Ogaden area. J. Trop. Paediat. & Envir. Childh. 23: 29-36.

Gomez, F., Galvan, R.R., Frenk, S., Munoz, J.C., Chavez, R. and Vazquez, J. (1956). Mortality in second and third degree malnutrition. J. Trop. Paediat. 2 / 2 : 77-83.

Greenway, R.M., Littell, A.S., Houser, H.B., Lindan, O. and Weir, D.R. (1965). An evaluation of the variability in measurement of some body composition parameters. Proc. Soc. Exp. Biol. & Med. 120 / 2 : 487-492.

Gupta, S. (1977). "A Model for Income Distribution, Employment and Growth - Case Study of Indonesia". World Bank Staff Occasional Papers No. 24. Baltimore: John Hopkins University Press.

Harinasuta, C., Sornmani, S. and Migasena, P. (1976). "Studies on Nutrition and Some Related Parasitic Diseases Arising from Water Resource Development in the Lower Mekong Basin.

Faculty of Tropical Medicine, Mahidol University, Bangkok Thailand.

Hegsted, D.M. (1978). Protein-calorie malnutrition. American Scientist 66 /1 : 61-65.

Hernandez, M., Hidalgo, C.P., Hernandez, J.R. Madrigal, H. and Chavez, A. (1974). Effect of economic growth on nutrition in a tropical community. Ecology of Food and Nutrition 3 : 283-291.

Hicks, N. and Streeten, P. (1979). Indicators of development: the search for a basic need yardstick. World Development 7 : 567-580.

Hiernaux, J. (1963). Heredity and Environment: their influence on human morphology - a composition of two independent line of study. Amer. J. Phys. Anthrop. 21 : 575-589.

IBRD. (1976). World Bank Atlas. Washington.

ILO. (1976). "Employment, Growth and Basic Needs: A One-World Problem". Geneva.

Institute of Health. (1979). "A Study of the Nutritional Status of Infants and Pre-school Children Attending Maternal and Child Health Clinic in the Institute of Health". Singapore.

Japanese Ministry of Health and Welfare. (1948-1975). "Annual Report of National Nutrition Survey". Department of Nutrition, Ministry of Health and Welfare. Tokyo: Jae Il Publishing Company.

Jelliffe, D.B. (1966). "The Assessment of the Nutritional Status of the Community". WHO Monograph Series No. 53. WHO, Geneva.

Kandiah, N. and Boo, L.J. (1976). "Report on the Health Status of a Group of Traditional Malay Villages in Ulu Jempol". Rural

Health Research Study No. 1, Institute for Medical Research No. 17. Kuala Lumpur, Malaysia.

Kardjati, S., Kusin, J.A. and de With, C. (1977). "East Java Nutrition Survey" Report 1. Joint project by School of Medicine/ University Airlangga/Surabaya/Indonesia, Provincial Health Services/Surabaya/Indonesia and Royal Tropical Institute/ Amsterdam/Netherland.

Kielmann, A.A. and McCord, C. (1978). Weight-for-age as an index of risk of death in children. Lancet _1_ / 2 : 1247-1250.

Larson, D.A. and Wilford, W.T. (1979). The Physical Quality of Life Index: A useful social indicator? World Development _7_ : 581-584.

Levinson, J.F. (1974). Morinda: An economic analysis of malnutrition among young children in rural India. Cornell/MIT International Nutrition Policy Series.

McMahon, B. and Pugh, T.F. (1970). "Epidemiology - Principles and Methods". Boston: Little, Brown and Company.

McLaughlin, M.M. and the Staff of the Overseas Development Council. (1979). "The measurement of development progress: a note on the Physical Quality of Life Index (PQLI) and Disparity Reduction Rate (DRR)", The United State and World Development Agenda 1979. London, Praeger Publisher.

Mizoguchi, T. (1975). The distribution of household income in post-war Japan. In: "Income Distribution, Employment and Economic Development in Southeast and East Asia". Papers and Proceedings of the Seminar sponsored jointly by the Japan Economic Research Center and the Council for Asian Manpower Studies (with contribution from ILO World Employment Programme) Volume 1 : 473-511. Tokyo.

OECD. (1953-1975). "National Account". Paris.

Puffer, R.R. and Serrano, C.V. (1973). "Patterns of Mortality in Childhood". Pan American Health Organization, Pan American Sanitary Bureau, Regional Office of the World Health Organization. Washington.

Rao, V.V.B. and Ramakrishnan, M.K. (1977). Economic Growth, Structural Change and Income Inequality - Singapore (1966-1975). Council for Asian Manpower Studies Discussion Paper No. 77-15.

Reddy, V., Jagadeesan, V., Ragharamula, N., Bhaskaram, C. and Srikantia, S.G. (1976). Functional significance of growth retardation in malnutrition. Amer. J. Clin. Nutr. 29 / 1 : 3-7.

Robson, J.R.K. (1972). "Malnutrition: Its Cause and Control". Vol. 1. New York: Gordon and Breach Press.

Sadre, M., Emami, E. and Donoso, G. (1971). The changing pattern of malnutrition. Ecology of Food and Nutrition 1 / 1 : 55-60.

Sauberlich, H.E., Skala, J.H. and Dowdy, R.P. (1974). "Laboratory Test for the Assessment of Nutritional Status". Cleveland: CRC Press.

Sheldon, E. and Moore, W.E. (1968). "Indicators of Social Change: Concepts and Measurements". New York: Russell Sage Foundation.

Sommer, A. and Lowenstein, M.S. (1975). Nutritional status and mortality: a prospective validation of the QUAC stick. Amer. J. Clin. Nutr. 28 : 287-292.

Stuart, H.C. and Stevenson, S.S. (1959). Physical growth and development. In: "Textbook of paediatrics 7th Ed. : 12-14. Nelson, W.E. (eds.), Philadelphia: W.B. Saunders Company.

Uttley, K.H. (1963). The death rate in the age-group 1-4 years as an index of malnutrition in tropical countries. Trans. Roy. Soc. Trop. Med. Hyg. 57 / 1 : 41-45.

United States Department of Health Education and Welfare, Public Health Service, Health Resources Administration. (1976). NCHS Growth Charts. HRA 76-1120, 25/3. Rockville, Maryland.

Vestergaard, P. and Leverett, R. (1958). Constancy of urinary creatinine excretion. J. Lab. Clin. Med. 51 / 2 : 211 -

Wada, O.R. (1975). Impact of economic growth on the size distribution of income; the post-war experience of Japan. In: "Income Distribution, Employment and Economic Development in Southeast and East Asia". Papers and Proceedings of the Seminar sponsored jointly by The Japan Economic Research Center and the Council for Asian Manpower Studies. (with contribution from ILO World Employment Programme) Vol. 1 : 516-561.

Waterlow, J.C. and Mendes, C.B. (1957). Composition of muscle in malnourished human infants. Nature 180 : 1361-1362.

WHO. (1972). "Nutritional Anaemia: Report of a WHO Group of Experts". WHO Technical Report Series No. 503. Geneva.

WHO. (1973). "Energy and Protein Requirements". Report of a Joint FAO/WHO Expert Committee, WHO Technical Report Series 522.

Yarbrough, C., Habicht, J.P., Martorell, R. and Klein, R.E. (1974). Anthropometry as an index of nutritional status. In "Nutrition and Malnutrition". Roche, A.F. and Falkner, F. (eds.). New York: Plenum Press.

APPENDIX 1 Prevalence of weight-for-age deficit for children at age 2-5 (inclusive) years in four South-East Asian countries at three different cut-off points.

1.1. Prevalence of weight-for-age deficit at the cut-off point of 80% Harvard weight median.

Country	Age (years)	No. of children examined	No. of children whose weight below the cut-off point	Rate of prevalence (%)
Indonesia	1	167	65	38.9
	2	151	84	55.6
	3	237	136	57.4
	4	228	142	62.3
	5	272	169	62.1
	6	201	159	79.1
	T	1256	755	60.1
Thailand	1	68	18	26.5
	2	62	32	51.6
	3	75	32	42.7
	4	53	26	49.1
	5	31	10	32.3
	6	47	16	34.0
	T	336	134	39.9
Malaysia	1	24	8	33.3
	2	10	2	20.0
	3	16	4	25.0
	4	9	6	66.7
	5	12	7	58.3
	6	13	5	38.5
	T	84	32	38.1
Singapore	1	45	3	6.7
	2	60	2	3.3
	3	28	6	21.4
	4	34	0	0
	5	8	1	12.5
	6	75	5	6.7
	T	250	17	6.8

1.2. Prevalence of weight-for-age deficit at the cut-off point of 70% Harvard weight median

Country	Age (years)	No. of children examined	No. of children whose weight below the cut-off point	Rate of prevalence (%)
Indonesia	1	167	12	7.2
	2	151	33	21.9
	3	237	60	25.3
	4	228	45	19.7
	5	272	71	26.1
	6	201	65	32.3
	T	1256	286	22.8
Thailand	1	68	7	10.3
	2	62	9	14.5
	3	75	8	10.7
	4	53	11	20.8
	5	31	2	6.5
	6	47	3	6.4
	T	336	40	11.9
Malaysia	1	24	2	8.3
	2	10	2	20.0
	3	16	0	0
	4	9	0	0
	5	12	1	8.3
	6	13	2	15.4
	T	84	7	8.3
Singapore	1	45	0	0
	2	60	0	0
	3	28	1	3.6
	4	34	0	0
	5	8	0	0
	6	75	0	0
	T	250	1	0.4

