ILLNESS DURING THE FIRST FIVE YEARS OF LIFE

RESULTS OF AN INQUIRY IN THE BOROUGH OF LUTON

BY

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(1) INTRODUCTION

In a previous communication (Grundy, 1949), an interim report was made of the early results (for the period 0-2 years) of an inquiry into the sickness experience of a group of children during the first 5 years of life. The group comprised 1,849 babies* born in Luton during 1945 to women resident in Luton at the time. In the present paper three subjects in particular are examined:

- (1) the volume of sickness and its broad pattern at different periods during the first 5 years of life;
- (2) social class differences in sickness experience;
- (3) hospital admissions.

For all three subjects the present report develops the account given for the first and second years of life in the interim report and continues the study to the end of the 5-year period.

For a number of reasons it has proved convenient to prepare the present account as a self-contained paper covering the entire survey period. In the first place, the social classification used in the interim report was the Registrar General's 1931 classification, whereas in the present report the 1951 classification has been adopted. Next, additional information which became available at the end of the survey period enabled a social class to be assigned to many parents who could not be classified when the interim report was prepared. Finally, much more detailed analyses have been made than was practicable at the time of the interim report—of special note, in the present report a study of social class differences is made for the main groups of diseases separately and for four social groups, namely the Registrar General's Groups 1 and 2 combined, R.G.3, R.G.4, and R.G.5. (In the interim report 1, 2, and 3 were combined to constitute one social group, and 4 and 5 to constitute a second.) Because of these procedural differences, the figures given here for the period 0-2 years are not directly comparable with figures for the corresponding years in the earlier

contribution. The present paper therefore not only enlarges but in some respects supersedes the interim report.

In addition to the subjects just mentioned, the present paper contains a short appendix which illustrates the effect on social class differences when a modification of the Registrar General's classification is used. The appendix itself is not of great importance, but the reasons which led us to examine an alternative social class classification are not without interest.

Two years ago, the results were published of a national sample survey of mortality and morbidity during the first 2 years of life (Douglas, 1951). The national survey, employing a social class grouping based on the occupational groups of the Family Census, disclosed unmistakable gradients for morbidity; the Luton material at the stage of interim analysis did not. The national and local findings are not, however, necessarily in conflict: the presence of a national gradient does not exclude the existence of local areas with gradients steeper than the national, with gentler gradients, or with no gradient at all.

Douglas (1951), examining the Luton material critically, was unable to accept the absence of social class differences in Luton as fully substantiated. He thought that on the one hand the combinations of social classes examined in the interim report did not provide groups which were sufficiently contrasting, and that on the other hand the Family Census occupational groups classification might have shown social class differences in the Luton material which were masked by the Registrar General's classification. The extent to which the results of the interim analysis of the Luton data are modified by the more detailed analysis now made is clear from the text which follows; the appendix deals briefly with Douglas's second point.

In another communication, Dykes (1950) carried the Luton studies a step further. Depending on investigations collateral with the main study, he was led to conclude that in addition to the absence of social class differences there were also no differences

* 1,849 singletons. Seventeen pairs of twins (34 infants) were excluded because of the methodological complications their inclusion would have introduced.

in Luton when sickness incidence during the first year of life was analysed according to housing standards and standards of maternal care. Grundy (1950), pointing out that the presence of a social gradient for infant mortality cannot be assumed to imply a corresponding gradient for sickness, argued that extensive combined studies of infant sickness and infant mortality were needed to define the relation which the one bears to the other.

Whether differences in infant mortality rates at different social levels or in different administrative and geographical areas are due wholly, in part, or not at all, to differences in sickness rates is a question of considerable practical importance, but one which the present paper does not attempt to answer. Indeed, the facts needed to answer this question could only be obtained from morbidity and mortality studies conducted simultaneously in a number of areas according to a common plan.

The value of information to be gained from this type of investigation in areas "even where the infant mortality rate may not give rise to undue anxiety" is the subject of comment in a recent report of the Ministry of Health (1950); and we may perhaps be permitted to mention here that a study designed to clarify the mortality-morbidity issue in infancy is nearing completion* and will in due course become the subject of another communication.

(2) THE SURVEY POPULATION

The year 1945 proved, in one sense, to be an unfortunate choice for beginning the investigation. Luton had been a reception area during the early years of the war, and many women—often the young wives of men in the Services—had made the town their war-time home and were having their babies there. When the war was over these women began to return to London and other areas in a steady stream. The 1,883 babies originally included in the survey are compared below with the official returns (figures in brackets):

Sex	Male	Female	Total
Legitimate ..	901 (902)	839 (839)	1,740 (1,741)
Illegitimate ..	76 (77)	67 (67)	143 (144)
Totals ..	977 (979)	906 (906)	1,883 (1,885)

* Studies of sickness during their first year of life of infants born in 1952, and studies of infant deaths occurring in 1951, 1952, and 1953 are being conducted in fourteen areas according to a common plan, the total infant population under review being some 24,000. The local investigations, co-ordinated by the Department of Preventive Medicine of the Welsh National School of Medicine, are being undertaken in each area by the local Medical Officer of Health. The areas participating are: Ashton-under-Lyne, Blackburn, Cardiff, Gloucester County, Leyton, Luton, Preston, Rochdale, Slough, Soke of Peterborough, Walsall, Warwickshire County, Warrington, and West Ham.

The correspondence between the official return (Luton births published in the Registrar General's Annual Report for 1945) and the group of babies for whom cards were made out is virtually complete. But early losses were heavy.

The exclusion of 34 twins (mentioned earlier) reduced the number initially "exposed to risk" from 1,883 to 1,849. In 328 instances the Health Visitor found on making her first survey visit that the family had moved. These removals may be divided into two groups. Of the first (153 families) many had left the United Kingdom and the new addresses of a substantial proportion of the remainder could not be ascertained. These 153 might be regarded as outward transfers, or births which occurred in Luton to mothers normally resident elsewhere. The second group (175 families) differed from these "transfers out" only in that the father's civilian occupation was known and the child could therefore be assigned to a social class. In the "Exposed to Risk" Tables, these 328 infants are included but are allowed no exposure.

