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Social and nutritional influences on morbidity: a community study of young children in Lagos

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In 1965 the WHO Expert Committee on Nutrition and Infection suggested that: 'In developing countries where for many reasons vital and statistical data are incomplete, valuable information can be obtained by long term longitudinal studies in selected representative population groups.' (WHO, 1965.) The study here described is in line with this suggestion though its length (1·5–2 years) was relatively short. Longitudinal observations on nutrition and morbidity were recorded on representative Nigerian children under 5 years of age in the urban setting of Lagos. The survey was undertaken in order to measure the medical care needs of this age group which contributed more than half of all registered deaths at a time of expansion and change in the health services of Lagos.

Selection of subjects

Children under 5 years of age were selected from five districts of Lagos (Rea, 1969) and divided into three socio-economic groups.

Group 1 (ninety-six children) came from a 'control' group of families of professional or executive status living in a new freehold housing development in the suburb of Suru Lere. Housing was good, though overcrowded by British standards.

Group 2 (150 children) came from a recently built (1957), though overcrowded, low-cost housing estate in Suru Lere and from the older suburb of Yaba.

Group 3 (165 children) came from the very overcrowded traditional district of Isale Eko on Lagos Island and from the peripheral slum area of Mushin.

Most families, even in groups 2 and 3, had access to a piped water supply of good quality. Group 1 families were volunteers; groups 2 and 3 were randomly selected by

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address. All children under 5 years of age living at the address were included in the survey. The ages of the children were known accurately. Group 1 represented the most privileged 3–4% of the population of Lagos, group 2 the next 20–25% and group 3 the poorest 70–75%.

Method of observation

After recruitment, children were visited at intervals of 2–3 weeks at home by health visitors or nurses. Mothers were asked to bring their children to a daily morbidity clinic at the survey headquarters if they became ill. Children were also brought by microbus to the survey base on their '3 month birthdays' for routine clinical and anthropometric assessment and tests. Their morbidity experience over the previous 3 months was reviewed and each episode scored for duration and clinical severity using the method described by Valadian, Stuart & Reed (1961). McFie (1967) has described a food consumption survey carried out on a sample of these children.

Nutrition and growth

Anthropometry. Growth in all aspects and in all three groups was rapid and equalled or exceeded British norms (Tanner, Whitehouse & Takaishi, 1966) in the first 3 months of life (Rea, 1970). In groups 2 and 3, growth then slowed greatly between 5 and 18 months of age. Subcutaneous fat, weight, upper arm muscle circumference, supine length and skeletal maturity were affected in that order. From 21 months to about 3 years there was a recovery phase in which growth again exceeded British norms. In group 1, slowing of growth was transient and restricted to a reduction in weight and subcutaneous fat. Fig. 1 illustrates the difference between the groups in the percentage of children whose weight fell below the UK 3rd percentile.

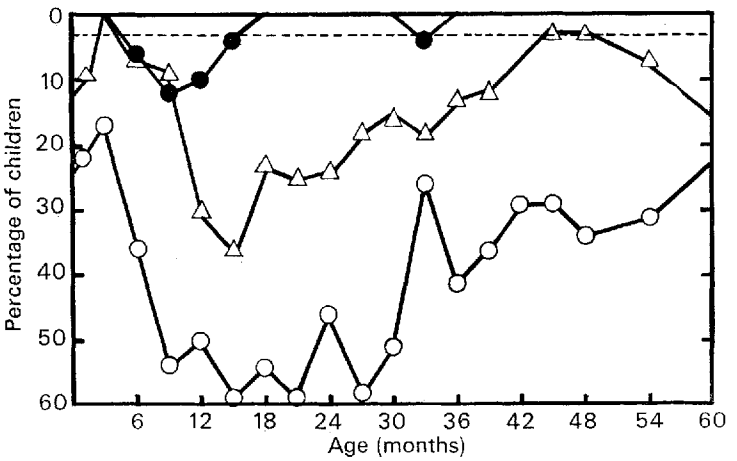

Fig. 1. Percentage of children in the three socio-economic groups in Lagos whose weight fell below the UK 3rd percentile (sexes combined). ●, group 1; △, group 2; ○, group 3. The dotted line represents the UK standard.

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Dietary studies. The results of the weighed food consumption study (McFie, 1967) are summarized in Table 1. In all groups the calorie deficiency was more severe than the protein deficiency. Because of this, the children in Isale Eko (group 3) were in a precarious state of nitrogen balance with a mean positive value of only 97 mg N/d (Miller & Payne, 1964).

Table 1. *Intake of nutrients by sixty-four children in Lagos as a percentage of WHO/FAO requirements (taken from McFie, 1967)*

Group (see p. 223)	No. of children	Age* months	Mean percentage of WHO/FAO requirements		
			Calories	Protein	Riboflavine
Group 1 (optimum)	5	45 (9–84)	93	113	62
Group 2 (Suru Lere and Yaba)	25	36 (12–72)	76	92	46
Group 3 (Isale Eko and Mushin)	34	39 (15–84)	61	72	31

*Median age with range in parentheses.

