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# **HUMAN DEVELOPMENT AND PUBLIC HEALTH**

**Report of a WHO Scientific Group**

**WORLD HEALTH ORGANIZATION**

**GENEVA**

1972

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ON HUMAN DEVELOPMENT AND PUBLIC HEALTH**

*Geneva, 27 April — 3 May 1971*

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# HUMAN DEVELOPMENT AND PUBLIC HEALTH

## Report of a WHO Scientific Group

*Healthy development of the child is of basic importance; the ability to live harmoniously in a changing total environment is essential to such development.*

— Preamble to the Constitution of the World Health Organization.

A WHO Scientific Group met in Geneva from 27 April to 3 May 1971 to discuss human development and public health. The meeting was opened by Dr H. Mahler, Assistant Director-General, who welcomed the participants on behalf of the Director-General.

### 1. INTRODUCTION

Human development embraces every aspect of the maturation process, including its physical, biological, psychological, and social aspects. To bring about healthy development and to realize human potential, it is necessary to draw upon many areas of scientific knowledge and many components of the health service. Such areas as nutrition, communicable diseases, human reproduction, mental health, handicaps, and many others, together with the corresponding services, are related to human development. Many of these services have their greatest impact on development when they are employed early in the individual's life.

The principal requirement for healthy growth and development is good nutrition. Closely related to this is the requirement for measures to prevent infections; to be effective, such measures must be taken early in life and pursued in later years. Human development is favoured at the outset by the careful management of pregnancy and by the practice of family planning. For those problems of mental and social health that have their origins in childhood, early preventive and educational measures help to forestall or obviate problems in adulthood. Certainly the early detection and treatment of handicapping conditions will improve the long-term prospects for almost all children with handicaps. The precise role that factors in childhood play in the degenerative diseases of later life remains to be fully explored, but there are already indications that some factors are important.

The promotion of healthy development cannot be achieved by measures that derive from any single health discipline, nor can health measures

be considered independently of the broader educational, social, economic, and administrative factors that are crucial to human development. Health measures aimed at promoting biological development—especially the control of infection, the improvement of nutrition, the management of pregnancy, and family planning—can improve the health of people; higher levels of health in turn contribute to socio-economic development.

Until recently, one of the main goals of maternal and child health (MCH) services was the reduction of infant and child mortality (see accompanying table). Governments and WHO gave a high priority to this task and achievements have been substantial. In many places, where mortality rates during early life are still high, the prevention of perinatal, infant, and child deaths remains a principal aim of many MCH activities. With the reduction of mortality rates, however, the health of the survivors becomes a growing concern. It was at one time assumed that if a child survives he must be well, but studies of the health of survivors now show that even when mortality rates are falling, many health problems remain unresolved. In fact, there is evidence that many children do not attain their full developmental potential because of adverse environmental factors before and after birth.

The main objective of the Scientific Group was to provide a synthesis of the priority needs for human development and of the principal opportunities for health services to bring about healthy development. Inevitably, the Group's deliberations could not be comprehensive, and many problems that deserve detailed consideration, such as mental and psychological development, were touched upon only briefly.

## 2. THE PHASES AND TRANSITIONAL EVENTS IN HUMAN DEVELOPMENT

There are several ways to classify the phases and critical transitional events of human development.<sup>1</sup> The choice of classification usually depends upon the objective, as in the selection of age groups for statistical purposes. In a broad consideration of human development, no single classification suffices since the timing of each transitional event and the duration of each intervening phase are calculated differently in each of the relevant disciplines. The diagram reproduced on page 8 emphasizes the biological and psychological aspects of the developmental sequence and shows that human development is continuous and cyclical.

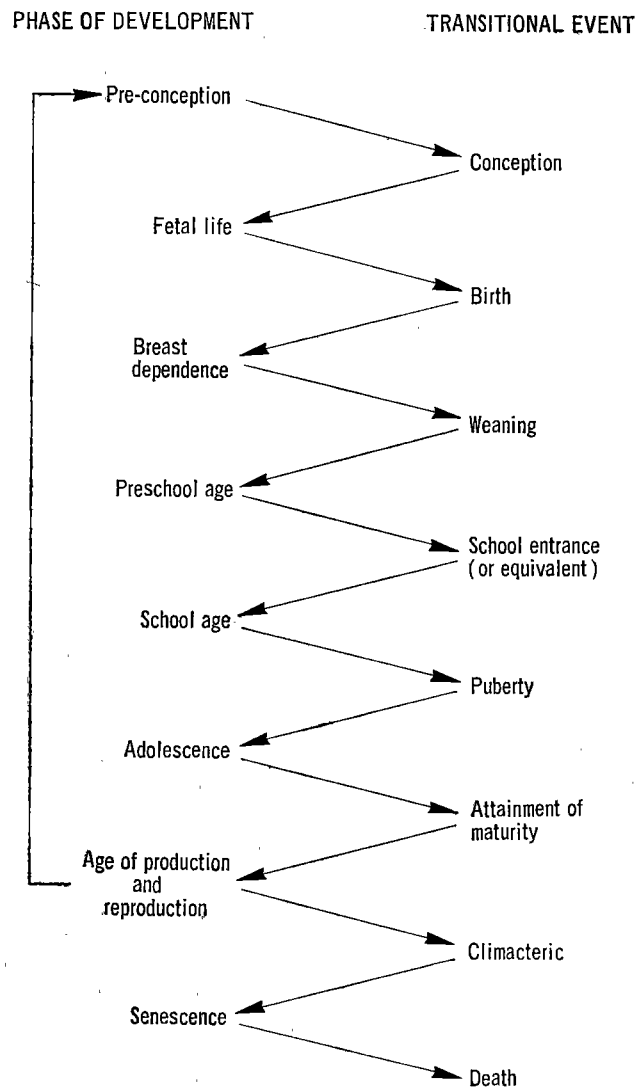
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<sup>1</sup> Tanner, J. M. & Inhelder, B., ed. (1956-1960) *Discussions on child development; a consideration of the biological, psychological, and cultural approaches to the understanding of human development and behaviour: Proceedings of the WHO Study Group on the Psychobiological Development of the Child, Geneva, 1953-1956*, London, Tavistock Publications. See especially vol. 4, p. 116 ff.

## VARIOUS MORTALITY RATES AND BIRTH RATE IN SELECTED COUNTRIES, 1968

Country	Perinatal mortality per 1 000 live births			Infant mortality (deaths under 1 year) per 1 000 live births	Deaths from 1-4 years per 1 000 live births	Deaths (all ages) per 1 000 population	Live births per 1 000 population	Population (thou- sands)
	Total	Late fetal deaths	Deaths under 7 days					
<b>Africa</b>								
Egypt .....	15.5	7.5	8.0	131.3	35.0	16.1	38.1	31 693
Mauritius .....	67.6	45.5	22.2	69.1	7.6	9.1	31.0	787
<b>Americas</b>								
Canada .....	24.0	10.8	13.2	20.8	0.9	7.4	17.5	20 772
Dominican Republic .....	46.7	31.5	15.2	73.3	7.1	6.9	33.9	4 029
Ecuador .....	24.7	11.7	13.0	86.1	16.0	10.8	39.6	5 695
El Salvador .....	20.8	9.3	11.5	59.2	10.0	9.2	43.2	3 266
Mexico .....	31.6	16.9	14.7	64.2	10.6	9.6	43.5	47 267
USA .....	27.1	12.5	14.6	21.8	0.9	9.7	17.5	199 861
<b>Asia</b>								
Ceylon .....	36.4	14.0	22.4	50.3	5.9	7.9	32.0	11 992
Israel, total population .....	23.5	12.1	11.5	24.8	1.1	6.8	25.5	2 745
Jewish population .....	23.1	11.5	11.6	20.0	0.7	6.9	22.8	2 408
Japan .....	24.5	17.2	7.3	15.3	1.1	6.8	18.5	101 080
Malaysia (West) .....	38.3	22.7	15.6	42.2	5.5	7.6	35.2	8 789
Singapore .....	23.5	10.6	12.8	23.4	1.8	5.5	23.8	1 988
<b>Europe</b>								
Austria .....	27.2	10.9	16.4	25.5	1.0	13.1	17.2	7 349
Bulgaria .....	19.2	9.9	9.3	28.3	1.3	8.6	16.9	8 370
Czechoslovakia .....	20.7	7.5	13.2	22.2	1.0	10.7	14.9	14 362
Denmark .....	19.1	8.5	10.6	16.4	0.8	9.7	15.3	4 865
Federal Republic of Germany (with West Berlin) .....	26.7	11.0	15.7	22.8	1.0	12.2	16.1	60 165
West Berlin .....	27.4	9.7	17.7	24.6	0.7	19.4	10.9	2 151
Finland .....	19.9	9.9	10.0	14.4	0.8	9.6	15.7	4 689
France .....	26.1	14.3	11.8	20.4	0.8	11.1	16.7	9 914
Greece .....	29.0	14.0	15.0	34.4	1.1	8.3	18.2	8 803
Hungary .....	34.0	10.0	24.0	35.8	1.1	11.2	15.1	10 255
Iceland .....	23.7	12.1	11.6	14.0	0.9	6.9	21.0	201
Ireland .....	27.0	15.3	11.7	21.0	0.8	11.4	21.0	2 910
Italy .....	34.0	17.5	16.5	32.7	1.1	10.1	17.6	52 750
Luxembourg .....	24.7	13.8	10.8	17.0	0.8	12.2	14.0	336
Malta .....	31.9	14.0	17.9	27.2	0.9	9.0	16.1	319
Netherlands .....	20.4	11.4	9.0	13.6	0.9	8.3	18.6	12 725
Norway .....	19.9	11.2	8.7	13.7	0.9	9.9	17.6	3 819
Poland .....	24.8	11.0	13.8	33.4	1.1	7.6	16.2	32 305
Portugal .....	39.6	22.6	17.0	61.1	3.7	10.0	20.5	9 465
Romania .....	31.5	16.4	15.1	59.5	2.4	9.6	26.7	19 721
Sweden .....	18.4	9.1	9.3	13.0	0.5	10.4	14.3	7 918
Switzerland .....	21.1	10.2	11.0	16.1	1.0	9.3	17.1	6 147
United Kingdom :								
England and Wales .....	25.1	14.5	10.6	18.3	0.8	11.9	16.9	48 593
Northern Ireland .....	29.9	16.3	13.6	24.0	0.7	10.6	22.1	1 502
Scotland .....	26.3	15.0	11.2	20.8	0.9	12.2	18.3	5 188
Yugoslavia .....	26.3	9.9	16.4	58.6	2.6	8.7	19.0	20 154
<b>Oceania</b>								
Fiji .....	33.9	27.2	6.7	24.8	3.4	5.2	30.2	505
New Zealand, total population .....	22.3	12.1	10.2	18.7	1.1	8.9	22.6	2 751
Maoris .....	23.2	14.0	9.1	27.4	1.9	6.1	38.0	216
Pacific Islands .....	43.0	23.5	19.5	32.6	4.0	5.8	36.4	96