By the end of the 5-year follow-up period, another 199 infants had become lost to the Survey by a change of address. These, and losses by death (see Table I, cols 3 and 4, p. 34), are taken account of for the period during which their sickness history was available—i.e. up to the date of death or last contact made with the family by the health visitor, or in a few instances to a later date up to which records of hospitalization or notifications of infectious diseases were available.

(3) METHOD OF THE SURVEY

With the exceptions mentioned below, the enquiry was conducted by means of a questionnaire addressed to the child's mother. A record card was made out for each child, incorporating in the first place such facts as name and address, date of birth, sex, legitimacy, birth weight, maternal age and birth order, duration of marriage, and (for legitimate children) father's occupation. These particulars and certain others relating to housing standards were obtained from existing departmental records and verified when necessary on the occasion of a home visit.

As soon as practicable after the child's first birthday, and then after each succeeding anniversary of the birth until the survey was completed, a special visit was paid by a health visitor to the child's home. The child's mother was asked for information about the child's illnesses up to the date of the first visit, or thereafter during the interval which had elapsed since the previous visit. The nature, date of onset, and duration of the illness, as far as the mother could recall them, were entered on the record card by the health visitor.

Records of illnesses obtained in this way were checked against information from two other sources. Information

about infectious diseases occurring among the cohort (received by the department as an ordinary routine) was transferred to the record cards to amend or supplement information obtained by the health visitor. Also, during the entire survey period, hospital records of the four hospitals situated in the Borough (Luton Children's Hospital, Isolation Hospital, St. Mary's Hospital, Luton and Dunstable Hospital) were examined at intervals by a member of the Health Department staff; particulars relating to any child born during 1945 were abstracted, and appropriate additions or amendments were made on the survey record cards.

(4) DEFINITIONS AND INDICES OF SICKNESS

SICKNESS.—This was defined for the purpose of the survey as an illness or an accident fulfilling one of the following requirements:

- (a) it needed treatment in bed for 48 hours or more,
- (b) a doctor was called,
- (c) it left a recognized disability.

The adoption of this arbitrary definition implies that the amount of sickness recorded falls short of actuality. Many minor ailments, such as simple colds or the so-called teething troubles and bowel upsets of infancy, would in all likelihood be incompletely entered in the records. This consequence was foreseen and the definition of sickness was formulated in the above exclusive form on three grounds: first, because it seemed doubtful if trivial departures from health in infancy are sufficiently distinctive to be identified with any certainty; secondly, because many if not all would have been forgotten by most mothers (but perhaps remembered by some) after the elapse of weeks or months; thirdly, because it did not seem, in a survey which could not be expected to give more than a general picture of infant morbidity, that uncomplicated trivial incidents could usefully be included.

GROUPS OF ILLNESSES.—The illnesses recorded were classified into ten broad groups, viz:

- I. Pneumonia and bronchitis.
- II. Influenza, colds, and other respiratory infections.
- III. Gastro-enteritis, gastric influenza, diarrhoea, dysentery, and other diseases of the stomach.
- IV. Infectious diseases, including measles, whooping cough, scarlet fever, mumps, and chicken pox.
- V. Skin diseases, abscesses, and boils (other than of the ear).
- VI. Accidents and injuries (including burns and scalds).
- VII. Tonsillectomy and tonsillitis.
- VIII. Diseases of the ear.
- IX. Diseases of the eye.
- X. Other diseases.

Examples of conditions recorded under Group X are:

Swollen glands, jaundice, fluid on the knee, shingles, rectal prolapse, intussusception, and congenital malformations.

SOCIAL CLASS.—As mentioned earlier, social class was determined for the present paper by referring the father's occupation to the Registrar General's 1951 classification of occupation by social class. In 1945, when survey cards were originally made out, a large number of men were serving with the forces, predominantly in the army. According to the 1931 classification, these men, unless they held commissions, were allocated to social class 4 by the 1931 classification then employed. After the survey was completed an effort was made, in a large proportion of cases successfully, to discover the occupation of these men in civilian life. Most of them were in skilled occupations and the births were re-classified accordingly. We believe this was the right course to follow since the circumstances in which a child is reared are more likely to be determined by the father's civilian occupation than by his army rank at the time of the child's birth.

The relatively high proportion of Class 3 in our series (Luton, 1945—71 per cent., England and Wales, 1949—57 per cent.) is consonant with the results of a post-war local census, *Report on Luton* (1945), and also with what is known about the town's leading industries which all employ a high proportion of skilled labour.

INDICES STUDIED.—Two indices of the volume of sickness experienced at each year of life (or in the case of the first year of life at each of the four periods, 0–3, 3–6, 6–9, and 9–12 months) are used:

- (i) Incidence rate—the ratio of the number of sickness incidents occurring in a group of children during the year* before attaining a specified age, to the average number under observation during the period in question:
i.e. (No. of sicknesses recorded) ÷ (Average number exposed to risk of sickness).
- (ii) The average number of days of sickness per child—the ratio of the total days of sickness during the year* before attaining any age, to the average number alive during the year:
i.e. (Total days of sickness) ÷ (Average number exposed to risk of sickness).

The first index, whilst having the advantage of enabling hospital admission rates to be stated, has, on the other hand, the disadvantage of recording every illness as the equivalent of every other in "aggregated" sickness rates; it fails, moreover, to

* Or 3 months, in the first year of life.

provide an adequate measure of the volume of sickness from different causes at different ages. For these reasons alone the second index would be the one of preference, but, in addition, since birthday anniversaries are arbitrary boundaries and illnesses beginning in one year often extend into the next, the second index avoids the necessity of allocating an incident entirely to the period in which it commences.

In apportioning illnesses whose date of onset or duration were vaguely stated, an element of arbitrariness had to be introduced, but any error incurred by this procedure is more than offset by the advantage of the index made available.

The duration of an illness, never easy to define, is particularly difficult to delimit in infancy. Apart from errors due to faulty parental memory—inevitable in inquiries of this kind—the duration attributed to such conditions as whooping cough and bronchitis, for example, must depend to no small extent on personal standards of judgment. Mainly because we recognize such limitations as these, incidence rates as well as rates based on days of sickness are quoted in some parts of the paper.

The numerators of the indices need no comment; the method of calculating the denominator common to both—i.e. the number exposed to risk of sickness in each year (or part of a year) of life—requires a word of explanation.

