

THE RELIABILITY OF LONGITUDINAL SURVEYS

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IN a recent paper on research techniques Cochran³ makes the following comment on longitudinal surveys: "My guess would be that we now know how to observe groups for as long as three years, and perhaps for as long as five years: beyond that, there are too few successfully completed studies to be able to say that the technique has been mastered." For the past ten years a national sample of children has been kept under observation in Great Britain. Losses have been small and the reliability of the information obtained appears to be high. It therefore seemed of interest to give an account of this sample study; the methods used and the problems encountered are described below.

NATURE OF THE INQUIRY

The original stimulus for the study came from the Royal Commission on Population who wished to have information on the use made of the maternity services and on the costs of child-bearing. A Joint Committee of the Population Investigation Committee and the Royal College of Obstetricians and Gynaecologists was set up in 1945 to collect information about the circumstances and costs of all confinements occurring in Great Britain during the first week of March, 1946. The results of this first inquiry were published in 1948.

At the end of the maternity inquiry we found ourselves in possession of a sample that was fully representative of children from all social groups and from all parts of the country. It was unlikely that the chance of obtaining another such sample would recur in the near future and the Committee decided to use this unique opportunity to observe the health, growth and

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³ Cochran, William G.: *Research Techniques in the Study of Human Beings*. The Milbank Memorial Fund *Quarterly* April, 1955, XXXIII, No. 2, pp. 121-136.

development of the group of children. The enthusiastic support given by the Society of Medical Officers of Health and the local authorities made it possible to start a longitudinal inquiry which has continued until the present day, in cooperation with the Institute of Child Health (University of London), and supported by grants from the Nuffield Foundation; the Hospital for Sick Children, Great Ormond Street; the Regional Hospital Boards of Great Britain; and the Ford Foundation.

Limitations of money and staff made it necessary to reduce the size of the original sample. This was done by taking only one-in-four of the children of manual workers and of the self-employed, who comprised 72 per cent of the original maternity survey sample. The full numbers of children in the other occupational groups were retained. The result was that the number of survey children was reduced from 12,930 to 5,386. The numbers in the reduced sample were sufficient for most purposes of statistical analysis, and when required the original sample structure could be regained by suitable "weighting." It should also be mentioned that all twins and all illegitimate children were excluded from the longitudinal inquiry (*see* page 232).

During the first ten years of the inquiry six main sources of information have been used:

Home Visits. The homes have been visited nine times by health visitors or school nurses. The records of these visits describe the changing home background of the families, their increase in size, and their movement upwards or downwards in the social scale. They also give a running record of accidents, major episodes of illness and major disturbances of behaviour. These events can be set against the basic information collected early in the survey on such characteristics as the parents' ages, duration of marriage, and education.

Clinical Examinations. The school doctors have examined the survey children twice (at six and seven years-of-age), using a schedule which asked for both a clinical history and an examination paying particular attention to defects of the special senses and locomotor system and to the condition of the nose and pharynx. In addition, the doctors weighed and measured the children.

School Absence Records. A complete record of school absences has been kept by the teachers on special record cards which are changed each year. All prolonged absences (of one week or more) were checked with the mothers in the course of the subsequent home visits.

School Teachers' Questionnaire. At the end of the first year at school, teachers were asked to give information on the type of school and class and on the interest shown by parents in their child's education.

Tests of Mental Ability and School Achievement. Four tests were designed for this inquiry by the National Foundation for Educational Research in England and Wales and given to the children when they were eight years old. There were two tests of reading, one of vocabulary and one picture intelligence test.

Hospital Records. All reported hospital admissions of survey children were checked with the hospitals concerned. The hospital superintendents were asked to state dates of admission and discharge, to give the initial and final diagnoses and to describe the ward layouts and visiting rules.

It will be seen that this inquiry has covered a wide field. In the early years interest was centered on the health and growth of children in relation to their home environment. In later years problems of mental ability and school achievement have become relatively more important.

RETURN OF SURVEY FORMS

It was intended that in each survey all the children should be seen at approximately the same date, but owing to the substantial movement of families and the difficulty in tracing some of them, this could not always be done. A typical pattern of the distribution of interviews is shown in Figure 1 which refers to the visit made in 1950 when the children were $4\frac{1}{4}$ years old.

