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Malnutrition and Mortality

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Recent scholarly exchanges in India on the magnitude and nature of the malnutrition problem have made several enquiries and references with regard to my research papers, "Anthropometric assessment of energy-protein malnutrition and subsequent risk of mortality among preschool aged children" and "The use of anthropometry for nutritional surveillance in mortality control programmes."

The paper and the letter to the editor, respectively, were both published in the *American Journal of Clinical Nutrition* (Chen, L.C., A.K.M.A. Chowdhury, and S.L. Huffman. Anthropometric assessment of energy-protein malnutrition and subsequent risk of mortality among preschool aged children. *Am. J. Clin. Nutr.* 33:1836-1845, 1980; Chen L.C., A.K.M.A. Chowdhury, and S.L. Huffman. The use of anthropometry for nutritional surveillance in mortality control programmes. *Am. J. Clin. Nutr.* 34:2596-2599, 1981). These notes are intended to summarise the published evidence and to clarify which conclusions are (and are not) supported by the reported findings.

The paper cited is an epidemiologic investigation of the relationship between various anthropometric indicators of energy-protein malnutrition and the subsequent risk of mortality among children in a rural area of Bangladesh.

Cross-sectional anthropometric measurements of 2,091 children aged 13 to 23 months were undertaken in an earlier study on nutrition and fertility. These children were all residing in an area which has been under independent longitudinal demographic surveillance (registration of birth, death, and migration) for 15 years. (Chen L.C., M. Rahman, and A.M. Sardar. Epidemiology and causes of death among children in a rural area of Bangladesh. *Intern. J. Epidem.* 9:25-33, 1980).

By linking the cross-sectional anthropometric data with the mortality experience of the same study children over the following 24 months, the relationship of anthropometry and the subsequent risk of mortality was examined.

24 Months Comparison

Children were grouped according to standard anthropometric classifications (weight-for-age, weight-for-height, height-for-age, arm circumference-for-age, and arm circumference-for-height) and their mortality experiences over the subsequent 24 months were compared.

The major findings were that: all classifications were able to prognosticate subsequent mortality risk; weight-for-age and arm circumference-for-age possessed the highest discriminatory power: and the discriminatory capacity was enhanced with maternal nutritional status and socioeconomic indicators were also included.

The results showed that severely malnourished children according to all indices, experienced markedly higher mortality risk whereas normally nourished and mildly and moderately malnourished children all experienced lower but similar risks (Table 1).

It is this last finding, graphically depicted in Figure 1, that has generated widespread interest. The remainder of this note elaborates on this key finding and discusses the validity of various interpretations.

It is important to recognise at the outset that the study's objective was epidemiologic; to determine the usefulness of anthropometric classifications for screening of high mortality risk children to facilitate preventive nutritional interventions. The study design did not address the definition of malnutrition, and the analysis used the epidemiologic concept of "risk". Risk connotes associative relationships, and is only one component of proving direct causal links (Lilienfeld, A.M. *Foundations of Epidemiology*. New York: Oxford University Press, 1976). Thus, while the study showed a strong association between severe malnutrition and mortality, it does not prove necessarily that the former caused the latter. In fact, the analysis showed that other variables, such as maternal nutritional status and the socioeconomic condition of the family, were also powerful predictors of mortality.

The study used anthropometry exclusively as an indicator of nutri-

tional status. The current debate in India focusses primarily on nutrient intake, not anthropometry, to define malnutrition (Chen, L.C., E. Huq, and S.L. Huffman. A prospective study of the risk of the diarrhoeal diseases according to nutritional status of children. *Am. J. Epidem.* 114:284-292, 1981). The concept of malnutrition is elusive and controversial. It may be reflected in many indicators, including dietary, biochemical, clinical, and functional performance parameters. Each parameter contains inherent strengths and weaknesses. There is unfortunately little empirical data between populations or amongst individuals on the degree of congruence between these various measures.

The use of mortality also has strengths and weaknesses. The definition of mortality is unambiguous, and quantitative measurement is possible. Because it reflects the ultimate consequence of ill-health, mortality is affected by multiple, simultaneous, and inter-active processes (Chen, L.C., M. Rahman, and A.M. Sardar. Epidemiology and causes of death among children in a rural area of Bangladesh. *Intern. J. Epidem.* 9:25-33, 1980). As such, measurement of mortality can detect indirect and difficult-to-predict effects. Attempts to dissect the unidirectional impact of any single factor on mortality, however, may be difficult and subject to high "background noise" of other important factors.

