Available anthropometric data on different communities around the world broadly indicate a close relationship between the heights of children (and, for that matter, of adults) in a community and the level of its socioeconomic development. The greater the socioeconomic deprivation in a community, the greater, generally, are the extent and degree of stunting in it.

Socioeconomic underdevelopment (poverty) generally signifies the following: (a) low levels of income, (b) inadequate diets, (c) low-paid unskilled and semi-skilled manual occupations of adults, (d) poor levels of education, (e) poor environmental sanitation and housing conditions, (f) large family size, and (g) high prevalence of morbidity and clinical signs of undernutrition (other than growth retardation), especially among children. Among communities subject to socioeconomic deprivations, these attributes of the "poverty syndrome" invariably coexist and tend mutually to reinforce their respective ill effects. Children and adults caught up in this situation cannot but be stunted.

All these factors of the poverty scenario listed above, however, must ultimately act through a final common pathway to bring about stunting, the ultimate determinant being the lack of availability at the cellular level, in adequate amounts, in proper combinations, and at appropriate times, of all the essential nutrients required for growth, development, maintenance, repair, and normal functions of the organism. Stunting associated with poverty is, therefore, in the final analysis, a direct reflection of the undernutrition induced by it. It is the most convenient and practical quantifiable index of undernutrition available to the health scientist.

There may be academic debates as to what stunting per se does or does not do, but there can be no two opinions about the need for eradication of poverty, which automatically implies the eradication of stunting as well.

Physical stunting in poverty-stricken cases is invariably associated with varying degrees of impairment of mental development as well, as is ably pointed out by Dr. Colombo in this volume, though these two attributes may not always be directly causally related. In the same way as physical stunting is not a reflection of low genetic potential for growth, mental stunting is not a reflection of low intellec-
tual potential but presumably results from environmentally induced learning disabili-
ities and lack of adequate opportunities for cultivation of such potential in
poverty situations.
A community in which a very high proportion of children and adults are stunted
is most likely to be a community whose human resources are of poor quality.

RECENT INDIAN STUDIES

Three recent Indian studies throw light on the context and real-life setting in
which stunting is generally seen.
An extensive longitudinal study on growth and development of children of dif-
f erent socioeconomic groups, followed from birth for periods extending now to
nearly 15 years, has been ongoing in Delhi in India since 1969. These unique stud-
ies originally initiated by Ghosh and colleagues (1) are now being continued by
S. K. Bhargava and V. Kapani. The observations presented here are based on an
as-yet unpublished report of S. K. Bhargava and V. Kapani.
Nearly 8,200 children have been covered in this study. The communities inves-
tigated ranged from the poorest (less than Rs 50/- per person per month, 1969

FIG. 1. Weight and lengths/standing heights of girls by per capita income and age. (From
S.K. Bhargava and V. Kapani, unpublished data.)
level) to the fairly well-to-do upper middle class (more than Rs 200/- per person per month, 1969 level). The longitudinal data from children belonging to these two income groups (Fig. 1) show the clear relationship between socioeconomic status and heights and weights of children.

K. Satyanarayana and colleagues (2) at the National Institute of Nutrition, Hyderabad, have assembled data from longitudinal observations on the heights and weights of children of different socioeconomic groups in rural Hyderabad observed over a 15-year period (5 to 20 years). The children belonging to their group I, with heights between the mean and the mean minus 2 SD of the Boston Standard, mostly came from families of affluent landlords owning more than 5 acres of fertile land; those of their group III were from the poorest rural households owning no land of their own, with adults being illiterate and eking out their living from seasonal agricultural wage labor. Some of their observations have been set out in Table 1. The same table also shows data on heights and weights of children of the most affluent Indian communities as observed and reported by D. Hanumantha Rao and Gowrinath Sastry (3) of the same institute on the basis of their cross-sectional studies. The striking difference between the different socioeconomic groups is again obvious.

The National Nutrition Monitoring Bureau in Hyderabad, India, has recently completed a study of the dietary, nutritional, and anthropometric status of 32,332 subjects (12,925 adults and 19,407 children) drawn from 15 major cities of India (4). The sample households were classified into five major socioeconomic categories.

The high-income group (HIG) and the slum laborers (SL) represented the two extreme ends of the economic spectrum, with the other three groups lying in between. The SL was the group subject to the greatest socioeconomic deprivation—poor, largely illiterate or semiliterate, living in highly overcrowded and unhygienic conditions.

