

NUTRITION AND INFECTION^{*}

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A longitudinal follow-up study of children from birth to six years was initiated in 1963 in a highland Mayan-Indian village of 1300 inhabitants, where old traditions are maintained and conditions leading to malnutrition and infectious diseases prevail (2). Anthropometric, clinical, dietary and microbiological data were obtained at frequent intervals from cohort children from birth to at least the sixth birthday. Some of the important observations are summarized.

The enteric agents isolated during pregnancy in the mothers of cohort children are given in Table I.

TABLE I. ENTERIC AGENTS ISOLATED IN MOTHERS DURING PREGNANCY (1964-1965)

Number of mothers	Agent	Percentage positive
24	<u>Entamoeba histolytica</u>	54
	<u>Entamoeba coli</u>	92
	<u>Dientamoeba fragilis</u>	8
	<u>Giardia lamblia</u>	8
	<u>Ascaris lumbricoides</u>	83
	<u>Trichuris trichiura</u>	58
	One or more parasites	100
116	Shigellae	9
	Salmonellae	5
32	Enteroviruses	25
	Adenoviruses	3

It would appear that almost all the mothers were harbouring one or more pathogenic infective agents in the alimentary tract and would have suffered from clinical disease at some time or other during pregnancy. Also, the food intake during pregnancy was not adequate in a great proportion of the mothers. The percentage adequacy of nutrient intake of two village mothers, one from the higher socioeconomic group and the other from the lower income group, in the second trimester of pregnancy, and of the same age, height, and family size are shown in Table II.

Deficient diet and frequent infection during pregnancy undoubtedly lead to low birth weights. The height, weight and head circumference of 323 infants from a series of 355 consecutive births occurring in the village from 1964 to 1970 are presented in Table III. The data are compared with data for infants from the high socioeconomic group of Guatemala, who are similar to infants from industrialized societies.

Undoubtedly both factors, the poor nutritional state and the frequent episodes of infection in the pregnant women, determine the growth deficit observed at birth. In a series of 70 randomly-selected infants of the same village, elevated levels of cord IgM were detected in 43% (4). Since significant amounts

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TABLE II. PERCENTAGE ADEQUACY OF NUTRIENT INTAKE OF TWO PREGNANT WOMEN (1967)

Nutrient	Adequacy, %	
	Woman A	Woman B
Total calories	136	80
Total protein*	115	74
Calcium	124	76
Iron**	203	119
Vitamin A	103	21
Riboflavin	92	42
Vitamin C	120	60

* Most protein is of vegetable origin, mainly corn. Figures are not corrected for biological value.

** Most iron is of vegetable and pulse origin.

TABLE III. WEIGHT, HEIGHT AND HEAD CIRCUMFERENCE OF VILLAGE AND CITY NEWBORNS

Parameter	323 Village newborns	300 City newborns*
Weight, g	2540 \pm 409**	3261 \pm 417
Height, cm	45.6 \pm 2.3	49.9 \pm 1.1
Head circumference, cm	32.1 \pm 1.5	34.2 \pm 0.95

* Hurtado (1)

** Means \pm 1 standard deviation.

of this immunoglobulin do not cross the placental barrier, and specimens with admixture with maternal blood had been discarded, the findings indicate the production of antibodies by the foetus. A significant proportion of the intrauterine antigenic stimulation was probably mediated by maternal-foetal infection, suggesting the establishment of nutrition-infection interaction in utero. The significance of frequent intrauterine infections in population groups of low socioeconomic condition must be assessed in relation to the growth and development, both physical and mental, of the children.

Birth weight was found to be related to the survival of children. Data on the mortality of infants according to birth weights are presented in Table IV. Village children with birth weights below 2100 grammes had a greater neonatal and postneonatal mortality than children born with greater weights.

TABLE IV. DEATHS OF INFANTS ACCORDING TO BIRTH WEIGHT

Weight, grammes	Number of children	Deaths*		
		neonatal	post-neonatal	total
<2100	33	6(18)	10(30)	16(48)
2100-2499	95	3(3)	5(5)	8(8)
2500-2899	137	2(1)	8(6)	10(7)
2900+	53	0	0	0

* Rounded percentage in parenthesis.

During the early neonatal period, some infants were found to suffer from frequent infections and it was possible to isolate pathogenic agents from stool samples. For example, during the neonatal period, shigella was isolated in 3.7% and one-fourth of all infants excreted enteroviruses in the first week of life. Infections increased with age, tended to be of more prolonged nature and were more frequently associated with clinical manifestations (3). Figure 1 depicts the history of a cohort child in the first three years of life. Weekly visits to the home and frequent examinations permitted a detailed clinical study. It was evident that despite a deficient birth weight, many children, like this one, grew well in the first few months of life. This was greatly due to adequate nutrition through successful breast-feeding, protection from infection effected by maternal antibodies received through the placenta and milk, and other mechanisms. As weaning began and passive immunity decayed, infections occurred frequently, often accompanied by symptoms. Multiple and associated illnesses were also common. This particular child had, in the first three years of life, as measured in the stools: 84 weeks with enteroviruses; 4 with adenoviruses; 8 with shigellae; 1 with enteropathogenic Escherichia coli; 18 with Entamoeba histolytica; 12 with Giardia; and 52 with Ascaris.