There are at least three possible hypotheses to explain the central finding (Figure 1) that the severely malnourished experienced significantly higher mortality risk while the normally nourished and mildly and moderately malnourished all experienced the same but lower risk:

The reported findings are *incorrect*. There is indeed a difference of mortality risk between the normally nourished and the mildly and moderately malnourished, but the differences are small and thus were not detected because of methodological constraints.

The reported findings are *correct*, but the explanation lies in the associative, not necessarily causal, links between nutritional status and mortality and on the complex interaction between nutrition and infection.

Table I

NUTRITIONAL STATUS		NO. OF CHILDREN	FOLLOW-UP MORTALITY RATE		
Degree	**% Standard**		**0-11 mo**	**12-23 mo**	**0-23 mo**
Wt/age					
Normal/mild	75	546	23.8	12.8	36.6
Moderate	60-74	1046	26.8	15.3	42.1
Severe	60	427	46.8	65.6	112.4
Wt/ Ht					
Normal	90	399	35.1	17.5	52.6
Mild	80-89	979	26.6	26.6	53.2
Moderate	70-79	566	28.3	21.2	49.5
Severe	70	75	66.7	80.0	146.7
Ht/age					
Normal	95	182	16.5	16.5	33.0
Mild	90-94	656	22.9	16.8	39.6
Moderate	85-89	713	28.0	9.8	37.9
Severe	85	468	51.3	62.0	113.2
All		2019	30.2	25.3	55.5

Mortality rate (per 1000) 0 to 11 and 12 to 23 months after nutritional assessment classified by percentage wt/age, wt/ht and ht/age of the Harvard standard.

The reported findings are *correct*. Mortality risk is indeed similar between the normally nourished and the mildly and moderately malnourished. This is due to "homeostasis" or "adaptation," which imply physiologic normality.

Let us deal with each in turn. The first hypothesis seems unlikely. It should be noted that the demographic registration system in this study population is one of the most accurate and reliable in the world. (Chen, L.C., M. Rahman, and A.M. Sardar. Epidemiology and causes of death among children in a rural area of Bangladesh. *Intern J. Epidem.* 9:25-33, 1980).

All children aged 13-23 months residing in 86 villages were sampled, and the age of the study children was known with precision because all births were registered. However, as described in the paper's methods section, about 450 children were excluded from the final analysis because of infant mortality (deaths from birth to the study age), unavailability for anthropometry measuremnt, or mis-linkage between anthropometry and mortality records. (Chen, L.C., A.K.M.A. Chowdhury, and S.L. Huffman. Anthropometric assessment of energy-protein malnutrition and subsequent risk of mortality among preschool aged children. *Am. J. Clin Nutr.* 33:1845, 1980).

The final study cohort, therefore, may contain hidden biases; this exclusion may have implications for the interpretation of the data. There are no reasons to suspect, however, that had all children been included, the pattern of mortality risk would have differed from the observed.

The second hypothesis is more plausible. Although the analysis demonstrated an associative relationship between anthropometry and mortality, many other factors (which are also associated with poor growth) could be important determinants of mortality as well.

The study, in fact, showed that maternal nutritional status and the economic condition of the family are two such variables. These collinear determinants could generate high "background noise", which could obscure whatever modest differences actually exist. In this regard, the role of parental child care and parental response to illness may be important. Children who are severely malnourished may constitute a subgroup for whom maternal competence or family social factors may play a critical role. (Chen, L.C Where have the women gone:

insights from Bangladesh on the low sex ratio of India's population. *Econ. Polit. Weekly*. Vol. XVII, No 10, 1982. I am also indebted to Prof. Gopalan for these observations).

When infections strike, these same children are more likely to receive inadequate health care, thereby resulting in high mortality. For the normal, mild, and moderate groups, nutrition may also be important, but social behaviour such as health care could reduce whatever differences of mortality would be expected.

This explanation is supported by the data in Table 1. Severely malnourished children experienced not only higher mortality risk but also a different mortality trend over time. For the normal, mild, and moderate categories, mortality risk declined with aging (lower risk in the second 12-month period of observation in comparison to the first 12-month period).

The mortality risk of the severely malnourished, however, increased with aging (high mortality risk in the first 12 months of observation, followed by even higher risk in the second 12-month period). This difference in trends suggests that the severely malnourished consisted of a distinct population subgroup, at very high risk and with the risk increasing over time—a pattern distinctly at variance with the general phenomenon of declining risk with aging.