In most investigations it can be assumed that withdrawals are evenly distributed in the final period of observation, so that on an average each is exposed for half the period. In the present investigation this assumption cannot be made. Health visitors did not make their visits exactly at anniversaries of births, but usually some weeks (0–13) thereafter. The ages at which infants were lost sight of are therefore evenly distributed, not throughout each year of age but throughout the range x to $(x+0.25)$. Because of this it was necessary to calculate, for each child lost sight of, the exact length of exposure from birth to the date when the last contact was made and sickness history recorded. A similar argument applies to children lost to the inquiry by dying before attaining their fifth birthday.

In Table I, which shows deaths and withdrawals at each period of life, the items entered under df_x and wf_x are the sums of the fractions of the period contributed respectively to their final period of exposure by those who died or withdrew.

(5) TOTAL VOLUME OF SICKNESS

In Table II, the number of morbid incidents of all kinds per hundred children is shown for each period of life.

TABLE I
DEATHS AND WITHDRAWALS AT EACH PERIOD OF LIFE

x	Period of Life	Deaths		Withdrawals		Existing at Close of Observation s_x	Number Exposed to Risk E_x
		d_x	df_x	w_x	wf_x		
0-25	0- mths	35	3.5	328*	0	—	1,490
0-50	3- mths	7	1.7	—	—	—	1,481
0-75	6- mths	—	—	—	—	—	1,479
1-100	9- mths	1	—	1	1.0	—	1,478
2	1- yrs	4	1.0	70	17.9	—	1,422
3	2- yrs	2	0.7	44	5.3	—	1,363
4	3- yrs	2	1.1	49	9.5	—	1,317
5	4- yrs	4	1.8	35	3.4	—	1,272
		55		527		1,267	1,849

* Including 153 "transfers out"—see para. 3 of Section 2 (p. 32).

Column 6 shows the number exposed to risk of sickness at each period of life. The formula employed for calculating this number is explained below; the question of bias introduced by withdrawals is discussed in Section 8 (p. 39).

The number of children exposed to risk of sickness during any year of life (see note) for the whole of that year is clearly equal to the total births less the sum of the withdrawals (w) and deaths (d) occurring in the year (s) up to attaining age x . The deduction made for these withdrawals and deaths is represented by Term 1 in the formula:

$$E_x = \text{total births} - \sum_{(i)} (d_x + w_x) + \sum_{(i)} df_x + \sum_{(i)} wf_x$$

The expression df_x (Term 2) is then added, being the sum of the increments of the year of dying during which the d_x children remained in the survey before death; similarly, the addition of the term wf_x makes a corresponding adjustment for the withdrawals, being the sum of the fractions of the year of withdrawal for which they were exposed to risk before they were lost sight of. Thus, to take a numerical example, E_1 (at 1-2 years) in Table I becomes:

$$\begin{aligned} E_1 &= 1,849 - (47 + 399) + 1 + 18 \\ &= 1,849 - 446 + 19 \\ &= 1,422. \end{aligned}$$

NOTE: "year" should be read as "year or period", whenever it occurs in this footnote.

TABLE II
ATTACK RATES PER 100 CHILDREN EXPOSED, AT DIFFERENT PERIODS OF LIFE

Period of Life	Number of Illness Incidents	Rate per 100 Children Exposed
0- mths	103	6.9
3- mths	129	8.7
6- mths	139	9.4
9- mths	175	11.8
Total 1st yr	546	36.9
2nd yr	650	45.7
3rd yr	513	37.6
4th yr	671	51.0
5th yr	510	40.1

In Table III (opposite) the morbid incidents are classified according to cause.

The general picture presented by the Tables is readily perceived. Respiratory infections (Groups I and II) are the leading causes of sickness during the first year of life, when they account for half the recorded incidents.

Thus, fifteen children in every hundred had an attack of pneumonia or bronchitis beginning in the first year of life, or to be precise, the attack rate from

TABLE III
INCIDENTS CLASSIFIED ACCORDING TO CAUSE (GROUPS I-X, see p. 33) AT DIFFERENT PERIODS OF LIFE

Period of Life	Illness Groups									
	I	II	III	IV	V	VI	VII	VIII	IX	X
0- mths	36 (2.4)	9 (0.6)	10 (0.7)	14 (0.9)	5 (0.3)	2 (0.1)	—	4 (0.3)	3 (0.2)	20 (1.3)
3- mths	51 (3.4)	10 (0.7)	18 (1.2)	19 (1.3)	11 (0.7)	2 (0.1)	—	3 (0.2)	2 (0.1)	13 (0.9)
6- mths	63 (4.3)	18 (1.2)	15 (1.0)	25 (1.7)	1 (0.1)	—	—	5 (0.3)	—	12 (0.8)
9- mths	72 (4.9)	9 (0.6)	26 (1.8)	42 (2.8)	3 (0.2)	2 (0.1)	—	7 (0.5)	—	14 (0.9)
Total	222 (15.0)	46 (3.1)	69 (4.7)	100 (6.7)	20 (1.3)	6 (0.4)	—	19 (1.3)	5 (0.3)	59 (4.0)
1st yr	135 (9.5)	37 (2.6)	43 (3.0)	325 (22.9)	18 (1.3)	17 (1.2)	10 (0.7)	16 (1.1)	3 (0.2)	46 (3.2)
2nd yr	60 (4.4)	29 (2.1)	15 (1.1)	284 (20.9)	11 (0.8)	20 (1.5)	33 (2.4)	17 (1.2)	1 (0.1)	43 (3.1)
3rd yr	77 (5.9)	31 (2.3)	16 (1.2)	413 (31.4)	11 (0.8)	18 (1.4)	47 (3.6)	18 (1.4)	1 (0.1)	39 (3.0)
4th yr	37 (2.9)	36 (2.8)	8 (0.6)	278 (21.9)	5 (0.4)	17 (1.3)	73 (5.7)	20 (1.6)	3 (0.2)	33 (2.6)
5th yr										

NOTE: Figures in brackets are rates per 100 child-years of exposure.

these causes during the first year of life was 15 per 100 children.

During the second year of life this group of infections is much less prominent, and in succeeding years makes a diminishing contribution to the total number of illnesses recorded.