1.2. Prevalence of weight-for-age deficit at the cut-off point of 70% Harvard weight median

Country	Age (years)	No. of children examined	No. of children whose weight below the cut-off point	Rate of prevalence (%)
Indonesia	1	167	12	7.2
	2	151	33	21.9
	3	237	60	25.3
	4	228	45	19.7
	5	272	71	26.1
	6	201	65	32.3
	T	1256	286	22.8
Thailand	1	68	7	10.3
	2	62	9	14.5
	3	75	8	10.7
	4	53	11	20.8
	5	31	2	6.5
	6	47	3	6.4
	T	336	40	11.9
Malaysia	1	24	2	8.3
	2	10	2	20.0
	3	16	0	0
	4	9	0	0
	5	12	1	8.3
	6	13	2	15.4
	T	84	7	8.3
Singapore	1	45	0	0
	2	60	0	0
	3	28	1	3.6
	4	34	0	0
	5	8	0	0
	6	75	0	0
	T	250	1	0.4

1.3. Prevalence of weight-for-age deficit at the cut-off point of 60% Harvard weight median

Country	Age (years)	No. of children examined	No. of children whose weight below cut-off point	Rate of prevalence (%)
Indonesia	1	167	0	0
	2	151	12	7.9
	3	237	10	4.2
	4	228	9	4.0
	5	272	12	4.4
	6	201	7	3.5
	T	1256	50	
Thailand	1	68	0	0.0
	2	62	3	4.8
	3	75	2	2.7
	4	53	2	3.8
	5	31	0	0.0
	6	47	0	0.0
	T	336	7	2.1
Malaysia	1	24	1	4.2
	2	10	0	0
	3	16	0	0
	4	9	0	0
	5	12	0	0
	6	13	1	7.7
	T	84	2	2.4
Singapore	1	45	0	0
	2	60	0	0
	3	28	0	0
	4	34	0	0
	5	8	0	0
	6	75	0	0
	T	250	0	0

APPENDIX 2. Prevalence of *anaemia for children at age 2-5 (inclusive) in three South-East Asian countries.

Country	Age (years)	No. of children examined	No. of anaemic children	Rate of prevalence (%)
Indonesia	2	148	34	23.0
	3	222	38	17.1
	4	218	31	14.2
	5	267	40	15.0
	Total	856	143	16.7
Thailand	2	62	6	9.7
	3	69	4	5.8
	4	53	3	5.7
	5	27	3	1.1
	Total	211	16	7.6
Malaysia	2	8	2	25.0
	3	14	3	21.4
	4	5	0	0
	5	8	0	0
	Total	35	5	14.3

* based on < 10 mg Hg (Sauberlich et al., 1974).

APPENDIX 3. Estimation of PQLI in Japan for the year 1950.

3.1. Basic information for PQLI.

3.1.1. Most unfavourable performance in 1950 (by ODC, 1977).

Components	Performance	Index
Infant mortality rate per 1,000 live births	229	0
Life expectancy at birth	38	0
Literacy Rate (%)	0	0

3.1.2. Basic statistics for Japan in 1950. (Japanese Annual Statistical Yearbook

Components	Performance
Infant mortality rate per 1,000 live births	52.1
Life expectancy at birth	61.3
Literacy Rate (%)	95.6

3.1.3. Best performance expected by the year of 2000 (by ODC, 1977).

Components	Performance	Index
Infant mortality rate per 1,000 live births	7	100
Life expectancy at birth	77	100
Literacy Rate	100	100

3.2. Estimation for PQLI in Japan for the year 1950.

3.2.1. Index of each component.

Index of infant mortality per 1,000 live births (x_1)

$$100 : (229 - 7) = x_1 : (229 - 52.1)$$

$$\therefore x_1 = 79.7$$

Index of life expectancy at birth (x_2)

$$100 : (77 - 38) = x_2 : (61.3 - 38)$$

$$\therefore x_2 = 59.7$$

Index of literacy rate (x_3)

$$x_3 = 95.6$$

3.2.2. Index of average three components (PQLI)

$$(x_1 + x_2 + x_3)/3 = 78.3$$

APPENDIX 4. Weight of Japanese Children Aged 1-6 during 1953-1975.

Unit: Kg

( ): No. of Individuals surveyed

National Average, sex combined

Age (years)	Year				
	1953	1958	1964	1972	1975
1	9.4±7.5 (676)	9.8±1.5 (826)	10.3±1.4 (660)	10.8±4.0 (478)	11.2±7.6 (341)
2	11.6±1.5 (771)	11.7±1.7 (687)	12.3±1.4 (685)	12.7±2.6 (485)	12.7±3.0 (404)
3	13.4±1.7 (910)	13.5±1.8 (857)	14.1±1.5 (722)	14.6±2.9 (557)	14.4±1.8 (369)
4	15.0±1.8 (919)	15.2±1.8 (835)	15.6±1.9 (792)	16.1±2.3 (485)	16.4±5.9 (389)
5	16.5±1.9 (1009)	16.7±2.0 (934)	17.2±2.2 (818)	18.0±3.3 (524)	18.5±6.7 (352)
6	18.0±1.7 (795)	18. ±2.3 (954)	19.0±2.5 (751)	19.7±3.4 (374)	20.3±4.9 (394)

Source: "Report for Annual National Nutrition Survey" by the Japanese Ministry of Health (1948-1975).

APPENDIX 5. Estimation of household income for the under 40% income class in the five countries observed.

5.1. Estimation of household income for the under 40% income class in the cross-sectional data in 1975.

5.1.1. Basic information for five countries observed in 1975.

Country	(*1) mid year population in 1975 (1,000)	(*2) GNP (US$)
Indonesia	132,112	220
Thailand	41,870	350
Malaysia	12,306	760
Singapore	2,250	2,450
Japan	111,570	4,450

Sources of data: *1: UN (1976). UN Statistical Year book, New York.

*2: IBRD (1976). World Atlas. Washington.

5.1.2. Basic information available for income distribution in each country.

5.1.2.1. [*1] Income distribution in Indonesia (1969).

Income group (Decil)	size (%) of household belong to each class	[*2] Population (million)
First Decile	3.1	11,287
Second Decile	4.4	11,287
Third Decile	6.4	11,287
Fourth Decile	5.2	11,287
Fifth Decile	7.8	11,287
Sixth Decile	6.9	11,287
Seventh Decile	10.2	11,287
Eight Decile	15.2	11,287
Ninth Decile	11.0	11,287
Tenth Decile	29.8	11,287

Sources: *1: Hendra, E. (1974). "Regional Income Disparity in Indonesia". In: paper for JERC/CAMS Seminar on "Income Distribution, Employment and Economic Development in Southeast and East Asia", Tokyo, May, 1974.

*2: IBRD. (1970). World Atlas. Washington.

5.1.2.2. Income Distribution in Thailand (1969): Recalculated in relation to the population ratio in the urban and rural

Household annual income group (Bht.= 1/20.38 US$)	Population in %	Population in cumulative %
< 3,000	23.35	23.35
3,000 - 5,999	23.36	46.71
6,000 - 8,999	16.09	62.80
9,000 - 11,999	10.02	78.82
12,000 - 14,999	6.95	79.77
15,000 - 17,999	4.75	84.52
18,000 - 23,999	4.83	89.35
24,000 - 29,999	3.88	93.23
30,000 - 35,999	2.09	95.32
36,000 - 47,999	3.02	98.34
48,000 - 59,999	0.59	98.93
>60,000	1.08	100.00

Source: Council for Asian Manpower Studies. (1978). "Income Distribution: Economic Growth (Thailand)". Council for Asian Manpower Studies Discussion paper Series No. 78-04.

5.1.2.3. Income Distribution in Malaysia (1970).

Income group	(*1) Income in Million Malaysian dollars (M$=2.4 US$)	(*2) Population (1,000)
First Decile	83.4	1,039
Second Devile	194.7	1,039
Third Decile	222.5	1,039
Fourth Decile	312.9	1,039
Fifth Decile	382.4	1,039
Sixth Decile	472.8	1,039
Seventh Decile	632.7	1,039
Eight Decile	743.9	1,039
Ninth Decile	1049.8	1,039
Tenth Decile	2857.4	1,039
Total	6952.4	10,390

Sources: *1: Maton, J. and Garzuel, M. (1978). "Income Distribution and Employment programme, Redistribution of income patterns of consumption and employment: The Case Study for Malaysia". World Employment programme research working papers. No. 71. ILO, Geneva.

*2: IBRD. (1971). World Atlas. Washington.

5.1.2.4. Income Distribution in Singapore (1972).

Monthly household income group in Singapore dollar (S$)	Mean income in Singapore dollar (S$=1/2.82 US$)	House-hold in %	Household in cumulative %
< 200	150	11,0	11,0
200 - 299	250	19.0	30.0
300 - 399	350	15.5	45,5
400 - 499	450	11.8	57,3
500 - 599	550	9.5	66.8
600 - 699	650	7,6	74.4
700 - 799	750	4.9	79,3
800 - 899	850	3.9	83.2
900 - 999	950	3,1	86.3
1000 - 1499	1200	8.0	94,3
>1500	2500	5,7	100,0

Source: Council for Asian Manpower Studies (1977), "Income Distribution: Economic Growth (Singapore)". Council for Asian Manpower Studies Discussion Paper Series No. 77-15.

5.1.2.5. Income Distribution in Japan (1974) - All household

Income group in Quintile	Annual household income in 1000 Japanese Yen (¥ = 1/293.08 US$)
I	- 1550
II	1550 - 2023
III	2023 - 2558
IV	2558 - 3412
V	3412 -

Source: Bureau of Statistics. (1974). "Report on National Survey of Family Income and Expenditure (NFIE)". Bureau of Statistics, Office of Prime Minister, Tokyo, Japan.