Another possible explanation consistent with the second hypothesis is the complex interaction of nutrition and infection. Although it is generally accepted that the malnourished experience more episodes of infections because of compromised host resistance, a recent study showed that the attack rate of diarrhoea was similar across all nutritional groups (Chen, L.C., E. Huq, and S.L. Huffman. A prospective study of the risk of the diarrhoeal diseases according to nutritional status of children. *Am. J. Epidem.* 114:284-292, 1981). The differences between nutritional groups was not in incidence rates but, in the duration and severity of illness, with the malnourished experiencing longer diarrhoeas and more deaths per episode (Chen, L.C., E. Huq, and S.L. Huffman. A prospective study of the risk of the diarrhoeal diseases according to nutritional status of children *Am. J. Epidem.* 114:284-292, 1981).

This observation is consistent with recent advances in the understanding of the transmission pattern of the various pathogens responsible for diarrhoea (Chen, L.C., E. Huq, and S.L. Huffman. A prospective study of the risk of the diarrhoeal diseases according to nutritional status of children. *Am. J. Epidem* 1.114:284-292, 1981). If valid, these findings suggest that the mortality effects of infections may be of three types.

Firstly, some children irrespective of nutritional status experience mortality because of the pathogenicity of the attacking agent. Second are deaths due to nutritionally-related impaired host resistance; these would be concentrated amongst the most severely malnourished. Thirdly, amongst the normally nourished and mildly and moderately malnourished, the primary effect of infection could be to nutritionally deplete the victim, shifting children into poorer nutritional states. But this shift,within a specified period of time, need not result in death, especially if health services are available.

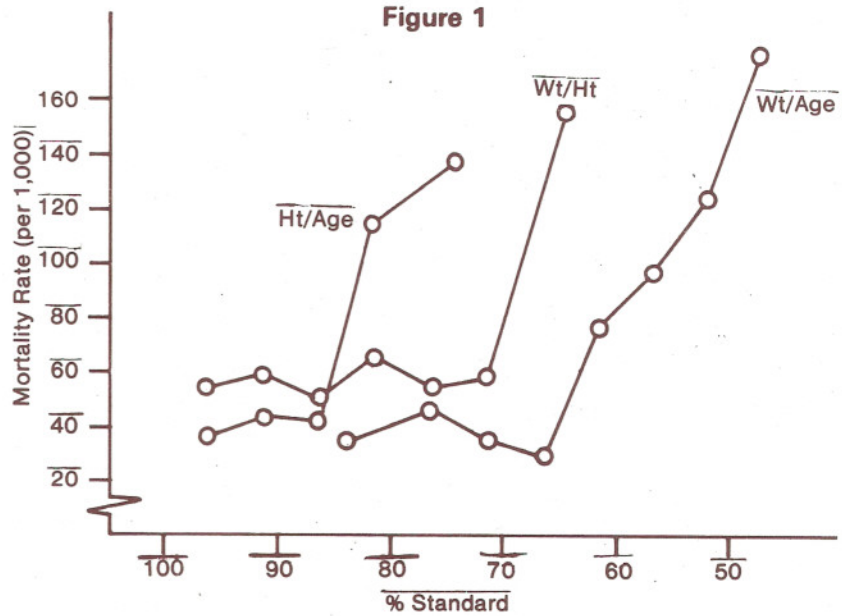
If these three inter-relationships between infection and nutrition operate simultaneously, the net pattern of mortality by nutritional status could approximate that observed in this study.

More controversial is the third hypothesis. In support of this hypothesis is the simple observation of very high mortality risk amongst the severely malnourished and *lower but similar* risk between the normally nourished and the mildly and moderately malnourished. This finding is consistent with the interpretation that, in terms of subsequent mortality risk, these latter three nutritional states are indeed comparable. Our knowledge base in the nutritional sciences is not sufficiently strong to demarcate the "range of normality" or to identify the point in the malnutrition spectrum at which adverse consequences of malnutrition become manifest or measurable.

There are both knowledge gaps and dangers inherent in the translation of these findings into policy. The major knowledge gap is that nutrition investments need to be weighed between the more short-term urgency of preventing mortality amongst the severely malnourished versus longer-term approaches that improve the overall nutritional status of a population—including the mild and moderate varieties.

The root causes of all three forms of malnutrition, however, are well-substantiated. Among others, these include: economic poverty, high prevalence of infections due to unsanitary environment, and ineffi-

Figure 1



Mortality rates (per 1000) according to percentage of Harvard standard.

cient uses of household resources. Any long or short-range attack on malnutrition must deal with all three.