From the first birthday onwards the situation is dominated unmistakably by the notifiable infectious diseases (Group IV), when in each year they account for over half the recorded sickness.

The location of the bulk of respiratory infections in Group I (pneumonia and bronchitis) is almost certainly due to the understatement of minor illnesses—probably a gross understatement—for reasons previously stated. It will be seen that at 0-1 year this group of illnesses containing most of the serious respiratory infections, outstrips in numerical importance every other group by a wide margin.

The high attack rates in the 2nd and 4th year of life (Table II) are mainly attributable to a high incidence of measles in the late months of 1946 and the early months of 1947, and a similar epidemicity 2 years later.

In Tables IV and V sickness rates are expressed in days of sickness per child exposed at different periods.

Table IV shows that the average number of days of sickness in the first year of life was 7.3 per child, distributed approximately as 1.3 days in the first 3 months of life and 2 days in each of the remaining 3-month periods. In the next 4 years of life the rate lies between 6 and 8 days' illness per child per year. Comparing Table IV with Table II, their likeness is evident. In both, for example, the fourth year shows the highest, and the second year the next highest rate. Comparing Table V with Table III, the similarity of trends disclosed by the alternative indices is seen to extend to individual categories of

TABLE IV
DAYS OF ILLNESS PER CHILD EXPOSED TO RISK, ALL CAUSES COMBINED

Period of Life	Days of Illness	Rate per Child Exposed
0- mths	1,893	1.27
3- mths	2,821	1.90
6- mths	3,126	2.11
9- mths	2,949	2.00
Total 1st yr	10,834*	7.31
2nd yr	11,638	8.19
3rd yr	8,727	6.40
4th yr	11,045	8.39
5th yr	7,647	6.01

* The difference between this figure and the summation of the four quarters of the 1st year is explained in para. 3 under the heading "indices studied" (p. 33).

TABLE V
DAYS OF ILLNESS FROM DIFFERENT CAUSES PER CHILD EXPOSED TO RISK

Period of Life	Illness Groups									
	I	II	III	IV	V	VI	VII	VIII	IX	X
0- mths	0.35	0.09	0.09	0.14	0.12	0.04	—	0.01	0.07	0.29
3- mths	0.69	0.06	0.11	0.38	0.27	0.02	—	0.07	0.09	0.16
6- mths	0.91	0.12	0.07	0.40	0.27	0.01	—	0.12	0.08	0.06
9- mths	0.67	0.04	0.20	0.54	0.09	0.06	—	0.12	0.01	0.12
Total										
1st yr	2.62	0.31	0.47	1.47	0.76	0.13	—	0.32	0.24	0.63
2nd yr	1.31	0.32	0.41	4.26	0.38	0.39	0.04	0.19	0.02	0.63
3rd yr	0.78	0.25	0.10	3.87	0.13	0.39	0.19	0.15	0.01	0.49
4th yr	0.78	0.24	0.11	5.89	0.10	0.27	0.30	0.20	—	0.35
5th yr	0.35	0.19	0.03	3.92	0.04	0.24	0.49	0.15	0.03	0.31

TABLE VI

SICKNESS RATES AT DIFFERENT AGE PERIODS IN DAYS PER CHILD EXPOSED TO RISK IN EACH OF THE SOCIAL CLASSES

Period of Life	Social Class				All Classes (excluding illegitimate)
	1 and 2	3	4	5	
0- mths	0.85* (66)	1.37* (107)	0.80* (62)	2.20* (172)	1.28 (100)
3- mths	3.11* (158)	2.00 (102)	1.41* (72)	1.00* (51)	1.97 (100)
6- mths	1.59* (76)	2.31* (110)	1.38* (66)	2.00 (95)	2.10 (100)
9- mths	0.79* (39)	2.13* (105)	1.85 (91)	3.22* (159)	2.02 (100)
Total 1st yr	6.16* (83)	7.87* (106)	5.47* (73)	8.40* (113)	7.40 (100)
2nd yr	8.19 (98)	8.63* (103)	7.45* (89)	6.99* (84)	8.35 (100)
3rd yr	6.92 (104)	6.68* (101)	6.43 (97)	5.96 (90)	6.63 (100)
4th yr	7.08* (85)	8.53 (102)	8.55 (102)	7.52 (90)	8.35 (100)
5th yr	7.36* (124)	6.05 (102)	4.84* (82)	4.92* (83)	5.94 (100)

The figures in brackets show individual rates as a percentage of the rate for "All Social Classes", taking Rate = 100.

* Indicates statistically significant differences from the rate of the same period for all classes combined:

$$i.e. \frac{(\text{Actual}-\text{Expected}) \text{ days of sickness (based on all classes)}}{\sqrt{\text{Expected days of sickness}}} > 2.5$$

sickness. Both indices show the pre-eminence of bronchitis and pneumonia in the first year of life, and their supersession from the second year onwards by the specific fevers of childhood.

(6) SOCIAL CLASS AND SICKNESS

In this section it is not proposed to duplicate the tabulations by presenting data based on both the indices used in the preceding section. The analyses we have made show that it makes no substantial difference to the results whether "days of sickness" or "incidents" is taken as index. In the Tables which follow only the former, which we have described as the index of preference, is used.

The social gradient for all causes can be studied from the actual rates presented in Table VI, but is more easily appreciated from rates expressed as percentages of the rate for all classes combined (figures in parenthesis in Table). The number of children at risk at each age period in the several social groups is given in Table VIA.

TABLE VIA

NUMBER OF CHILD YEARS OF EXPOSURE ON WHICH EACH SICKNESS RATE IS BASED (ILLEGITIMATE NOT INCLUDED)

Period	Social Class				All Classes
	1 and 2	3	4	5	
0- mths	140	1,012	190	70	1,412
3- mths	140	1,006	189	70	1,405
6- mths	140	1,006	188	70	1,404
9- mths	140	1,006	188	69	1,403
Total 1st yr ..	140	1,007	189	70	1,406
2nd yr	130	971	182	67	1,350
3rd yr	121	935	173	63	1,293
4th yr	114	902	171	63	1,250
5th yr	108	872	166	62	1,209

Rates for illegitimate infants are not made the subject of comment, and their sickness experience has been omitted from the Table.

