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SOME CIRCUMSTANCES AFFECTING THE SURVIVAL OF PREMATURE CHILDREN.

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Of recent years increasing care has been bestowed on the premature child, but prematurity remains a formidable contributor to the tale of infant deaths. In the city of Glasgow in the year 1950 6.3 per cent of all live births notified to the Medical Officer of Health were described, either on notification or in Health Visitors' reports, as 'premature.' It has seemed to be worth while to look back, after the elapse of six or seven years, at premature children born in the city during the trying war years 1943 and 1944, primarily to ascertain differences between the medical and social circumstances surrounding the birth of those premature children who survived and those who died; to see how the early history and growth of surviving premature children compared with that of 'normal' children, as disclosed by routine medical inspection when they went to school; to consider the circumstances of those premature children who failed to survive to the age of school entry; and to study the reproductive histories of families in which a premature birth occurred in 1943 and 1944, so as to obtain a picture of reproductive pattern both before and after the birth of the premature child.

From the Register of Notifications of Births were drawn at random the names of 327 premature children born in 1943 and 1944 who were known to have died and 515 who were believed to have survived to age six. The home of each child, whether alive or dead, was visited during 1950 and information collected from the mother of the child (or, where the mother had died, from a relative) about family history and social circumstances, about the particular pregnancy in question and about the health of the mother and surviving children: medical histories were amplified by reference to the records of hospitals, child welfare clinics and family doctors. Information was obtained from the Registrar-General about the age at death and the certified cause of death of those premature infants who had died: and from the School Medical Officer about the height, weight, health and defects of those children who survived and who were examined medically on school entry.

An enquiry largely retrospective, as this was, is necessarily attended with certain practical difficulties. Some mothers have died and some cannot be traced ; and the flight of time inevitably blunts the recollection of some circumstances on which more accurate information might have been desired : but on the other hand, by way of compensation, past happenings can often be seen in a truer perspective and information about them amplified by subsequent events. A remarkably high degree of co-operation was obtained from the mothers concerned, and the broad picture that came to light as a result of the investigation is presented with reasonable confidence as to its accuracy.

Sixty-six surviving children and 85 of those who failed to survive were the products of multiple births and this group of multiple births has been entirely deleted from the general consideration which follows of differences between the series of surviving and dead children. Labour had been induced in 75 of the cases in which premature infants survived and in 28 of the cases where the infant failed to survive.

In both series, whether the child was alive or dead when the case was investigated in 1950, wide variations were found in the birth weight of the ' premature ' child and in the reputed duration of pregnancy.

TABLE 1.

Birth weight and reputed duration of pregnancy : surviving and dead premature infants.

Weight of child at birth	Children surviving			Children dead		
	Male (228)	Female (222)	Total (450)	Male (134)	Female (108)	Total (242)
	%	%	%	%	%	%
—3½ lbs. ..	5.9	10.2	8.1	14.3	14.9	14.6
3 3/16—4½ lbs. ..	14.9	21.3	18.0	18.1	25.3	21.3
4 3/16—5½ lbs. ..	39.3	31.9	35.7	34.3	44.8	39.1
5 3/16—7 lbs. ..	33.5	30.1	31.8	25.7	11.5	19.3
Over 7 lbs. ..	6.3	6.5	6.4	7.6	3.5	5.7
	100.0	100.0	100.0	100.0	100.0	100.0
Reputed duration of pregnancy						
	%	%	%	%	%	%
—28 weeks	17.5	14.9	16.2	45.1	46.7	45.8
29—32 weeks	53.1	56.6	54.8	43.6	39.3	41.7
33 weeks or more ..	29.4	28.5	29.0	11.3	14.0	12.5
	100.0	100.0	100.0	100.0	100.0	100.0

Birth weights were appreciably lower and duration of pregnancy shorter among children who failed to survive. All the female infants born of pregnancies of reputed duration not exceeding 28 weeks and all

but five of the males weighed not more than 5½ lbs. at birth, as did 78 per cent of the males and 75 per cent of the females resulting from pregnancies of 29-32 weeks duration. Approximately one third of the male infants and one half of the female infants born of pregnancies of over 32 weeks duration weighed not more than 5½ lbs. at birth.

Of premature children who survived 50.7 per cent were males and of those who died 55.4 per cent. Fully 16 per cent of infants who survived and fully 11 per cent of infants who died were born following induction of labour.

The season of the year at which birth took place affected the prospect of survival of premature children : thus, 32.6 per cent of all the infants who died were born in the cold first quarter of the year and only 17.8 per cent in the second quarter ; the corresponding fractions of surviving children were 29.6 per cent and 25.3 per cent.