The major difficulty in this, as in all other visits, was to trace families that had moved to a new authority. Many were found only after several months; for example, in 1950, sixty-nine children were traced only after the cards were punched

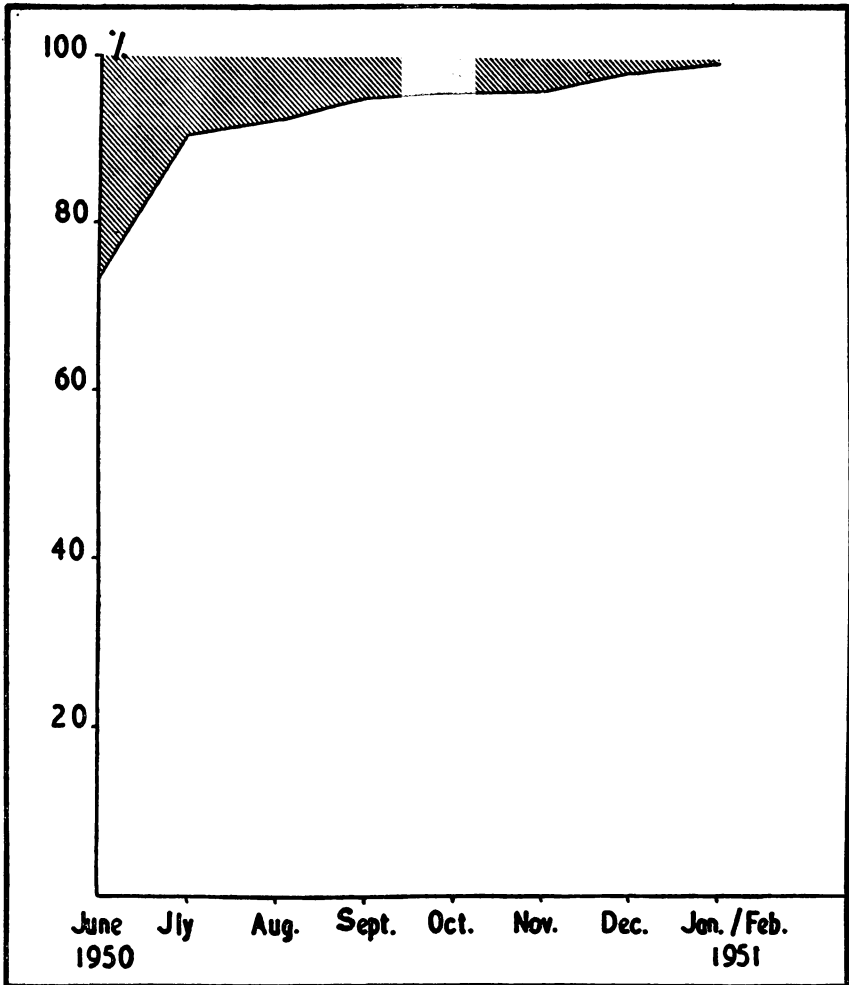


Fig. 1. Rate of return of completed forms in the 1950 survey.

and that part of the survey closed. The missing information for these sixty-nine children was obtained at the next home visit.

The standard of form filling was high, but occasional questions were missed while some of the answers given were inconsistent with information already received. All problems of this type were referred back to the health authorities, who were most helpful. As an example of the help given, the 1950 survey

may again be cited. 3,451 answers were queried and all but 207 of them answered satisfactorily.

We shall now consider a number of questions relevant not only to longitudinal investigations, namely:

1. How far, if at all, has the sample been distorted by withdrawals and other losses?
2. What additional distortion would have been suffered if we had been unable to follow our families across local administrative boundaries?
3. What is the reliability of the information given by mothers about their children's health?

1. THE EXTENT AND NATURE OF THE SURVEY LOSSES

Two types of loss are involved here: that incurred in obtaining the original maternity survey sample in 1946, and that incurred in following up the children since then.

Maternity Survey Losses. At the time of the maternity survey there was no intention of following the children born. Consequently, the losses were greater than would have occurred if, from the start, we had used all the means of tracing children that were applied at later stages of the inquiry.

The original aim was to investigate all births that occurred during the first week of March, 1946, in all parts of England, Wales, and Scotland. We were fortunate in securing the cooperation of 424 out of a total of 458 local authorities responsible for maternity and child welfare at that time. In the thirty-four authorities unable to take part in the survey, 1,300 children were born during the survey week. It is unlikely that any serious bias was introduced by their loss since the thirty-four authorities were evenly distributed over Great Britain and the combined infant mortality rate for 1946 in those authorities was similar to that for the rest of the country.

In addition, 1,443 children were lost in 1946 because their mothers had either refused to give information or had moved since their confinements and could not be traced. The children concerned formed 9.5 per cent of all those born during the sur-

vey week in the 424 participating authorities. We were able to obtain details of 425 of the children from the antenatal records, and since 1946 we have traced a further 417, so that we now have information about 58 per cent of the 1,443 missing children.

Losses of illegitimate children were high and, indeed, 34 per cent of all illegitimate births occurring during the survey week were untraced. Because of this, and of the difficulties of keeping in touch with unmarried mothers, no attempt was made to include illegitimate children in the follow-up inquiry.

The losses of legitimate children were unevenly distributed over the occupational groups,⁴ being highest among the most prosperous families. In order to judge whether these unequal losses have significantly distorted the structure of the sample we have compared in Table 1 the number of children falling into each occupational group of the maternity survey sample with the number that would have been expected if the losses had been randomly distributed over all occupational groups. The third row of the table shows how far the number of children in each group exceeds or falls below expectation. The differences between the numbers found and the numbers expected in each occupational group are small and the 1946 losses produced no serious bias in the sample.