The general picture presented in Table VI is one of absence of any consistent social gradient. For

the first year of life there is an upward gradient to the extent that the rate for children of unskilled workers is higher than that for the children of well-to-do classes. But Social Class 4 have the lowest rate of all. The 5th year shows a downward gradient and there is a similar trend in the 3rd year. In the 2nd and 4th years the rates are almost the same in each of the social groups.

As, however, these rates are for all causes of sickness combined, a nil gradient in the Table could conceal substantial gradients for individual categories of sickness, some of which might be upward and others downward. Moreover, the existence of a gradient in the Table could be due to the summation of several gradients for individual diseases, or alternatively could be ascribable in its entirety to a single category gradient.

Table VII shows the rates for bronchitis and pneumonia (Group I) and Table VIII the rates for the infectious diseases (Group IV). Table VII discloses an upward gradient for the 1st year of life and for each quarter of the 1st year; in the 3rd year there is a contrary gradient, and in the 2nd, 4th, and 5th years, no gradient at all. In Table VIII (opposite) no consistent gradient is apparent.

TABLE VII

SICKNESS RATES DUE TO PNEUMONIA AND BRONCHITIS, IN DAYS PER ANNUM PER CHILD EXPOSED TO RISK, BY SOCIAL CLASS

Period of Life	Social Class				Total Classes 1-5
	1 and 2	3	4	5	
0- mths	0.05	0.28	0.59	1.20	0.35
3- mths	0.75	0.64	1.12	0.90	0.73
6- mths	0.33	1.01	0.42	0.70	0.85
9- mths	—	0.72	0.93	0.51	0.67
Total 1st yr	1.13	2.65	3.06	3.31	2.58
2nd yr	1.31	1.26	1.81	1.19	1.34
3rd yr	1.04	0.85	0.79	0.22	0.83
4th yr	0.79	0.88	0.73	0.38	0.83
5th yr	0.58	0.36	0.25	0.50	0.37

TABLE VIII

SICKNESS RATES DUE TO INFECTIOUS DISEASES, IN DAYS PER ANNUM PER CHILD EXPOSED TO RISK, BY SOCIAL CLASS

Period of Life	Social Class				Total Classes 1-5
	1 and 2	3	4	5	
0- mths	—	0.19	0.05	0.20	0.15
3- mths	1.01	0.39	0.18	—	0.41
6- mths	0.15	0.52	0.02	0.60	0.42
9- mths	0.24	0.64	0.34	0.61	0.54
Total 1st yr	1.41	1.73	0.59	1.40	1.53
2nd yr	4.64	4.62	3.39	2.57	4.35
3rd yr	4.12	3.97	3.65	4.35	3.96
4th yr	4.39	5.82	7.15	5.38	5.85
5th yr	4.56	3.88	3.17	3.99	3.85

We make no extended reference to other groups of causes, for the numbers of incidents attributed to them are too small to justify the inclusion of Tables. We mention only in passing that our analyses showed skin diseases to have lower rates in Social Classes 4 and 5; tonsillectomy and tonsillitis a higher rate among well-to-do children; some excess of gastro-enteritis, diarrhoea, and dysentery in Class 5 in the first year of life—but confined entirely to the first 3 months; and an upward gradient for diseases of the ear during each of the first 3 years of life. On this last point a brief comment is made.

The ninety incidents in Group VIII (diseases of the ear) account for only about 3 per cent of all the recorded sickness incidents (2,890) during the 5-year period, and it would be unwise to draw conclusions from these numbers standing alone. The clinical association of diseases of the ear and respiratory infections gives, however, some ground for regarding as other than fortuitous the upward gradient of ear diseases during the first year of life, when it is steepest. And it is not unreasonable to regard the upward gradient for diseases of the ear in the second and third year of life as a likely consequence of the upward gradient for respiratory infections at 0-1 year.

These rather speculative inferences are not however of great importance here. The outstanding facts established by the social class analysis is the presence of an upward gradient for bronchitis and pneumonia and a similar gradient for all causes during the first year of life.

A question these facts raise is whether the one accounts entirely for the other; and in Table IX we therefore examine the effect of excluding bronchitis and pneumonia from the sickness rates for all causes.

Taking the first year as a whole, the differences between Classes 1 and 2 and Class 5 are virtually extinguished by this exclusion, from which it might

TABLE IX

SICKNESS RATES IN DAYS PER CHILD EXPOSED TO RISK FOR ALL CAUSES (EXCLUDING PNEUMONIA AND BRONCHITIS)

Period of Life	Social Class				Total
	1 and 2	3	4	5	
0- mths	0.80	1.09	0.21	1.00	0.94
3- mths	2.36	1.36	0.29	0.10	1.24
6- mths	1.26	1.30	0.96	1.30	1.26
9- mths	0.79	1.41	0.92	2.71	1.35
Total 1st yr	5.03	5.22	2.41	5.09	4.82

appear that our question is answered in the affirmative.

But the wide differences remaining at 3-6 and 9-12 months suggest that no such simple interpretation of the facts is admissible. It is apparent that an extended analysis based on bigger numbers than we have from the Luton survey is needed to unravel the complexities of the situation.

(7) HOSPITAL ADMISSIONS

Illnesses for which children were admitted to hospital are included but not distinguished in the Tables in previous sections. As presented below (Table X) they were obtained directly from a scrutiny of hospital records.

TABLE X

HOSPITALIZATION OF LUTON CHILDREN BORN IN 1945

Reason for Admission	Age (yrs)					Total
	0-	1-	2-	3-	4-	
Pneumonia and bronchitis	9	5	5	2	1	22
Influenza, colds, and other respiratory infections	—	—	1	—	1	2
Infectious diseases	2	1	5	8	9	25
Gastro-enteritis, dysentery, etc.	11	3	1	1	—	16
Skin diseases (excluding pemphigus)	2	3	3	1	4	13
Accidents and injuries	3	7	2	7	11	30
Tonsillectomy, tonsillitis	—	—	17	27	62	106
Diseases of the ear	—	2	1	2	5	10
Malformations	10	6	—	—	2	18
Hernia	3	2	2	1	8	16
Feeding difficulties, malnutrition	13	—	—	—	—	13
Pemphigus	7	—	—	—	—	7
Others (specified)	5	2	9	6	10	32
Others (not specified)	3	2	5	4	8	22
Total	68	33	51	59	121	332
Number Exposed to Risk	1,482	1,422	1,363	1,317	1,272	
Rate per 100	4.6	2.3	3.7	4.5	9.5	
Days in Hospital	1,774	328	568	655	988	
Average Duration of Stay in Hospital	25.5	10.0	10.7 (14.3)	10.7 (17.5)	7.9 (12.9)	

NOTE: Admissions for circumcision are not included. Figures in brackets are durations excluding tonsillectomies.