## THE HUMAN LIFE CYCLE



WHO 10642

Rather than deal with the various phases of development separately, the Group decided to consider the various factors that affect human development in all its aspects. This approach is simple and appropriate from the viewpoint of public health action. There are a great number of factors that influence human development favourably or unfavourably, and the Group was not able to discuss all of them in detail.

Since the most general factor, the environment, was repeatedly mentioned in connexion with each other factor, it is considered first.

### 3. THE ENVIRONMENT

The environment — natural or man-made, physical, chemical, biological, and social — has a significant effect, whether direct or indirect, on human development. While scientific knowledge of the environment is growing, there is still much to be learned about its immediate and long-term effects on human development. Furthermore, current knowledge is not always applied, or not used in the best way to improve the quality of human life. There still exist numerous environmental hazards that could be at least partially controlled.

As is illustrated opposite, the child experiences a series of developmental phases and transitional events, each of which represents a different relationship to the environment. In the fetal phase, when the uterus forms the immediate environment, dependence on the mother is total. After birth, the infant remains in close physical contact with the mother. If breast-fed, as in most developing countries, the infant is carried by the mother during much of the day and lives in an environment that preserves excellent temperature control, provides high-quality nutrition, and confers protection from most infection. In industrialized countries where standards of personal and environmental hygiene are satisfactory, the substitution of artificial feeding for breastfeeding is certainly compatible with very low rates of infant mortality. Whether such substitution is equally compatible with completely satisfactory emotional and metabolic development remains to be seen: some workers suggest that the dietary composition of artificial feeds may be partly responsible for degenerative, circulatory, and other diseases in later life, and that separation from the mother — especially when enforced, as with the isolation of low-birth-weight infants in sterile cubicles — may predispose towards subsequent emotional disturbances.

When the child can no longer be fed on a diet consisting entirely or mainly of breast milk, and when he becomes too heavy to be carried conveniently and too active to be kept at his mother's side or in some other relatively safe, special environment, he is exposed for the first time to the normal adult environment of his family and community. In some cultures,

weaning is abrupt and also marks a change of attitude towards the child; if the child is brought up to behave passively, his behaviour pattern will sooner or later have to be reversed, and this reversal may be very harsh.

If the environment of the community is grossly unhygienic, the child is exposed to a host of infectious agents that he is physically unable to withstand. Such exposure, with modifications, continues throughout life, but children who survive the initial encounter with infection and infestation acquire their own defences of active immunity. For millions of people in poor communities, the hygiene of the physical environment remains extremely unsatisfactory and dangerous. The absence of adequate facilities for the disposal of excreta accounts for the high prevalence of bacterial, viral, protozoal, and helminthic diseases. The lack of a plentiful, convenient, and safe water supply complicates efforts to maintain a sanitary environment, to keep food clean, and to practise good personal hygiene. Overcrowding and lack of ventilation predispose children to a host of airborne infections. Despite notable advances in control, insect vectors continue to be major sources of infection in many parts of the world.

It is worth recalling that modern health programmes began in the nineteenth century with environmental hygiene, which was used to combat many waterborne, airborne, and other kinds of infection at source at a time when there was interminable and often fruitless speculation about the nature of epidemic diseases and their relation to sanitary, meteorological, and geophysical conditions. In the twentieth century, science and technology have solved many riddles regarding the origin of disease, but have introduced a host of new problems. Release from the necessity for physical effort has committed man to a sedentary way of life; commercial production of food has exposed him to refined foods and food additives; industrial expansion has subjected him to chemical and other pollutants; and the mass production of pharmaceuticals has exposed him to the use of drugs, sometimes for non-medical purposes. The social aspects of the human environment are dealt with at greater length in the next section.

#### 4. ECONOMIC AND SOCIAL FACTORS

Human growth and development are influenced at every stage by the customs and beliefs of the community. Where rapid technological changes are occurring, adjustments of social organization and of educational patterns are required. The type and degree of success of these adjustments affect the maturing individual profoundly. Efforts to improve health will not be successful unless they take into account the social and cultural characteristics of the communities in which they are made. Since economic resources, in the broadest sense, constitute our material and physical

environment and are an underlying determinant of many cultural, social, and behavioural patterns, they are dealt with in this section. A few significant examples of the social aspects of the human environment are discussed below.

#### **4.1 Economic resources**

The abolition of poverty remains a prerequisite for healthy development, even though affluence, if misdirected, may bring new problems in its wake. The importance to health of the economic factor extends well beyond the ability to pay for health services. Family income influences the kind and amount of food eaten, the quality of housing, the type and duration of education — indeed the whole range of social and economic factors bearing on human development. The family's economic resources may be especially strained in the early years of marriage when the children are young and their needs are greatest.

Economic resources also influence a government's ability to provide the services necessary for optimum development. For example, many governments, especially in the developing areas, cannot afford health services or do not give them sufficiently high priority.

#### **4.2 Education**

If man is to maintain or, if possible, improve his level of development in a changing world, he must be helped to adapt to his cultural milieu and to his biological and physical environment. Education, which engenders change and fosters adaptation, helps man make this adjustment and contributes significantly to his level of development. At present, one of the major problems in all countries is the education of children to live in a world that changes rapidly, constantly, and unpredictably, rather than in a social organization that is stable. The Group limited its discussion to the health aspects of education.

A society that regularly monitors patterns of physical, mental, and social development, and takes steps to prevent deterioration and encourage progress, is more likely to promote human development than one that reacts only when changes become too obvious and too radical to be ignored. Formal education services bear a special responsibility for the forecasting, recognition, and understanding of changes, for the identification of means to cope with them, and for the teaching of the relevant ideas and techniques. This type of education should be an integral part of public health and other services; it is especially needed in areas that lack formal education services, where the dissemination of ideas and knowledge to the general public will depend on the public health worker.

### 4.3 Cultural factors

Cultural factors have an enormous impact on health and human development. Attitudes towards life and death determine the value placed on health by a community, and may thereby decide the demand for health services and the use made of them. As Margaret Mead has said, "If all children are expected to live and every effort is made to keep the puny and defective alive, this changes the position of all individuals in a given society."<sup>1</sup> The status of women affects pregnancy, parturition, and lactation: whether women are expected to do heavy physical work even during the perinatal period, whether their diet is restricted by food taboos or by the custom of serving women last, or whether breastfeeding is customary, will establish the perinatal environment of the child. The status of children, preferences for boys or girls, and child-rearing practices all influence the course of human development.

Cultural beliefs should be respected, studied, and understood by all workers in a community. Some beliefs are harmless to health and development and can be employed to advantage; others are harmful, and long-term educational programmes are necessary to effect change. These programmes should be planned and implemented with the participation of the people to whom they are directed. Change implies, of course, the substitution of one thing for another, and every effort should be made to ensure that the advice given is scientifically sound as well as culturally acceptable.