TABLE 1. Longitudinal studies of growth of Indian children of different socioeconomic groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Initial (5 years of age)</th>
<th>Final (20 years of age)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Height (cm)</td>
<td>Weight (kg)</td>
</tr>
<tr>
<td>Mostly from families of well-to-do landlords (owning about 5 acres of fertile land) (mean ± SD)*</td>
<td>104.7 ± 2.90</td>
<td>15.3 ± 1.4</td>
</tr>
<tr>
<td>Mostly from families of agricultural laborers on seasonal daily wages (mean ± SD)*</td>
<td>89.2 ± 4.02</td>
<td>11.5 ± 1.08</td>
</tr>
<tr>
<td>Highly affluent*</td>
<td>108.0</td>
<td>18.3</td>
</tr>
</tbody>
</table>

*Satyanarayana et al. (2).
*Hanumantha Rao and Gowrinath Sastry (3).
conditions and having to depend mostly on unskilled manual labor to eke out a precarious livelihood. Their diets were decidedly lower in energy content, and their children showed a higher prevalence of signs of vitamin deficiencies.

The heights and weights of children and adults faithfully reflected the socioeconomic gradient, with the HIG at one end and SL at the other and the other groups falling in between. For the sake of convenience, only part of the data from the two groups at the extreme ends (HIG and SL) are shown in Tables 2 and 3.

**THE POVERTY TRAP**

The outstanding finding in all three studies cited above is the striking relationship between income and occupational status on the one hand and physical stature on the other. It appears that the more lowly (using the expression for the sake of convenience) the job that a community is engaged in, the greater is the degree of stunting in its children and adults. The cart pullers, scavengers, manual laborers

| TABLE 2. Heights and weights of children from the highest (HIG) and lowest (SL) socioeconomic groups in 15 major cities of India |
|---|---|---|---|---|
| Age (years) | Sex | Height (cm) | Weight (kg) |
| | | HIG | SL | HIG | SL |
| 5 | Boys | 110.4 | 99.8 | 18.2 | 13.9 |
| | Girls | 107.6 | 98.7 | 16.2 | 13.6 |
| 12 | Boys | 144.2 | 132.6 | 30.8 | 25.1 |
| | Girls | 140.4 | 133.7 | 29.9 | 26.8 |
| 16 | Boys | 164.5 | 154.7 | 46.2 | 38.6 |
| | Girls | 156.2 | 148.6 | 43.1 | 39.1 |

From the National Nutrition Monitoring Bureau (4).

| TABLE 3. Heights and weights of adults from the highest (HIG) and lowest (SL) socioeconomic groups in 15 major cities in India |
|---|---|---|---|
| Age group | Heights (cm) | Weights (kg) |
| | HIG | SL | HIG | SL |
| 20–25 years, M | 166.4 | 161.4 | 50.4 | 46.6 |
| | (161.0–164)* | | (47.2–49.8) | |
| 20–25 years, F | 154.6 | 150.1 | 46.8 | 41.7 |
| | (149.4–151.9) | | (41.0–44.2) | |
| 40–45 years, M | 166.8 | 161.2 | 66.3 | 48.1 |
| 40–45 years, F | 153.1 | 149.6 | 56.0 | 41.6 |

*Figures within parentheses in columns 3 and 5 are measurements of the corresponding rural group.
From the National Nutrition Monitoring Bureau (4).
SIGNIFICANCE AND POLICY IMPLICATIONS

(including those engaged in strenuous work), stone cutters, porters having to carry heavy loads, and agricultural laborers are apparently the ones who are most stunted and have the lowest body weights; unfortunately, these are precisely the occupation groups who stand in greatest need of a sturdy body build for optimal productivity and output and for earning a reasonable wage from their occupation.

In developed countries, it is most unlikely that one sees such a striking relationship between the occupation a community is engaged in and its physical stature. For instance, it should be surprising if the Canadian lumbermen, Norwegian fishermen, or Swedish farm workers of today were significantly shorter and lighter than people engaged in intellectual activities in those countries. If anything, they may be expected to be far sturdier. It may also be similarly expected that the children of Canadian lumbermen and Swedish farm workers will not be stunted from lack of adequate food and end up as stunted adults only fit for unskilled manual labor with low levels of productivity and earning capacity. Even the lowest jobs in those countries fetch incomes adequate for at least the basic minimal diet.

It may be reasonable to argue that in the developed countries of today (whatever the position might have been in the early part of this century), the occupation an individual takes on is largely (though not entirely) determined by his innate talents, interests, and abilities. In short, it is the genetic endowment, and not the accident of birth, that largely determines the occupation. Those with "more brawn than brain" may be moving into occupations involving strenuous labor. In developing countries, on the other hand, where communities are caught up in the poverty trap, neither the genetic potential for physical growth nor that for intellectual activity is able to find adequate expression, and a considerable part of the human resources of the state run to waste and are forced to drift to jobs calling mostly for unskilled or semiskilled manual labor.

Stunting is the outstanding feature of this poverty trap. In fact, it appears to be the feature that ensures that not this generation only but the next as well does not escape from the poverty trap. Stunted children with impaired learning abilities and schooling end up as stunted adults with low levels of productivity, educational attainment, and resourcefulness, earning low incomes and thus continuing to be enmeshed in the poverty trap and so unable to feed their children adequately. Stunted women beget offspring with low birth weight who thus start their lives with an initial handicap, which compounds the effects of superimposed undernutrition in their infancy and childhood. Thus, stunting and the poverty with which it is invariably associated continue from one generation to another.