One danger of the third hypothesis is not with regard to its validity, but to its possible misinterpretation for nutrition policy. Derived conclusions may go too far beyond cautious hypothesis formulation. If the terms "homeostatis" or "adaptation" are used to imply *successful and harmless* adjustment to stress, or that mild and moderate malnutrition are not a problem, the overwhelming weight of scientific evidence, in this paper and in the published literature, is inconsistent with this policy conclusion, for several reasons:

First, the pattern of risk (Figure 1) overshadows the key finding that the mortality level reported even for the normally nourished Bangaladeshi children is 30-50 deaths per 1,000 per year (Figure 1). This level is approximately *tenfold* that of more privileged children in rich and poor countries (Chen, L.C., M. Rahman, and A.M. Sardar. Epidemiology and causes of death among children in a rural area of Bangladesh. *Intern. J. Epidem.* 9:25-33, 1980). Thus irrespective of the demarcation between "normal" and "abnormal," the level of mortality among even "normal" children in rural Bangladesh is staggering and largely preventable

Second, privileged children in Bangladesh, as elsewhere, attain growth standards remarkably similar to their counterparts in rich populations (Institute of Nutrition and Food Sciences. *Nutrition Survey of Rural Bangladesh*, Dacca, University of Dacca, 1978). In other words, stunting and retardation are not the consequences of varying genetic potential, but reflect primarily biologic insult—due predominantly to insufficient nutrient intake and repeated infections.

In biologic terms, the human organism, appears to recognise the abnormality of stunting and retardation. During the convalescent phase after acute nutrition insult, for example, the phenomenon of "catch-up" growth is well documented (Rohde, J.E. Preparing for the next round: convalescent care after acute infection. *Am. J. Clin. Nutr.* 31: 2258, 1978).

Catch-up growth involves physiologic adjustments of increasing appetite and enhancing efficiency in the deposition of body mass. Like tissue repair after injury, the body appears to recognise growth slowdowns as abnormal and attempts to adjust by more-rapid-than-normal growth recovery. After a child attains normal weight for height, "catch-up" growth ceases.

Third, the study examined only the survivors. Those who died prior to the study period are excluded. In Bangladesh, the infant mortality rate is about 140 per 1,000 live births (Chen, L.C., M. Rahman, and A.M. Sardar. Epidemiology and causes of death among children in a rural area of Bangladesh. *Intern J. Epidem.* 9: 25-33, 1980).

Low Birth Weight Mortality

For a study beginning with 13-23 months old children, at least 14 percent of the same birth cohort have already died. One effect of this bias is illustrated by low birth weight. Low birth weight babies possess significantly higher mortality risk than their heavier counterparts (Habicht, J.P., A. Lechtig, C. Yarborough, and R.E. Klein. Maternal nutrition, birth weight, and infant mortality in *Size at Birth*, CIBA Foundation Symposium 27, Elsevier, London, 1974).

The risk is highest immediately after birth and, with aging, tends to move towards the population mean. Surviving low birth weight babies often follow growth tracks that parallel, but remain lower at each age than, their heavier counterparts (Yarborough, C., J.P. Habicht, A. Lechtig, and R.E. Klein. Length and weight in rural Latino children. *Phys. Anthropol.* 42: 390, 1975).

Thus, mildly and moderately malnourished children at 13-23 months would consist of disproportionately more surviving low birth weight babies than normally nourished children. Even if the subsequent mortality risk of the malnourished approached that of normally nourished children, the high mortality toll of low birth weight babies in the early years should be an integral consideration in interpreting the study.

Fourth, mortality is only one of the many well-documented adverse consequences of malnutrition. The pattern of functional impairment due to malnutrition will vary according to the parameter examined. Some of the more important effects, in contrast to mortality, may be the most difficult to measure and quantify. Of possible relevance here are subtle, less-discernible, and difficult-to-measure changes of exploratory activity, initiative, creativity, learning, and social interaction (Calloway, D.H. Functional consequences of malnutrition. Paper prepared for the Workshop on Interaction of Parasitic Diseases and Malnutrition, Bellagio, Italy, September 27-October 1, 1980).

Fifth, even if mildly and moderately malnourished children experience the same mortality risk as normally nourished children, the phenomenon does not assess the human cost of the adjustment process. High mortality at younger ages is one such cost. Other possible costs include hunger and dietary insufficiency, repeated onslaught of infections, other morbidities, compromised exploration and learning.