Breast-feeding was almost universal in all groups, but ceased at a median age of 6 months in group 1, 13 months in group 2 and 17 months in group 3. In groups 2 and 3, it was often supplemented by bottle-feeding of overdiluted and unsterile evaporated milk, and hand-feeding of maize pap ('eko'). Weight gain was significantly reduced in the 3-month period in which breast-feeding ceased.

Clinical examination. Commonly described signs of nutritional deficiency were uncommon. Despite the marked riboflavine deficiency (Table 1), glossitis and angular lesions were only found in nine children at routine 3-monthly examinations; seven of these were in group 3. Soft straight hair and dry skin were more common in underweight children in group 3. Eight cases of nutritional oedema were observed between routine examinations, all in very underweight weaned children between 1 and 2 years of age; seven of them were in group 3, an incidence of 14% in this group between these ages. The skin changes of kwashiorkor were present in five of these eight children, of which one died.

Biochemical measurements. Total protein estimations gave relatively normal values with no significant differences between the groups; only a small number of children with overt signs of protein-calorie deficiency had low values. Serums from a random sample of sixty-nine children tested for amino acid ratio (Whitehead & Dean, 1964) showed a higher proportion of abnormal ratios in groups 2 and 3 than in group 1.

Mortality

Only thirteen deaths occurred during the 540 child-years of observation. This relatively low mortality was partly due to the fact that the children were being observed and treated when they presented with illness by virtue of being in

the survey. The distribution of the observed deaths by age in relation to the population at risk is given in Table 2 in the form of a modified 'life-table' which also compares the observed mortality rates with those prevailing in the UK at the same time. The highest rate occurred between 1 and 1·5 years. Under 1 year, mortality was surprisingly low, considering the poor circumstances in which many of the families were living.

Table 2. *Mortality rates among children in Lagos shown as a modified life-table*

Age (months)	No. of children	Deaths	Death rate*	UK death rate (1963)	Ratio, Lagos:UK
0–5	98	2	41	21	1·5
6–11	132	2	30		
12–17	136	4	58	1·4	31
18–23	136	2	30		
24–35	118	2	17	0·9	19
36–47	99	1	10	0·7	14
48–59	70	0	0	0·6	—
0–59	107†	13	24	4·9	4·9

*Expressed as annual rate/1000 living at beginning of age period.
†Total number of child-years observed, divided by 5.

Table 3 shows sib mortality rates calculated from recollected maternity histories (checked by two observers at different times). It was between the ages of 1 and 4 years, when nutritional differences were probably greatest, that differences between the groups were most highly significant.

Table 3. *Mortality rates of children in Lagos at different ages taken from maternity histories of mothers in the three socio-economic groups*

Group (see p. 223)	Births	Deaths in different age groups: 0<1 month No.	%	1–11 months No.	%	1–4 years No.	%	0–4 years No.	%
1	173	8	4·4	6	3·3	1	0·5	15	8·7
2	287	8	2·7	18	6·2	28	9·6	54	18·5
3	356	26	7·1	32	8·7	49	13·8	107	30·0
Total	816	42	5·2	56	6·9	78	9·5	176	21·5
Significance		$0{\cdot}025<P<0{\cdot}05$		$0{\cdot}05<P<0{\cdot}1$		$P<0{\cdot}0005$		$P<0{\cdot}0005$	

Morbidity

Parasitism. Table 4 gives the crude malaria parasite rates and haemoglobin levels of the three groups at routine examination, compared with a group of village children living 32 km outside Lagos who were examined at the same time. Among the Lagos children the highest rate was in group 3 after 7 months. This was because fewer parents in this group used mosquito nets or antimalarials; they also made more journeys outside Lagos. Even so, the rates are remarkably low compared with those observed by Bruce-Chwatt (1952) in Lagos 12 years previously. Haemoglobin values were also generally high compared with the lower values of the village children whose diet was basically similar but who had a higher parasite rate with much

Table 4. *Crude malaria parasite rates and haemoglobin levels of children in Lagos in the three socio-economic groups compared with village children*

Group (see p. 223)	Age group 0–5 months: No. examined	0–5 months: % positive	0–5 months: Mean haemoglobin (g/100 ml)	Age group 7–23 months: No. examined	7–23 months: % positive	7–23 months: Mean haemoglobin (g/100 ml)	Age group 2 years and over: No. examined	2 years and over: % positive	2 years and over: Mean haemoglobin (g/100 ml)
1	17	18	12·5	51	6	10·7	67	0	11·6
2	20	20	10·8	97	6	10·7	5	5	11·0
3	27	11	10·3	77	14	10·5	127	14	11·0
All groups	64	16	10·8	227	6	10·7	344	8	11·1
Igbogbo village	8	13	9·2	33	55	8·8	21	33	9·5

higher densities. The differences between the haemoglobin values of the Lagos and village children were similar to those found by Draper (1960) before and after a malaria-eradication programme.