The stillbirth and neonatal death rates in the survey popu-

Table 1. Number of children enrolled and numbers of children expected in each occupational group in 1946.

	OCCUPATIONAL GROUPS					ALL GROUPS
	Professional and Salaried	Black-Coated	Manual Workers	Agricultural Workers	Own Account and Farmer	
Number Enrolled	1,129	1,443	8,998	571	789	12,930
Number Expected	1,164	1,469	8,931	558	808	12,930
Difference	-35	-26	+67	+13	-19	

$$\chi^2 = 2.72 \quad \text{d.f.} = 5 \quad 0.8 > P > 0.7.$$

⁴ For a description of the contents of the occupational groups see MATERNITY IN GREAT BRITAIN, (Oxford University Press, 1948).

lation were closely similar to those for Great Britain during 1946. The survey stillbirth rate was 26 per 1,000 total births as compared with the national figure of 28. The survey neonatal death rate was 28 per 1,000 live births as compared with the national figure of 25. Here is further support for the lack of bias in the sample.

Losses from the Longitudinal Survey. We have already mentioned that the size of the longitudinal survey sample was reduced by excluding illegitimate children and twins and by taking a random one-in-four sample of children in two occupational groups—the “manual workers” and the “own account and farmers.” The results are shown in Table 2.

It will be seen that there are eleven fewer children in the follow-up survey sample than were expected, a discrepancy that is explained by the exclusion of illegitimate children who had been wrongly coded as legitimate in 1946. At the same time a number of errors in occupational coding were corrected with a consequent small change in the numbers in the five groups.

During the first ten years of the inquiry, twelve contacts were made with the children at home, school or clinic, and on each occasion some of the children were lost. The losses were of two broad types which will be described separately. First, there were the *unavoidable* losses of children who had died or left the country with their parents; secondly, there were the

Table 2. Numbers of children in each occupational group of the follow-up survey sample compared with the numbers expected from the 1946 maternity survey sample after differential sampling.

	OCCUPATIONAL GROUPS					ALL GROUPS
	Professional and Salaried	Black-Coated	Manual Workers	Agricultural Workers	Own Account and Farmer	
Numbers in 1948 Sample	1,075	1,387	2,157	557	210	5,386
Numbers Expected	1,086	1,399	2,168	554	190	5,397

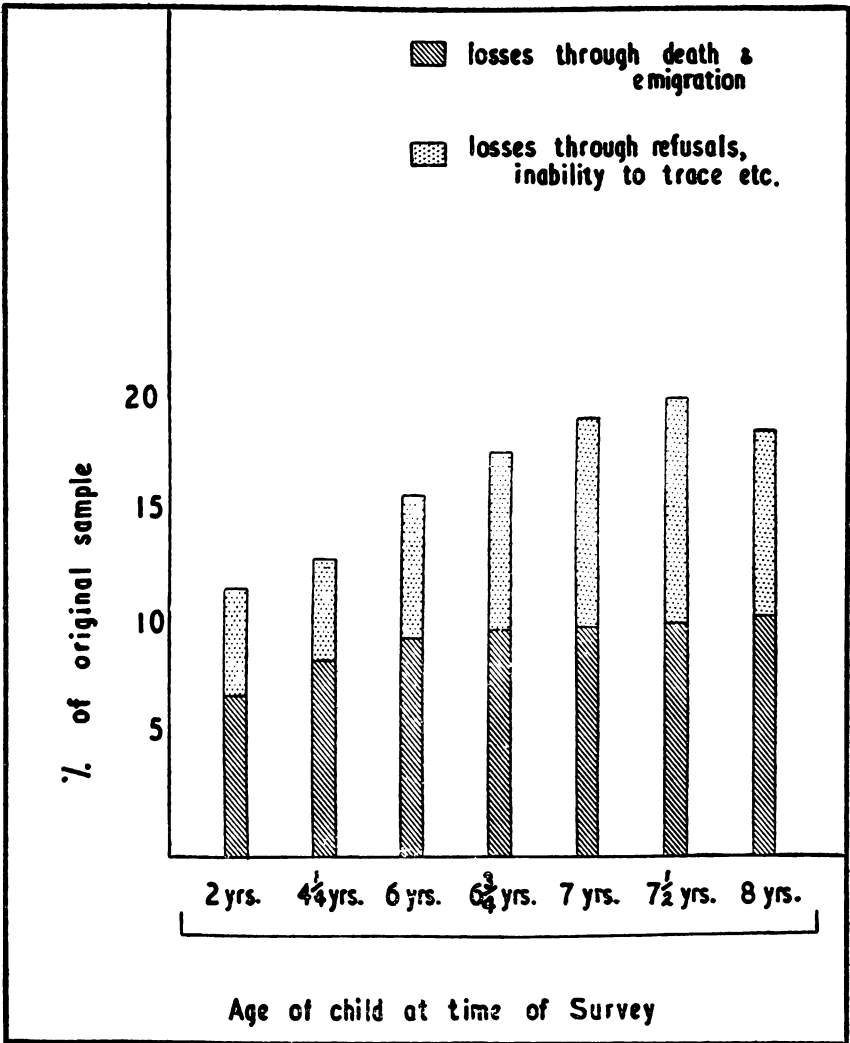


Fig. 2. Losses from the survey sample.

avoidable losses for such reasons as the refusal of a parent to give information or our own failure to trace a child. The first represents a natural decrease in the population, which is not a source of bias, the second needs to be considered more carefully. The proportion of children lost for these two reasons for seven home visits is shown in Figure 2.⁵

⁵ Losses from medical examinations, school reports and mental tests were closely similar and need not be shown here.