If circumcisions are disregarded, the number of admissions to hospital in the first year of life is 68, in the 2nd 33, in the 3rd 51, in the 4th 59, and in the 5th 121. These numbers related to the numbers exposed to risk in each year of life yield hospital admission rates for the successive years of life of 4·6, 2·3, 3·7, 4·5, and 9·5 per 100 exposed to risk. The high rate in the 5th year is clearly due to tonsillectomies.

Admissions of the same child on more than one occasion are not distinguished.

The average duration of in-patient stay for successive years of life was 25·5, 10·0, 10·7, 10·7, and 7·9 days; becoming, when tonsillectomies are disregarded, 14·3, 17·5, and 12·9 days for the 3rd, 4th, and 5th years respectively.

The mild form assumed by the common infectious diseases in childhood is reflected in low ratios of admissions to notified cases. Thus, for example, the admission rate (Infectious Diseases Hospital, Luton) for measles per 100 notified cases was 0·56 in 1950, and 0·90 in 1951. The corresponding rates for whooping cough and scarlet fever were:

Whooping cough 4·45 (1950), 4·06 (1951);
Scarlet fever 22·15 (1950), 12·72 (1951).

During this 2-year period, notifications of measles outnumbered whooping cough by 3 to 1 and scarlet fever by 5 to 1. Relating hospital admissions to incidents recorded in the survey, we have an admission rate for the 5-year period of 2 per cent. (25/1,400) for infectious diseases, which compares with 4 per cent. (22/531) for pneumonia.

The total number of hospital admissions is too small for the rates for individual causes to have much meaning. They are given for grouped causes in Table XI, where proportionate rates for Luton are displayed alongside corresponding rates for England and Wales quoted from a preliminary study of in-patient discharges during the first half of 1949 (McKay, 1951).

Comparability of proportionate rates in the two series is to some extent destroyed by the differing proportions classified under "Other Causes" in the national and local series. This applies both to the first year of life and to the period 1-4 years. For the period 1-4 years the much higher proportion of admissions for Tonsillectomy in the Luton series is also a distorting influence, but fortunately in a contrary direction. Taking "Other Causes" and Tonsillectomy together, their contribution to the total rate is 49 per cent. in the national series, and 55 per cent. in the Luton series.

TABLE XI

LEADING CAUSES OF ADMISSION TO HOSPITAL
Rate per annum per 100 children, Luton, and percentage distribution,
England and Wales and Luton compared
(Males and females combined)

Age (yrs)	Leading Causes of Admission	Percentage Distribution		Rate per annum per 100 Children
		England and Wales	Luton	
0-1 (Total at risk 1,482)	Congenital malformations	15·7	14·7	0·7
	Gastro-enteritis and colitis	10·6	16·2	0·7
	Pneumonia and bronchitis	13·1	13·2	0·6
	Nutritional maladjustments	6·4	19·1	0·9
	All other specified causes	27·6	32·4	1·5
	All other unspecified causes	26·7	4·4	0·2
	All Discharges (other than special admissions)	100·1	100·0	4·6
1-4 (Total at risk 5,374)	Congenital malformations and hernia	13·8	7·6	0·4
	Bronchitis, pneumonia, and upper respiratory tract infections, acute pharyngitis, and tonsillitis	9·7	6·8	0·3
	Otitis media and mastoiditis	6·9	3·8	0·2
	Measles, scarlet fever, and whooping cough	6·6	7·6	0·4
	Tuberculosis	2·7	0·8	0·04
	Infections of skin and subcutaneous tissue	3·0	4·5	0·2
	Gastro-enteritis and colitis	0·7	1·9	0·1
	Burns, scalds, wounds, superficial injury, head injury	5·7	10·2	0·5
	Appendicitis	1·6	1·5	0·1
	Hypertrophy of tonsils and adenoids	17·1	39·0	1·9
	Other causes	32·1	16·3	0·8
		49·2	55·3	2·7
	All Discharges (other than special admissions)	99·9	100·0	4·9

NOTE: (Table 1-4 years)

- (1) Rates in Column 5 are (Number of discharges in 4 years) ÷ (Number of years of life exposed in 4 years).
- (2) In the Registrar General's publication, the sexes are given separately and in some instances two or more causes listed separately by the Registrar General are combined in our Table.

In both series a substantial proportion of specified causes at 0-1 year are assigned to four headings:

Congenital malformations,
Gastro-enteritis and colitis,
Pneumonia and bronchitis,
Nutritional maladjustments.

These causes account for 46 per cent. of all admissions in the national series and for 63 per cent. in the Luton series.

In the period 1-4 years, the bulk of admissions are not credited to a few causes as they are at 0-1 year. The numerical importance of a variety of surgical conditions as causes of admission to hospital after the first year of life is apparent. In both the national and the local series, congenital malformations, hernia, burns, and physical injury account for

about 40 per cent. of admissions for specified causes other than hypertrophy of the tonsils and adenoids. The relatively important place occupied by non-specific infections, of the respiratory tract and ear compared with the common specific fevers of childhood is noteworthy. And the large number of admissions for tonsillectomy at these early ages will not escape attention.

(8) DISCUSSION

The dependability of our data and inferences can be impugned on many different grounds. Incompleteness of histories obtained by health visitors, inaccuracies in the stated durations of recorded illness, and the big losses by removals, particularly during the first year of life, are potential sources of error which require discussing.

There is no means of estimating directly how far health visitors succeeded in obtaining complete records of sickness as defined; and no means whatever of knowing whether there were greater deficiencies in the records of one social class than another because of differing degrees of co-operation or ability to remember illnesses which had occurred some time previously. There is, however, some information relevant to the first issue.

