Influence of illness on developmental progress in children under two

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SUMMARY. Illnesses occurring in children under two were recorded in relation to a systematic programme of child surveillance in one general practice.

The most important result of this study was that although illness does have a detectable effect on developmental progress, the degree of that influence is for the most part small.

Illnesses experienced between 0 and 7 months have less influence upon seven-month developmental scores than upon 24-month developmental scores, but have a greater influence upon the latter than do illnesses experienced between 7 and 24 months.

There was a significantly higher consultation rate for boys and for children from social classes 3b, 4, and 5.

Introduction

FOR many years child health surveillance has been an integral part of a group practice caring for 12,000 patients. As part of this service all the children in the practice have been seen for a developmental screening and physical examination at six weeks, seven months, two years, and four and a half years. The tests are done in accordance with a strict protocol, scored on a five-point scale, and the results recorded in the form of a developmental profile (Starte, 1974 and 1976).

Analysis of data for 240 children seen at seven months and again at two years yielded patterns of correlations that were statistically significant and medically and psychologically useful. For example, the largest factor at seven months loaded heavily on behavioural items relating to gross motor control, whereas at two years this was replaced by a factor relating to fine motor control. Language and communication also emerged as a significant factor at two years. Moreover, gross and fine motor control at two years correlated significantly with measures taken on these variables at seven months, and language and communication at two years correlated with imitative behaviour at seven months.

However, although statistically significant, correlations between seven-month and two-year developmental scores were uniformly low and of little value for predictive purposes. This finding is in accord with previously published research in the field (Lewis and McGurk, 1972).

It is, of course, already known that when groups of disabled children are studied a significant proportion of them will have had a serious predisposing physical illness. Fraser (1964) found that in a study of 2,355 children in residential schools for the deaf, about one third had suffered a serious illness, and in 393 the deafness had followed meningitis. This is similar to Johnson's study (1962) of 68 deaf or partially deaf children in which 26·5 per cent were due to postnatal illnesses.

In a study carried out on 474 developmentally delayed children (Minski and Shepperd, 1970) it was found that about one third of the deaf children and a quarter of the subnormal children had suffered from meningitis or encephalitis often associated with measles.

However, there have not been any studies on the relationship between the common childhood illnesses and the developmental progress of the children who suffer them.

Aim

The aim of this study was to investigate the possibility that the illnesses which children suffered affected their developmental progress.

Method

Selection of children

A total of 204 children who had attended the practice developmental screening clinic for both seven-month and two-year assessment between 1 March 1971 and 1

March 1973, and whose records were complete, were selected for the study. Each child was given an eight-digit identification number. Digits 1 to 5 represented respectively the following independent variables: sex, birth order, family size, social class, and any abnormality of pregnancy or labour. Digits 6 to 8 inclusive represented the child's individual code number. Only the general practitioner and the research assistant held the key to individual code numbers and hence confidentiality was ensured.

Collection of development data

The 1 to 5 code numbers were allocated from the data on the social and personal history part of the developmental record card. Each child was then allocated his personal identification number and the test scores in response to the tests, grouped in the six developmental categories, were recorded for both the seven-month and two-year examinations.

Data about illnesses

Each child's medical record was then analysed and a card instituted which contained the child's identification number and his date of birth. On this card was entered the date of each consultation and a code number for the diagnosis. For the purpose of coding the Royal College of General Practitioners' (1963) classification of morbidity was used, with a few additions for diagnoses which were not easily included under this code but which commonly occurred in the sample. A note was made of an illness which required hospitalization and the length of stay. If the consultation resulted in a diagnosis for the first time or was a follow-up of an already known illness this information was also recorded. The illness card was completed by recording the total number of consultations between 0 and 7 months and seven months to two years.

It is interesting that although 29 of the children had moved away from the area by the time the medical records were analysed, it was possible by the use of health visitor contacts and correspondence with family practitioner committees to trace all the missing records and complete the illness cards.

Analysis of consultation rates and development data

From the illness record card, consultation rates were calculated for each child covering the periods 0 to 7 months, 7 to 24 months, and 0 to 24 months. These data were then correlated with factor scores generated from the developmental screening tests for the corresponding periods. The developmental factors employed in this analysis were as follows:

7 months:

1. Gross motor control.
2. Fine motor control and perceptual discrimination.
3. Social imitation.

Table 1. Illness codings under the nine major headings.