### 4.4 Social and behavioural factors

In the context of human development, social and behavioural factors are best considered in relation to social institutions and phases of development. The Group emphasized the particular importance to health of these factors in the family, and during youth and middle age.

#### 4.4.1 *The family*

There is of course wide variation in the structure and functions of families, but in most societies the care and early training of dependent children remains primarily the responsibility of the family. This suggests a family responsibility for planning pregnancies so that no children are born unwanted or grow up in situations where they cannot receive adequate care.

The relationship between mother and fetus is immutable in all societies. After birth, dependence continues in a natural way when the infant is

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<sup>1</sup> Mead, M. (1962) *A cultural anthropologist's approach to maternal deprivation*. In: *Deprivation of maternal care*, Geneva, World Health Organization (*Publ. Hlth Pap.*, No. 14), p. 55.

breast-fed. Not only physical care, but also the emotional aspects of mothering, are of importance during infancy. In fact, the emotional, sensory, motorial, and verbal stimulation of the infant and young child are now considered to be significant for physical development as well as for psychological development. Lack of attention and care may have a detrimental effect on the health and nutrition of the child, and inadequate mothering may affect his intellectual development as well as his personality. Furthermore, it is suggested that the infant is more than "a bundle of needs and responses that passively waits for external stimulation"<sup>1</sup> and that such factors as the child's physical health are important in the interaction between parent and child.

The negative effect on child development of maternal separation and deprivation is of direct relevance to the creation of standards for the institutional treatment of children in orphanages, hospitals, day-care centres, crèches, kindergartens, etc.<sup>2</sup>

The child is not normally isolated in an exclusive pair relationship with the mother: there is participation in child rearing by the father; the child may be looked after by older siblings; and three generations may be living together. "Data on children within extended family systems. . . would seem to confirm the impression. . . that there is security in a larger number of nurturing figures."<sup>3</sup>

#### 4.4.2 Adolescence

Adolescence is a phase of human development that, in a sense, was created by modern technology; it is the increasingly lengthening period between puberty and adult independence. In complex, industrial societies, where the process of social and behavioural maturation takes considerably longer than that of biological maturation, individuals may be sexually mature by the age of 14 or earlier and fully grown by about 18; but education, both formal and informal, is by no means complete at such an age and few young people are economically and psychologically equipped to undertake, unaided, the responsibility of providing a home for a family.

This time-lag between biological and social maturation creates certain problems in some instances. For example, teenage girls may be physiologically capable of bearing children but not socially mature enough to rear them, and teenage fathers may not be able to support them. Pregnancy

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<sup>1</sup> Ainsworth, M. D. (1962) *The effects of maternal deprivation: a review of findings and controversy in the context of research strategy*. In: *Deprivation of maternal care*, Geneva, World Health Organization (Publ. Hlth Pap., No. 14), p. 158.

<sup>2</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1963, No. 256.

<sup>3</sup> Mead, M. (1962) *A cultural anthropologist's approach to maternal deprivation*. In: *Deprivation of maternal care*, Geneva, World Health Organization (Publ. Hlth Pap. No. 14), p. 57.

out of wedlock during adolescence, in societies where this is unacceptable, carries a high risk of infant mortality.

#### 4.4.3 *Effects in adulthood*

Despite phenomenal progress in the developed countries in controlling the principal hazards of infectious disease and malnutrition during infancy and childhood, there has been relatively little improvement in adult mortality rates. In some highly industrialized areas the incidence of lung cancer and of cardiovascular and degenerative diseases is increasing, and certain indices of mental health (e.g., suicide rates) indicate a high incidence of mental illness. Further study of the relationship between these problems of adulthood and developmental factors in early life is highly desirable, but already the influence of certain behavioural factors that originate in childhood—such as cigarette smoking, patterns of eating, physical activity and rest, and stress—can be identified. In order to maintain the highest possible standards of care and to further human development, more attention should be given to these factors during the formative years of childhood and adolescence.

### 5. CHANGES IN THE HUMAN SETTING

Human development is influenced by the rapid changes that are taking place in the human setting. Modern technology, industrialization, the expansion of cities, migration, and population growth result in many ecological, social and biological changes. These changes are not confined to the developed countries; in fact they are relatively far more rapid and occur in far more difficult situations in developing countries. The demographic transition is the most dramatic example. Rapidly falling death rates and persisting high natality rates influence the family and the community profoundly, and directly affect plans for the provision of resources for optimum development.

Some changes are beneficial to human development: the improved production and distribution of food have helped to control famine; the application of scientific knowledge has helped to control disease and extend life expectancy. But other changes have created new problems and exacerbated old ones. Unwelcome are the degradation of natural ecosystems under the impact of human settlement, the deterioration of cities as a result of uncontrolled migration from rural to already overcrowded urban areas, the extensive pollution of air and water with the unregulated expansion of industry, and many other problems.

Changes that are detrimental to human development exact an unnecessary toll from the young generation. Resources must be used wisely to

advance the healthy development of this generation in both developing and developed countries. In the opinion of the Group, national priorities should be based on the needs of children and youth and should take account of the factors that affect human development, as described in this report.

The Group urges WHO to encourage more research on the effect of urbanization on human development and to bring together members of the health professions and members of the professions that build and manage cities so that urban communities may be made to foster human development in the future.

## 6. GENETIC FACTORS

Growth and development are the result of interactions between the genetic information contained in the zygote and the environmental variables encountered in the course of time, from fertilization through birth to adulthood.

The developmental programme, constituted by the set of instructions coded in the DNA of genes along the chromosomes and in other cellular structures, is determined at the time of fertilization, together with all the genetic characteristics of the organism. Mutations occur, from time to time, usually for unknown reasons but occasionally from known environmental causes such as radiation. Slow modification of gene frequencies is occurring all the time under the influence of natural selection.

The way in which the instructions written in DNA are translated into enzymes and other protein structures that result in the complete individual is now known; however, knowledge of the sequence of elementary events leading to differentiation and growth is fragmentary and inadequate.

Family studies, pedigree analyses, and twin studies confirm the great importance of inborn factors in determining differences between individuals. For example, the correlation between intelligence levels in monozygotic twins remains high even if they are reared apart. Nevertheless, the action of the environment on the way in which genetic endowment is expressed gives ample scope for modification.

From a public health programme viewpoint, developmental disorders that are clearly of genetic origin may tentatively be classified in three groups : treatable, avoidable, and untreatable.

The disorders that may be treated, e.g., phenylketonuria and galactosaemia, entail the establishment of specific environmental measures, such as screening and diet restriction, or enzyme replacement.<sup>1</sup> Successful treatment may bring an increase in the proportion of such develop-

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<sup>1</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1968, No. 401.

mentally abnormal individuals in populations, but at a very low rate (of the order of mutation rates).

The disorders that are avoidable are those that can be diagnosed during intrauterine life, when a positive diagnosis is regarded as an indication for abortion.

Untreatable disorders such as Tay-Sachs disease are a challenge to modern medicine. The current public health approach to this class of disorders is to try to prevent them by offering genetic counselling to families in which they occur.

There are diseases of genetic origin which, because of their frequency, severity, and persistence, represent considerable public health problems. Among them are sickle-cell anaemia,  $\beta$ -thalassaemia,<sup>1</sup> and glucose-6-phosphate dehydrogenase (G6PD) deficiency.<sup>2</sup> No radical treatment is available for these disorders. According to the WHO Expert Committee on Human Genetics, genetic counselling is in some cases the most practical service that can be rendered.<sup>3,4</sup>

## 7. PERINATAL FACTORS

Perinatal factors include the duration of gestation, birth weight, and other factors that operate through the mother during pregnancy and parturition. The origin of much faulty development is to be found in various abnormalities of pregnancy. The birth process itself may be hazardous, and the establishment of respiration may be traumatic. The significance of perinatal factors has recently been reviewed<sup>5,6</sup> and will not be discussed in detail here.

The early prenatal period extends from fertilization through implantation to organogenesis. Interference with development during this phase of life, where it does not lead to abortion, is responsible for the majority of congenital malformations. For the most part, the etiology of such malformations is still unknown, but some are causally linked to the occurrence of rubella and other infections or to the administration of drugs during the critical phase of organogenesis. Others, notably some malformations of the central nervous system, show variations of incidence with socio-economic conditions, which suggests strongly that

<sup>1</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1966, No. 338.

<sup>2</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1967, No. 366.

<sup>3</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1964, No. 282.

<sup>4</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1969, No. 416.

<sup>5</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1970, No. 457.

<sup>6</sup> PAHO Advisory Committee on Medical Research (1969) *Perinatal factors affecting human development*, Washington, D.C., Pan American Health Organization (Scientific Publication No. 185).

they are partly attributable to environmental causes. Still others are related to the age of the mother at the time of conception. Some congenital malformations result sooner or later in death; others can be alleviated by surgical or other means so that continued life and development are possible.