5.1.3. Estimation of income for the low 40% income class from available data in each country.

5.1.3.1. Indonesia in 1969.

5.1.3.1.1. Basic information used in calculation:

- % Household belong to 4th decile income group : 5.2%.
- Total GNP: 2683 billion Rp (Rp = 1/393.42 US$)
- Total population: 112.87 million.

5.1.3.1.2. Calculation for the low 40% income class.

- GNP belong to 4th decile income group (Total GNP x % shared by 4th decile income group)

  : 2,683 billion Rp x 0.052

  = 139.516 billion Rp.
- GNP per capita for the 4th decile income group. (GNP of the group/No. of population of the group)

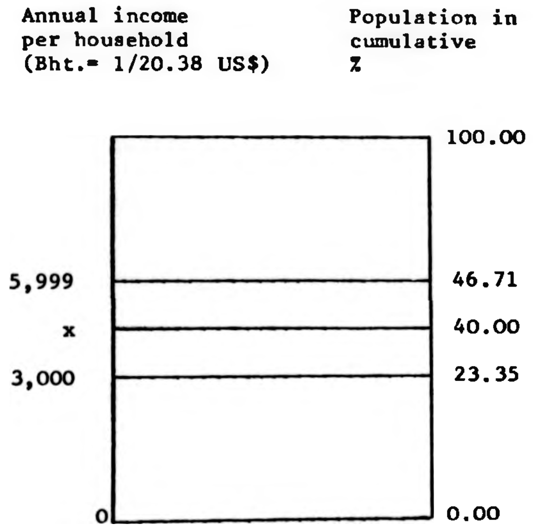
  : 139,516 billion Rp ÷ 11.287 million

  = 12360.76 Rp.

  (31.42 US$)

5.1.3.2. Thailand in 1969.

5.1.3.2.1. Basic information used in diagram



5.1.3.2.2. Calculation of annual household income for the low 40% income class (x):

$$(5{,}999 - 3{,}000) : (46.71 - 23.35) = (x - 3000) : (40 - 23.35)$$

$$\therefore x = 5138 \text{ Bht. } (252 \text{ US\$}).$$

5.1.3.3. Malaysia in 1970.

5.1.3.3.1. Basic information used for the low 40% income group

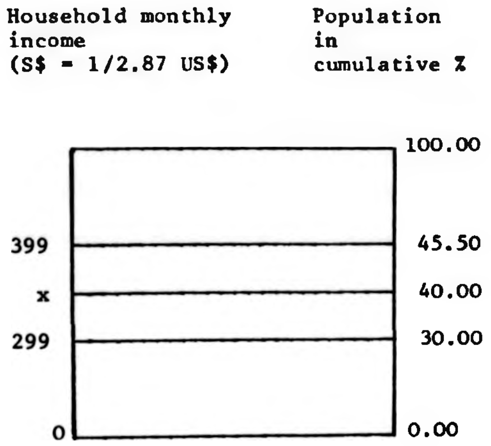
Income group	Income in million Malaysian dollar per year (M$=1/2.4US$)	Population
Fourth Decile	312.9	1,039,000

5.1.3.3.2. Estimation of annual per capita income for the low 40% income class.

312.9 million M$ ÷ 1039,000 = 301 M$ (125.4 US$).

5.1.3.4. Singapore in 1972.

5.1.3.4.1. Basic information used in diagram.



5.1.3.4.2. Estimation of household monthly income for the low 40% income class (x) :

$$(399 - 299) : (45.5 - 30.0) = (x - 299) : (40 - 30)$$

$$\therefore x = 363.5 \text{ S\$ } (128.9 \text{ US\$}).$$

5.1.3.5. Japan in 1974.

5.1.3.5.1. Basic information used

Income group in Quintile	Annual household income in Japanese Yen (¥ = 1/293.08 US$)
II	2,023,000

5.1.3.5.2. Estimation of monthly household income (annual income/12)

: 6902.6 ¥ (575 US$).

5.1.3.5. Japan in 1974.

5.1.3.5.1. Basic information used

Income group in Quintile	Annual household income in Japanese Yen (¥ = 1/293.08 US$)
II	2,023,000

5.1.3.5.2. Estimation of monthly household income (annual income/12)

: 6902.6 ¥ (575 US$).

5.1.4. Estimation of monthly household income by standardization

5.1.4.1. Summary of estimated income from available information in each country

Country	Year	Income of the low 40% income class (US$)	Unit of income	Average size of household (persons)
Indonesia	1969	31.4	Annual per caput	6
Thailand	1969	252.0	Annual per household	6
Malaysia	1970	125.4	Annual per caput	6
Singapore	1972	128.9	Monthly per household	5
Japan	1974	575.0	Monthly per household	4

5.1.4.2. Household monthly income (US$) by standardization in relation to size of household

Country	Year	Income for the low 40% income class (US$)
Indonesia	1969	16
Thailand	1969	21
Malaysia	1970	63
Singapore	1972	129
Japan	1974	575

5.1.4.2. Household monthly income (US$) after standardization to 1975 GNP level

Country	Year	Household monthly income (US$) for the low 40% income class
Indonesia	1975	26
Thailand	1975	50
Malaysia	1975	122
Singapore	1975	336
Japan	1975	633

5.2. Estimation of household income for the low 40% income class in Japan (1953-1972)

5.2.1. Basic information available in Japan (1953-1972)

Year	GNP/ capita (US$)	*2 Distribution of income by income group (decile) among total household									
		1	2	3	4	5	6	7	8	9	10
1953	230										
1954	250										
1955	270										
1956	300	2.9	4.3	5.9	6.9	7.8	9.5	10.6	12.5	15.1	24.5
1957	340										
1958	350										
1959	390	2.4	3.7	5.3	6.2	7.9	9.2	10.6	12.2	15.5	27.0
1960	460										
1961	570										
1962	620	1.7	3.8	5.1	6.3	7.5	8.5	10.3	12.2	15.8	28.8
1963	700										
1964	820										
1965	900	1.6	3.8	5.1	6.3	7.6	8.8	10.5	12.3	16.5	27.7
1966	1,020										
1967	1,190										
1968	1,400	1.0	3.6	5.0	6.3	7.7	9.1	10.4	13.0	15.6	28.2
1969	1,630										
1970	1,920										
1971	2,130	0.5	3.3	4.8	6.1	7.5	8.8	10.2	12.6	15.5	30.7
1972	2,320										
1973	3,630										
1974	4,040										
1975	4,450										

Sources: *1: UN. (1953-1975). UN Statistical Year Book.

*2: Wada, R.O. (1975). Impact of Economic Growth on the size distribution of income: The Postwar Experience of Japan. In: "Income Distribution, Employment and Economic Development in South East and East Asia". Papers and proceedings of the Seminar sponsored jointly by the Japan Economic Research Center and the Council for Asian Manpower Studies (with contribution from ILO World Employment Programme) Vol. 1. Tokyo.

5.2.2. Basic information used to estimate the income of the low 40% income class (1953, 1958, 1964, 1972).

Year	GNP/ capita (US$)	Population (1,000)	% income shared by fourth decile income group	Average no. of house-hold	Currency ex-change rate/ US dollar
1953	230	90,077(1955)	6.9	4	1/360
1958	350	94,302(1960)	6.2	4	"
1964	820	99,209(1965)	6.3	4	"
1972	2320	107,589	6.1	4	1/303.1

5.2.3. Estimation of annual per capita income for the low 40% income class.

5.2.3.1. Total annual GNP for the group (GNP/capita x pop.)

Year	GNP (US$)
1953	20,717,710,000
1958	33,005,700,000
1964	81,351,380,000
1972	249,606,480,000

5.2.3.2. Annual GNP belongs to the fourth decile income group (total GNP x income shared by the fourth decile group).

Year	GNP (US$)
1953	1,429,521,990
1958	2,046,353,400
1964	5,125,136,940
1972	15,225,995,000

5.2.3.3. Annual GNP per capita for the low 40% income class. (GNP belongs to the fourth decile income group ÷ no. of populations for this group).

Year	Annual GNP per capita (US$)
1953	158.7
1958	217.0
1964	516.6
1972	1415.2

5.2.3.4. Estimated monthly household income for the low 40% income class. (Annual GNP per capita ÷ 12 x no. of average persons per household).

Year	Monthly household income (US$)
1953	53
1958	72
1964	172
1972	472
1975	633

APPENDIX 6. Height of Japanese children in rural and urban populations (1953-1964).

Age (years)	Area	Year 1953	1958	1964
1	Urban	76.2±5.1 (370)	77.1±5.8 (459)	78.8±5.0 (358)
	Rural	75.4±4.6 (306)	75.4±5.1 (367)	78.1±4.4 (302)
2	Urban	84.9±4.8 (392)	85.3±5.0 (379)	87.5±4.5 (346)
	Rural	83.6±5.0 (379)	83.7±4.7 (308)	87.1±3.8 (339)
3	Urban	91.4±5.1 (512)	92.1±6.0 (488)	94.7±5.5 (368)
	Rural	90.5±4.4 (398)	91.4±5.7 (369)	93.8±3.9 (354)
4	Urban	97.5±5.2 (545)	98.6±5.0 (427)	100.9±4.7 (405)
	Rural	96.7±5.1 (374)	97.5±4.6 (408)	100.0±4.4 (387)
5	Urban	103.5±5.7 (566)	104.5±5.1 (499)	106.4±5.0 (414)
	Rural	103.1±5.3 (443)	103.8±4.7 (435)	106.4±4.6 (404)
6	Urban	108.7±5.1 (453)	110.4±5.3 (538)	112.6±5.0 (423)
	Rural	108.1±4.9 (342)	109.0±4.7 (416)	111.3±4.9 (328)

APPENDIX 7

1 Country :

2 Recorder : Name:
Address (full present postal address):

3 Date :

NUTRITIONAL STATUS (FORM ☐ ☐ ○ ○ ○)
4 5 9 10 12

* Please read instructions carefully before using.