Intestinal parastism. Both *Ascaris* and *Trichuris* were common, beginning to appear from 6 months onwards and increasing in prevalence with increasing age. The better sanitation of Suru Lere and Yaba (group 2) compared with group 3 was not reflected in lower parasite rates.

Acute infections. The total incidence and score of all types of illness observed are given in Figs. 2 and 3. The experience of the three groups of Lagos children is contrasted with that of Boston children (Valadian *et al.* 1961). In all Lagos children the greatest incidence and highest score were in the second 6 months of life with a decrease after 12 months, more marked in group 1 than in groups 2 and 3. The period of greatest morbidity thus occurred 6 months before the period of greatest

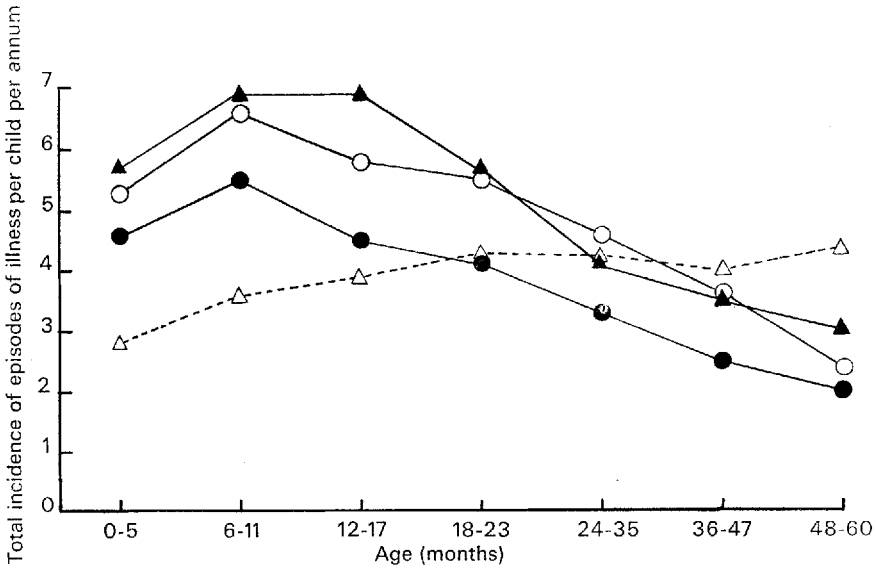

Fig. 2. Morbidity experience of children in the three socio-economic groups in Lagos compared with Boston children (Valadian *et al.* 1961). Total incidence of episodes of illness per child per annum. ●, group 1; ▲, group 2; ○, group 3; △, Boston.

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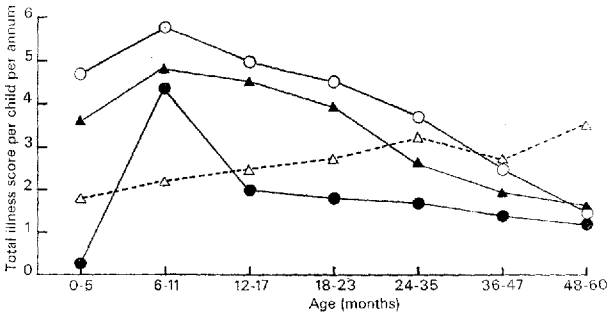

Fig. 3. Morbidity experience of children in the three socio-economic groups in Lagos compared with Boston children (Valadian *et al.* 1961). Total illness score per child per annum. ●, group 1; ▲, group 2; ○, group 3; △, Boston.

mortality. There was evidence that infections in the second 6 months of life accelerated the deterioration in nutritional state which was already occurring and which reached its lowest ebb at about 1 year of age. Further infections at this point probably met with little resistance and were more likely to result in death, especially in recently weaned children. The contrast in incidence between groups 2 and 3 is slight but the scores of group 3 are consistently higher than those of group 2. The general Lagos pattern contrasts with the Boston pattern which is characteristic of industrial countries where the greatest incidence of illness occurs around 3–4 years of age. After the first year, the Lagos group 1 children fared better at all ages than the Boston children.

Respiratory illness. Fig. 4 shows that the total incidence of respiratory illness was very similar in the three groups. Lower respiratory illness was also similar under 6 months of age but became nearly three times as common in group 3 as in group 1 between 6 months and 3 years.