From the completion of organogenesis at around 10 weeks of gestation until birth, the fetus grows very rapidly. While the fetus is remarkably well protected from many forms of physical and metabolic damage, a host of factors may interfere with the progress of intrauterine development. The placenta may become diseased, as for example by malaria and syphilis, affecting the development of the unborn child. Under conditions of severe maternal malnutrition, nutrient supplies may be insufficient even in the presence of an adequate placenta and fetomaternal blood supply. The blood supply may become limited through defects of placentation, and in a high proportion of such cases, even with healthy mothers in an excellent environment, there is reason to believe that fetal growth during the final stages of gestation is limited because the blood supply is no longer adequate to support full fetal development.

With a few limited exceptions, longitudinal studies *in utero* are not possible, and most information on growth and development comes from cross-sectional examinations, in which each baby is studied only once after delivery. For practical reasons, much attention has been paid to birth weight, and it has long been recognized that mortality and morbidity rates are high among babies of unusually low or high birth weight. Rates of low birth weight are important statistical indices of perinatal health. Increasing attention is now being paid to the independent effects of birth weight and of gestational age in relation to fetal and subsequent development.

The WHO Expert Committee on Maternal and Child Health, which defined low birth weight as 2500 g or less, recommended that "all countries and anyone (for example, in hospitals, domiciliary services, etc.) with interest in the statistical aspects of this subject, collect and study the birth weights in 500-g weight groups as follows: 0-1000; 1001-1500; 1501-2000; 2001-2500; 2501-3000; 3001-3500; 3501-4000; 4001-4500; 4501-5000; 5001 or more".<sup>1</sup> More recently, the Expert Committee on the Prevention of Perinatal Mortality and Morbidity agreed "to define *pre-term* as before 37 weeks (259 days) of gestational age (calculated from the first day of the last menstrual period), *term* as from 37 to before 42 weeks (294 days), and *post-term* as from 42 weeks".<sup>2</sup> Both these recommendations were recently endorsed by an informal Working Party of obstetricians and paediatricians from 13 European countries who were

<sup>1</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1961, No. 217, p. 7.

<sup>2</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1970, No. 457, p. 20.

attending the Second European Congress of Perinatal Medicine.<sup>1</sup> It is hoped that published statistics will in future conform to these definitions, in the interest of comparability. Furthermore, all definitions based on the term "maturity", which has been used so variously that standardization is no longer practicable, should be abandoned.

The use of standard distributions of birth weights by gestational period makes it possible to arrive at objective definitions of "low birth weight", "small for dates", and other categories of babies, each of which represents a different pattern of intrauterine growth. For example, the growth of a baby whose birth weight is below the 10th percentile of weight for gestational age was probably retarded *in utero*; whereas the growth of a baby whose weight is the same but is average for gestational age was probably satisfactory until pregnancy was interrupted. With the standards suggested it will be possible to make precise studies of the long-term effects of low birth weight and short gestation.

Current information is incomplete and scanty, but the fact that neurological development proceeds at its most rapid rate during the perinatal period has led workers to suspect an association between impaired mental development and fetal malnutrition. Several studies show that the baby of very low birth weight is frequently handicapped permanently in its subsequent physical and mental development, although interpretation of the data is far from simple. Some workers studying mental subnormality suggest that there are probably three broad categories of antecedent causes: genetic and familial factors; biological insults to which the child is exposed before, during, and after birth; and a substandard social and physical environment which, while not causing direct physical damage, may influence the course of development.

The problem is to isolate the effects of low birth weight from other causes of impaired growth and development. This task is complicated by the fact that mothers who bear low-birth-weight babies tend to live in hostile social and physical environments, are usually prone to other deleterious perinatal experiences, and may carry adverse genetic and familial factors. The results of a community study in Aberdeen, Scotland, and of a similar study in Kauai, Hawaii, suggest that the influence of low birth weight on mental ability at school age may be much less marked in the more affluent and well-educated sections of the community than in the poorer and worse educated. It is essential to conduct more community-wide follow-up studies in an attempt to differentiate and separate as many factors as possible.

Other adverse perinatal factors are associated with delivery: special hazards of mechanical damage and of oxygen deprivation or excess; difficulty in establishing respiration or maintaining body temperature

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<sup>1</sup> *Acta paediat. scand.*, 1970, 59, 480.

after delivery; and specific perinatal infections, such as those due to unhygienic procedures during delivery, especially insanitary methods of cutting the cord. These factors have a considerable bearing on growth and development: it has been found that complications of pregnancy and the perinatal period are proportionately more common in the histories of mentally subnormal children than in those of the general population, even when allowance is made for social class. These findings lend support to the hypothesis that a number of cases of mental subnormality can be attributed to central nervous system damage which, in turn, can be ascribed to severe complications of delivery. The probability is that severe brain damage attributable to obstetric factors affects only a few children, whereas many more suffer minor mental impairment that is partly attributable to faulty intrauterine development.

Probably the best evidence that the impairment of fetal development has long-term effects comes from studies of identical twins who were reared together. These studies show a persistent performance differential in twins of disparate birth weight, with the smaller of the pair scoring lower on all tests of development.

The importance of providing high-quality antenatal, intrapartum and postpartum care in order to eliminate or ameliorate adverse perinatal factors is obvious. Scarcely less important is the education of families to appreciate the role of perinatal factors in the ultimate development of the child and the need to give the unborn and newborn child the best chance of developing satisfactorily.

## 8. FAMILY PLANNING IN HUMAN DEVELOPMENT

The Group decided to use the term *family planning* in its broadest sense to include the planning of pregnancies so that they occur at the desired time, the spacing of births for the optimum health of all family members, and the prevention of further births when the family has reached the total size desired. In this sense, family planning may be regarded as an aspect of individual and social behaviour as well as an aspect of individual and public health. Family planning as a means of promoting human development rests on a number of associations between health (as measured by maternal, perinatal, infant, and child mortality and morbidity rates and by indices of physical growth and mental development) and reproduction (as expressed in the timing, number, and spacing of pregnancies). For example, there is a poor prognosis for the infant born of a mother who began childbearing at a very young age and has already had many closely spaced pregnancies. Family planning will have a positive effect on health when it is used to postpone the first pregnancy until the woman has completed her own growth, thus avoiding the double burden of

growth and reproduction; when it is used to space births and extend the interval between pregnancies, so that the woman has time to recuperate after each birth; and when it is used to limit the total number of births, since a poor outcome of pregnancy is associated with both high parity and advanced maternal age.<sup>1</sup>

Health and reproduction can seldom be considered outside the context of an individual's social, economic, and cultural milieu. For example, high parity is commonly associated with low socio-economic status, poor nutrition, poor hygiene, overcrowding, poor education, and resistance to change. These factors are associated with each other and are linked with many of the obstetric complications described in section 7. Where the modal age at which first children are born is well above the optimum biological age (which is about 18 or 20 years), a high proportion of women who start families at an earlier age have a background of relative social and material deprivation. These environmental and social disadvantages may outweigh the biological advantage conferred by youth.

The lowest perinatal mortality rates are found in second pregnancies, the highest in fifth and subsequent pregnancies. Late fetal and neonatal mortality rates are reportedly lowest when the interval from the termination of one pregnancy to the beginning of the next is between 2 and 3 years. A progressive rise in infant mortality as birth intervals decrease has also been demonstrated. In developing countries, this is associated with diarrhoeal diseases and poor weaning practices: early weaning often follows a short pregnancy interval. In a society where family limitation is widely practised, large families—i.e., families in which each child is born a year or so after the last—tend to occur selectively among the poorest, least educated, and worst nourished segment of the population.

The few studies carried out so far on the health and behaviour of unwanted children are difficult to interpret and are often inconclusive. Part of the problem lies in the difficulty of determining when a child is unwanted. Since, in many societies, illegitimate births are unwanted, the mortality and morbidity of the unmarried mother and her child have been studied. Virtually every available measure shows that they face significantly higher health risks than the married mother and her child, even when allowance is made for socio-economic factors. Other studies have examined children of mothers whose application for therapeutic abortion was refused. An investigation in Sweden in which 120 subjects were followed to the age of 21 found, in general, a high incidence of anti-social and criminal behaviour, a greater need for psychiatric care, and more educational subnormality among unwanted children than among a control group.

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<sup>1</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1970, No. 442, p. 8.

## 9. NUTRITION AND HUMAN DEVELOPMENT

Nutrition is fundamental to human development, and influences it throughout the life span : it has far-reaching effects on physical, intellectual, emotional, and psychomotor development and indirectly affects social development. Malnutrition and undernutrition constitute major health problems not only in developing countries, but in many of the developed parts of the world as well. The important role played by malnutrition in the high mortality and morbidity attributed to infectious diseases is also recognized. The highest toll is exacted during the critical stages of development, especially during early childhood.

Estimates of the prevalence of protein-calorie malnutrition (PCM), based on community sample surveys, give some idea of the magnitude of the problem. Data from 24 countries indicate that the prevalence of severe PCM ranges from 0.5 % to 8 % and the prevalence of moderate PCM from 4 % to 43 % (see Annex, p. 39).