Take as a parallel example, not malnutrition, but contaminated drinking water. Repeated exposure to pathogens from contaminated water leads to gastrointestinal infections. With each episode, some children die while others experience transitory illness. Among the survivors, each infectious insult also stimulates an immune response.

Thus, at some future time, one may observe surviving children with no apparent problems (and even possessing immunity against many infections). It would be fallacious to conclude that since children exposed to contaminated water appear healthy (even healthier than others), contaminated drinking water is not a problem.

These notes have summarised the salient features of the relationship between malnutrition and mortality. Particular attention was devoted to three alternative hypotheses explaining the reported findings. If the hypotheses are extended too far to derive the conclusions that mild and moderate malnutrition does not

constitute a problem, the interpretation is fallacious.

Too much attention may be paid to the future risk of those who are already mildly, moderately or severely malnourished. The central question ought to be to the past as well. All forms of malnourishment are due to antecedent root causes, such as lack of income and infections. These deserve the highest priority in any nutrition policy.

A study that focuses on only survivors, on mortality measurements, and on subsequent or future risk does not deal with the central issue of the human cost absorbed in the past which has resulted in less-than-optimal growth. Clearly, there is a need to address all forms of malnutrition, mild to severe, and to work directly on the root causes of the problem.

The role of the nutritional sciences should be to provide insights that generate more political commitment, higher priority, and operationally effective interventions on-the-ground that will confront squarely one of the major challenges of contemporary humankind.

While intellectual dialogue on the magnitude of malnutrition is no doubt stimulating, we should not miss the main point with which we all concur, namely that poverty and malnutrition are massive, and its prevention and control demand the highest priority through effective action on-the-ground.

FOUNDATION NEWS

A meeting of the task force on studies on **health/nutrition consequences of developmental programmes** in Punjab and Uttar Pradesh was held in New Delhi on July 23, under the chairmanship of Dr. Srikantia.

A meeting of the task force on **studies on disabilities in school children related to malnutrition** was held in New Delhi on September 11, under the chairmanship of Dr. V.N. Rao, Director (Research), KEM Hospital, Pune.

The Nutrition Policy of Brinkmanship

C. Gopalan

Brinkmanship is defined as the art of advancing to the very brink of war or catastrophe but stopping just short of it. It would seem that brinkmanship is now being actively promoted and propagated as part of the nutrition policy of developing countries.

The art of brinkmanship in nutrition consists essentially in advocating that children who suffer from malnutrition of the so-called 'mild' and 'moderate' grades—a classification devoid of proven physiological validity—may be left severely alone to fend for themselves, and "nutrition intervention" need be attempted only when they reach the "severe" stage of impending death. In other words, saving children from the catastrophe of death, rather than ensuring their normal health and nutrition is the essence of the policy of brinkmanship.

Strange Justification

The justification proffered for this policy is that children who are not so severely malnourished as to be on the verge of death, may somehow "muddle through" and manage to survive—in which case they could be described as "adapted", meaning that they have come to terms with, and have learnt to reconcile themselves to, their bad lot. Unfortunately, many of those who are using the word "adaptation", in the debate do so rather loosely. A person with high blood pressure can "adapt" himself to his condition through hypertrophy of his heart; such "adaptation" helps him to buy some time before the inevitable disaster strikes, but he is by no means normal. The fact that between death and normalcy, there exists a broad twilight zone of morbidity, functional impairment of various kinds, apathy, lack of sense of well-being, poor physical stamina, low productivity, etc., is largely lost sight of.

The policy of brinkmanship—withholding nutrition intervention to children till they reach the verge of death, the so-called "severe" stage of malnutrition, is calculated to undermine and erode the quality of our human resources. Intervention in the last stages of malnutrition cannot help to build a strong and healthy nation, but will only serve to increase the pool of survivors of sub-standard physical stamina and productivity—the scars of childhood malnutrition; it will be akin to bolting the stable door after the horse has escaped, for many children who have reached the 'severe' stage of malnutrition cannot be restored to full normalcy.

Policy of Bankruptcy

To say this is not to advocate "triage"; for it is not implied here that 'severe' cases of malnutrition should be left alone to die. What is emphasised here is that a nutrition policy which consists in apportioning the predominant part of the Nutrition Budget only to saving severely malnourished children from the jaws of death, and in according little importance and support to improving the lot of other malnourished children in the community and in preventing them from sliding into the 'severe' stage, will be a policy of bankruptcy and brinkmanship.