THE COST OF STUNTING

In most discussions of the significance of stunting, the enormous "cost" that stunting implies to the society and to the state seems to be hardly appreciated. On the basis of cross-sectional data obtained from communities of growth-retarded children, "synthetic" growth curves have been constructed projecting the illusion that the growth of poverty-stricken children follows a well-ordered, well-regu-
lated, uneventful, smooth trajectory, no doubt running well below the "normal" curve, somewhat akin to what is observed in rats reared in laboratories on deficient diets. In an earlier publication (5), I pointed out the fallacy of this concept. In actual fact, many "apparently adapted" older children and adults are those who had just managed to scrape through the "valley of death" in their early preschool years.

A community in which a considerable part of the population is stunted is usually a community with high infant and child mortality, high levels of morbidity in children, and a high rate of dropouts from schools. This is also a community in which children have lost valuable time for learning skills, mothers have lost a considerable part of their daily wages, and health services are so overburdened with a heavy load of curative work to the point that preventive and promotive health programs are relegated to the background.

Even if, for argument's sake, we accept the position that those who have arrived at adulthood in a stunted state with body weights appropriate to their heights and currently with no obvious sign of nutritional deficiency are "functionally normal" and, therefore, do not need to be bothered about—a position that I do not accept—we cannot ignore the enormous cost to the community that this stunting process had been associated with. There can, therefore, be no equivocation over the position that stunting is undesirable and needs to be prevented irrespective of the question of whether stunting in adulthood is consistent with normal function or not.

Does Stunting per se Really Matter?

It is argued that a stunted subject with a weight appropriate to his height, currently showing no obvious signs of nutritional deficiency, and going about his job with no obvious disability could be considered "normal" or "adapted." We may concede that a number of people showing marginal degrees of stunting do not exhibit obvious functional disability, even as a large number of people with hemoglobin levels of 8 g/dl go about their jobs apparently normally. The term "adaptation" is unfortunately being used, in this connection, loosely as almost equivalent to normality.

The factual position is that large sections of stunted subjects in developing countries, including those who are moderately and severely stunted, have "adapted" themselves to function within the poverty trap. To call this "normal functioning" would be cruel irony. It must also be remembered that (a) many of these stunted (seemingly adapted) subjects might not, in the first place, be doing the jobs they are currently doing if they had access to adequate nutrition, schooling, and health care in their childhood, in which case they would not have been stunted at all, and (b) even in the jobs they are currently engaged in (particularly heavy manual labor), they might have been able to earn more and to escape dire poverty if they had better physical stamina.
It is not necessary to go over the ground so ably covered by Dr. Spurr (this volume), nor need I expand on the work of Satyanarayana and colleagues (6), which showed a direct correlation between productivity and body weight in industrial workers drawn from the poor socioeconomic groups even with respect to operations in which body weight may not be expected to make a difference. It is meaningless and cynical to argue that per kilogram of body weight the output of these workers was not significantly lower; unfortunately, workers are paid their wages on the basis of their individual output and not on the basis of output per kilogram body weight.

Indeed, it is hardly necessary to resort to functional tests in laboratories to show that the productivity of stunted subjects, especially in strenuous manual occupations, is impaired. Observations in the field under real-life conditions provide indubitable evidence. The stunted rickshaw puller from the slums of Calcutta plies his rickshaw just for a few hours of the day until he has made his 50 cents to a dollar, which will just help him and his family to escape starvation for the next day. He has neither the physical stamina nor the will to ply his vehicle for longer hours to earn a larger daily income. One does not need functional laboratory tests to guess that the work that one Canadian lumberman can do in the course of the day will probably require at least three stunted Indian workers. The fact that stunted Indian laborers are still managing to work and survive in a marginal state of poverty is no argument in support of the sweeping conclusion that the stunted state is quite compatible with "normal" function. Stunting can at best help to "preserve" them in a state of poverty and underdevelopment.

In a longitudinal study on undernourished boys in India by Satyanarayana and colleagues (7,8), it was found that the wages earned by adolescent boys employed by farmers in rural areas were significantly related to body weight and height.

Better nourished boys were sought after by the farmers and were assigned the more demanding jobs and were paid higher wages that went with those jobs. . . . Poorly nourished young men could never compete with normally nourished matched counterparts either with respect to work capacity or wages earned. Men and women with better nutritional anthropometry earned 30% to 50% additional incentive money (over and above the uniform basic pay) in factories where an individual incentive system based on work output was in operation. (8)

Maternal Stunting and Low Birth Weights

An important aspect that has largely been ignored in discussions on the public health significance and implications of stunting is in the effect of stunting in the mother on the birth weight of her infant. In India, as in many other developing countries, more than one-third of all infants born alive have a birth weight below 2,500 g. Bhargava and colleagues (9) in India have carried out extensive studies in this area.