Unavoidable losses rose steadily from 7.1 per cent at two years-of-age to 10.7 per cent at 8½. In the early years both death and emigration were heavy sources of loss; by 1950, 220 children had died and 240 had emigrated with their families. The loss through emigration was particularly heavy during this early period because of the aftermath of the war. Out of the 240 families lost in this way during the first four years of the survey, 108 were dominion, colonial, or foreign nationals returning to their own countries.

It is likely that many of the families going to the Colonies and all the families going abroad with the Armed Forces will in time return to this country, but no attempt will be made to enrol them again in this survey when they do so. It would be difficult to trace them and, in view of the inevitable gaps in their histories and of the exceptional living conditions abroad, the additional information obtained would hardly justify the expense and effort involved.

Whereas the *unavoidable* losses increased with each successive contact, the *avoidable* losses reached a peak of 10.1 per cent at 7½ years and then declined to 8.3 per cent. This decline reflects the success of efforts to persuade parents who had withdrawn their children to allow them to rejoin. The final figure of 8.3 per cent exaggerates our final loss, since some of the children will be found and included in later surveys when earlier gaps will be filled in. It is probably more realistic to take as completely lost only those children missing in both 1953 and 1954, they amount to 345 or 6.4 per cent of those originally enrolled.

Before discussing any possible distortion of the sample introduced by these losses, it may be of interest to mention that measures have been taken at intervals during the course of the survey to keep alive the interest of those taking part—both the health visitors and the mothers. Two booklets giving a simple account of the more important findings were produced for the health visitors and seem to have been greatly appreciated. In addition, the Committee sent a letter of appreciation

	PROFES- SIONAL AND SALARIED	BLACK- COATED	MANUAL			OWN ACCOUNT AND FARMER	ALL GROUPS
			Skilled	Semiskilled and Unskilled	Agricul- tural		
Actual Numbers Enrolled	793	1,136	1,255	593	486	189	4,452
Expected Numbers	823	1,143	1,241	579	476	190	4,452
Difference	-30	-7	+14	+14	+10	-1	nil

Table 3. Number of children in each occupational group enrolled in 1954 compared with the numbers expected assuming no bias.

to each mother after the first eight years and offered a free copy of the health visitors' booklet to those who were interested enough to apply for it. Shortage of funds alone prevented the Committee from doing more in this line, which may contribute materially to the success of a long-term survey.

In October, 1954, after excluding the 345 children (missing in 1953 and 1954) and the children who had died or who had left the country, there were 4,452 still enrolled in the survey. Table 3 shows how their actual distribution by occupation of father differs from that which would be expected on the assumption that the avoidable losses were not biased in respect of this factor.

It will be seen that there is a small deficit in the more prosperous groups and a small excess in the poorer groups. But as tested by X^2 the distribution of observed and expected numbers in these six groups is not significantly different.

Similar calculations are shown in Table 4 after regrouping the children by position in family. Here again, there is no significant difference between the observed and expected distribution.

We may conclude that up until October, 1954, the sample had not become appreciably biased in respect of either occupational groups of the parents or ordinal position of the child in the family. Similar conclusions are reached when other charac-

	FIRST BORN	SECOND OR THIRD BORN	LATER BORN	TOTAL
Actual Numbers Enrolled	1,725	2,065	662	4,452
Expected Numbers	1,739	2,057	656	4,452
Difference	-14	+8	+6	nil

Table 4. Number of children of different ordinal position in family enrolled in 1954 as compared with the number expected assuming no bias.

teristics, such as age of mother or degree of crowding, are examined.

It has been suggested that in long-term studies the very fact of being under observation may introduce a bias. For example, in the present study the more intensive and more frequent medical examinations may have revealed defects that would otherwise have been missed. In order to estimate the extent of this bias we shall examine some 2,000 children who, though born during the survey week, were excluded from the longitudinal study when a one-in-four sample of manual workers' children was taken. By comparing their school health records and records of clinic attendances with those of a matched group of the survey children, we shall be able to see in what ways, if any, the latter have been influenced by being enrolled in the survey.