Diarrhoeal illness. This showed the greatest and most consistent contrast between the three groups (Table 5). The same difference was seen when the diarrhoea

Table 5. *Annual incidence of diarrhoea per* 100 *children in Lagos in the three socio-economic groups*

Group (see p. 223)	0–5 months	6–11 months	12–23 months	24–35 months	36–47 months	48–59 months	0–59 months
1	50	160	100	10	20	10	59
2	120	190	130	80	40	30	90
3	140	270	180	90	80	50	126

occurred as part of an episode of respiratory illness. However, it was not possible to show that diarrhoea was related to weight for age within each group, in contrast to the findings of Wittman, Moodie, Hansen & Brock (1967).

Measles. The total incidence of measles was comparatively low, since many children had already had measles before recruitment. The incidence of complications was significantly greater in children in groups 2 and 3 than in group 1, who received no more chemotherapy though they made greater use of medical care facilities. In groups 2 and 3, diarrhoea as a complication of measles was significantly

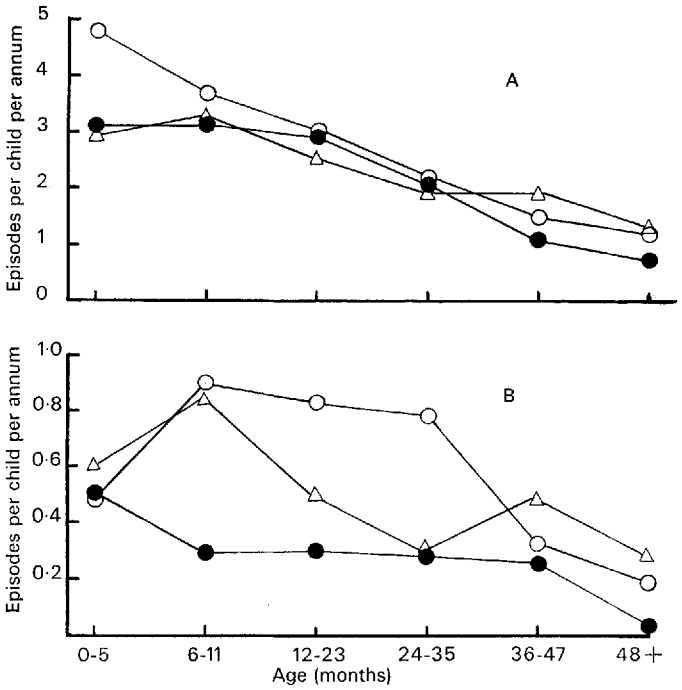

Fig. 4. Morbidity experience of children in the three socio-economic groups in Lagos: incidence of (A) all respiratory illness and of (B) lower respiratory illness as episodes per child per annum. ●, group 1; △, group 2; ○, group 3.

more frequent in children under the UK 5th percentile in weight. Diarrhoea was slightly but not significantly more common in weaned children. The cessation of breast-feeding during measles, initially due to a sore mouth, had serious consequences, resulting in two out of the three deaths due to measles and one case of post-measles kwashiorkor.

Ascariasis and weight gain. In the dry season (when mean weight gains were in any case smaller), children of 15 months and over in groups 2 and 3 with ascariasis gained slightly less weight than those who were ascaris-free. This was more marked if the child had an illness score of 1 or more during the same period. Ascariasis alone thus appeared to be of marginal nutritional importance but had a measurable effect on weight gain in the presence of other stresses such as nutritional inadequacy or superimposed infection.

Discussion

As in other studies which have attempted to measure the effect of nutritional state on response to infection in human populations, clear-cut findings are difficult to demonstrate. An excess of severe forms of illness, especially lower respiratory illness and diarrhoea, among the least well-nourished children is difficult to explain solely in terms of different physical environment, since the total incidence of illness showed much less contrast. This was most clearly illustrated by measles, in which the

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same infection followed a different course in well-off and poor children. The medical treatment given to all groups was similar; the contrast in morbidity and mortality might have been even greater had no treatment been given.

These findings suggest that the effect of undernutrition in these children may have been to increase the severity of common childhood infections rather than to produce detectable signs of nutritional deficiency. This study underlines the importance of programmes of nutritional education and the provision of suitable low-cost high-calorie high-protein foods to upgrade the nutritional status of the preschool population in developing countries. Foods of this type are particularly important in urban areas where calories are especially likely to be inadequate owing to poverty and a cash-based economy. Such programmes, however, will be undermined if suitable facilities for the prevention and treatment of common childhood infestations and infections are not simultaneously provided.

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Nutrition education in rural societies

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Prominent in the Department of Human Nutrition in the London School of Hygiene and Tropical Medicine in the days of the late Professor Platt was a diagram showing the interrelationships of the many disciplines concerned with nutrition (Fig. 1). Professor Platt believed that among these disciplines the medically qualified nutritionist had a special responsibility. Because it was only the doctor who saw the effects of malnutrition, particularly on children, the bringing together of the