Records of infectious diseases and of admission to hospital obtained independently of the main survey suggest that the health visitors' histories were reasonably complete. In only a very few instances had they failed to record an infectious disease or a hospital admission which came to notice by some other means. Also (as Table XII shows) the health visitors' records gave incidence rates for the infectious diseases considerably in excess of notification rates, and in close agreement with a recent estimate for London (Benjamin and Gore, 1952).

TABLE XII

INCIDENCE OF COMMON INFECTIONS OF CHILDHOOD
(Percentage of children attacked by the age of 5 years)
Estimate for London and recorded incidence for Luton compared

Disease	London County Council	Luton
Chicken Pox	20	14
Rubella	7	
Measles	35	46
Mumps	10	10
Whooping Cough	25	32
Scarlet Fever	4-5	2
Total	102	104

Against this it is not easy to accept at face value the total days of recorded illness shown in Table XIII.

TABLE XIII

DISTRIBUTION OF CHILDREN IN ALL SOCIAL CLASSES BORN IN LUTON IN 1945 ACCORDING TO THE NUMBER OF DAYS OF ILLNESS EXPERIENCED DURING THE FIRST 5 YEARS OF LIFE*

Number of days of Sickness	Number of Children	Number of days of Sickness	Number of Children	Number of days of Sickness	Number of Children
0	193	19	5	116-122	8
1	—	20	2	123-129	3
2	1	21	78	130-136	5
3	1	22	2	137-143	3
4	6	23	—	144-150	4
5	6	24	16	151-157	4
6	1	25-31	106	158-164	—
7	33	32-38	74	165-195	6
8	2	39-45	99	196-227	1
9	2	46-52	78	228-258	1
10	12	53-59	56	259-288	—
11	—	60-66	35	289-319	—
12	1	67-73	36	320-349	—
13	—	74-80	22	350-379	1
14	117	81-87	24		
15	4	88-94	18	Total	1,125
16	5	95-101	19	Not Stated	142
17	12	102-108	10		
18	4	109-115	8	Total	1,267

* Only children who completed the five years are included.

In the first place it is hard to believe that 193 children reached their fifth birthday without once needing treatment in bed for 48 hours or requiring the services of a doctor. This could be true without being inconsistent with the facts of Table XII (i.e. 104 incidents per 100 children by the age of 5 years), for a high proportion of the children who had at least one notifiable infectious disease were shown by our records to have had more than one. But the figure of 193 without recorded illness must raise a doubt about the completeness of the records.

The incidence of accidents recorded by the survey also appears to be grossly understated. Rowntree (1950), in a 2-year follow-up of the children included in the Maternity Survey of Great Britain, gives figures from which it appears that the incidence of treated accidents in the first 2 years of life is 80 per 1,000. The comparable rate in the Luton data is 16 per 1,000. If this order of disparity was at all likely to apply to infant sickness in general our records would be worthless, but there is no reason to believe that this is so. In the Luton survey the enquiries of the health visitor were probably mainly focused on disease, and, in consequence, the less serious accidents and injuries were not recorded. The high proportion of recorded accidents and injuries which were admitted to hospital over the 5-year period (40 per cent.) tends to confirm this view.

A scrutiny of individual records showed that the stated duration of different illnesses was as a rule consistent with expectations on clinical grounds, though, as Table XIII indicates, there was a tendency

to round off the length of an illness to the nearest week. The margin of inaccuracy from this cause would doubtless be narrowed in an enquiry with more frequent visits, though not, for reasons suggested earlier, entirely eliminated. A certain degree of approximation is inevitable in any questionnaire enquiry based on recollections, and this fact is recognized.

Turning next to uncertainties introduced by withdrawals from the survey, the question arises whether the social class gradients displayed would have been different had the children lost sight of remained in the survey. There are two separate problems; first, whether the social classes were represented in the same proportions among withdrawals as they were in the group of 1,521 children whose social class is known; secondly, whether the sickness experience of the withdrawals taken class by class was in any way unusual.

The first question is answered in Table XIV, from which it appears that there was an excess of withdrawals in Social Classes 1 and 2.

TABLE XIV
WITHDRAWALS

Social Class ..	1 and 2	3	4	5	Illegitimate	All Groups
Total ..	145	1,033	190	70	83	1,521
Withdrawals	31	129	20	7	11	199
Per cent. Withdrawals	21	13	11	10	13	13

NOTE: The 328 children who were lost to the survey before the health visitor's first enquiry are ignored.

A detailed analysis of the 328 "transfers out" and withdrawals in the first year of life showed, moreover, an overweighting with infants born to mothers younger on the average than survey mothers generally (43 per cent of the 328 mothers who withdrew were under the age of 25, compared with 21 per cent. of the remaining mothers). The duration of marriage of the withdrawals was overweighted with durations of less than one year, and a high proportion of removals were first-born children compared with other births (60 per cent. of the "transfers out" and 45 per cent. of the first-year removals, compared with 34 per cent. of other births). If therefore, the original cohort is regarded as "representative" in some sense, then the survey survivors after one year appear as an unrepresentative group. In fact, the group remaining in the survey at the end of the first year cannot be said to be representative of anything but itself, though it probably reflects more truly than the original cohort the stable population of Luton at the time.

The second and more important issue (whether the health of withdrawals taken class by class was representative of the survey population as a whole) is a question which unfortunately cannot be satisfactorily resolved. For withdrawals after the first year of life, it is true, we can compare the sickness experience before withdrawal of each social class with the contemporaneous experience of corresponding groups remaining in the survey for periods longer than one year. Then, assuming that the relation between the sickness experience of withdrawals and non-withdrawals would have continued unchanged had the withdrawals remained in the survey, an estimate can be made of the effect their extended inclusion would have had on sickness rates. On the basis of this assumption, which is one of rather dubious applicability, we satisfied ourselves that losses after the first year of life would not have altered the Tables in any material particular had they been included. But it was, of course, during the first year of life that withdrawals were heavy enough to be likely to introduce a serious bias; and it is for just this period that no arithmetical device is of any avail whatever.

Enough has been said to indicate that imperfections of the survey method and deficiencies in the records set bounds to the conclusions which can be drawn with confidence from the data at our disposal.

We believe, nevertheless, that if the survey is looked upon largely as a pilot enquiry it is not without substantial value. Inasmuch as it sketches an outline of the pattern of morbidity in infancy and brings into relief inadequacies of method, it can serve as a useful guide to the conduct of more extensive researches in this little-explored field.