In each case an attempt was made to determine the probable cause of premature birth. This was often difficult, usually because several possible causes were present. In these cases an estimate could only be attempted in the light of all the available information. The factors thought to have been chiefly responsible for more than two thirds of the cases studied are set out in Table 2, premature births resulting in children who survived to age six being shown separately from those resulting in non-surviving infants and first pregnancies separately from fourth and subsequent pregnancies.

TABLE 2.

Probable cause of premature birth.

Premature birth associated with	Pregnancies producing a premature child					
	that survived to age 6			that failed to survive to age 6		
	All pregnancies	1st	4th and subsequent	All pregnancies	1st	4th and subsequent
	%	%	%	%	%	%
Toxaemia, high blood pressure	23.6	27.6	21.3	17.8	26.8	14.1
Ante-partum haemorrhage	12.0	7.7	14.0	17.4	10.4	15.5
Anaemia and debility ..	9.6	4.4	16.4	9.9	6.5	7.0
Strain of work	8.2	9.9	8.2	11.2	19.5	9.9
Continuous worry ..	8.0	9.9	5.7	6.6	12.2	5.6
Falls	6.9	9.3	4.9	7.4	3.7	5.6

General social background.

The proportions of the premature infants who were born in hospital were about equal in the two series—67.3 per cent of the surviving group and 67.8 per cent of those who failed to survive.

Of infants who survived, 4.0 per cent were illegitimate and of infants who died, 10.3 per cent.

A high proportion of the premature infants were first children in their families ; 40.2 per cent of those surviving and 33.9 per cent of those who died were first children. Apart from this condition of parity, the prospect of survival of a premature infant appeared to be brighter when the age of the mother at the birth of the premature infant was 35 years or more. Among non-surviving children born to mothers in the older age groups, the proportion of infants of low birth weight tended to be above average : half of those premature children who subsequently died born to mothers over 35 years of age weighed 4½ lbs. or less at birth, whereas the corresponding figure for mothers of all ages was 36 per cent.

Ante-partum haemorrhage and anaemia occurred relatively more frequently in association with prematurity in large families rather than in small.

Of surviving premature infants, 13.6 per cent were born within a year after marriage : of the infants that were born alive but failed to survive only 6.1 per cent were born within a year after marriage, toxaemia and strain of work being the factors usually contributing to prematurity. It has to be remembered that 4.0 per cent of surviving infants were illegitimate as compared with 10.3 per cent of those who died, prematurity here being often associated with ante-partum haemorrhage and falls or with strain of work ; so that if the fractions born before marriage are added to those born within a year after marriage the totals account for 17.6 per cent of surviving infants and 16.4 per cent of those who died. Where the birth of the premature infant took place more than a year after marriage the length of time elapsing between marriage and the birth of the child bore no significant relationship to the infant's prospect of survival.

Where the premature child had survived, the mother's general health since marriage was described as ' good ' in 49 per cent of cases ; where the child failed to survive it was described as ' good ' in 45 per cent. This slightly inferior general health record among the mothers whose premature infants died was not confined to any particular social level, as estimated by the degree of skill of the husband's occupation. But the proportion of mothers whose health since marriage was described as ' good ' was only 30 per cent among those mothers of non-surviving premature children whose husbands had experienced severe unemployment (*e.g.*, more than 15 months in the course of the five years preceding this investigation) ; and several of the mothers in this group had suffered from tuberculosis or pleurisy. The health record of mothers whose premature infants survived was better than the others, even in the presence of a similar degree of unemployment.

Among mothers of surviving premature children the level of general health since marriage deteriorated as severity of crowding in the home increased : but this did not seem to be the case among the mothers of premature infants which failed to survive.

Of the mothers of surviving premature infants, 19 (4.2%) had died in the course of the six years following the birth of the child (from tuberculosis, 9 ; cardio-vascular disease, 7 ; maternal deaths, 2 ; cancer, 1) ; over the same period 14 (5.4%) of the mothers of non-surviving infants had died (from tuberculosis, 4 ; cardio-vascular disease, 3 ; nephritis, 4 ; maternal death, 1 ; diabetes, 1).

Health of the mother during the pregnancy producing a premature child.