2. INTERNAL MIGRATION AS A POSSIBLE SOURCE OF BIAS

Some of the difficulties in following up our children were caused by a high incidence of movement from one local authority to another. And it is of interest to see how far this inquiry would have been biased if we had been unable to extend the survey across administrative boundaries. Most longitudinal surveys have been limited to a single city and all those moving out have been lost, so that this question has considerable practical importance. The following comments refer to the *internal* movements of the population during the first four years of the present survey: it is not feasible at the moment to give an account of movements in more recent years.

During the first four years nearly half of our survey families had moved from where they were living in March, 1946. Some had moved within local boundaries and others had overstepped them. This is to some extent an artificial distinction since when a town is growing rapidly it will expand beyond its administrative area, but the characteristics of the local and non-local migrants are different and they have accordingly been kept separate in the following discussion.

The period 1946-1950 was in some ways abnormal. Movements of population in part represented a return of those who had migrated during the war. On the other hand, throughout the period there was a shortage of houses, limiting freedom of movement especially in the lower income groups. Local authority housing was mainly available for those who were local inhabitants and families moving across administrative boundaries largely moved to privately owned dwellings. The general effect was to discourage the movement of the poorer families or to direct it to areas in which there were relatives to house them.

Only 55 per cent of our families had remained in the same dwelling between 1946 and 1950 whereas 14 per cent had crossed local administrative boundaries and 31 per cent had moved to another address within the same administrative area.

Table 5. Occupational group of families that did not move and of families making local and nonlocal moves in 1946-1950.

OCCUPATIONAL GROUP	TOTAL	NO CHANGE OF ADDRESS PER CENT	MOVED	
			Within Local Boundaries Per Cent	Across Local Boundaries Per Cent
Professional and Salaried	865	16.2	14.5	33.3
Black-Coated	1,193	24.3	23.6	31.1
Skilled Manual	1,303	30.4	30.3	18.2
Semiskilled Manual	347	8.8	7.8	3.5
Unskilled Manual	252	5.9	6.8	1.9
Agricultural	497	9.1	14.0	8.7
Own Account and Farmer	211	5.3	3.0	3.3
TOTAL	4,668 ^a	100.0	100.0	100.0

^a This number refers to complete interviews in 1950; that is to say, it excludes all losses through death, emigration, or other causes.

We cannot show the full extent of movement during these years, for change of address was noted only at the time of each survey and some families may have moved more than once in between. Accordingly, in the following discussion we have simply grouped the families into those that *did not move*, those *moving within local boundaries*, and those *crossing local boundaries*. Attention will be drawn to some of the characteristics of each of these groups.

Table 5 gives the social composition of these three groups.

Those that made local moves tended to come from the poorer social groups, especially the unskilled and the agricultural workers. The differences, as compared with families which did not move, are significant, though small.⁶ In contrast, the families that moved across local boundaries showed a great excess in the non-manual groups, particularly in the professional and salaried group, whereas those in the manual worker groups, particularly the semiskilled and unskilled, were under-represented.⁷ If all the families that moved across administrative boundaries had been lost and if only the stable families and those making local moves had been retained, the sample would have been heavily biased by the poorer social groups. Instead of an expected total of 710 families of professional and salaried workers remaining in the inquiry there would have been 591, while the number of manual worker families would have been correspondingly increased.

We have next related migration to occupational movement, confining our attention to the two groups of black-coated and skilled manual workers where both upward and downward movements can be clearly distinguished. The results of this analysis are shown in Table 6.

The following statistically significant differences are found: (a) The families that did not move show less occupational mobility than the migrants; (b) families of black-coated workers that make local moves tend to move downwards in the

⁶ ($\chi^2 = 32.98$ $n = 6$ $P < 0.001$).

⁷ Compared with the families that did not move ($\chi^2 = 186$ $n = 6$ $P < 0.001$).

occupational scale; (c) families of both occupational groups that have crossed local boundaries show a greater upward mobility and, among the black-coated group, a greater tendency to go into business on their own account. These differences cannot be explained by the younger age structure of the migrant families.

It appears, then, that the families making local moves are on the average poorer and of deteriorating social position, whereas those making non-local moves are more prosperous and are mounting the social ladder.

The migrant families differ from the stable families in other respects. The parents are younger and have a relatively low fertility before removal and a relatively high fertility afterwards. In these respects there is little to distinguish the local from the non-local migrants.

The answer to our question of whether the sample would have been biased if we had been unable to follow our families across local boundaries is thus unequivocal. In these circumstances the survey population would have been progressively denuded of the younger and more rapidly growing families, of those in the upper social groups, and of those who were mount-

Table 6. Occupational mobility (1946-1950) of stable families and of families making local and non-local moves.