101	Infection—viral and others
102	Asthma, eczema
103	Behaviour disorders
104	Diseases of central nervous system
105	Respiratory tract infections
106	Accidents
107	Skin infections, including nappy rash
108	Diseases of the eye
109	Otitis media

24 months:

1. Fine motor control and perceptual discrimination.
2. Language production and comprehension.
3. Gross motor control.

For each age level, the factors are listed in order of magnitude of variance accounted for. The three seven-month factors accounted for 53·61 per cent of the total variance at that age, while the three 24-month factors contributed 45·24 per cent of the total variance.

Analysis of illness data

To reduce the data to manageable proportions, the illnesses were divided into nine major groups (Table 1) and frequency multiplied by illness group rates were generated for each child. Correlations were then calculated between specific illness groups and developmental factor scores. Correlations were also calculated between 0 to 7-month illness incidence and 7 to 24-month illness incidence.

Results

Consultation rates and incidence of illness

An analysis of the frequency of consultations is shown in Table 2. As the rate did not vary significantly during the two periods under review in 0 to 7 months and 7 to 24 months, it is reasonable to take the total figure for the annual consultation rate as representative of both sections of the sample. The annual consultation rate of 4·22 can be compared with a national average in the 0 to 4 age group of 3·63 (RCGP, OPCS and DHSS, 1974). Bain (1976) in a study from Livingstone gave consultation rates of 8·2 in the 0 to 1 age group and 4·9 in the one to five age group.

When the rates were analysed further in accordance with the fixed social data, two major differences became apparent. The first was a sex difference: the rate for boys was 4·60 and for girls 3·65. Secondly, there was a difference across the Registrar General's social classes (OPCS, 1970): the annual consultation rate for classes 1, 2 and 3a was 3·25, while for classes 3b, 4 and 5 it was 4·80.

An analysis of the episodes of illness recorded on the

Table 2. Analysis of consultation rates from 0 to 7 months, 7 to 24 months, and 0 to 24 months.

	Number of consultations							
	Total	Modal	Median	Range	Mean	SD	Monthly mean	Annual
0-7 months	501	1	2	0-22	2.46	2.908	0.351	
7-24 months	1,218	2	4	0-35	5.97	5.665	0.352	
0-24 months	1,719	3	7	0-48	8.45	7.251	0.352	4.22
					N = 204			

medical cards is shown in Table 3. A total of 88 coded illnesses were recorded but only the first 28 which occurred in seven or more patients have been included lest the table become too unwieldy. The full analysis provides an interesting profile of illness in the first two years of life. Surprisingly perhaps, otitis media was the commonest single diagnosis even at this young age. Not so surprisingly it confirms the well known frequency of respiratory tract illness in the young child. Seven of the first ten illnesses come into this category and respiratory illness accounted for 569 (56·6 per cent) out of 1,005 consultations (Table 3).

Correlations

Table 4 records the results of correlating the consultation rates from 0 to 7 months, 7 to 24 months, and 0 to 24 months with the factor scores generated from the developmental test data at seven months and two years. From this table two main conclusions can be drawn. First, the correlations are negative—that is, the higher

Table 3. Analysis of illnesses, using the RCGP classification of morbidity, in order of frequency of occurrence (excluding 60 identified illnesses which occurred in six or fewer patients).

Illness no.	Illness in order of frequency of occurrence	No. of patients	No. of incidents
183	Acute otitis media	95	181
303	Non-specific diarrhoea/vomiting	76	105
267	Non-specific cough	66	94
272	Non-specific URTI not included by name	59	74
247	Acute bronchitis/bronchiolitis	56	108
170	Conjunctivitis	46	61
242	Acute pharyngitis/acute tonsillitis	36	43
261	Catarrh	28	30
12	Rubella	26	26
240	Acute non-febrile nasopharyngitis/coryza	22	26
381	Infantile eczema	22	38
386a	Nappy rash	19	24
483	Lacerations/abrasions/contusions	19	20
150	Behaviour disorders—mainly sleep disturbance	15	18
321	Other diseases male genitals mainly balanitis	14	15
436	Congenital abnormality genitourinary system	14	15
244	Acute laryngitis/tracheitis/croup	13	13
308a	Feeding problems	12	14
160	CNS hyper/hypotonic children—no specific diagnosis	12	12
178	Strabismus	11	13
284	Hiatus and umbilical herniae	10	14
290	Constipation	10	13
493	Other injuries and effects of external trauma	10	10
13	Chickenpox	8	8
31	PUO without rash	8	8
11	Measles	7	7
237	Signs of cardiac disease including innocent murmurs	7	8
398	Undiagnosed rash without pyrexia	7	7

Table 4. To show the significance of correlations between the consultation rates from 0 to 24 months and the developmental factor scores of the same children at seven months and two years.