MEASUREMENTS			POPULATION CHARACTERISTICS				SAMPLE SIZE		MEASURED VALUE							
6 Kind	Date		9 Geo.Location	10 S.E. Status	11 Age	12 Sex	13 No.	14 %	15 Unit	16 Mean	17 S.D.	Distribution (No., %)				
	7 Year	8 Month	R / U / T	U / M / L / T		M / F / T						18 I	19 II	20 III	21 IV	22 V

INSTRUCTIONS FOR FORM B

1. Country.
2. Name of person who is recording the nutritional status FORM B.

   Title (Mr., Mrs., Dr., etc...), first name and surname in order

   e.g. Mrs. Young Ok Seo

   The current official postal address of the recorder

   e.g. Dept. of Human Nutrition
   London School of Hygiene & Tropical Medicine
   Keppel st. (Gower st.)
   London WC1E 7HT
   U.K.
3. Date when the record is being made

   e.g. 16th August 1979
4. Identification code for different measurement of nutritional status as follows:

   Biochemical measurement B, physical measurement P, functional measurement F, respectively.

   (You have been allocated one of these)
5. Identification code for nutritional disorder such as Protein-Calorie Malnutrition, Vitamin A, Vitamin B_1, Vitamin B_2, and Iron deficiencies, and Overnutrition.

   (You have been allocated certain of these)
6. Kind of measurement which you used to measure particular aspect of nutritional status

   (1) Serum Albumin for PCM, (2) Serum (Plasma) Vitamin A for Vitamin A, (3) Urinary Thiamin for Vitamin B_1,
   (4) Urinary Rioboflavin for Vitamin B_2,
   (5) Haemoglobin and Haematocrit for Iron,
   (6) Serum Cholestrol for Overnutrition are the preferred measurement.

   If you do not have the data for any of these, supply whatever alternative information you can as follows.

Nutritional Status	Test
Protein-Calorie Malnutrition	Serum Total Protein, Urinary urea Creatinine Ratio, Urinary Sulfur Creatinine ratio, Serum Amino Acid Ratio, Urinary Hydroxyproline Index, Urinary Creatinine Height Index, etc.
Vitamin A	Serum (Plasma) Carotene, etc.
Vitamin B_1	Erythrocyte Transketolase Activity Coefficient, etc.
Vitamin B_2	Erythrocyte Riboflavin, Erythrocyte Glutathion Reductase Activity Coefficient, etc.
Iron	Serum Iron, Transferrin Saturation (%), etc.
Overnutrition	Urinary Sugar, etc.

7. Date of measurement (or survey).

   Data for the year 1975 are the first preference. However, if you do not have this, data for any year between 1973 and 1977, inclusive, are adequate.

8. Specific month when data were collected (7)

   e.g. 1975, July

   August etc.

9. Geographical location of survey area in terms of rural and urban. If you do not have separate date for two such populations, mark the total data

   e.g. Rural / Urban / Total

0. Socio-economic status of population based on income level. Upper class is defined as belonging to the top 20%, middle class is the middle 40%, and lower class is the bottom 40% population ordinally ranked by income.
This corresponds to the following table for differnt countries :

(Unit: U.S. Dollar)

COUNTRY S.E. STATUS	Upper	Middle	Lower
THAILAND			
MALAYSIA			
SINGAPORE			
INDONESIA			
JAPAN			

Table shows the limits of income in each class

11. Age classification for population surveyed.
(MAINLY interested in the 3 vulnerable groups, PRESCHOOL CHILDREN, SCHOOL CHILDREN and PREGNANT WOMEN)
Yearly age classification is prefereable from age 1 to 17, and pregnant women 1st, 2nd and 3rd trimester. Under age 1, monthly age classification is preferable. But you may use any age classification depending on what you used in your survey.

11. continued

e.g. < 1 year

1 year

2 "

3 "

.

.

.

17 year

pregnant 1st

pregnant 2nd

pregnant 3rd

Age has been rounded off to the nearest birthday

e.g. 1 year : age between 0.5 and 1.4

12. Sex for population surveyed.

If you do not have sex-specific data, mark total data

e.g. Male / Female / Total

13. Sample size for defined population determined by previous columns 9, 10 and 12 for different ages of any age classification you used

e.g. No. of population sampled in rural, upper class, male at age 1.

14. 13 as a % of the total number of the defined population in the same area (i.e. sample fraction).

15. Unit for measured value

e.g. Serum Albumin .... g/100 ml.

16. Mean of measured value

e.g.

Kind	Date	Geo.	S.E.	Age	Sex	Sample	Unit	Mean
Serum Albumin	1975	R	L	2	M	5%	g/100ml	2.58

17. Standard Deviation of measured value

e.g.

Kind	Date	Geo.	S.E.	Age	Sex	Sample	Unit	Mean	S.D.
Serum Albumin	1975	R	L	2	M	5%	g/100ml	2.58	0.99

8.19.20. Distribution of measured value over different range (You may express the distribution either as an absolute number or as a %)

Fill in columns I, II, III, and if necessary, IV and V. I, II, and III columns correspond to the suggested value in the following tables.

Tentative suggested guidelines (for columns 18, 19 and 20) adapted from "Laboratory Test for the Assessment of Nutritional Status" Sauberlich, H.E. et al. CRC press 1974.

utritional Disorder	Measurement or index	Age	I	II	III
PCM	Serum total Protein (g/100ml)	0 - 11 months	≥5.0	<5.0	
		1 - 5 years	≥5.5	<5.5	
		6 - 17 years	≥6.0	<6.0	
		Preg. 2nd & 3rd tri.	≥6.0	5.5-5.9	<5.5
	Serum Albumin (g/100ml)	0 - 11 months	≥2.5	<2.5	
		1 - 5 years	≥3.0	<3.0	
		6 - 17 years	≥3.5	<3.5	
		Preg. 1st	≥4.0	3.0-3.9	<3.0
		Preg. 2nd & 3rd tri.	≥3.5	3.0-3.4	<3.0
	Nonessential/ essential amino acid ratio	All ages	<2.0	2.0-3.0	>3.0
	Hydroxyproline Index	3 months - 17 years	>2.0	1.0-2.0	<1.0
	Creatinine height index	3 months	>0.9	0.5-0.9	<0.5
	Urea/ Creatinine		>12.0	6.0-12.0	<6.0
VITAMIN A	Plasma (serum) retinol	0 - 5 months	>20	10 - 19	<10
		0.5 - 17 years	>30	20 - 29	<20
	Plasma (serum) carotene	0 - 5 months	>10	10	
		6 - 11 months	>30	30	
		1 - 17 years	>40	40	
		Preg. 2nd	>80	30 - 79	
		Preg. 3rd	>80	40 - 79	

VITAMIN B_1	Urinary Thiamine µg/g Creatinine	1 - 3 years	≥176	120-175	<120
		4 - 6 years	≥121	85-120	<85
		7 - 9 years	≥181	70-180	<70
		10 - 12 years	≥181	60-180	<60
		13 - 15 years	≥151	50-150	<50
		Preg. 2nd tri.	≥55	23- 54	<23
		Preg. 3rd tri.	≥50	21- 49	<21
	Erythrocyte Transketolase thiamine pyrophosphate	All ages	0.15%	16- 20%	>20%
VITAMIN B_2	Urinary riboflavin	1 - 3 years	≥500	150-499	<150
		4 - 6 years	≥300	100-299	<100
		7 - 9 years	≥270	85-269	<85
		10 - 15 years	≥200	70-199	<70
		Preg. 2nd tri.	≥120	39-119	<39
		Preg. 3rd tri.	≥90	30- 89	<30
	Erythrocyte glutathion activity coefficients	All ages	<1.20	1.20-1.40	>1.40
OVER NUTRITION	Serum Cholestrol (mg/100 ml)				
RON	Haemoglobin (g/100 ml)	<2 years B	≥10.0	9.0- 9.9	<9.0
		2 - 5 years B	≥11.0	10.0-10.9	<10.0
		6 - 12 years B	≥11.5	10.0-11.4	<10.0
		13 - 16 years M	≥13.0	12.0-12.9	<12.0
		F	≥11.5	10.0-11.4	<10.0
		16 years M	≥14.0	12.0-13.9	<12.0
		F	≥12.0	10.0-11.9	<10.0
		Preg. 2nd	≥11.0	9.5-10.9	<9.5
		Preg. 3rd	≥10.5	9.0-10.4	<9.0

IRON cont.	Haematocrit	< 2 years B	≥31	28-30	<28
		2 - 5 years B	≥34	30-33	<30
		6 - 12 years B	≥36	30-35	<30
		13 - 16 years M	≥40	37-39	<37
		F	≥36	31-35	<31
		16 years M	≥44	37-43	<31
		F	≥48	31-37	<31
		Preg. 2nd	≥35	30-34	<30
		Preg. 3rd	≥33	30-32	<30
	Serum Iron	2 years	≥30		<30
		2 - 5 years	≥40		<40
		6 - 12 years	≥50		<50
		13 - 16 years M	≥60		<60
		F	≥40		<40
		16 years M	≥60		<60
		F	≥40		<40
		Preg. 2nd			
		Preg. 3rd			
	Transferrin	2 years	≥15		<15
		2 - 5 years	≥20		<20
		6 - 12 years	≥20		<20
		12 - 16 years M	≥20		<20
		F	≥15		<15
		16 years M	≥20		<20
		F	≥15		<15

B stands for both male and female
M stands for male
F stands for female

23. Give any other details concerning geographical location of population surveyed

e.g. Name of district, distance from particular city, or reasons for surveying this area, etc.