	UN- CHANGED OCCUPA- TIONAL GROUP	UP- WARD MO- BIL- ITY	DOWN- WARD MO- BIL- ITY	MOVE TO SELF- EM- PLOY- MENT	TOTAL	No. IN GROUP
	PER CENT	PER CENT	PER CENT	PER CENT	PER CENT	
<i>Black-Coated Workers</i>						
(No Change of Address)	69.6	13.2	14.0	3.2	100.0	569
(Local Moves)	62.7	12.2	20.5	4.6	100.0	327
(Non-Local Moves)	54.5	23.6	13.8	8.1	100.0	246
<i>Skilled Manual Workers</i>						
(No Change of Address)	78.3	6.3	12.4	3.1	100.1	719
(Local Moves)	74.5	9.1	13.7	2.8	100.1	431
(Non-Local Moves)	63.8	15.8	13.8	6.6	100.0	152

during the social ladder or setting up in their own businesses. During the survey years the extent of these losses would have been sufficient to make the sample decreasingly representative either of the whole country or of individual social groups, and its value would have been greatly impaired. Accordingly, it is of practical interest to see how far losses of this type can be reduced by extending the area of a survey over several adjacent authorities instead of limiting it to a single one. In Table 7 we consider the case in which the authorities are grouped into regional aggregates.

The table shows the percentage of families moving out of each region during the survey years and the average loss for all regions of 4.4 per cent should be compared with the average loss through movement across local boundaries which is 13.6 per cent. Thus, by choosing regional aggregates rather than individual authorities as the unit of study two-thirds of the losses through migration can be avoided.

The number of individual authorities in each region is large and the question arises whether smaller aggregates of authority could profitably be taken. It was originally expected that the main saving would be achieved when urban authorities were related to their surrounding county areas, but this is not

Table 7. Families moving out of each regional aggregate in 1946-1950.

REGIONAL AGGREGATE	NUMBER OF ¹ COOPERATING AUTHORITIES	NUMBER OF CHILDREN IN 1946 WHO WERE STILL SURVIVING AND ENROLLED IN THE SURVEY IN 1950	PER CENT LEAVING ² REGION 1946-1948
Greater London and South East	27	1,452	3.0
North	51	1,182	4.3
Midlands	27	807	5.4
East	15	247	5.9
South West	8	155	8.2
Wales	16	253	7.3
Scotland	55	572	3.5
ALL PARTS	199	4,668	4.4

¹ Counties, country boroughs and large boroughs only—the smaller authorities that were Maternity and Child Welfare authorities in 1946 are included with the counties.

² Adjusted for sampling fraction.

so as the following figures for Northumberland and Durham and their seven contained county boroughs show. The movement from these authorities considered individually was 17.6 per cent whereas the movement from the whole area was 14.6 per cent; that is to say, by including all the nine authorities in a single inquiry, we should have saved only one-fifth of the losses. This is a far smaller saving than would have been achieved if the whole Northern region had been taken, in which case the losses through migration would have been 4.3 per cent or one-quarter of the losses from the individual authorities.

3. THE ACCURACY OF THE INFORMATION OBTAINED

Underlying the whole inquiry is the assumption that women will give reliable answers to questions about their homes and families and that they can remember over varying periods of time specified major illnesses and accidents and the approximate dates when they occurred. It is also assumed that the women can answer with reasonable accuracy such questions as when their child first walked alone, when he was immunized, or when he was taken to an infant welfare center. These assumptions are clearly open to question and our object here is to show how far they are justified.

We obtained the following direct checks on our information:

1. Five local maternity and child welfare authorities were visited and the information on immunization and infant welfare center attendance given on the survey forms was checked with that on the local records.
2. The mothers' answers to questions on hospital admissions were checked with the hospitals concerned.
3. An analysis was made of answers given by the same mothers to the same questions in successive surveys.

These checks have so far been applied only to information gathered during the first four years of the survey, when the interviews were most widely spaced and the possibilities of error greatest.

In the succeeding paragraphs it will become clear that no general statement on the accuracy of memory can be made. The memory and placing of events varies with the intensity of their impact and women who remember the precise date of a hospital admission may give the date of an attack of whooping cough with much less accuracy. The important fact is that similar errors are made by women in all occupational groups so that social comparisons of the age incidence of disease may be valid although the errors in each group are large. It is also important that few of the illnesses asked about appear to have been forgotten and that most diagnoses were given correctly.

Accuracy of Information on Infant Welfare Attendances and Diphtheria Immunization. In Table 8 it will be seen that social differences in the use made of welfare centers are as clearly shown from the answers given when there was a two year period of recall, as from those given concurrently. None of the small differences shown in the table is significant.

When the answers given by mothers in five local authority areas were checked against the public health records it was found that the *dates* of 51 per cent of first attendances at welfare centers were given correctly to the nearest week, 32 per cent showed errors of between one and four weeks and 17 per cent showed larger errors. Seven per cent of the mothers said

Table 8. Proportion of mothers making their first attendance at infant welfare centers in the eight weeks following confinement. (Rowntree, 1950 b).

	PER CENT USING CENTERS IN FIRST EIGHT WEEKS					TOTAL
	Profes- sional and Salaried	Black- Coated	Manual Workers	Agricul- tural Workers	Own Account and Farmer	
Maternity Survey (1946)	44.5	62.5	61.5	35.1	39.5	6,469 ^a
Follow-up Survey (1948)	49.7	63.9	63.2	34.0	37.8	4,690 ^b

^a In the 1946 maternity survey only approximately half the mothers were asked questions on the use of the infant welfare centers. (See, MATERNITY IN GREAT BRITAIN, p. 4.)