Malnutrition appears to affect the development of successive generations in the following way. Maternal malnutrition during pregnancy, especially in areas of chronic food shortages, may retard fetal growth *in utero*. Consequently the baby is born "small-for-dates" and may develop specific deficiencies, such as iron deficiency anaemia. If the baby is then malnourished during early childhood, his growth may be retarded, and possibly his mental and motor development as well. The pubertal growth spurt may be delayed. In the case of females, menarche may be delayed and reproductive efficiency impaired. In comparison with tall mothers, women of short stature tend to give birth to babies of low birth weight who are at higher risk of death in the perinatal period. In addition, if pregnancies are closely spaced and numerous, thereby straining maternal nutritional stores to the utmost, both maternal and child health will be affected.

This picture of the consequences of malnutrition is tentative, since much of the direct evidence comes from animal studies that may not be applicable to man; moreover, evidence of the effects on man is indirect since it is difficult to isolate the precise influence of any specific factors, such as the quantity or quality of the maternal diet, from the complex of socio-economic and other environmental factors that affect development. For example, in communities where nutritional standards are generally good, maternal diet appears to have less effect on birth weight than other factors such as maternal size, antenatal care, and smoking habits. Whether the same situation obtains in developing countries, or in the poorest sections of other populations, is not yet clear.

Babies who are undersized at birth tend, on average, to become relatively small children and adults, but the correlations are low : in an

unpublished series from Newcastle upon Tyne, England, the coefficients of correlation between birth weight and adult height and weight were about 0.25. For individuals, therefore, birth weight is a poor predictor of subsequent size.

### 9.1 The genesis of malnutrition in childhood

The problem of protein-calorie malnutrition, as manifested by obvious cases of kwashiorkor and marasmus, is frequently described as the tip of an iceberg. One piece of evidence that all is not well with the majority of children who do not show dramatically severe manifestations of malnutrition is that the *average* growth curves of young children in developing countries all over the world show the following characteristics :

(1) From birth until 3–6 months of age, infants who are breast-fed usually grow well, and gains of weight and height are very satisfactory in almost all environments. Indeed, it is remarkable that in many communities where levels of nutrition, hygiene, and medical care are unquestionably low, the rate of growth of young babies is greater than that accepted as satisfactory in advanced countries.

(2) From about 6 months until about 2 years of age, growth falters, so that a growth curve that was previously average or even above the median for advanced countries may fall to below the tenth percentile.

An important cause of deterioration is the poor quality and quantity of child feeding. By the age of 6 months breast milk as the sole food is insufficient and does not provide adequate energy and protein for normal growth. Such supplementary food as may be given (e.g., thin gruel, glutinous rice, mashed banana) often has a low protein content and is not given in sufficient quantities. Breastfeeding may also be interrupted during this period, commonly by another pregnancy. Traditional weaning foods are generally so inadequate that the child may develop some form of protein-calorie malnutrition.

The poor nutritional status observed in some children in developing countries cannot be explained solely in terms of inadequate diet. Infectious diseases are common, especially diarrhoeas, which set up a synergism in the malnourished host. Infectious diseases not only condition and precipitate severe states of malnutrition, but are also more serious in malnourished children, accounting for the higher mortality from measles, for example, in developing countries.<sup>1</sup>

(3) From the third year on, mortality rates drop considerably in the developing countries, but the physical growth and mental development

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<sup>1</sup> Scrimshaw, N. S., Taylor, C. E. & Gordon, J. E. (1968) *Interactions of nutrition and infection*, Geneva (*World Health Organization: Monograph Series*, No. 57).

of some children who experienced severe malnutrition and frequent episodes of infection in early childhood appear to be permanently affected. Older children demonstrate the phenomenon of "catch-up growth", in which growth that has slowed during illness becomes accelerated during recovery so that the individual's ultimate level of growth is not affected. Apparently no such compensation occurs with illnesses experienced in the first two years of life; the Group recommended that research be carried out to determine whether this failure to catch up is real or apparent.

In only relatively few developing countries have average growth curves been plotted for children who, in exceptional cases, were brought up in a good environment. Where such measurements have been made, they suggest that ethnic differences in growth, at least in children before the age of puberty, may be less great than has hitherto been believed.

## **9.2 Early malnutrition and the development of the central nervous system**

A question of cardinal importance is whether early malnutrition interferes with the growth and development of the brain. Evidence that this may be the case comes from three types of research: observations of head circumference, studies of learning and behaviour in both animals and children and, most recently, studies of cellular growth.

Head circumference has been found to correlate well with brain size, and a number of studies show that children who suffered severe malnutrition during the first year of life have smaller head measurements than children of the same age and racial background who were well nourished.

There is evidence that the extent and degree of growth retardation are directly related to the rate of cell division of an organ at the time of nutritional deprivation. All fetal organs are necessarily in this critical and vulnerable phase of proliferative growth and are therefore liable to sustain permanent damage from nutritional deprivation. Animal studies show that the brain is vulnerable to nutritional deprivation during the period of rapid growth. Evidence is also accumulating from both animal investigations and studies of children that severe early malnutrition affects learning and behaviour as well as brain size. These observations have stimulated studies in several parts of the world, including extensive ones now in progress in Latin America. Impressive as these studies appear to be, their results should be viewed in the ecological context of malnutrition. In other words, behavioural studies attempting to assess the specific effect of nutritional deficiency on learning ability should consider the coexisting biological and social factors that may interact with malnutrition and thus help determine how well an individual performs in tests. For example, certain rearing and feeding practices may be detri-

mental to the child's intellectual development. Furthermore, the gradual physical deterioration of the child as a result of chronic, severe protein-calorie malnutrition is usually accompanied by apathy and listlessness and may precipitate a partial breakdown between the child and his environment—a situation, similar to sensory or perceptual deprivation, that affects the child's ability to learn from his environment or to be stimulated by it.

Recent developments in the study of cellular growth are helping to explain the observed effects of malnutrition on growth and development. By means of chemical measurement, it is possible to determine the number of cells (DNA content) and their size (total protein) in tissues. Studies in rats show that nutritional deprivation during the early growth period (rapid cell division) results in permanent growth failure due to a reduction in the number of cells in a tissue. If the stress is applied at a later stage of growth, during the stage of cell hypertrophy, the resulting growth retardation can be reversed by reinstating an adequate food supply. Nutritional deprivation also affects the rat's central nervous system and other tissues during gestation and shortly after birth. If these findings are applicable to man, then severe malnutrition during infancy may inflict permanent damage on the brain, and infants born of severely malnourished women and poorly nourished after birth may be in double jeopardy. So far only a few studies have been conducted on human tissues. Marked reductions in the DNA content of brains were noted in studies carried out in a Latin American country on children who died of marasmus in the first year of life.

### **9.3 Malnutrition and resistance to infection**

The view has long been held that malnutrition could increase susceptibility to infectious disease and also influence the course and outcome of illnesses. Support for this hypothesis came from clinical observations in areas where malnutrition prevails. Resistance to infection is determined by a great number of host factors, but a significant variable is the adequacy of the immune response. Since knowledge of the effect of malnutrition on the immune response is very incomplete, this is an area for intensive research. The little evidence so far available suggests there may be two ways in which nutrition can affect host resistance, i.e., antibody synthesis and cellular immune response.

#### *Antibody synthesis*

Protein malnutrition seems to impair the production of circulating antibodies in response to certain bacterial and viral antigens. This effect is reversed when proteins are added to the diet. Secondary malnutrition,

as in the case of patients with various diseases who are generally undernourished, does not impair the immune response to bacterial antigens. Immunity to certain viral antigens seems to be affected less adversely by poor nutrition than immunity to others. Children with kwashiorkor, for example, apparently develop antimeasles immunity at a younger age than do healthy controls. Different antigens, however, behave differently. Children with kwashiorkor who were immunized with yellow fever and poliomyelitis vaccines produced high titres of anti-polio antibodies but responded poorly to the yellow fever vaccine. The immunogenicity of poliomyelitis vaccine may be related to its oral route of administration, for this method allows the antigen to reach lymphoid centres of the gut and thereby calls upon immunologically competent cells that would not be reached by ordinary subcutaneous immunizations. Also, live vaccines may be more immunogenic than either killed vaccines or bacterial products.

#### *Cellular immune responses*

The basic mechanisms in cellular immunity are lymphocyte-mediated phenomena such as delayed hypersensitivity. Undernutrition and the depletion of protein reserves result in atrophy of liver, spleen, bone marrow, and lymphoid tissues from which phagocytes and lymphocytes originate. Consequently, infections in kwashiorkor patients are not always accompanied by a leukocytosis. Malnutrition also seems to depress delayed hypersensitivity, e.g., reaction to tuberculin in tuberculous persons. Phagocytosis has been shown to be impaired in children with kwashiorkor; the bactericidal capacity of leukocytes also seems to be affected. It should be stressed that many of the humoral and cellular immunological lesions that result from malnutrition can be rapidly repaired by supplementary dietary therapy.