Most of the mothers experienced illness of one kind or another in the course of the pregnancy that produced the premature child : but 23.1 per cent of the mothers of children who survived and 13.6 per cent of mothers of infants who subsequently died had no illness of any kind in the course of the pregnancy. The excess of illness among mothers of premature infants who failed to survive was independent of parity. In both groups the most prevalent illness was toxaemia, though toxaemia was relatively less frequent among the mothers of non-surviving children, whereas ante-partum haemorrhage, general diseases not directly associated with pregnancy and ' accidents ' and ' frights ' assumed added prominence in that group : it was difficult to know how many of the ' accidents ' were associated with the fear of an unwanted child. Toxaemia, general diseases, ' frights ' and ' accidents ' affected chiefly first children, whereas ante-partum haemorrhage affected later parities more than early.

The birth-weight of infants who survived varied but little with the health of the mother during pregnancy ; it averaged about 4½ lbs. whether the mother had been ill nor not. The birth-weight of children who failed to survive, on the other hand, was relatively high where the mother had experienced no illness during pregnancy (4.2 lbs.), where she had suffered from toxaemia (4.4 lbs.) or experienced ' fright ' (4.4 lbs.) ; lighter, where she had suffered from some general disease (3.6 lbs.) or from ante-partum haemorrhage (4.0 lbs.).

Pregnancy was of not more than 28 weeks duration in 16.2 per cent of the cases in which the premature child survived to age six and in 45.8 per cent of cases in which the infant, though born alive, did not survive to that age. Where the mother had experienced no illness in the course of her pregnancy the figures were 14.6 per cent of not more than 28 weeks duration where the child survived and 56.7 per cent where the child failed to survive—a wide gap : where she had suffered from toxaemia, 16.4 per cent and 37.0 per cent : where from ante-partum haemorrhage, 12.5 per cent and 37.0 per cent : where from general disease not directly associated with pregnancy, 16.9 per cent and 45.5 per cent ; and where she had experienced some ' accident ' or ' fright,' 43.8 per cent and 54.5 per cent—with both figures high and relatively little difference between the two groups.

Mothers who went out to work during the pregnancy that produced the premature child experienced no more illness during pregnancy than mothers who did no work out of the home : this held true whether the premature child survived or not. But among the mothers of infants who failed to survive a higher proportion gave up their outside work during the first three months of the pregnancy (30 per cent compared with 17 per cent of the mothers of children who were still alive six years after birth) and, on the other hand, fewer continued to work after the sixth month of pregnancy.

Social circumstances of the fathers of premature children.

In the course of the six years following the birth of the child, 15 (3.3%) of the fathers of surviving premature infants died (from tuberculosis, 3 ; from pneumonia, 4 ; cardiac disease, 3 ; violence, 3—one on war service ; nephritis, 1 ; cancer, 1) : over the same period 13 (5.4%) of the fathers of premature infants that had failed to survive died (from tuberculosis, 4 ; cardiac disease, 4 ; violence, 2—one on war service ; cancer, cerebral cerebral haemorrhage and unknown causes, each 1).

Of the fathers of the premature children who survived to age six, 19.6 per cent were unskilled labourers ; of the fathers of children who failed to survive, 29.3 per cent were unskilled labourers. Toxaemia contributed slightly more than its share to prematurity among the wives of skilled workers, anaemia and worry to prematurity among the wives of unskilled workers. Whether the premature child survived or not, the wives of husbands in skilled employment enjoyed greater freedom during pregnancy from general illness unrelated to pregnancy.

Where fathers of surviving premature infants had a background of freedom from serious unemployment, a larger proportion of the mothers escaped illness during their pregnancy. This relationship between the father's unemployment record and illness of the mother during pregnancy did not apply where the premature infant had failed to survive.

Ante-natal care.

The great majority of mothers in both series received some ante-natal care in the course of pregnancy ; but 2.2 per cent of the cases where the child survived to age six and 9.5 per cent of those where the child failed to survive had no ante-natal care. The reason for failure to obtain ante-natal care was often the desire to conceal an illegitimate pregnancy ; but occasionally mothers who had already borne large families did not wish ante-natal care. Just over one third of the pregnancies resulting in a premature child which failed to survive to age six were first births and 18.3 per cent of the mothers of first-born non-surviving premature infants had received no ante-natal care, the younger mothers having least of all.

There was no great difference between the sources from which mothers in the two series of cases received their ante-natal care: in both groups the largest number attended Local Authority clinics (Table 3).

TABLE 3.

Source of ante-natal care.