The close correspondence between the sickness rates, stated alternatively in terms of incidents and days of sickness, and the independent checks afforded by hospital records and notifications of infectious diseases encourages us to believe, moreover, that the survey presents a reasonably true picture of the more serious illnesses suffered by a child population during the first 5 years of life. Though, of course, the extent to which it represents the experience of the child population of the country as a whole, or of child populations elsewhere in the country, must be entirely conjectural.

But if the sickness rates for the infant survey population as a whole have a title to a fair degree of confidence, far greater caution is needed in drawing inferences when differences between social groups are examined. Even for the population to which the survey relates, it is not possible to answer with any finality questions about the influence of social class

on sickness rates in infancy and early adolescence. To conclude, as we do, in the summary which follows, that with the exception of respiratory infections in the first year of life no consistent social gradient was demonstrated is in a sense non-committal. It is not to say that none exists.

(9) SUMMARY

A questionnaire enquiry into the sickness experience during the first year of life of 1,849 children born in Luton during 1945 is described.

The effect of withdrawals (heavy during the first year) and certain imperfections of the records are examined critically.

The report portrays the broad pattern assumed by sickness at different periods during the first 5 years of life, its social class distribution, and the demand on hospital in-patient care.

Incidence rates and days of sickness per child are used as alternative indices of the volume of sickness.

The following conclusions are proposed:

(1) The leading causes of sickness during the first year of life are pneumonia and bronchitis, which account for half the recorded incidents in that period.

(2) From the first birthday onwards the notifiable infectious diseases account each year for half the recorded incidents.

(3) The average number of days of sickness per child was 7.3 in the first year of life, and from 6 to 8 days per year at the ages of 1 to 4 years.

(4) No social gradient progressing without interruption in either upward or downward direction was shown at any period of life for all causes combined.

(5) The respiratory infections show an upward gradient for the first year of life, and for each quarter of the first year.

(6) The notifiable infectious diseases show no consistent gradient at any period.

(7) Hospital admission rates for the successive years of life (disregarding circumcisions) are 4.6, 2.3, 3.7, 4.5, and 9.5 per 100 children exposed to risk. The high rate in the fifth year is due to tonsillectomies.

(8) At 0-1 year, 63 per cent. of admissions to hospital may be placed under one of four headings:

Congenital malformations,
Gastro-enteritis and colitis,
Pneumonia and bronchitis,
Nutritional maladjustments.

In the period 1 to 4 years there is no similar concentration of causes of hospital admissions; during this period the numerical importance of a variety of surgical conditions is noteworthy.

We wish to acknowledge our indebtedness to the many health visitors and sanitary inspectors who took part in the investigation and to the technical and clerical staffs of the two departments concerned who shared between them a burden of routine paper work. Also we wish to thank especially Mr. Herman Chalkley, M.B.E., Registrar of Births and Deaths for Luton, who provided much information about the social classes of the children and helped us in many other ways.

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APPENDIX

EFFECT OF EMPLOYING AN ALTERNATIVE SOCIAL CLASS CLASSIFICATION

A criticism sometimes made of the Registrar General's social class grouping is that Class 3 (skilled workers) includes a large number of black-coated workers whose mortality experience bears a closer resemblance to the lower rates of Class I (the professional group) than it does to the remainder of Class 3. This is not, in our opinion, a justification for combining the black-coated group with the professional classes for the purpose of defining social class differences of mortality and morbidity—for the main object of a social class classification is to afford indices of the influence of differing physical standards of living on mortality and morbidity rates. To transfer to Class 1 the members of Class 3 with favourable mortality rates, but living under

the general environmental conditions of Class 3, seems to us to defeat this purpose.

In Appendix Table A (overleaf) we distinguish two sub-divisions of the Registrar General's Class 3 births: 3a relating to infants whose fathers are engaged in commercial and clerical pursuits, including shopkeepers and their assistants; and 3 to the remainder.

The tabulation undoubtedly supports the view that the sickness rates of children in Class 3a are more akin to Class 1 rates than to those of Class 2 or 3 (remainder). Even in the years when Class 1 rates are higher than Class 3 rates, so also are those of 3a.

The social class gradients resulting from the re-combination are shown in Appendix Table B. They may be compared with those given in Table VI (figures in parenthesis in that Table), when, with a single minor exception, it is seen that the conclusions reached on Table VI are unaltered by the recombination proposed. The general picture is still one

of absence of any consistent social gradient, the only difference between the two tables being that Appendix Table B shows a downward gradient in the second year of life which was not apparent in Table VI.

APPENDIX TABLE A
DAYS OF ILLNESS PER CHILD FROM ALL CAUSES
Social Class 3a compared with Classes 1, 2, and 3 (remainder)

Period of Life	Social Class			
	1	2	3a	3
0- mths	0.37	0.93	1.02	1.43
3- mths	1.47	3.36	1.35	2.11
6- mths	1.58	1.60	1.70	2.42
9- mths	—	0.92	1.58	2.23
Total 1st yr	3.42	6.59	5.63	8.25
2nd yr	11.54	7.64	9.57	8.47
3rd yr	6.48	6.99	5.73	6.84
4th yr	10.21	6.63	9.42	8.38
5th yr	5.71	7.61	4.97	6.23

APPENDIX TABLE B
SOCIAL GRADIENT BASED ON "DAYS OF ILLNESS PER
CHILD FROM ALL CAUSES" (LEGITIMATE BIRTHS ONLY)
Rate for "All Social Classes" = 100

Period of Life	Social Class				All Classes (except illegitimate)
	1, 2, 3a	3 (remainder)	4	5	
0- mths	73.4	111.7	62.5	171.9	100
3- mths	111.7	107.1	71.6	50.8	100
6- mths	78.6	115.2	65.7	95.2	100
9- mths	59.4	110.4	91.6	159.4	100
Total 1st yr	79.6	111.5	73.9	113.5	100
2nd yr	106.8	101.4	89.2	83.7	100
3rd yr	94.9	103.2	97.0	89.9	100
4th yr	99.8	100.4	102.4	90.1	100
5th yr	102.2	104.9	181.5	82.8	100