#### *Other mechanisms*

Malnutrition may depress host resistance through certain other mechanisms. It may have some effect on the activity of nonspecific factors such as lysozymes. Nutritional deficiency may reduce the integrity of tissues, thus reducing body resistance to infection, and may also effect some alteration in the endocrine balance, which in turn is related to resistance. Finally, malnutrition may introduce changes in the intestinal flora. The mechanism of such interactions and of the subsequent relative change in resistance is not clearly understood. For example, *Lactobacillus bifidus*, which is present in higher concentrations in a breast-fed child than in an artificially-fed child, is thought to inhibit the multiplication of some intestinal pathogens. The Group recommended intensive research on the interaction of malnutrition and resistance to infection and especially on the resistance to infection found in the breast-fed child.

#### 9.4 Measures to combat malnutrition

The improvement of nutrition within the broad limitations set by economic levels and availability of food depends on making the most of available resources. The first step is the identification of nutritional needs and of vulnerable groups in the community. These groups should then be educated as to their needs and the local resources available for improving their diets. Personal education is the principal measure for combating malnutrition and for obtaining maximum benefit from local resources. If, however, needs cannot be met locally, then it is necessary to consider whether supplementary foods should be distributed to vulnerable groups. In deciding whether to distribute food, the authorities must take into consideration such questions as hygiene (e.g., are there sanitary means of reconstituting dried milk ?), the influence on breast-feeding (e.g., will dried milk be substituted for breast milk ?), and the effects on family eating patterns if these foods are later withdrawn (since food supplements should not replace locally available nutritious foods). Furthermore, distribution costs may exceed the value of the food. When foodstuffs are distributed through clinics or school lunch programmes, the opportunity to educate people and to influence their dietary habits should be taken. The production of cheap weaning foods has much appeal; however, their success has been limited by distribution problems and by the fact that they are sometimes alien to local cultural traditions.

The entire population's requirements for certain specific nutrients can be met by a variety of measures, such as the production of iodized salt and of various foods fortified with vitamins and minerals. There are also measures for selected population groups; for example, one massive dose of vitamin A (200 000 I.U.) administered orally every 6 months during the first 3 years of life could, on the basis of trials conducted by the Nutrition Institute of Hyderabad, India, prove a practical measure for the prevention of keratomalacia. There is, however, some question as to whether the interval between dosages should be shortened.

Family planning measures used to limit the number of births or to space pregnancies can have an indirect influence on the nutritional status of children. A study in India showed that almost two-thirds of the children admitted to hospital for severe protein-calorie malnutrition belonged to birth orders of 4 and above. The use of family planning measures to limit family size may alleviate some malnutrition in poor communities where large families cannot afford to buy enough good-quality food to feed all their children. In areas where breast milk is an important source of protein for the infant, family planning measures can be used to extend the interval between pregnancies and thus avoid the early curtailment of breast-feeding.

Finally, it must be emphasized that measures to combat malnutrition will have a much more significant impact on health and development when they are combined with efforts to control infection.

## 10. INFECTION

One of the major hazards of severe or prolonged infection is its potentially deleterious effect on growth and development, especially in the presence of malnutrition. Any significant infectious or parasitic disease affects the biology of the living tissue or organ by producing increased catabolism, which may result in weight loss. The effect on growth and development is much the same as that of dietary deprivation. The clinical literature indicates that severe, prolonged infection causes growth retardation in muscles and bones, and that it culminates in stunting, especially when it occurs very early in life. The combination of infection and malnutrition may also have an untoward effect on mental development and neurological function.

Infection also tends to impair nutrition in a number of ways. Besides its general catabolic effect, infection can alter absorption, metabolism, and the excretion of specific nutrients. It can also diminish food intake—either directly, through anorexia, or indirectly through the widespread customs of withdrawing solid food, using starvation therapy, and occasionally using purgatives in the treatment of febrile illnesses. The results can be serious, especially in infants and young children whose previous level of nutrition was marginal.

### 10.1 Infection and intrauterine growth

The fetus is protected from infection to a certain degree by its coverings and by the placenta, which permits the passage of nutrients and antibodies but acts as a barrier against the transmission of most maternal infectious and parasitic diseases. The few disease agents that are capable of passing the placental barrier affect growth and development significantly; these include rubella and other viral diseases, syphilis, and toxoplasmosis. In addition, any acute febrile condition in the mother during pregnancy produces constitutional disturbances that may, on occasion, be great enough to produce abortion or pre-term delivery. Chronic maternal infection impairs the nutrition of the mother and may impair that of the fetus as well.

Intrauterine undernutrition and growth retardation may also result from infection of the mother, leading to placental insufficiency or poor blood supply. Falciparum malaria has a predilection for the placenta, and prophylactic treatment of the mother, even in the absence of symptoms, has been shown to improve birth weight.

## **10.2 Infection and growth in infancy**

Once the fetal membranes are ruptured, the fetus becomes exposed to the external environment and the possibility of outside infection. The risk is, of course, increased after birth.

In the first few months of extrauterine life, adequate maternal antibodies are usually present to protect the baby against certain infectious diseases, such as poliomyelitis, measles, rubella, tetanus, and diphtheria, provided of course that the mothers had themselves been immunized effectively or had acquired immunity through natural exposure to the disease. Protective maternal antibodies against whooping cough, smallpox, and tuberculosis are usually inadequate or non-existent. By the age of 6 months antibodies are greatly reduced and may have disappeared completely by the end of the first year of life. The pre-term baby usually has inadequate stores of maternal antibodies and is therefore more susceptible to infection. In areas where malaria is holoendemic, mothers usually possess antibodies that protect against parasitization; they pass them on to their babies, who are thereby protected at least during the first 3 months of life. Babies of non-immune mothers possess no such immunity, and may have malaria at or soon after birth.

## **10.3 Infection during early childhood**

From 6 months of age until the fourth year of life, infectious and parasitic diseases play a significant role in maintaining high infant and child mortality rates in the developing areas of the world. Death is often the result of multiple pathological conditions. Many of the common and most dangerous conditions, particularly diarrhoea, respiratory infection, and parasitic infestation, cannot at present be prevented by specific measures such as immunization. Prevention depends on general measures for the improvement of environmental hygiene. Furthermore, these diseases often occur in areas where protein-calorie malnutrition is widespread; in many cases PCM is a major factor in the illness and may determine its outcome.

## **10.4 Principles of infectious disease control in the context of human development**

### *Surveillance and reporting*

It is often necessary to identify infectious diseases and the ages at which they occur before initiating control measures, in order to decide where these measures should be focused. Adequate laboratory facilities are required for this.

### *Immunization*

The largest possible proportion of the population at risk should be immunized before infection occurs. The decision to immunize should not depend on the current prevalence of a disease, but on its potential incidence in the absence of control measures. The age at which children are exposed to various infections is different in each setting, and immunizations must be timed in accordance with local epidemiological findings. For example, in areas where smallpox is present, immunization must be provided as early in life as possible, even in the neonatal period. Since measles tends to occur at earlier ages and with greater severity in West Africa than elsewhere, immunization at about 8 months of age is desirable. Serological surveys, when available, provide a valuable additional means of identifying common infections, particularly those in which subclinical infection and the development of natural immunity are frequent (e.g., poliomyelitis).

### *Sanitation*

The provision of clean water, adequate housing, and latrines, and the control of vectors are all important measures for the prevention of infection. Making available an abundant supply of clean water for the use of families is one of the most effective ways of improving the sanitary environment in homes. It reduces exposure to innumerable pathogens in the immediate environment, and thereby enables infants and very young children to make a smoother transition from the passive immunity provided by the mother to active immunity acquired by gradual exposure.

### *Education*

Health education of the public is essential in the control of infectious diseases. Habits of everyday living should be changed to improve nutritional status, personal hygiene, and the sanitation of the environment, as well as to ensure the acceptance of immunization. Sound education programmes, based on careful studies of the people concerned and organized with their participation, should form a part of all services to the family and, especially, of all treatment of infectious diseases.

### *Breastfeeding*

It is impossible to overemphasize the importance of breastfeeding in communities where breast milk substitutes are unsatisfactory, where hygiene is poor, and where educational standards are low. A clean cup, a spoon, or even feeding by hand is preferable to a dirty bottle and rubber nipple in which bacteria have been allowed to multiply.

*Treatment of infectious diseases*

Serious injury to development can be prevented by the early, effective treatment of infections. Mass treatment measures have been successful in the case of a few infections, notably yaws and other non-venereal treponematoses. However, treatment for acute infections should be made available on a continuous basis, and this implies the decentralization of services.

Particular attention should be given to malaria in areas where it is holoendemic and the interruption of transmission is not yet feasible. Ideally, prophylactic chemotherapy should be made available to the child during the first 3 years of life, when attacks are most severe and immunity is lowest, as well as to the mother during pregnancy. These measures would appear to have much potential for the reduction of childhood mortality and morbidity. The exact level of treatment in relation to the development of adequate immunity is a question that should be studied in various settings.