The follow-up studies of Bhargava and Kapani had been referred to earlier. In
Tables 4 and 5, the results of their longitudinal studies of three categories of infants have been indicated:

1. Premature infants with low birth weights (weights appropriate for their gestational age, AGA).
2. Full-term infants with birth weights less than 2,500 g (small for gestational age, SGA).

3. Full-term infants with birth weights above 2,500 g.

With respect to both height and weight, infants who start with the initial handicap of low birth weight in spite of their being full term (SGA) apparently never fully recover from their initial handicap, unlike infants of the AGA group. Thus, low birth weights in full-term infants make a lasting contribution to stunting.

It may, however, be argued that since a great majority of SGA infants may be expected to come from poor households, unlike the "normal controls" with birth weights above 2,500 g, their poorer growth performance may be caused by their substandard postnatal nutrition and not necessarily be a reflection of their initial handicap of low birth weight.

In order to be able to answer this question, Bhargava and Kapani's data on the growth performance of SGA infants in both the poor (less than Rs 50/- per person per month) and the well-to-do groups (more than Rs 200/- per person per month) was compared to that of infants in both groups who started with normal birth weights are also shown (Figs. 2 and 3). In each income group, the growth performance of SGA infants was poorer than that of infants with normal birth weights in the same income group. The worst growth performance was seen in infants who belonged to the poor group and who also had the additional handicap of low birth weight to start with.

There is apparently a direct relationship between stunting in the mothers and the occurrence of low birth weights in their offspring (Table 6). According to the recommendation of international agencies, maternal heights below 145 cm may be considered to be indicative of risk of obstetric complications and low birth weight. It can be seen in Table 6 that a distinctly higher proportion of offspring of mothers with heights less than 145 cm were of low birth weight (SGA).

Here is direct evidence that stunting in the mother contributes to stunting in the infant; thus, the effect of stunting is not confined to the present generation alone. If reproduction of a healthy child who can grow normally is an important physiological function, here we have evidence that stunting in the mother does compromise this basic function of immense significance not just to this generation but to the next as well.

POLICY AND PROGRAMS

It is thus clear that stunting, now seen widely among poor communities around the world, cannot be viewed approvingly as an acceptable form of so-called "adaptation," as has been loosely suggested in some quarters. Acceptance of this hypothesis will only help perpetuate the current state of their underdevelopment. It is true that in a number of developing countries including India, a majority of children are stunted to varying degrees. This staggering vastness of the numbers of stunted itself provides the psychological temptation to raise the question
whether we should call such subjects abnormal at all and whether we should not accept stunting in these populations of developing countries as a feature of no consequence for them. Even according to the highly conservative estimate of India’s Planning Commission, more than 40% of India’s population is below the poverty line, and this so-called “poverty line” is based on very rigid criteria that signify only the most extreme degrees of economic deprivation and dire poverty by the standards of most developed countries of the world. Not more than 15% of India’s population can be considered affluent according to the average standards of developed countries of Europe and North America. If, as has been pointed out above, stunting is a concomitant feature of poverty, it is inevitable that it must be as widespread as poverty itself.

The removal of factors in the socioeconomic and health scene that prevent children from attaining their genetic potential for growth and development must
Mean Weight by Per Capita Income
Birth Weight and Age

FIG. 3. Mean weight by per capita income, birth weight, and age. (From S.K. Bhargava and V. Kapani, unpublished data.)

TABLE 6. Maternal height and incidence of low birth weight (LBW) in offspring

<table>
<thead>
<tr>
<th>Maternal height (cm)</th>
<th>Income group</th>
<th>Incidence of LBW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 145 cm</td>
<td>Less than Rs 50/- per person per month</td>
<td>35.5%</td>
</tr>
<tr>
<td>More than 145 cm</td>
<td>Less than Rs 50/- per person per month</td>
<td>24.2%</td>
</tr>
<tr>
<td>More than 145 cm</td>
<td>More than Rs 200/- per person per month</td>
<td>15.0%</td>
</tr>
</tbody>
</table>

From S.K. Bhargava and V. Kapani (unpublished observations).
clearly be the central objective of any national health policy devoted to the improvement of the quality of a country’s human resources.

**Antipoverty Programs**

Such a public health policy will imply not just narrow vertical programs confined to the health sector alone but broad-based programs of social and economic uplift that address the social and economic determinants of poverty and undernutrition. In the formulation and implementation of such integrated programs, health scientists and nutrition scientists must play a crucial role in order to ensure that health and nutrition aspects receive adequate focus and that the appropriate target groups are addressed.