^b This number excludes all losses during the first two years from death (210 children), emigration (118 children), refusal (56 children), and other causes (215 children), and also 97 children whose mothers were interviewed but failed to answer questions on infant welfare attendance.

	AGE ON ADMISSION (IN MONTHS)					TOTAL NUMBER OF CHILDREN
	0-12	13-24	25-36	37-48	More Than 48	
Mothers Hospital Records	153	127	167	204	12	663
	145	132	166	220	nil	663

Table 9. Comparison of the ages of children when admitted to hospital as recalled by their mothers and as given by the hospital records.

they had attended infant welfare centers when they had not done so. The total *number* of attendances made during the first two years was often incorrectly reported, but in general the number of attendances claimed by a mother was a fair indication of the actual frequency with which she had attended, and when the survey records and the local records were ranked according to the number of attendances in the first year a correlation of +0.69 ($n = 92$ $P < 0.001$) was found between the two sets of information.

In the same five authorities the mothers' statements on diphtheria immunization were checked with the health visitors records, and out of 145 answers only two were found to be incorrect (Rowntree 1950 a).

Accuracy of Information on Hospital Admissions. Hospital records were used to check the information given by mothers in respect to 663 hospital admissions during the first four years of life. The ages on admission, as given by the mothers, are compared in Table 9 with the actual ages.

The mothers' reports accurately describe the age distribution of hospital sicknesses in the whole survey population, and the mean reported age on admission (27.4 months) is not significantly different from the true mean age (27.2 months $t = 1.53$ $n = 662$ $0.2 > P > 0.1$).⁸ The correlation coefficient relating the ages of admission given by the mothers and by the hospitals is +0.96.

⁸ This test was based on the errors made by individual mothers and not on a direct comparison of the two means.

When the period of recall is less than two years there is a slight but not significant understatement of the age on admission. With longer periods of recall the age is significantly overstated,⁹ but not so much so that the mothers' estimates of the age distribution of early admissions are seriously distorted. With longer periods of recall the women from the lowest occupational groups are the most likely to make gross errors.

It was expected that women with many children would make larger errors than those with few, but this was not so. Nor can it be shown that the dates of admission are better remembered when the illnesses are serious than when they are slight.

We have also been able to check how accurately the number of days spent in hospital is remembered. While there was a close agreement between the mothers' accounts and the hospital records, (as shown by a correlation coefficient of +0.94), there was a consistent tendency to overestimate the length of stay. Thus the actual mean length of stay was 18.0 days whereas the remembered length of stay was 20.7 days.¹⁰ These overestimates were greater when the period of recall was long, when the length of stay was short, and when the mothers belonged to the manual worker group. The errors largely resulted from a tendency to report length of stay in weekly intervals rather than in days.

There is no evidence that mothers who make large errors in recalling age on admission are more likely to make large errors in recalling length of stay. The correlation coefficient relating the size of these two types of error is not significantly different from zero.

Comparing the mothers' statements of reason for admission with the final hospital diagnoses, it was found that only twenty-four were misleading in the sense that they would have led to a different classification of the illnesses concerned if we had used them alone. It is of interest that the majority of these errors were made by the women in the lower groups. Some had given

⁹ By 0.63 months ($t=2.37$ $n=275$, $0.02 > P > 0.01$).

¹⁰ ($t=2.21$ $n=1296$ $0.05 > P > 0.02$.)

the first but not the final diagnosis, for example, a suspected inguinal hernia was reported as such although it was later shown to be a cyst of the spermatic cord. Others mentioned a minor complaint but not a serious complication—for example, a child admitted to hospital with tonsillitis later developed acute nephritis, but only the first was mentioned. In two instances it appears that the mothers were hiding a condition which they considered shameful—a child with congenital syphilis was reported as having a “nervous complaint” and a mentally backward child was labelled “possible infantile paralysis.” Finally a mother reported that her child had been in hospital with pneumonia but did not say that the precipitating cause of admission was not this illness but severe erythema following the too enthusiastic application at home of thermogene wool poultices to the chest.

In general, it appears that the mothers have given an accurate account of the hospital admissions of their children and that even if we had had to rely on their memories alone, the reliability of our information on hospital care would still have been high.

How Completely Has Illness Been Reported? In the survey we have only asked about hospital admissions, accidents where the doctor was called in, and the major infectious diseases, and the questions concerned only one child in the family. Even so, a few incidents appear to have been left out; for example, out of 656 accidents to our children between birth and two years forty-six were forgotten or suppressed and only revealed at a later stage of the inquiry. These accidents were all trivial and six of them appear to have resulted from the mothers' own carelessness.