What is objectionable is the attempt to justify exclusive emphasis on 'severely' malnourished children not on the basis of lack of adequate resources for a broader coverage, but on the basis that children in poor communities, other than those "severely malnourished" and on the verge of death, are all normal and 'adapted' in spite of their very significant growth-retardation. In other words, we are being persuaded to accept mild and moderate malnutri-

tion in our children as our normal national feature.

When it is pointed out to those who advocate this policy of brinkmanship that malnourished children who may escape death eventually grow into stunted adults of low body size and poor productivity, it is argued that low body size is welcome because the energy requirement of such subjects will be low; the resultant low productivity and low earning capacity should not matter because in any case we are a labour-intensive, cheap-labour economy! "Improve the economy first, and then talk about improving nutrition of children and body-size of adults. Our labourers have the body-size suited to our economy," is the answer. Without questioning the bonafides of scientists who advocate this policy and with all due respect to them, it must be clear that this policy will only serve to perpetuate the current nutrition scenario and the underlying poverty syndrome—the vicious cycle of poverty, undernutrition, low productivity, poor income and poverty. This vicious cycle must be broken at several points and not in an ordained sequence.

A sensible National Nutrition Policy should aim at preventing malnourished children of poor communities from reaching the severe terminal stage, and not wait passively for them to arrive there in order to start rescue and repair operations, which, besides being expensive, will in any case not restore them to full normalcy.

It is from this point of view that we welcome Dr. Lincoln Chen's foregoing excellent paper; his earlier communications in the *American Journal of Clinical Nutrition* had led to unwarranted interpretations which were clearly not intended by him.

Dr. Chen's communication clearly underscores the need for a nutrition policy which seeks to attack the basic factors that underlie all forms of malnutrition, including the "mild" and "moderate" degress. His paper represents a cogent well-reasoned and forceful plea against the policy of brinkmanship in nutrition.

REVIEWS AND COMMENTS

On Brinkmanship in Nutrition

I am thankful to Dr. C. Gopalan for sharing with me the draft of his paper on "The Nutrition Policy of Brinkmanship". I agree heartily with what he has written, and especially endorse his objection to attempts to justify a nutrition policy of exclusive emphasis on 'severely' malnourished children, on the assumption that all other malnourished children in the community (the so-called mild/moderately malnourished) are normal and 'adapted'. Indeed, I would go further and say that in India, a country with enough food, *no baby* should be expected to adapt to deprivation of food. Instead of devising a nutrition policy based on such expectation and consisting mainly of dealing with severe' malnutrition *after* it has set in, the country should embark on a war-footing upon a policy of *preventing* such 'severe' malnutrition in children.

In every village of the country today, all the time, "horses are bolting out of open stable doors"—infants and children, victims of the inexorable interaction of chronic starvation and diseases die, often to be replaced by the next, with the mother progressively worn out and nutritionally depleted. I would call this a progressive spiral of descent into the state of misery (not just a vicious circle). Our experience in CMC Ludhiana, working with the health functionaries in a community development block, has shown us that all this misery can be avoided.

In every village, though the overall community nutrition profile may show little change over several months, in individual households it is all the time rapidly changing. New high-risk subjects will have emerged in families which did not have them before—new pregnancies, new births, and babies who were in good nutrition on exclusive breast-feeding just a few weeks ago, now steadily descending into malnutrition. Under the circumstances, what is needed for an effective *preventive* programme (as against a repair operation) is a strategy of continuous monitoring of the community for rapidly updating the data on changing nutrition profile in individual house holds and for timely identification of the high-risk subjects. This cannot be achieved through elaborate resurveys, following on an initial base-line survey, each of which resurvey may take at least three months for a team of multipurpose workers, working four hours a day, to complete in a sub-centre area. Such resurveys would prove as much tiresome and frustrating to the communities as to the health-personnel, for, in the meanwhile "several horses would have bolted out of the stables".

At present the Multipurpose Workers attached to each Subsidiary Health Centre (population 5,000) in Punjab, visit every home once in 6-8 weeks. Their emphasis is on maternal and child health and family planning but the continuing high infant and toddler mortality and the prevalence of so much malnutrition, especially in the second and third year, shows that the goals of these workers are not being achieved. In the Community Development Block allocated in 1980 to our medical college, without disturbing the basic working pattern of the existing work force, we have simply more effectively deployed that force so that they have adopted the "need-based" approach developed by us.