Among populations of most developing countries, we may expect an almost continuous socioeconomic gradient between the affluent groups at the top and the abjectly poor at the bottom. Poverty will be found to deepen progressively and stunting to increase in severity as we descend the socioeconomic scale. Because of their severe resource constraints, it is most unlikely that developing countries will be able to eradicate their massive problem of poverty and its accompaniments (including stunting) within the next decade. Hard realities will demand that they settle for gradual elimination of these problems in a phased manner. For this purpose, they will have to set for themselves, from time to time, during various stages of their development, targets that fall far short of the eventual goal of total eradication of these problems. This is perfectly understandable. The level of poverty and the level of stunting that are to be chosen as a cut-off point for identifying target groups for action programs at a given stage of development have to be decided by each country depending on its resources, its perception of priorities, and its value systems. It will be wrong to attempt to invest such practical arbitrary decisions with scientific validity. In particular, it will be unscientific to “adjust” standards of normality to suit the actual scale of problems within the country. Standards are expected to determine the magnitude of a problem; it would be perverse to let the magnitude of a problem determine the standard.

Long-range integrated antipoverty programs will naturally take time to show results. In the immediate short run, intensive programs in the health and social welfare sectors will be necessary. Where resources are limited, it will be prudent to direct such resources to the early phases of growth and development, namely, the intrauterine phase (pregnancy), infancy, and early childhood. It could be inferred from the studies of Satyanarayana et al. (2) that if stunting can be averted until the fifth year, normal growth thereafter may be possible even at current levels of socioeconomic development.

**Maternal Nutrition**

Through intensive antenatal care, nutrition education of pregnant women directed to improving their diets during the second and third trimesters of pregnancy,
and correction of anemia, it may be possible to bring about a significant reduction in the incidence of low birth weights. This program must be given high priority. The great majority of pregnant women in many developing countries currently receive no health care.

**Breast Feeding**

For most developing countries, the remarkable ability of even their poorest women to successfully breast feed their infants for prolonged periods has been the most valuable national asset in an otherwise bleak child nutrition scene. This salutary practice, which now faces the threat of progressive erosion, must be preserved and protected.

It has been suggested that since in some studies growth faltering in breast-fed infants is detectable even by the end of the second month after delivery, supplements to breast milk may have to be introduced even by that period. In the first place, this growth faltering by the second month is apparently by no means a universal phenomenon. Cowan (10) has actually demonstrated that infants can be reared successfully through exclusive breast feeding for 6 months. Growth faltering in early infancy in breast-fed infants, where it is seen, may also well be related to faulty breast-feeding practices (offering water to the infant in between feeds, not putting the infant to the breast as often as may be necessary, etc.) and not to inadequacy in breast milk as such. What may be needed, then, is education with respect to improving breast-feeding practices and not early supplementation.

Even if there is some faltering of growth by the end of the second month, it will be prudent in the case of mothers belonging to the poorest communities living in highly unsanitary surroundings to advise them to continue with exclusive breast feeding of their infants until at least the end of the fourth month if not the sixth month (11). This is because in such situations, the marginal nutritional advantage of earlier supplementation (if any) will be more than offset by the definite disadvantage of earlier supervision of diarrheal episodes. In fact, a study carried out by the Nutrition Foundation of India among poor communities has shown that infants who had received supplements before the fourth month arrived at their ninth month with a poorer anthropometric status than those who had been exclusively breast fed for 4 to 6 months (12).

**Supplements**

Supplements to breast milk to be introduced after at least 4 months of exclusive breast feeding must be based on inexpensive, locally available foods within the economic reach of the poor. There is a great need for educating mothers and children (and health workers) as to how such locally available foods can best be successfully used for infant feeding. Efforts in this area are at present woefully inadequate, and much of the undernutrition and stunting in children of developing countries may be traced to poor education and training in this regard.
Misuse of Commercial Baby Foods

Among poor communities living in highly unhygienic conditions, the use of commercial baby foods as supplements must be actively discouraged. The poor have neither the means to buy these foods in adequate amounts for feeding their infants nor the facilities to feed them hygienically. Unfortunately, these foods are currently being widely misused much to the detriment of infant nutrition in many developing countries. A study by the Nutrition Foundation of India (13) showed that in the urban slums and periurban rural areas of Bombay, Calcutta, and Madras, 22% to 30% of mothers belonging to the poorest income group were currently misusing these foods with results that could only be described as disastrous.

Outreach of Health Care

Infections (respiratory and gastrointestinal) account for much of the undernutrition (and stunting) in children in poor communities. The present poor outreach of health services in many developing countries precludes efforts at effective prevention and treatment of such infections. Perhaps even more important than the extension of government health services to villages is the need to develop programs within the villages to improve self-reliance and health/nutrition awareness of the community (especially the women) and to involve the community in its own health-care operations. It is gratifying that many developing countries have now launched programs for raising women’s clubs and health volunteer forces in villages so that health care becomes a people’s (and not the government’s) movement. In the long run, it is through such means that real social transformation can come about in the villages and the basic factors that underlie their present poverty will be addressed.