The same questions on incidence asked in successive surveys did not always yield the same results. At two years of age 1,296 children were reported by their mothers to have had either measles or whooping cough or both. But ninety-six mothers failed to recall these illnesses two years later until they were pressed by the health visitors and shown local records. It

PERIOD OF RECALL	28-33 MONTHS	34-39 MONTHS	40-45 MONTHS	46-51 MONTHS
AGE OF CHILD	2 YEARS TO 19 MONTHS PER CENT	18 MONTHS TO 13 MONTHS PER CENT	1 YEAR TO 7 MONTHS PER CENT	6 MONTHS TO 0 MONTHS PER CENT
Proportion of Attacks <i>Not</i> Reported in the 1950 Survey (<i>i.e.</i> Taken at 4 Years of Age)	11.1	7.6	5.9	3.7

Table 10. Comparison of information on measles and whooping cough given in 1948 and in 1950. Losses with different periods of recall.

is worth noting that the mothers were least likely to forget illnesses that had occurred early in their child’s life, as Table 10 shows.

The ages of admission to hospital were also best remembered when they occurred within six months of birth and illnesses in infancy appear to have a greater impact on the memories of mothers.

A further source of error lay in the confusion of the survey child with his sibs. Twelve mothers incorrectly attributed accidents or illnesses to the survey children which had in fact occurred to their brothers or sisters.

None of the sources of error discussed in this section appears to be large enough to have distorted the general pattern of reported illnesses.

PRESENT AIMS AND FUTURE DEVELOPMENT

The main fields of interest in the early years of this study are shown by the titles of the twenty-two publications listed at the end of this paper. In addition, a book on the health, growth and environment of the pre-school child is nearly completed. Particular fields of interest at the present time are as follows:

1. We are in a position to isolate and define groups which fail to use the welfare services even when they are available. And we can also assess the value of these services in terms of the health and growth of the children. The infant welfare services

existing in Great Britain today were, to a considerable extent, designed for the economic environment and standards of education of twenty years ago, and it is administratively important to make an objective assessment of how far they meet our present needs. This, we believe, can be done by using the information provided by this survey.

2. We have a unique opportunity to examine the handicaps suffered by certain groups of children and the extent to which they need special help. The largest group and the one that is administratively the most important is made up of the prematurely-born children, about whose health and development there have been many conflicting reports owing to the difficulty in finding adequate samples of premature children and of mature controls to compare them with. In the present study these sampling difficulties are avoided. All children prematurely born during the survey week have been followed up and compared with a closely matched group of children born at term. Four papers comparing the health, growth, and mental ability of premature children with their controls have been published and in general show the former to be little handicapped, though a small well-defined group made exceptionally low scores in tests of school achievement and mental ability.

3. This study is especially well adapted for getting direct evidence on such problems as whether maternal employment has an adverse effect on the child or whether separation from the mother in infancy leads to later difficulties in emotional adjustment. We have accordingly noted all major periods of separation from the mother and all periods during which she was employed. In addition, we hear of all broken marriages in our sample. A paper describing the incidence of such marriages and examining children from broken homes has already been published.

4. The children in the sample are now approaching the point in their school careers when they take the examination which determines whether they go to a grammar, secondary modern, or technical school. Relatively little is known about the factors affecting achievements in this examination, and we hope to examine the part played by the attitude of the parents, by illness or absence from school, by the size of the class, by the frequency of change of teacher, etc.

There would be no difficulty in following our children through the remainder of their school careers, even into their first jobs and, for the boys, until they have completed their National Service. And there are many questions relating to adolescence and entry into employment which could be answered if the survey were continued. It would also be of value to continue to follow the special groups of premature children, deprived children, bedwetters, etc. In such further investigations the problems involved are not likely to be of the kind referred to by Professor Cochran. As has been shown, all the authorities concerned have been extremely cooperative and continue to be so, while our experience suggests that the mothers of the survey children tend to become more, rather than less, cooperative with time. Moreover, the possible "warping" of the survey children can be tested periodically by drawing upon the children not covered by the continuous survey. The main difficulty as regards the future, is primarily one of finance. So far all our interviewing has been carried out without cost to the Committee, the services of the health visitors, school nurses, and school doctors having been given most generously by these groups, with the enthusiastic consent of their authorities. Nevertheless, substantial costs are involved in maintaining the central organization necessary for keeping in contact with the children and the interviewers, and in tracing migrant families, as well as in the processing and analysis of the data collected. And such costs can only be met by correspondingly substantial grants from Foundations.

SUMMARY

A longitudinal study of the health and development of a national sample of children has been described. Losses during the ten-year period for which the survey has been running were analyzed and it was shown that no significant bias has been introduced into the sample thereby.

Internal migration was discussed and the likelihood of a progressive distortion of the sample in longitudinal studies

which do not attempt a national coverage was shown to be considerable. Such distortion could be reduced by covering large regional aggregates instead of a single administrative area.

The reliability of the information given by mothers in answer to questions on their child's health and early history was examined and it was shown that while some events are remembered better than others the errors made are not large enough to lead to an appreciable distortion of the facts.

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