**11. IMPLICATIONS FOR PUBLIC HEALTH PROGRAMMES**

All the previous sections provide a background to the role that public health programmes can play in the promotion of optimum human development. It is not the purpose of this report to discuss in detail the organization of maternal and child health services, since this is covered elsewhere,<sup>1</sup> but the Group wished to stress a few general principles for the orientation of health services towards human development.

Measures for the promotion of human development are *time-oriented* in that they are related to certain opportunities and needs that occur during the various phases and transitional periods of the life cycle. This principle is based on the concept that in the process of development there are *critical periods*—turning points, especially for better or worse—during which the trend of future events is determined.

The requirement for *continuity of care* is also based in part on the cycle of human development, and is closely related to the need for *combined services*. On the basis of the evidence reviewed, which indicates *inter alia* close relationships between nutrition and infection, and between antenatal and postnatal development, the Group endorsed the principle of a unified, integrated approach to public health, which would combine services for nutrition, communicable disease control, maternal and child health, and family planning. Conventional linear planning and the execution of separate programmes cannot meet the needs of human development in the way that family care and community health services can.

<sup>1</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1970, No. 428.

The administration of the health services that affect human development determines the way in which those services are delivered to the people; hence administration has an indirect impact on human development itself. A basic principle of public health administration in developing and developed countries is that scarce resources, including medical manpower, should not be concentrated in high-powered clinical establishments to treat rare diseases, but should be used in public health services to combat common child health problems. The reorientation of medical education and the redeployment of medical services might well be assisted by greater involvement of the political and social sciences in medical affairs.

A unified approach to public health will not be achieved while many workers with specialized interests are attempting to provide different services. The Group emphasized that at the peripheral level it is necessary for *one health worker* to look at all the health needs of a family. The health worker should regard every contact with the family as having many purposes, and each family member should be screened for health problems in relation to his stage of development. Technical guidance, as well as specialized services for referral purposes, should be available to all workers.

The health worker must consider the entire range of multiple factors that influence human development. His concern should not be limited to the diagnosis of a single cause or the treatment of a specific disease. The principle underlying this approach is that *multi-purpose workers* are best fitted to respond to the *multi-factorial* nature of disease. The training of health workers must be designed to give them the skills needed to perform multiple tasks.

The use of multi-purpose workers will also help to extend health services to cover the entire population, which is an ultimate goal. In many developing countries these workers are nurse-midwives or their auxiliaries. Their effectiveness depends greatly on their skills in teaching and administration, their knowledge of human development, and the support they are given by their supervisors.

Education of the public in the protection of their own and their children's health and in the principles of human development is of great importance. It is best accomplished on the basis of individual teaching in an atmosphere of mutual understanding and trust. The multi-purpose worker who is familiar with all the families in a village and with their customs is best placed to influence health behaviour through *person-to-person communication*. This education should be carried beyond the family to leaders of opinion in the community who are responsible for or influence the setting of priorities. It should also be carried into the school, and the health worker should encourage the collaboration of teachers, students, and parents in the dissemination of health information.

Studies of the beliefs and attitudes concerning health among the people to be educated, studies of the comparative effectiveness of various educa-

tional methods, and studies of the social factors related to the adoption of different health practices would be of great advantage in assessing the success of educational programmes.<sup>1</sup>

A final principle related to the cycle of human development is the necessity of considering the immediate problems of the individual in the context of the life cycle. How the child fares in each phase of development (and each transitional period) influences his health in the next phase and ultimately determines his life-long level of health.

## 12. MONITORING OF TRENDS IN HUMAN DEVELOPMENT

Unfortunately many changes in human development are brought about by unforeseen forces, and even if the change occurs as a result of planning the outcome may be unexpected. In times of rapid change, there is a great need for monitoring devices whereby public service organizations and professional bodies can recognize the processes of change and seek to direct changes into beneficial channels. In all communities where some degree of central organization exists, there are devices to keep governments informed about the health of the people they govern. The Group believes that there is a need to perfect such monitoring devices so that they will provide a sensitive indication of trends in health and development, enable planners to take well-informed decisions, and bring adverse trends to notice in time for remedies to be applied effectively.

### **Population data**

Governments that do not yet take a census on a regular basis should collect statistics that will enable them to monitor migrations and other changes in the distribution of the population.

### **Statistics on births and deaths**

The registration of births and deaths, together with causes of death and other information relevant to health, is recognized as an essential component of health planning. New methods for estimating births and deaths should be developed in countries that lack reliable vital statistics.

### **Morbidity statistics**

Data on morbidity are much less easy to collect than data on mortality, but even crude analyses of the types of illness treated in hospitals and outpatient clinics give useful information on the occurrence of diseases that influence human development.

<sup>1</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1970, No. 432.

**Environmental information**

In many parts of the world poor environmental hygiene remains an important cause of disease, malnutrition, and retarded development. Civil authorities should maintain records on water supplies, sanitary facilities, types of housing, and degrees of overcrowding, at the very least. These basic data could be collected at the time of a census, or by means of sample surveys. More detailed information on such matters as air pollution is also desirable in heavily industrialized areas.

**Food supply and dietary habits**

It is equally desirable to maintain records of food available for consumption. Estimates of agricultural production and of food imports and exports are maintained by many countries; these could be supplemented by measurements of actual consumption, e.g., sample dietary surveys at the family level. The dietary survey is, however, a costly and technically difficult procedure; it should be planned, supervised, and evaluated by specialized institutions.

**Physical development**

Since measurements of height and weight are relatively simple to make, it is surprising that anthropometry has been so little used as a means of monitoring growth. The main reasons are, of course, the problems of sampling and of making measurements in a reasonably accurate and standardized manner under difficult conditions in the field. Increasing height and body weight are not necessarily beneficial, but it is certainly helpful to know whether mean height and body weight in various segments of the population are shifting under the influence of economic, environmental, and nutritional changes. A WHO meeting of investigators has prepared an outline of procedures for the anthropometric appraisal of trends in the nutritional status of populations.<sup>1</sup> If uniformly and widely adopted after adequate testing in the field, these procedures would provide a major new monitoring system within communities. Moreover, the publication of monitoring results in a standardized manner would facilitate the precise comparison of national data. The Group noted that, despite the enormous amount of literature on the growth of children, current information is of limited value because the lack of standardized reporting methods makes comparisons difficult. The collection and publication

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<sup>1</sup> Mimeographed document WHO/NUTR/70.129. Copies of the document are available on request from Distribution and Sales, World Health Organization, 1211 Geneva 27, Switzerland.

of data should not depend mainly on the enthusiasm of individual workers but should be supported by public service organizations and professional bodies.

#### **Mental development**

Well-standardized tests of intellectual function are available and are widely used by educational psychologists. Perhaps their main limitation is that most of them are influenced by the culture in which they originate; it is still necessary to interpret with caution the results from different cultures, or even from socio-economically and educationally diverse groups within the same culture. Tests of the development of neurological functions, which are now being investigated and used by several research centres, may prove to be of great value in monitoring changes in the central and peripheral nervous system.

#### **Emotional development**

Emotional and psychological development was touched upon only briefly in the discussions. The Group recognized the importance of emotional development, especially in times of rapid change when adaptability and emotional stability are highly valued. It has frequently been suggested that emotional stability and behaviour are influenced by events during early life, and it would undoubtedly be of great interest to monitor emotional development. Tests should be devised for this purpose.

#### **Monitoring public health services for human development**

A variety of services can contribute to the improvement of human development if they are organized with that purpose in mind. The following activities, each of which should include an educational component, should be incorporated into basic services in all human settlements: curative services, preventive services, health promotional services, services for families and for individuals, and community services. To ensure that these services are available to all and that they are co-ordinated and effective, they should be monitored systematically.

In the opinion of the Scientific Group, the types of monitoring described above deserve high priority in public health services.

### **13. CONCLUSIONS AND RECOMMENDATIONS**

This report contains a brief review of the scientific knowledge (and lack of knowledge) of various needs and opportunities for intervention that occur during the cycle of human development, in so far as these needs

and opportunities are significant for public health programmes. The factors influencing development are only summarized, since the Group was concerned with the scope of the question rather than with the details of any single factor.

Human development is a concept that views man's life as a continuous process of change, marked by phases and distinctive transitional events that are of special significance in every kind of human culture. These phases and events cannot be considered in isolation or from the viewpoint of a single discipline; they require a co-ordinated approach by workers in many different disciplines. The Group believes that a holistic concept of growth and development is necessary as a guide when setting the focus of future public health programmes. The principle stated in the WHO Constitution should direct the design both of research and of the delivery of services: "The health of all peoples is fundamental to the attainment of peace and security and is dependent upon the fullest co-operation of individuals and States".

With this principle in mind, the Group's most important recommendation to WHO is that the Organization exert its leadership among nations in the search for effective methods to use the unifying concept of human development to bring about better integration of all public health programmes. All government departments should be encouraged to introduce this concept into policy-making and planning and into the execution of programmes at all levels.