Monitoring and Surveillance

Any meaningful health policy must rest on a proper information system and data base. Currently, few developing countries have adequate facilities for nutrition monitoring and surveillance. With few exceptions, such data on the prevalence of stunting in children as are available are based on ad hoc surveys; and since such surveys have not often been based on standardized methodology and sampling design, results obtained at different times and in different locations are often not comparable; it has also not been possible, under the circumstances, to evaluate the impact of action programs. The setting up of national systems for continuous nutrition monitoring should not be considered a luxury that developing countries can ill afford; indeed, it would help them to utilize their meager resources to maximal advantage and enable them to inject timely midcourse corrections in their action programs.
Research

There are still major gaps in our knowledge of the pathogenesis and significance of growth retardation. We do not know, for example, if the environmental constraints on growth in childhood that eventually lead to stunting and those that lead to wasting are necessarily always identical, or whether in certain situations, some factors in the environment (deficiencies of specific nutrients such as zinc) may preferentially contribute to stunting as opposed to wasting. We still do not know whether, given the same order of stunting, previous growth experience (the growth route the child took to arrive at the present stunted state) makes a difference with respect to functional performance. Clearly, answers to these and other questions can only come from extensive and careful studies conducted in developing countries. The need for continuing research in this area must not, therefore, be underestimated.

REFERENCES


DISCUSSION

Dr. Waterlow: Dr. Gopalan, you used the phrase, “the problem of undernutrition and stunting.” Is stunting a problem? I get the impression, for example, from Dr. Van Lerber-
Dr. Van Lerberghe: That is exactly what I wanted to say. I think it is dangerous to talk about the "problem of stunting." Is "stunting" a problem, or is "poverty" a problem for which stunting could be an indicator? If we go on using the term "stunting problem," we might be formulating "stunting control programs," which could create the illusion that we can solve the "stunting problem." But why should we solve a so-called "stunting problem" as such and let the problem of poverty remain? Such "stunting control programs" would divert attention from looking at the real solutions, which conceptually are much more difficult to develop and will certainly go far beyond what is considered to be the territory of the nutritionist.

Dr. Gopalan: I totally agree with you. I am not talking about "stunting control," and I do not look at "stunting" as an isolated problem. I look at it in its full context, in a real-life situation, as a manifestation of poverty and undernutrition, as an index. I do not think that there is any conflict at all. I am talking of eradication of poverty and undernutrition.

Dr. Martorell: This is an important point. I think all of us agree that growth retardation is an indicator, and I liked Dr. Gopalan's emphasis at the end that we should try to pinpoint when the process of stunting really takes place. This is important because it allows us to identify the real problems. I think it is clear that stunting surfaces during the preschool period, particularly during the first 3 years. We know that stunting is associated with problems that arise during the weaning process. It is precisely in the area of child feeding and health practices that we need to work, and all the evidence we have today indicates that height retardation is our best indicator of how successful our programs, whatever specific policies we implement, will be. We can also use stunting as an indicator of the quality of life, as an indicator of social inequalities; we can map countries and talk about areas of high and low prevalence and infer that there are social inequalities that have to be corrected. I totally agree that stunting is best viewed as an indicator. From the policy point of view, I think that it is the wrong approach to emphasize the implications of stunting; let's rather talk about the causes and use stunting as an indicator of those causes.

Dr. Gopalan: I agree that stunting is a good indicator, but there is more to it than that. Stunting by itself, as pointed out by Dr. Spurr, has its deleterious repercussions. It helps to perpetuate poverty. For example, to what extent is low birth weight related to stunting in women? To what extent does stunting reduce productivity? Does stunting perpetuate poverty over the generations? Stunting is not just an indicator but an undesirable feature that has got to be corrected. But I am not talking of stunting in isolation; it can only be corrected as part of an overall attack on the problem of poverty and undernutrition. When I spoke about the implications of stunting, I did not mean that these flow out of stunting per se; I said: "the community in which you see a lot of stunting is a community that is afflicted by a number of other things that go with stunting." That is what I meant by "the cost of stunting and its implications." It is not a relationship of cause and effect.

Dr. Martorell: I agree that there are some areas we talked about, infant mortality, for instance, where you can argue in that way. But it is much more difficult in other areas, productivity, for example. I think we stand a better chance of improving the situation if we emphasize that stunting is an indicator of social inequalities.

Dr. Kraisid: About 6 years ago, the National Economic and Social Development Board sponsored a study in Thailand on the use of malnutrition in terms of wasting and stunting as a social indicator. We have a so-called poverty eradication program, the concept of which was just as you mentioned. I think it is important to emphasize, for all countries who initiate similar programs, that they need to be supported from the top; many processes
are involved, and the approach needs to be a holistic one.

Dr. Golden: I would like to ask how you reconcile the data presented earlier by Dr. Keller, in which no change in the distribution of stunting was seen in Jordan from 1974 until 1985 and yet, during that time, they had all sorts of public health programs, such as improving the literacy of the mothers, introducing oral rehydration, etc. No change at all was observed in the profile of stunting, but quite marked changes in the profile of wasting. We have contradictory data that we have to reconcile, and I would like your comments.