.25.26. Give any other details concerning the data recorded in this questionnaire form.

e.g. measured by qualified technician, auxillary health worker, health worker, medical student, nurse, or doctor etc. Measured at the school, hospital, field mobile car, or particular laboratory etc.

Reported to you by school teacher, special research team, or particular laboratory etc.

Kept by medical record library in hospital, ministry of health, institute of nutrition, or department of certain university etc.

THANK YOU VERY MUCH FOR YOUR TIME AND GENEROUS CO-OPERATION

INSTRUCTIONS FOR FORM F

1. Country
2. Name of person who is recording the nutritional status Form F. Title (Mr., Mrs., Dr., etc.), first name and surname in order
   e.g. Mrs. Young Ok Seo
   The current official postal address of the recorder
   e.g. Dept. of Human Nutrition,
   London School of Hygiene and Tropical Medicine,
   Keppel Street (Gower Street),
   London WC1E 7HT.
   U.K.

3. Date when the record is being made
   e.g. 16th August, 1979.

4. Identification code for the different measurements of nutritional status as follows:

Biochemical measurement	B
Physical measurement	P
Functional measurement	F

(You have been allocated one of these)

5. Identification code for nutritional disorder such as Protein-calorie malnutrition, Vitamin A, Vitamin B_1, Vitamin B_2 and Iron deficiencies, and Overnutrition.
   (You have been allocated certain of these)

6. Kind of measurement which you used to measure the functional change of population:
   1. Age-specific mortality rate and crude death rate for general information.
   2. Prevalence of PCM, Vitamin A deficiency, Vitamin B_1 deficiency, Vitamin B_2 deficiency, Iron deficiency, and Overnutirtion by clinical diagnosis for morbidity from each nutrient deficiency.
   3. Prevalence of Measles, Diarrhoea and Tuberculosis for the morbidity from infectious disease.
   4. Prevalence of Measles, Diarrhoea and Tuberculosis for the morbidity from infectious disease.

5. Case fatality rate of PCM, Vitamin A deficiency (clinical manifestation), Vitamin B_1 ("), Vitamin B_2 (") and Iron deficiencies ("), and Overnutrition (obesity, coronary heart disease, and atheroma etc).
6. Cause-specific mortality rate including the above five nutritional disorders.

These items are the preferred measurements. However, if you do not have any of these, please supply whatever similar alternative information you have.

7. Date of measurement (or survey).
Data for the year 1975 are the first preference.
However, if you do not have this, data for any year between 1973 and 1977 inclusive, are adequate.

8. Specific month when data were collected (7)
e.g. 1975 July
August etc...

9. Geographical location of survey or report area in terms of rural and urban. If you do not have separate data for two such populations, mark total data.
e.g. Rural/Urban/Total

10. Socio-economic status of population based on income level.
Upper class is defined as belonging to the top 20%
Middle class is the middle 40%
Lower class is the bottom 40%
- the population being ordinally ranked by income.

This corresponds to the following table for different countries.

COUNTRY	UPPER	MIDDLE	LOWER
THAILAND			
MALAYSIA			
SINGAPORE			
INDONESIA			
JAPAN			

The table shows the limits of income in each class

11. Age classification for population surveyed or reported. (MAINLY interested in 3 vulnerable groups: PRESCHOOL CHILDREN, SCHOOL CHILDREN and PREGNANT WOMEN). Yearly age classification is preferable from age 1 to 17, and pregnant women by 1st, 2nd and 3rd trimester. Under age 1 - monthly age classification is preferable. But you may use any age classification, depending on what you used in your survey or report

e.g. <1 year
1 year
2 years
3 years
.
.
.
17 years
Pregnant 1st
" 2nd
" 3rd

(Age has been rounded off to the nearest birthday)

e.g. 1 year : age between 0.5 and 1.4

12. Sex for population surveyed or reported.
    If you do not have sex-specific data, mark total data
    e.g. Male/Female/Total

13. Sample size defined population determined by previous columns 9, 10 and 12 for different age or any age classification you used
    e.g. No. of population sampled in rural, upper class, male at age 1.

14. 13 as a % of the total number of the defined population in the sample area (i.e. sample fraction).

15. Unit for measured value.
    e.g. Age-specific mortality rate ...... per 1000, etc..

16. Measured value (mean does not imply anything special in this form).

17. No need to fill (you may leave this column empty).

18. No need to fill this column EXCEPT in the case of prevalence of PCM, Vitamin A, Vitamin B_1, Vitamin B_2 and Iron deficiencies, and Overnutrition by clinical diagnosis for morbidity (i.e. in the case of (2) of column 6 in this instruction form).
    You may express the distribution either as an absolute number or as a %.
    Columns 18 (I), 19 (II) and 20 (III) corresponds to the suggested criteria of clinical diagnosis as given on the following 2 pages.

KIND OF DISORDER	DEGREE		
	I (18)	II (19)	III (20)
PROTEIN-CALORIE MALNUTRITION (sign: oedema dyspigmentation of the hair, easy pluckability of the hair, thin sparse hair, straight hair, muscle wasting, diffuse depigmentation of the skin, psychomotor change, moon face, hapatomegaly, and flaky-paint dermatosis)	SINGLE SIGN	2 or 3 SIGN	<3 SIGN
VITAMIN A DEFICIENCY (sign:Bitot's spots, conjuntival xerosis, corneal xerosis, keratomalacia, xerosis of skin and follicular hyperkeratosis)	SINGLE SIGN	2 or 3 SIGN	<3 SIGN
VITAMIN B_1 (sign: oedema, loss of ankle jerks, loss of knee jerks, motor weakness, calf-muscle tenderness, sensory loss, cardiac enlargement, and tachycardia.	SINGLE SIGN	2 or 3 SIGN	<3 SIGN
VITAMIN B_2 (sign: angular stomatitis, cheilosis, magenta tongue, atrophic lingual papillae, dyssebacea, angular palpebritis, scrotal dermatosis, and corneal vascularization)	SINGLE SIGN	2 or 3 SIGN	<3 SIGN

KIND OF MEASUREMENT	DEGREE		
	I (18)	II(19)	III(20)
IRON DEFICIENCY (sign: pale conjuntive, koioonychia, atrophic lingual papillae)	SINGLE SIGN	2 sign	3 sign plus other restriction
OVERNUTRITION (sign: obesity, diabetes hypertention, atheroma, caris, and any other forms of coronary heart disease)	SINGLE SIGN	2 sign	<3 sign

21. Give any other details concerning geographical location of population surveyed or reported

    e.g. Name of district, distance from the particular city, or reasons for surveying area, etc.

23. 24. Give any details concerning the data recorded in this questionnaire form

    e.g. Measured by nurse, health worker, village health worker, doctor, or special survey team, etc. Measured at village, hospital, health centre, or special mobile car, etc. Reported to you by health worker, government officer, or research team, etc. Kept by Ministry of Health, hospital record room, Institute of Nutrition, Department of certain University, etc.

THANK YOU VERY MUCH FOR YOUR TIME AND GENEROUS CO-OPERATION

INSTRUCTIONS FOR FORM P

1. Country

2. Name of person who is recording the nutritional status form P.
   Title (Mr., Mrs., Dr., etc.), first name and surname in order
   e.g. Mrs. Young Ok Seo
   The current official postal address of the recorder
   e.g. Dept. of Human Nutrition,
   London School of Hygiene and Tropical Medicine,
   Keppel Street (Gower Street),
   London WC1E 7HT.
   U.K.
3. Date when the record is being made
   e.g. 16th August, 1979.

4. Identification code for different measurement of nutritional status as follows: biochemical measurement B, physical measurement P, functional measurement F, respectively.
   (you have been allocated one of these)

5. Identification code for nutritional disorder such as Protein-Calorie Malnutrition, Vitamin A, Vitamin B_1, Vitamin B_2, and Iron deficiencies, and Overnutrition.
   (you have been allocated one of these)

6. Kind of measurement which you used to measure the physical change of population.
   (1) Weight (2) Height (3) Arm-circumference (4) Tricep skinfold thickness are the preferred measurement.
   If you do not have any of these, supply the data whatever alternative information you have such as followings:
   Supine length (infant), Height of anterior superior iliac spine, Sitting height, Crown-rump (infant), Biocondylar femur, Wrist breadth, Calf circumference, Total arm length, Biacromial diameter, Transverse chest, Antero-posterior chest, Head length, etc.

7. Date of measurement (or survey).
Data for the year 1975 are the first preference.
However, if you do not have this, data for any year between 1973 and 1977 inclusive are adequate.

8. Specific month when data were collected (7)
e.g. 1975, July
August etc.

9. Geographical location of survey area in terms of rural and urban. If you do not have spearate data for two such populations, mark the total data
e.g. Rural / Urban / Total

10. Socio-economic status of population based on income level.
Upper class is defined as belonging to the top 20%
Middle class is the middle 40% and lower class is the bottom 40% population ordinally ranked by income.
This corresponds to the following table for different countries.

(Unit: U.S. Dollar)

COUNTRY / S.E. STATUS	UPPER	MIDDLE	LOWER
THAILAND			
MALAYSIA			
SINGAPORE			
INDONESIA			
JAPAN			

Table shows the limits of income in each class.