The workers, realising that attitudes and long-standing practices cannot be changed during a home visit lasting 3-5 minutes every 6-8 weeks have recognised that all homes do not need 5 minutes, and that in the homes of more than half of the family folders they take out daily, they need spend only 2 minutes monitoring any change which has taken place.

In these homes there will be no potentially "at risk" individual and this allows them 15-20 minutes in homes where there are pregnant women and/or under-five children, especially when these high risk subjects do not attend the local clinics for mothers and children. This "intensive care" approach allows the

workers time to teach mothers, no matter how poor or over-worked, how to make the best use of whatever is available in that home.

Having spent half an hour daily in the centre recording in appropriate section of the Master Register, all changes found on that day's home visiting, the workers and supervisor—who may be a medical officer or Lady Health Visitor, discuss all priority persons seen that day and make a plan for each. Thus for a clinic attender of 18 months, eating adequately, there may be no need to see her till the routine visit.

However, a female of 10 months from a poor home, eating inadequately in spite of earlier advice and whose mother's pregnancy was noted that day, is of very high risk. Even though she is on the "Road to Health"—she must go on a high risk list so that the home receives visits every 4 or even 2 weeks until the child is out of danger as a result of the mother's acceptance of the oft-repeated nutrition health education.

Through such a programme, we have shown that women of poor communities can have splendid babies through encouraging exclusive breast feeding for 6 to 7 months; and that through timely advice on the use of inexpensive locally available supplements (based just on *roti*, vegetables and tea) which can be eaten by the seven-month old, even first degree malnutrition can be *prevented* in them. We can ensure that a very high percentage of children avail of facilities for immunisation, and the practice of timely oral hydration of children with diarrhoea is promoted and propagated.

We are convinced from our experience in CMC-Ludhiana that this strategy of *preventing* infants and young children from sliding into severe malnutrition (rather than a strategy of belated repair and rescue-brinkmanship) is perfectly feasible, with the existing infrastructure, facilities and resources, and that this is not a "pipe-dream".

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Integrated Rural Development: The Narayanapuram Experience

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Some years ago, the Indian Institute of Technology, Madras, obtained from the Tamil Nadu Government a 94 acre tract of land near the southern boundary of the city to establish a Rural Development Project. This land, part of a seasonal swamp, which gets inundated by knee-deep water for about four months in a year, was uncultivated and uncultivable, with not even water hyacinth surviving on it.

On this inhospitable land, the Institute has established during the past two years, an integrated development complex, employing about 300 people with monthly wages ranging from Rs 300 to Rs 1200. The main resource available on site was plenty of subsoil, brackish water, with salt content as high as 30,000 parts per million. It was decided that the best way to utilise this asset was to cultivate the fish that thrive in brackish water.

From the earth that came out of digging this fish pond, bricks were made, and to help make bricks, a biogas plant was established, naturally along with a dairy farm. To facilitate both dairy farming and brick making, a rice mill was started, the bran being used for the cattle and the husk for making bricks. In addition a bakery was established to use the biogas.

As this project involved considerable construction work—worth over Rs 20 lakh during the past one year—a carpentry and a welding section were formed, which have proved to be profitable industrial activities in their own right.

It so happened that the Science Centre of the IIT-Madras had already developed kits for teaching electronics in schools, and had secured substantial orders from various state governments. The fabrication of these kits also was taken up by the Centre.

During fabrication, a need was felt for screen printing and for plastic bags. It was found far more convenient to have these things done in-house hence a screen printing unit and a small plastic moulding plant were also started.

As an adjunct to screen printing, a printing press was also established. Finally, to utilise the considerable amount of waste paper that is available from the IIT and elsewhere, a Paper Recycling Plant of one ton capacity per day was erected.

Thanks to the considerable amount of sludge from the biogas plant, the uncultivable land in which even water hyacinth would not grow is now gradually being reclaimed. Today, there are hundreds of cocqnut plants and thousands of kubabul trees. Further expansion will be in the direction of providing various social, municipal and commercial amenities, as well as housing. A dispensary is already in operation and a bank is about to start. Together, these constitute the Narayanapuram Integrated Development Project.

Commercial Venture

There are several novel concepts in this scheme. Firstly, it is not a welfare project but a commercial venture. Most rural development projects run mainly with subsidies from Government and other agencies. However, this project has been financed by commercial loans taken from the United Commercial Bank at the usual rates of interest. Most rural development schemes were not replicable because they did not inspire adequate confidence regarding their economic viability. The best way to demonstrate such a viability is to have a bankable project.