	Pearson's product–moment correlation coefficient N = 204					
0-7 months consultation rate	−.009	−.072	−.164*	−.163*	−.231**	.028
7-24 months consultation rate	.122	.046	.011	−.091	−.027	−.094
0-24 months consultation rate	.091	−.004	−.046	−.116	−.113	.072
	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
	Gross motor control	Perceptual discrimination and fine motor control	Social imitation	Fine motor control and social imitation	Language (verbal production and comprehension)	Gross motor control
		7-month tests			24-month tests	
			Development			

*Indicates significant correlation at the .01 to .05 level.
**Indicates significant correlation at the .001 to .009 level.

Table 5. To show the significance of correlations between grouped illnesses suffered from 0 to 7 months and the developmental factor scores of the same children at seven months and two years.

	Pearson's product–moment correlation coefficient N = 204					
Infections—viral and others	.120	−.047	.001	−.073	−.053	.021
Asthma and eczema	.166	−.039	.173*	−.114	−.121	.045
Behaviour disorders	.095	.044	.021	.062	−.079	−.040
Diseases of the central nervous system	−.242**	−.103	−.236**	−.226**	−.200**	−.086
Respiratory tract infections	−.050	.047	−.174*	−.181*	−.212**	.057
Accidents	.012	.112	.020	.143*	.033	.044
Skin infections	.061	.102	.027	−.073	−.157*	−.140*
Diseases of the eye	−.030	−.064	−.143*	.057	−.023	−.021
Otitis media	.003	.060	−.111	−.081	−.007	.022
	Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
	Gross motor control	Perceptual discrimination and fine motor control	Social imitation	Fine motor control and social imitation	Language (verbal production and comprehension)	Gross motor control
		7-month tests			24-month tests	
			Development			

*Indicates significant correlation at the .01 to .05 level.
**Indicates significant correlation at the .001 to .009 level.

the consultation rate the lower the developmental scores.

Secondly, though the level of these correlations is generally small, corresponding to about one to four per cent of the variance, the consultation rate from 0 to 7 months is a better predictor of the two-year developmental scores than any other possible combination. This emphasizes the relative importance of illnesses in the first seven months compared with illnesses in the next 17 months and that the effect of this early illness is more apparent at two years than at seven months.

Table 5 shows the relationship between the nine groups of illnesses and developmental factor scores at seven months and two years. The validity of this matrix can be inferred by the significance of the correlation between diseases of the central nervous system and developmental scores.

The other correlation significant at the $p<0{\cdot}001$ level is between respiratory tract infections and speech at two years, a finding that is of interest to those concerned with language development. It will be noted that no such correlation was found between otitis media and subsequent speech development at two years. This is because the practice has a very active programme of treatment for children with otitis media, which includes following them up until the hearing test gives a normal result. The analysis suggests that this activity is proving to be successful but raises the question of using hearing tests following respiratory infection not complicated by otitis media.

References

Bain, D. J. G. (1976). *Update,* **12,** 707-720.

College of General Practitioners (1963). *Journal of the College of General Practitioners,* **6,** 207-216.

Fraser, G. R. (1964). In *Research in Deafness in Children,* ed. L. Fisch. London: National Deaf Children's Society and Blackwell Scientific Publications.

Johnson, J. C. (1962). *Educating Hearing-impaired Children in Ordinary Schools.* Manchester: Manchester University Press.

Lewis, M. & McGurk, H. (1972). *Science,* **178,** 1174-1177.

Minski, L. & Shepperd, M. (1970). *Non-communicating Children.* London: Butterworths.

Office of Population Censuses and Surveys (1970). *A Classification of Social Class.* London: HMSO.

Royal College of General Practitioners, Office of Population Censuses and Surveys & the Department of Health and Social Security (1974). *Morbidity Statistics from General Practice. Second National Study 1970-1.* London: HMSO.

Starte, G. D. (1974). *Practitioner,* **213,** 823-828.

Starte, G. D. (1976). *Practitioner,* **216,** 311-316.

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