11. Age classification for population surveyed.
(Mainly interested in the 3 vulnerable groups, PRESCHOOL CHILDREN, SCHOOL CHILDREN, and PREGNANT WOMEN).

11. continued

Yearly age classification is preferable from age 1 to 17, and pregnant women by 1st, 2nd and 3rd trimester. Under age 1 monthly age classification is preferable.

But you may use any age classification depending on what was used in your survey.

e.g. <1 year
1 year
2 "
3 "
.
.
17 years
Pregnant 1st
Pregnant 2nd
Pregnant 3rd

Age has been rounded off to the nearest birthday

e.g. 1 year: age between 0.5 and 1.4

12. Sex for population surveyed.
If you do not have sex-specific data, mark total data
e.g. Male / Female / Total

13. Sample size for defined population determined by previous columns 9, 10 and 12 for different ages or any age classification you used
e.g. No. of population sampled in rural, upper class, male at age 1.

14. 13 as a % of the total number of the defined population in the sample area (i.e. sample fraction).

15. Unit for measured value

e.g.	Weight	Kg
	Height	Cm
	Arm-circumference	Cm
	Tricep fatfold thickness	mm

16. Mean of measured value e.g.

Kind	Date	Geo.	S.E.	Age	Sex	Sample	Unit	Mean
Weight	1975	R	L	2	M	5%	Kg	12.4

17. Standard deviation of measured value e.g.

Kind	Date	Geo.	S.E.	Age	Sex	Sample	Unit	Mean	S.D.
Weight	1975	R	L	2	M	5%	Kg	12.4	0.8

18. 19. 20. 21 and 22.

Distribution of measured value over different range. (you may express the distribution either as an absolute number of as a %).

Columns I, II, III, IV, and V correspond to the suggested value in the following table.

23. Give any other details concerning geographical location of population surveyed

e.g. Name of district, distance from particular city, or reasons for surveying this area etc.

24. 25. 26.

Give any other details concerning the data recorded in this questionnaire form

e.g. Measured by nurse, village health worker, government health worker, shcool teacher, or doctor, etc. At school, hospital, health centre, mobile car, or village yard etc. Reported to you by school teacher, special survey team, health worker, or government officer, etc. Kept by ministry of health, hospital record room, institute of nutrition, or department of certain university, etc.

THANK YOU VERY MUCH FOR YOUR TIME AND GENEROUS CO-OPERATION

*Standard is taken from NCHS (1978)

STANDARD	MEASUREMENT	AGE	SEX	DEGREE				
				I	II	III	IV	V
3.3	WEIGHT	0 months	Male	>3.0	2.6- 3.0	2.3- 2.5	2.0- 2.2	<2.0
4.3		1		>3.9	3.4- 3.9	3.0- 3.3	2.6- 2.9	<2.6
5.2		2		>4.7	4.2- 4.7	3.6- 4.1	3.1- 3.5	<3.1
6.0		3		>5.4	4.8- 5.4	4.2- 4.7	3.6- 4.1	<3.6
6.7		4		>6.0	5.4- 6.0	4.7- 5.3	4.0- 4.6	<4.0
7.3		5		>6.6	5.8- 6.6	5.1- 5.7	4.4- 5.0	<4.4
7.8		6		>7.0	6.2- 7.0	5.5- 6.1	4.7- 5.4	<4.7
8.3		7		>7.5	6.6- 7.5	5.8- 6.5	5.0- 5.7	<5.0
8.8		8		>7.9	7.0- 7.9	6.2- 6.9	5.3- 6.1	<5.3
9.2		9		>8.3	7.4- 8.3	6.4- 7.3	5.5- 6.3	<5.5
9.5		10		>8.6	7.6- 8.6	6.7- 7.5	5.7- 6.6	<5.7
9.9		11		>8.9	7.9- 8.9	6.9- 7.8	5.9- 6.8	<5.9
10.2		1 year		>9.2	8.2- 9.2	7.1- 8.1	6.1- 7.0	<6.1
12.3		2		>11.1	9.8-11.1	8.6- 9.7	7.4- 8.5	<7.4
14.6		3		>13.1	11.7-13.1	10.2-11.6	8.8-10.1	<8.8
16.7		4		>15.0	13.4-15.0	11.7-13.3	10.0-11.6	<10.0
18.7		5		>16.8	15.0-16.8	13.1-14.9	11.2-13.0	<11.2
20.7		6		>18.6	16.6-18.6	14.5-16.5	12.4-14.4	<12.4
22.9		7		>20.6	18.3-20.6	16.0-18.2	13.7-15.9	<13.7
25.3		8		>22.8	20.2-22.8	17.7-20.1	15.2-17.6	<15.2
28.1		9		>25.3	22.5-25.3	19.7-22.4	16.9-19.6	<16.9
31.4		10		>28.3	25.1-28.3	22.0-25.0	18.8-21.9	<18.8

*STANDARD is taken from NCHS (1978)

*STANDARD	MEASUREMENT	AGE	SEX	DEGREE				
				I	II	III	IV	V
35.3	WEIGHT	11 year	Male	>31.8	28.2-31.8	24.7-28.1	21.2-24.6	<21.2
39.8		12		>35.8	31.8-35.8	27.9-31.7	23.9-27.8	<23.9
45.0		13		>40.5	36.0-40.5	31.5-35.9	27.0-31.4	<27.0
50.8		14		>45.7	40.6-45.7	35.6-40.5	30.5-35.5	<30.5
56.7		15		>51.0	45.4-51.0	39.7-45.3	34.0-39.6	<34.0
62.1		16		>55.9	49.7-55.9	43.5-49.6	37.3-43.4	<37.3
66.3		17		>59.7	53.0-59.7	46.4-52.9	39.8-46.3	<39.8
68.9		18		>62.0	55.1-62.0	48.2-55.0	41.3-48.1	<41.3
3.2	WEIGHT	0 months	Female	> 2.9	2.6- 2.9	2.2- 2.5	1.9- 2.1	< 1.9
4.0		1		> 3.6	3.2- 3.6	2.8- 3.1	2.4- 2.7	< 2.4
4.7		2		> 4.2	3.8- 4.2	3.3- 3.7	2.8- 3.2	< 2.8
5.4		3		> 4.9	4.3- 4.9	3.8- 4.2	3.2- 3.7	< 3.2
6.0		4		> 5.4	4.8- 5.4	4.2- 4.7	3.6- 4.1	< 3.6
6.7		5		> 6.0	5.4- 6.0	4.7- 5.3	4.0- 4.6	< 4.0
7.2		6		> 6.5	5.8- 6.5	5.0- 5.7	4.3- 4.9	< 4.3
7.7		7		> 6.9	6.2- 6.9	5.4- 6.1	4.6- 5.3	< 4.6
8.2		8		> 7.4	6.6- 7.4	5.7- 6.5	4.9- 5.6	< 4.9
8.6		9		> 7.7	6.9- 7.7	6.0- 6.8	5.2- 5.9	< 5.2
8.9		10		> 8.0	7.1- 8.0	6.2- 7.0	5.3- 6.1	< 5.3
9.2		11		> 8.3	7.4- 8.3	6.4- 7.3	5.5- 6.3	< 5.5
9.5		1 year		> 8.6	7.6- 8,6	6.7- 7.5	5.7- 6.6	< 5.7

*STANDARD is taken from NCHS (1978)

*STANDARD	MEASUREMENT	AGE	SEX	DEGREE				
				I	II	III	IV	V
11.8	WEIGHT	2 years	Female	>10.6	9.4-10.6	8.3- 9.3	7.1- 8.2	< 7.1
14.1		3		>12.7	11.3-12.7	9.9-11.2	8.5- 9.8	< 8.5
16.0		4		>14.4	12.8-14.4	11.2-12.7	9.6-11.1	< 9.6
17.7		5		>15.9	14.2-15.9	12.4-14.1	10.6-12.3	<10.6
19.5		6		>17.6	15.6-17.6	13.7-15.5	11.7-13.6	<11.7
21.8		7		>19.6	17.4-19.6	15.3-17.3	13.1-15.2	<13.1
24.8		8		>22.3	19.8-22.3	17.4-19.7	14.9-17.3	<14.9
28.5		9		>25.7	22.8-25.7	20.0-22.7	17.1-19.9	<17.1
32.5		10		>29.3	26.0-29.3	22.8-25.9	19.5-22.7	<19.5
37.0		11		>33.3	29.6-33.3	25.9-29.5	22.2-25.8	<22.2
41.5		12		>37.4	33.2-37.4	29.1-33.1	24.9-29.0	<24.9
46.1		13		>41.5	36.9-41.5	32.3-36.8	27.7-32.2	<27.7
50.3		14		>45.3	40.2-45.3	35.2-40.1	30.2-35.1	<30.2
53.7		15		>48.3	43.0-48.3	37.6-42.9	32.2-37.5	<32.2
55.9		16		>50.3	44.7-50.3	39.1-44.6	33.5-39.0	<33.5
56.7		17		>51.0	45.4-51.0	39.7-45.3	34.0-39.6	<34.0
56.6		18		>50.9	45.3-50.9	39.6-45.2	34.0-39.5	<34.0

*STANDARD is taken from NCHS (1978)

* STANDARD	MEASUREMENT	AGE	SEX
50.5	HEIGHT	0 months	male
54.6		1	
58.1		2	
61.1		3	
63.7		4	
65.9		5	
67.8		6	
69.5		7	
71.0		8	
72.3		9	
73.6		10	
74.9		11	
76.1		1 year	
85.6		2	
94.9		3	
102.9		4	
109.9		5	
116.1		6	
121.7		7	
127.0		8	
132.2		9	
137.5		10	
143.3		11	