Dr. Gopalan: As I mentioned, I don't think that intensive health care alone can solve the problem of stunting. You can have a very efficient health service but a great deal of poverty, and if you haven't addressed the question of poverty, you are not going to solve the problem of stunting. This is what I mean by integrated development: income generation programs, which go hand in hand with health care, education of women, etc. There must be a comprehensive attack on the problem of poverty; otherwise, you may reduce deaths and that is all.

Dr. Waterlow: In other words, you are assuming that in Jordan there was no change in the degree of poverty in the refugee camps.

Dr. Gopalan: I don't know the Jordan situation, but I wouldn't be surprised if the emphasis were all on intensive health care and not on overall economic improvement.

Dr. Van Lerberghe: We still seem to get stuck with stunting either as a problem or as an indicator. Stunting is not a problem, but it is also certainly not the only indicator. I am not surprised by data like those from Jordan, where you do not find significant associations between the prevalence of stunting and the implementation of public health programs. This indicator does not work everywhere; it is one of the indicators one can use in order to obtain effective decision making, but it is not the only one.

Dr. Valyasevi: I agree almost totally with what Dr. Gopalan has said. It is the overall development that is important. Our government in Thailand is heading this way. But children are born every day, and we cannot wait until the total socioeconomic situation has improved, because this may take 10 to 20 years. I thus have three practical questions. If resources are limited:

1. What are the at-risk groups? Dr. Gopalan mentioned the fetus in utero and young children up to 5 years of age; this seems acceptable to me.
2. Which indicators should be used? These need to be reasonably sensitive, specific, and applicable in the existing social structure. At present, the public health authority in Thailand uses weight by age, but it has been criticized for that; what else should be recommended?
3. When should intervention programs start and stop? Here, of course, since resources are limited, we need to think in terms of cost effectiveness.

Dr. Gopalan: Questions as to what the mix in the intervention package should be, when it should start, and within which target groups are matters for local governments to decide. In a country like India, this cannot be legislated from New Delhi. There is a need for studying the problems locally. I am not able to say what has to be done in all developing countries. An important question, when we are talking of intervention, is "what is the intervention we are talking about?" If we are referring to education, for example, educating mothers on how to feed their children, then that should go on continuously as part of the health care program; in fact, it should start even before a girl becomes a mother. I would put great emphasis on that. Supplementation, giving nutrient supplements, is very expensive—it involves a lot of investment—and there, of course, we run into political pressures.
Dr. Aponso: Dr. Gopalan, you have given the right perspective of the situation in Third World countries. You mentioned seven different factors that converge to a common pathway and produce chronic undernutrition, stunting, and deterioration of child health in our countries. You called the common pathway the "poverty syndrome." This is true, but I know you will agree that it is not merely a question of poverty, but it is a triad of (a) poverty; (b) ignorance; and (c) customs, beliefs, and tradition.

Most of our villages are bound by some of these customs, beliefs, and traditions: some are very good; some are harmful. Our resources are limited; we need time and money. Some resources are available in our countries. You mentioned nutrition education; this is excellent, but we should make use not only of health professionals but of social scientists as well. With the resources we have, we can increase our productivity if we accept the use of the community itself and if we accept community participation. Our community is today made up of people who are used to doing things as they are told. We should educate them to do things not merely because they are asked to do so but as an expression of their own self-will; in other words, as active acceptors.

Dr. Gopalan: The extensive use of health volunteers, as in Sri Lanka and Indonesia, is a very good thing. I wish it could happen on a large scale in India also.

Dr. Mukerjee: In developing countries, the poverty syndrome—poor food, housing, education, and employment opportunity, frequent illness, and inadequate health care—represents a formidable problem. To meet the challenge we should make a sincere effort in prevention: early screening of cases, improvement of weaning practices, education in general as well as health and nutrition education, application of knowledge in practice, and teaching and training of parents and paramedical and medical personnel in health and nutrition of children.

Dr. Nabarro: Most of the interventions that have been suggested are likely to have only a limited impact. The association between stunting and socioeconomic deprivation implies that reducing the incidence of stunting requires broad development strategies and not just public health interventions. The implementation of poverty-focused development programs is both difficult and costly. I would predict that the average cost of preventing Nepalese children from becoming stunted would be at least U.S.$100 per child per year; it would certainly be much more than the present figure for health care expenditure (U.S.$1 to 2 per year).

Dr. Gopalan: I am not discouraged by prophecies of gloom. I challenge this calculation of over U.S.$100 per child per year. It may be correct under the American scale, but not under the Nepalese scale.

Dr. Tomkins: There is an increasing tendency for people to perceive nutrition and stunting as things that could be changed by vertical programs. I wonder what advice you would give for the next 10 to 20 years as to how we are going to avoid being obsessed with vertical programs within the health sector as opposed to the more integrated approaches that you have suggested.