Several illnesses were followed by faltering of weight or weight loss. A relationship between weight gain and infectious disease was observed, in the sense that the children who grew better experienced fewer illnesses, while children with defective growth were ill more frequently (4). Dietary intakes were severely deficient during the weaning process, particularly in the second year of life. Relative improvement was observed after the

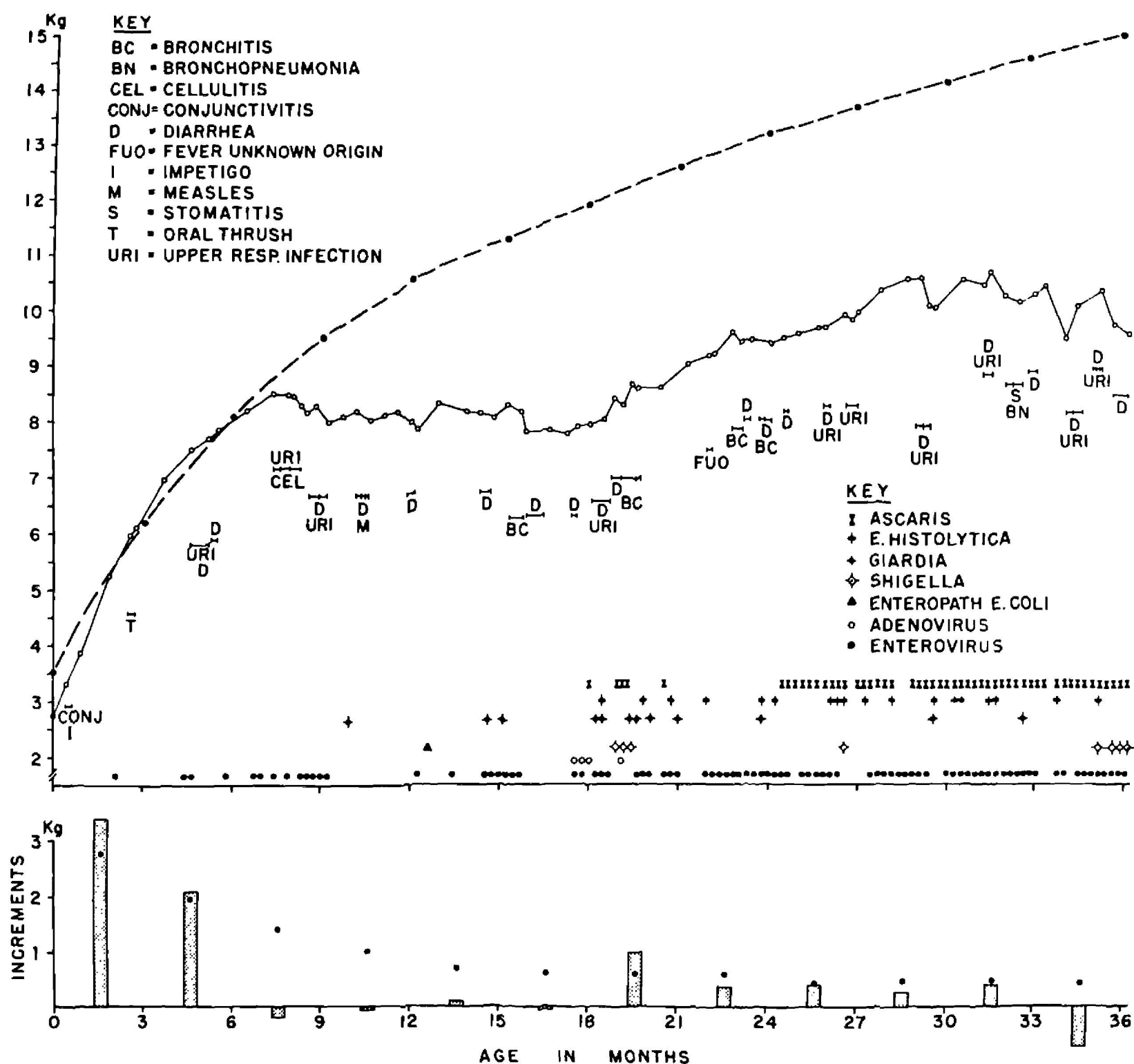
third year, but the children, in general, were already stunted with no apparent catch-up later on.

Although further studies in the field are necessary to understand clearly the nutrition-infection interactions in preindustrial societies, it can be safely asserted that poor diets and frequent infection affect the human host beginning with intrauterine life. The diets of mother and child in low socioeconomic populations are deficient, but the magnitude of infection is, by itself, an important determinant of undernutrition and deficient growth of foetus and child.

References

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FIGURE 1



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KEY :

Top: The solid line represents weight of child; the broken line is the median of the standard. The length of each horizontal line indicates duration of infectious disease. Each mark shows a week positive for the particular infectious agent.

Bottom: Observed weight increments (vertical bars) and expected median increments of the standard.