DEGREE				
I	II	III	IV	V
>45.5	40.4- 45.5	35.4- 40.3	30.3- 35.3	<30.3
>49.1	43.7- 49.1	38.2- 43.6	32.8- 38.1	<32.8
>52.3	46.5- 52.3	40.7- 46.4	34.9- 40.6	<34.9
>55.0	48.9- 55.0	42.8- 48.8	36.7- 42.7	<36.7
>57.3	51.0- 57.3	44.6- 50.9	38.2- 44.5	<38.2
>59.3	52.7- 59.3	46.1- 52.6	39.5- 46.0	<39.5
>61.0	54.2- 61.0	47.5- 54.1	40.7- 47.4	<40.7
>62.6	55.6- 62.6	48.7- 55.5	41.7- 48.6	<41.7
>63.9	56.8- 63.9	49.7- 56.7	42.6- 49.6	<42.6
>65.1	57.8- 65.1	50.6- 57.7	43.4- 50.5	<43.4
>66.2	58.9- 66.2	51.5- 58.8	44.2- 51.4	<44.2
>67.4	59.9- 67.4	52.4- 59.8	44.9- 52-3	<44.9
>68.5	60.9- 68.5	53.3- 60.8	45.7- 53.2	<45.7
>77.0	68.5- 77.0	59.9- 68.4	51.4- 59.8	<51.4
>85.4	75.9- 85.4	66.4- 75.8	56.9- 66.3	<56.9
>92.6	82.3- 92.6	72.0- 82.4	61.7- 71.9	<61.7
>98.9	87.9- 98.9	76.9- 87.8	65.9- 76.8	<65.9
>104.5	92.9-104.5	81.3- 92.8	69.7- 81.2	<69.7
>109.5	97.4-109.5	85.2- 94.3	73.0- 85.1	<73.0
>114.3	101.6-114.3	88.9-101.5	76.2- 88.8	<76.2
>119.0	105.[illegible]-119.0	92.5-105.7	79.3- 92.4	<79.3
>123.8	110.0-123.8	96.3-109.9	82.5- 96.2	<82.5
>129.0	114.6-129.0	100.3-114.5	86.0-100.2	<86.0

*STANDARD is taken from NCHS (1978)

* STANDARD	MEASUREMENT	AGE	SEX
50.5	HEIGHT	0 months	male
54.6		1	
58.1		2	
61.1		3	
63.7		4	
65.9		5	
67.8		6	
69.5		7	
71.0		8	
72.3		9	
73.6		10	
74.9		11	
76.1		1 year	
85.6		2	
94.9		3	
102.9		4	
109.9		5	
116.1		6	
121.7		7	
127.0		8	
132.2		9	
137.5		10	
143.3		11	

DEGREE				
I	II	III	IV	V
>45.5	40.4- 45.5	35.4- 40.3	30.3- 35.3	<30.3
>49.1	43.7- 49.1	38.2- 43.6	32.8- 38.1	<32.8
>52.3	46.5- 52.3	40.7- 46.4	34.9- 40.6	<34.9
>55.0	48.9- 55.0	42.8- 48.8	36.7- 42.7	<36.7
>57.3	51.0- 57.3	44.6- 50.9	38.2- 44.5	<38.2
>59.3	52.7- 59.3	46.1- 52.6	39.5- 46.0	<39.5
>61.0	54.2- 61.0	47.5- 54.1	40.7- 47.4	<40.7
>62.6	55.6- 62.6	48.7- 55.5	41.7- 48.6	<41.7
>63.9	56.8- 63.9	49.7- 56.7	42.6- 49.6	<42.6
>65.1	57.8- 65.1	50.6- 57.7	43.4- 50.5	<43.4
>66.2	58.9- 66.2	51.5- 58.8	44.2- 51.4	<44.2
>67.4	59.9- 67.4	52.4- 59.8	44.9- 52-3	<44.9
>68.5	60.9- 68.5	53.3- 60.8	45.7- 53.2	<45.7
>77.0	68.5- 77.0	59.9- 68.4	51.4- 59.8	<51.4
>85.4	75.9- 85.4	66.4- 75.8	56.9- 66.3	<56.9
>92.6	82.3- 92.6	72.0- 82.4	61.7- 71.9	<61.7
>98.9	87.9- 98.9	76.9- 87.8	65.9- 76.8	<65.9
>104.5	92.9-104.5	81.3- 92.8	69.7- 81.2	<69.7
>109.5	97.4-109.5	85.2- 94.3	73.0- 85.1	<73.0
>114.3	101.6-114.3	88.9-101.5	76.2- 88.8	<76.2
>119.0	105.[illegible]-119.0	92.5-105.7	79.3- 92.4	<79.3
>123.8	110.0-123.8	96.3-109.9	82.5- 96.2	<82.5
>129.0	114.6-129.0	100.3-114.5	86.0-100.2	<86.0

*STANDARD is taken from NCHS (1978)

* STANDARD	MEASUREMENT	AGE	SEX
50.5	HEIGHT	0 months	male
54.6		1	
58.1		2	
61.1		3	
63.7		4	
65.9		5	
67.8		6	
69.5		7	
71.0		8	
72.3		9	
73.6		10	
74.9		11	
76.1		1 year	
85.6		2	
94.9		3	
102.9		4	
109.9		5	
116.1		6	
121.7		7	
127.0		8	
132.2		9	
137.5		10	
143.3		11	

DEGREE				
I	II	III	IV	V
>45.5	40.4- 45.5	35.4- 40.3	30.3- 35.3	<30.3
>49.1	43.7- 49.1	38.2- 43.6	32.8- 38.1	<32.8
>52.3	46.5- 52.3	40.7- 46.4	34.9- 40.6	<34.9
>55.0	48.9- 55.0	42.8- 48.8	36.7- 42.7	<36.7
>57.3	51.0- 57.3	44.6- 50.9	38.2- 44.5	<38.2
>59.3	52.7- 59.3	46.1- 52.6	39.5- 46.0	<39.5
>61.0	54.2- 61.0	47.5- 54.1	40.7- 47.4	<40.7
>62.6	55.6- 62.6	48.7- 55.5	41.7- 48.6	<41.7
>63.9	56.8- 63.9	49.7- 56.7	42.6- 49.6	<42.6
>65.1	57.8- 65.1	50.6- 57.7	43.4- 50.5	<43.4
>66.2	58.9- 66.2	51.5- 58.8	44.2- 51.4	<44.2
>67.4	59.9- 67.4	52.4- 59.8	44.9- 52-3	<44.9
>68.5	60.9- 68.5	53.3- 60.8	45.7- 53.2	<45.7
>77.0	68.5- 77.0	59.9- 68.4	51.4- 59.8	<51.4
>85.4	75.9- 85.4	66.4- 75.8	56.9- 66.3	<56.9
>92.6	82.3- 92.6	72.0- 82.4	61.7- 71.9	<61.7
>98.9	87.9- 98.9	76.9- 87.8	65.9- 76.8	<65.9
>104.5	92.9-104.5	81.3- 92.8	69.7- 81.2	<69.7
>109.5	97.4-109.5	85.2- 94.3	73.0- 85.1	<73.0
>114.3	101.6-114.3	88.9-101.5	76.2- 88.8	<76.2
>119.0	105.[illegible]-119.0	92.5-105.7	79.3- 92.4	<79.3
>123.8	110.0-123.8	96.3-109.9	82.5- 96.2	<82.5
>129.0	114.6-129.0	100.3-114.5	86.0-100.2	<86.0

*STANDARD is taken from NCHS (1978)

*STANDARD	MEASUREMENT	AGE	SEX	DEGREE				
				I	II	III	IV	V
149.7	HEIGHT	12 years	male	>134.7	119.8-134.7	104.8-119.7	89.8-104.7	<89.8
156.5		13		>140.9	125.2-140.9	109.6-125.1	93.9.109.5	<93.9
163.1		14		>146.8	130.5-146.8	114.2-130.4	97.9-114.1	<97.9
169.0		15		>152.1	135.2-152.1	118.3-135.1	101.4-118.2	<101.4
173.5		16		>156.2	138.8-156.2	121.5-138.7	104.1-121.4	<104.1
176.2		17		>158.6	141.0-158.6	123.3-140.9	105.7-123.2	<105.7
176.8		18		>159.1	141.4-159.1	123.8-141.3	106.1-123.7	<106.1
49.9	HEIGHT	0 months	Female	>44.9	39.9- 44.9	34.9- 39.8	29.9- 34.8	<29.9
53.5		1		>48.2	42.8- 48.2	37.5- 42.7	32.1- 37.4	<32.1
56.8		2		>51.1	45.4- 51.1	39.8- 45.3	34.1- 39.7	<34.1
59.5		3		>53.6	47.6- 53.6	41.7- 47.5	35.7- 41.6	<35.7
62.0		4		>55.8	49.6- 55.8	43.4- 49.5	37.2- 43.3	<37.2
64.1		5		>57.7	51.3- 57.7	44.9- 51.2	38.5- 44.8	<38.5
65.9		6		>59.3	52.7- 59.3	46.1- 52.6	39.5- 46.0	<39.5
67.6		7		>60.8	54.1- 60.8	47.3- 54.0	40.6- 47.2	<40.6
69.1		8		>62.2	55.3- 62.2	48.4- 55.2	41.5- 48.3	<41.5
70.4		9		>63.4	56.3- 63.4	49.3- 56.2	42.2- 49.2	<42.2
71.8		10		>64.6	57.4- 64.6	50.3- 57.5	43.1- 50.2	<43.1
73.1		11		>65.8	58.5- 65.8	51.2- 58.4	43.9- 51.1	<43.9
74.3		1 year		>66.9	59.4- 66.9	52.0- 59.3	44.6- 51.9	<44.6
84.4		2		>76.0	67.5- 76.0	59.1- 67.4	50.6- 59.0	<50.6