A bankable project has also the advantage that, as and when the loan is repaid, there will be funds to

start another similar project, and when the loan is repaid with interest, one can actually generate funds to start more than one such project. Subsidies, on the other hand, tend to dry up sooner or later. Thus, only a bankable project is self-regenerative and has the ability to grow exponentially.

Secondly, most rural projects aim at marginal improvement in the conditions of life and the economic status of the concerned individuals. As already stated, the salary levels that have been established, range from Rs 300/- to Rs 1200/- per month. These are much higher than what is normally obtained in village development schemes.

A Quantum Jump

Thus, the attempt is to ensure a quantum jump rather than a marginal improvement. In fact, this quantum jump is much more substantial than what may appear from the kind of salaries that are being paid. It is planned that the people working on this project will get subsidised modern housing, protected water supply, proper sewage systems, fuel and other amenities such as schools, health centres, commercial and transportation systems.

The effective income and quality of life will, therefore, be far higher than what the salaries indicate.

The reason why we consider it feasible to establish an improvement in the quality of life as listed above is because the main basis of development is not agriculture but industry. Agriculture has the limitation that the consumption of agricultural products is comparatively inelastic. On the other hand, there is an insatiable demand for industrial goods and hence, the margin of development through industrial development is immensely higher.

Most major schemes of rural technology are based on maximising employment and minimising productivity.

In Narayanapuram, on the contrary, the aim has been to maximise productivity and to minimise direct employment in every field of activity. The overall employment is made high, however, by increasing the number of such activities. To ensure high productivity we have to use the best possible technology in contrast with the accepted norms of appropriate technology which usually implies minimum of technology.

Such a minimum technology is generally advocated because of the workers' illiteracy and the cost of sophisticated equipment. We believe these arguments to be incorrect.

Firstly, there is a distinction between a sophisticated equipment and equipment which requires sophistication to handle. Quite a large variety of modern sophisticated production equipment require very simple skills indeed. In fact, the entire growth of the industry in the West has been based on the employment of more and more unskilled labour, as for instance, in the manufacture of automobiles. Thus, sophistication in machines actually demands less, not more, skill from labour and is better adapted to unskilled people than are simple tools.

No doubt, it is true that sophisticated equipment is expensive and, in a poor country like ours, funds are limited. Strictly speaking, however the real limitation is not funds for investment, but profitable ideas for investment. One of the main reasons why rural development works are starved of funds is because of the fear that, in most cases, the loans will never be repaid. Where the investment is profitable, there will be—in fact, this is our experience—no dearth of funds.

It might have been noticed that the 300 workers who have been employed under the scheme are all wage-employees. This again is in direct contrast to the traditional wisdom of rural development, which emphasises self-employment. To provide an additional cow, or pig, or loom to help an individual supplement his income, is no answer; self-employment requires a standard of foresight and entrepreneurship which even highly educated people rarely enjoy. It is far too much to expect an illiterate villager to succeed where even the best educated fear to tread.

Secondly, self-employment can never be properly integrated, whereas wage employment can be. The reason why we are able to generate a large amount of employment is because a variety of things have been integrated and such an integration is not possible where all the workers are self-employed with each one ploughing his own lonely furrow.

We were fortunate to get a reasonably large tract of unoccupied land. Thereby, we have avoided the pitfalls of adopting a village. Adopting a village implies that we have to come to terms with the internal social, political and economic structure within the village. By establishing the project outside any village, we have avoided many such problems. In fact, we draw our workers from as many as five villages in the vicinity. This further diffuses the problem of internal rivalries common in village communities.

Ideas for Investment

We have also more or less excluded the local leadership from the functioning or organisation of the project. In fact, apart from the senior faculty of the IIT-Madras who are working in this project, most of the functional leadership is with the hired supervisory staff who had to be drawn from outside the neighbourhood.

By insisting on such professional management, we have, at least so far, avoided the local caste, group and political pressures. We do not advocate enlargment of a scheme to obtain growth, but suggest replication instead. Incidentally, replication is also the only way a rural project remains rural.

Although these projects have drawn on the expertise of the Indian Institute of Technology, Madras, this is not strictly necessary. In fact, what IIT-Madras has provided is not so much technical expertise as managerial ideas. There is no reason why the concepts enumerated here cannot be implemented by others. As mentioned already the cost of investment, although substantial, is unlikely to be a problem, but a minimum of 100-200 acres is needed to try out such a scheme.

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