#### **Recommendations for research**

Broad, interdisciplinary research is required, not only to examine specific factors but also to investigate the relationships between various factors. Examples of both types of research were identified by the Group.

More research is required on the effects of the environment—natural or man-made, physical, chemical, biological, and social—on human development. Sensitive indicators must be developed and employed in a systematic way to monitor the deterioration of health and well-being. Special efforts should be made to learn more about the effect of urbanization on human development.

Among the many social and economic factors that affect human development, education has a profound influence and has a great potential for improving levels of development. The Group recommends intensive research on educational content and methods that will prepare children and young persons to live in a world of rapid and radical change.

Not enough is known about genetic influences on growth and development. The Group is particularly interested in the possible relationships

between genetics and malnutrition, and recommends research on such questions as how people with different genetic markers respond to malnutrition at various stages of development and whether genetic markers could be correlated with specific growth parameters.

A great deal of research has been done on perinatal factors, and a WHO Expert Committee on the Prevention of Perinatal Mortality and Morbidity recently identified some 25 areas for further research.<sup>1</sup> The present Group therefore limits its recommendations to the question of the long-term effects of perinatal factors on growth and development, and stresses the need for more well-designed community studies, especially in developing countries.

A previous WHO Scientific Group<sup>2</sup> urged that collaborative epidemiological studies of human reproduction be undertaken, and research on the relation of family size to family health and of fertility to childhood mortality is already under way in several countries. The present Group recommends the extension of these studies to include health parameters of growth and development.

The Group has identified a great many research questions in the area of nutrition. A number of them concern the effects of infant diets on health in later life: for example, what are the effects of different regimens (breast milk, standard milk formulae, and artificial milk that simulates breast milk) on growth and development? What is the relationship between artificial feeds consumed in infancy and atherosclerosis in later life, or between the pattern of feeding in infancy and obesity in adulthood? Other questions concern changes in diet as families move from rural to urban areas, particularly the trend away from breastfeeding among women in cities.

The long-term effects of poor nutrition on the immune response are not known, and the Group recommends further research in this area. A related question is the effect of the malnutrition-infection synergism in childhood on disease in adulthood and on life expectancy. The Group reiterates the need identified by a previous WHO Scientific Group<sup>3</sup> for continuing research on the effectiveness of various combinations of vaccines given at different ages by different techniques.

An example of a desirable study on the relationship between human development and infections is the investigation, in areas where malaria is holoendemic, of the effectiveness of practical and systematic antimalarial treatment in childhood in controlling the ravages of malaria during the most severe attacks, while at the same time permitting the development of resistance.

<sup>1</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1970, No. 457, pp. 57-59.

<sup>2</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1969, No. 435, pp. 38-39.

<sup>3</sup> *Wld Hlth Org. techn. Rep. Ser.*, 1968, No. 400, p. 24.

**Recommendations for immediate action**

As indicated above, more research is needed before the impact of health on human development can be fully understood. However, it is not necessary to await further major efforts before applying already established knowledge, which is at present under-utilized in nearly two-thirds of the world. The Group recognizes that economic factors constitute a serious limitation in some developing countries, but recommends that high priority be assigned to action through public health programmes in the following areas :

(1) Nutritional disorders and infectious diseases are detrimental to human development : that they are interdependent has been clearly demonstrated by the work of many investigators in laboratory experiments, in clinical management of patients, and in public health programmes for the control of disease. The Group recommends public health action to interrupt the synergism of malnutrition and infection wherever it exists. Successful control depends upon efforts directed equally against nutritional disorders and infectious diseases.

(2) There is a close relationship between prenatal and postnatal development : preconceptional factors and conditions arising during pregnancy, parturition, or the early neonatal period may influence perinatal mortality, the health of the newborn, or the ultimate development of the child. Greater attention to these factors and conditions can thus promote better health and development throughout the world. The Group recommends public health action to ensure that every mother receives some health care in pregnancy, assistance during delivery, and subsequent care for herself, including family planning services, as well as health care for her child.

(3) A better understanding of the basic principles of human development—by the health professions, by government leaders responsible for the planning of social and economic development and the allocation of funds, by teachers at all levels of education, and above all by the people—is essential to public health action for the promotion of optimum development. The Group recommends, as an initial step, the convening of regional conferences in which health ministers and other high administrative officials can exchange views on the policies required to direct major efforts toward the improvement of human development in their countries.

(4) To ensure the realization of the principle quoted from the WHO Constitution on page 35, and in particular to secure the fullest co-operation of individuals, the Group recommends that members of the younger generation participate, even at the highest policy-making levels, in the formulation of programmes for public health action.

(5) Since this report only outlines the scope of human development and public health, the Group recommends that future meetings be convened to discuss individually and in detail the many specific factors affecting human development.

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Annex  
**PREVALENCE OF SEVERE AND MODERATE PROTEIN-CALORIE MALNUTRITION (PCM)**

Country	Year of survey	No. of children examined	Age (years)	Cases of PCM			Source
				Severe <sup>a</sup> (%)	Moderate (%)	Total (%)	
<b>Africa</b>							
Algeria .....	1963	2 105	0-4	5.9	16.6	22.5	Raoult (1966)
Algeria (Sahara) .....	1964	1 188	0-4	5.4	—	—	Raoult (1968)
Kenya .....	1968	353	—	1.0	25.0	26.0	Boldal, M. (personal communication)
Malawi (South) .....	1969	619	—	3.2	25.8	29.0	Burgess, H.J.L. (personal communication)
Nigeria .....	1961	1 268	0-15	1.7	5.6	7.3	Dean (1967)
Nigeria .....	1965	432	0-5	3.2	—	—	United States, Office of International Research (1967)
Senegal .....	1964/5	164	0-5	—	—	13.4	Cros & Baylet (1967)
Tanzania (Hombolo) .....	1965	401	0-4	3.2	17.8	21.0	Burgess et al. (1968)
Tanzania (Kisarawe) .....	1968	630	0-5	7.6	19.3	26.9	Burgess et al. (1969)
Tanzania (Tabora) .....	1969	551	—	0.5	7.3	7.8	Burgess, H.J.L. (personal communication)
Tanzania (West) .....	1969	393	—	1.5	10.5	12.0	Burgess, H.J.L. (personal communication)
Uganda .....	—	—	1-4	5.0	25.0	30.0	Musoke (1968)
Uganda (Ankole) .....	1965	286	0-7	4.9	27.2	32.1	Cook (1967)
Zambia .....	1965	359	0-5	—	—	17.0	Med. J. Zambia (1967)
Zambia .....	—	1 104	0-3	1.7-4.4	—	—	Blankhart (1968)
<b>Americas</b>							
Chile .....	1966	1 540	0-6	2.6	32.0	34.6	Monckeberg et al. (1967)
Colombia .....	1968	3 378	—	1.7	19.3	21.0	Rueda-Williamson, R. (personal communication)
Costa Rica .....	1967	738	—	1.4	9.0	10.4	Instituto de Nutrición de Centro América y Panamá (1967)
Dominican Republic .....	1968	10 333	—	2.5	10.9	13.4	Daza, C.H. (personal communication)
El Salvador .....	1967	574	—	3.3	20.9	24.2	Instituto de Nutrición de Centro América y Panamá (1967)
Guatemala .....	1967	763	—	4.1	24.5	28.6	Instituto de Nutrición de Centro América y Panamá (1967)
Honduras .....	1967	633	—	2.0	20.5	22.5	Instituto de Nutrición de Centro América y Panamá (1967)
Mexico							
rural areas .....	1958/68	5 576	pre-school	3.4	27.5	30.9	Perez Hidalgo et al. (1970)
urban areas .....	—	—	—	1.3	14.8	16.1	Instituto de Nutrición de Centro América y Panamá (1967)
Nicaragua .....	1967	708	—	1.4	11.1	12.5	Instituto de Nutrición de Centro América y Panamá (1967)
Panama .....	1967	624	—	0.6	11.0	11.6	Id. Ofic. sanit. panam. (1969)
Peru (Puno) .....	1966	3 313	1-4	0.5	4.4	4.9	Jelliffe, D.B. (personal communication)
Windward Islands (St Vincent) .....	1967	2 490	0-4	1.5	25.7	27.2	Gopalan, C. (personal communication)
<b>Asia</b>							
India .....	1969	15 000	—	1.4-2.9 <sup>b</sup>	16.0	7.4-18.9	Tre et al. (1967)
Indonesia .....	1963/65	1 958	0-5	—	—	18.0	Pakistan, Directorate of Nutrition and Research (1966)
Pakistan .....	1962/64	1 020	0-4	2.7 <sup>b</sup>	—	—	Id. (1966)
Philippines .....	1968	534	—	—	43.1	—	Bailey, K.V. (personal communication)

<sup>a</sup> Including weights below 60% of the standard weight.

<sup>b</sup> Percentage of cases of kwashiorkor and marasmus and/or percentage of cases below 60% of standard weight.

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