*STANDARD is taken from NCHS (1978)

*STANDARD	MEASUREMENT	AGE	SEX	DEGREE				
				I	II	III	IV	V
94.0	HEIGHT	3 years	female	>84.6	75.2- 84.6	65.8- 75.1	56.4- 65.7	<56.4
101.6		4		>91.4	81.3- 91.4	71.1- 81.2	61.0- 71.0	<61.0
108.4		5		>97.6	86.7- 97.6	75.9- 86.6	65.0- 75.8	<65.0
114.6		6		>103.1	91.7-103.1	80.2- 91.6	68.8- 80.1	<68.8
120.6		7		>108.5	96.5-108.5	84.4- 96.4	72.4- 84.3	<72.4
126.4		8		>113.8	101.1-113.8	88.5-101.0	75.8- 88.4	<75.8
132.2		9		>119.0	105.8-119.0	92.5-105.7	79.3- 92.4	<79.3
138.3		10		>124.5	110.6-124.5	96.8-110.5	83.0- 96.7	<83.0
144.8		11		>130.3	115.8-130.3	101.4-115.7	86.9-101.3	<86.9
151.5		12		>136.4	121.2-136.4	106.1-121.1	90.9-106.0	<90.9
157.1		13		>141.4	125.7-141.4	110.0-125.6	94.3-109.9	<94.3
160.4		14		>144.4	128.3-144.4	112.3-128.2	96.2-123.2	<96.2
161.8		15		>145.6	129.4-145.6	113.3-129.3	97.1-113.2	<97.1
162.4		16		>146.2	130.0-146.2	113.7-129.9	97.4-113.6	<97.4
163.1		17		>146.8	130.5-146.8	114.2-130.4	97.9-114.1	<97.9
163.7		18		>147.3	131.0-147.3	114.6-130.9	98.2-114.5	<98.2

* STANDARD is taken from ten state Nutrition Survey (1968-1970)

*STANDARD	MEASUREMENT	AGE	SEX	DEGREE				
				I	II	III	IV	V
	ARM-CIRCUMFERENCE	0 months	male					
115		1						
125		2						
129		3						
146		4						
147		5						
145		6						
150		7						
150		8						
151		9						
151		10						
151		11						
152		1 year		>137	122-137	106-121	91-105	<91
157		2		>141	126-141	110-125	94-109	<94
161		3		>145	129-145	113-128	97-112	<97
165		4		>149	132-149	116-131	99-115	<99
169		5		>152	135-152	118-134	101-117	<101
172		6		>155	138-155	120-137	103-119	<103
176		7		>158	141-158	123-140	106-122	<106
185		8		>167	148-167	130-147	111-129	<111
190		9		>171	152-171	133-151	114-132	<114
200		10		>180	160-180	140-159	120-139	<120
208		11		>187	166-187	146-165	125-145	<125

*STANDARD is taken from ten state Nutrition Survey (1968-70)

*STANDARD	MEASUREMENT	AGE	SEX	DEGREE				
				I	II	III	IV	V
216	ARM-CIRCUMFERENCE	12 years	male	>194	173-194	151-172	130-150	<130
230		13		>207	184-207	161-183	138-160	<138
243		14		>219	194-219	170-193	146-169	<146
253		15		>228	202-228	177-201	152-176	<152
262		16		>236	210-236	183-209	157-182	<157
275		17		>248	220-248	193-219	165-192	<165
		18			-	-	-	
111		0 months	female					
120		1						
133		3						
135		4						
139		5						
143		6						
146		7						
146		8						
146		9						
146		10						
146		11						
146		1 year		>131	117-131	102-116	88-101	<88
155		2		>140	124-140	109-123	93-108	<93
157		3		>141	126-141	110-125	94-109	<94
162		4		>146	130-146	113-129	97-112	<97

*STANDARD is taken from ten state Nutrition Survey (1968-70)

*STANDARD	MEASUREMENT	AGE	SEX					
				I	II	III	IV	V
169	ARM-CIRCUM-FERENCE	5 years	female	>152	135-152	118-134	101-117	<101
170		6		>153	136-153	119-135	102-118	<102
178		7		>160	142-160	125-141	107-124	<107
183		8		>165	146-165	128-145	110-127	<110
192		9		>173	154-173	134-153	115-133	<115
203		10		>183	162-183	142-161	122-141	<122
210		11		>189	168-189	147-167	126-146	<126
220		12		>198	176-198	154-175	132-153	<132
230		13		>207	184-207	161-183	138-160	<138
240		14		>216	192-216	168-191	144-167	<144
245		15		>221	196-221	172-195	147-171	<147
249		16		>224	199-224	174-198	149-173	<149
250		17		>225	200-225	175-199	150-174	<150
		18			-	-	-	

*STANDARD is taken from Ten State Nutrition Survey (1968-70)

*STANDARD	MEASUREMENT	AGE	SEX	DEGREE				
				I	II	III	IV	V
6.0	TRICEP FAT-FOLD THICKNESS	0 months	male					
		1						
		2						
		3						
8.0		4						
		5						
		6						
		7						
		8						
		9						
		10						
		11						
9		1 year		>8.1	7.2-8.1	6.3-7.1	5.4-6.2	<5.4
10		2		>9.0	8.0-9.0	7.0-7.9	6.0-6.9	<6.0
9		3		>8.1	7.2-8.1	6.3-7.1	5.4-6.2	<5.4
9		4		>8.1	7.2-8.1	6.3-7.1	5.4-6.2	<5.4
8		5		>7.2	6.4-7.2	5.6-6.3	4.8-5.5	<4.8
8		6		>7.2	6.4-7.2	5.6-6.3	4.8-5.5	<4.8
8		7		>7.2	6.4-7.2	5.6-6.3	4.8-5.5	<4.8
8		8		>7.2	6.4-7.2	5.6-6.3	4.8-5.5	<4.8
9		9		>8.1	7.2-8.1	6.3-7.1	5.4-6.2	<5.4
10		10		>9.0	8.0-9.0	7.0-7.9	6.0-6.9	<6.0
10		11		>9.0	8.0-9.0	7.0-7.9	6.0-6.9	<6.0

*STANDARD is taken from Ten State Nutrition Survey (1968-70)

*STANDARD	MEASUREMENT	AGE	SEX	DEGREE				
				I	II	III	IV	V
11	TRICEP FAT-FOLD THICK-NESS	12 years	male	>9.9	8.8-9.9	7.7-8.7	6.6-7.6	<6.6
10		13		>9.0	8.0-9.0	7.0-7.9	6.0-6.9	<6.0
9		14		>8.1	7.2-8.1	6.3-7.1	5.4-6.2	<5.4
9		15		>8.1	7.2-8.1	6.3-7.1	5.4-6.2	<5.4
8		16		>7.2	6.4-7.2	5.6-6.3	4.8-5.5	<4.8
		17			-	-	-	
		18			-	-	-	
		0 months	female					
		1						
		2						
		3						
		4						
		5						
		6						
		7						
		8						
		9						
		10						
		11						
9		1 year		>8.8	7.2-8.8	6.3-7.1	5.4-6.2	<5.4
10		2		>9.0	8.0-9.0	7.0-7.9	6.0-6.9	<6.0
10		3		>9.0	8.0-9.0	7.0-7.9	6.0-6.9	<6.0

*STANDARD is taken from Ten State Nutrition Survey (1968-70)

*STANDARD	MEASUREMENT	AGE	SEX	DEGREE				
				I	II	III	IV	V
10	TRICEP FAT-FOLD THICKNESS	4 years	female	>9.0	8.0- 9.0	7.0- 7.0	6.0- 6.9	<6.0
10		5		>9.0	8.0- 9.0	7.0- 7.9	6.0- 6.9	<6.0
10		6		>9.0	8.0- 9.0	7.0- 7.9	6.0- 6.9	<6.0
10		7		>9.0	8.0- 9.0	7.0- 7.9	6.0- 6.9	<6.0
10		8		>9.0	8.0- 9.0	7.0- 7.9	6.0- 6.9	<6.0
11		9		>9.9	8.8- 9.9	7.7- 8.7	6.6- 7.6	<6.6
12		10		>10.8	9.6-10.8	8.4- 9.5	7.2- 8.3	<7.2
12		11		>10.8	9.6-10.8	8.4- 9.5	7.2- 8.3	<7.2
13		12		>11.7	10.4-11.7	9.1-10.3	7.8- 9.0	<7.8
14		13		>12.6	11.2-12.6	9.8-11.1	8.4- 9.7	<8.4
15		14		>13.5	12.0-13.5	10.5-11.9	9.0-10.4	<9.0
16		15		>14.4	12.8-14.4	11.2-12.7	9.6-11.1	<9.6
15		16		>13.5	12.0-13.5	10.5-11.9	9.0-10.4	<9.0
16		17		>14.4	12.8-14.4	11.2-12.7	9.6-11.1	<9.6
		18			-	-	-	

APPENDIX 8.

Country	Period
Thailand	31st August-14th September, 1979
Malaysia	15th-30th September
Singapore	1st October-14th October
Indonesia	15th October-30th October
Japan	15th November, 1979- 14th January, 1980

Itinerary (1979 - 1980)

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