Dr. Gopalan: Except for interventions for eliminating conditions such as goiter or to a certain extent keratomalacia, I don’t think that vertical programs are the answer. Primary health care as it is now being conceived, which is an integrated effort, is the way to go about it. That is what I am pushing for.

Dr. Davies: This meeting has been very helpful, but it does share one thing in common with many others of its kind in involving those who are already convinced. Since strategies that are supposed to improve matters are so much in the hands of politicians and social scientists, I sometimes feel that to have a political presence in these meetings would be
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helpful, so that at least we could have the opportunity of putting questions and points of view to people who are primarily responsible for making and implementing decisions. I would value comments from others on whether or not these symposia would be more meaningful and strategies for improvement more relevant had we also a political presence?

Dr. Gopalan: I agree.

Dr. Waterlow: As a physiologist, I am disappointed that nobody seems to be interested in the biology of stunting, in what actually causes it eventually. We know that this is a preventable phenomenon, so there must be a metabolic nutritional biological cause. I don’t think we know these causal factors. Can we do anything useful without really knowing the causal factors? I am not proposing an antistunting program, but it somehow seems wrong, and I rather agree with Professor Davies, to turn our back on ignorance and simply talk to each other as if we knew all the answers.

Dr. Tanner: Although, intellectually, I agree with Professor Waterlow, I think that that train of thought is extremely dangerous, because I think we may have the answer to his question in the not too distant future (in terms of the physiology of IGF I). We might then be tempted to do a kind of phenylketonuria program, what I believe you call a vertical intervention program, and then what will happen? You will still have massive poverty, but the people will not be short. So what have you achieved? I am thus absolutely at one with all the last few speakers. Height is only important as a proxy for social deprivation (as between groups).

Dr. Guesry: Nestlé Nutrition Workshops are supposed to be scientific workshops. We are not here to make decisions in the name of any government. I was also disappointed that the biological aspect has not been touched on.

Dr. Waterlow: To repeat what Dr. Golden said, we can’t apply knowledge we don’t have. Coming back to the political dimension, surely you would agree, Dr. Gopalan, that it has been extremely useful to know, if we are convinced by Dr. Colombo, that failure of physical growth has no direct relationship to failure of mental growth. The data of Dr. Spurr are very important. I am not suggesting, when looking at the biological implications, that, as a result, we should try to prevent stunting. I am trying to put it in its proper perspective, that’s all.

Dr. Valysevi: I agree with Dr. Waterlow; we all like to understand what is happening. However, in Japan, for example, in the past 30 years, the final length has remarkably increased; in Thailand too, although we still don’t know the causes of stunting, the height of school children has now increased by at least 2 inches compared to 20 years ago. Therefore, I think that both the physiological and political aspects of the problem need to be addressed together.

Dr. Golden: Undoubtedly there must be a biological reason, quite apart from poverty. If we look at many of the populations in Africa, we find populations living quite close to each other, in one of which the staple is sorghum and in the other plantain; both populations have equal body weights, but the cereal-eating population is much taller and thinner than the plantain-eating population, which is short and fat. In West Africa, where we have yam- and grain-eating people, we find exactly the same thing, although if we look at the level of poverty in these villages, we really find very little difference in terms of disposable income. There must be biological reasons that we have to tackle and not just put them all down to poverty.

Dr. Waterlow: I would like to suggest that two points of practical application have come out of the “biological” part of our discussion. One is that the data have emphasized, more than we knew before, that this growth failure starts very early in life and that it therefore
has some application to the question of "where should we concentrate our resources?" The precise determination will depend on local conditions, but this would bring us to concentrate our efforts on the first year of life rather than on the fifth.

The second important point that has emerged, again at the technical level, is the great sensitivity of velocity measurements as opposed to distance measurements and, as Professor Tanner and Dr. van Lerberghe have said, the value these may have for decision making. Perhaps we could agree that we don’t have two completely distinct points of view on this?

Dr. Nabarro: Is it really appropriate to propose that interventions be concentrated on the first year of life just because this is the period when linear growth retardation is more prominent? Do we know enough about the functional consequences of this growth retardation to be able to make such prescriptions? I would suggest that we do not yet have sufficient information at our disposal to make such recommendations.

Dr. Gopalan: I think that we should take the whole period of intrauterine development, infancy, and the preschool period as a continuum if only because some of the effects that you see in infancy could still be corrected in the preschool period. I would rather suggest that we treat this as one unit.

Dr. Waterlow: I do not agree with Dr. Nabarro, and I do not much care for the so-called "holistic," antianalytical point of view, which seems to me just a reiteration of received and obvious doctrine. However, disagreement among scientists is perhaps a sign that the subject is in a healthy state. It would be interesting to repeat this symposium in 5 years' time to see whether the disagreements persist in the light of whatever new information we may have succeeded in getting by then.