Source of ante-natal care	Child survived to age 6	Child dead before age 6
	%	%
None	2.2	9.5
Own doctor	22.9	20.7
Hospital	21.3	22.3
Local Authority clinic	47.1	40.9
Some combination of these sources ..	6.4	6.6

The source from which the mother obtained her ante-natal care showed some variation with the occupational status of the husband. This was more noticeable in the group of cases where the premature child resulting from the pregnancy survived: in this group there was a tendency for a higher proportion of the wives of husbands who held skilled jobs to obtain ante-natal care from private doctor or hospital, as compared with the wives of unskilled husbands, who rather more frequently obtained care at Local Authority clinics: but even in the 'skilled' group the Local Authority clinic was the source chiefly patronised.

In the series of cases where the premature child failed to survive, this relationship of source of care with social status was less apparent.

There was no over-all difference between the mothers of premature children who died and those who survived in stage of pregnancy at which they first came under ante-natal care; in both groups some 17 per cent of mothers obtained ante-natal care during the first three months of pregnancy and 10-11 per cent did not obtain care until after the sixth month. Among the mothers of infants who survived, 27 per cent of those who obtained ante-natal care from their own doctor came under supervision during the first three months of pregnancy, as compared with 17 per cent of those whose infants failed to survive. For mothers who received their ante-natal care from hospitals the corresponding figures were 23 per cent and 21 per cent; and for mothers who received their ante-natal care at Local Authority clinics, 9 per cent and 12 per cent. Mothers who sought ante-natal care at Local Authority clinics, therefore, tended to come under supervision later in the course of pregnancy than the others.

In both groups (but especially where the child failed to survive) mothers suffering from toxaemia sought ante-natal care at a rather earlier stage in pregnancy than the others.

Among the wives of non-manual and skilled manual workers the proportion of cases in which ante-natal care was instituted during the first three months of pregnancy was greater than that among the wives of unskilled manual workers. Mothers tended to seek ante-natal care earlier in pregnancy where the husband had a good history of freedom from unemployment : this held true whether the child survived or failed to survive.

Provided the mother received ante-natal care, there was no significant difference in survival rates of premature children with the stage in pregnancy at which ante-natal care was instituted. The ' take-up ' of extra milk and vitamin supplements was better when ante-natal care was instituted early in pregnancy : this applied equally to pregnancies culminating in a surviving child and to cases in which the child failed to survive.

The 'take-up' during pregnancy of vitamin supplements and extra milk rations.

The proportion of mothers who took up available supplies of vitamin supplements during pregnancy was 46 per cent where the premature child survived and 48 per cent where the premature child failed to survive, so the survival of the premature child was little influenced by whether or not the mother took vitamin supplements. The take-up of vitamin supplements was best during second and third pregnancies. There was no significant difference between the ' take-up ' of supplements by mothers who received ante-natal care from own doctor, hospital or Local Authority clinic. So far as can be judged, the take-up of supplements among these mothers who gave birth to premature children was not less favourable than that among mothers generally during the years concerned (1943-44) so that it would appear to be doubtful whether the taking of vitamin supplements played any notable part, either in determining prematurity or in determining the survival of a premature child.

Twenty-two per cent of the mothers whose premature children survived did not take up the extra ration of milk to which they were entitled during pregnancy : the corresponding figure for mothers whose premature infants failed to survive was 37 per cent. The ' take-up ' of extra milk rations was low among mothers who received no ante-natal care ; there was no significant difference in the extent to which extra milk was taken with the source from which the mother obtained ante-natal care.

The question inevitably arises whether the higher survival rate among premature infants of mothers who took extra milk could be related to the mother's consumption of the extra milk, or whether the take-up of extra milk was rather to be regarded merely as another index of better maternal care. In this connection it is relevant to recall that the take-up

of vitamin supplements, which could equally be regarded as an earnest of good maternal care, was not associated with any favourable effect on the survival of the premature child.

Where prematurity was associated with toxaemia or strain of work there was a wide difference between the ' take-up ' of milk by mothers whose infants subsequently survived to age six and those whose infants died ; there was no such difference where prematurity was associated with ante-partum haemorrhage (Table 4).

TABLE 4.

Factors in the causation of prematurity in relation to proportion of mothers taking extra milk in pregnancy.

Prematurity associated with	Percentage of mothers taking extra milk	
	Child survived to age 6	Child failed to survive
Oedema, high blood pressure, toxaemia	88	54
Strain of work	65	38
Ante-partum haemorrhage	84	84
Anaemia and debility	76	67

There was no significant difference in the take-up of extra milk between the wives of skilled and unskilled workers, but take-up was appreciably lower among the wives of husbands who had suffered heavily from unemployment ; the correlation with husband's record of unemployment was less marked in the series of cases in which the premature child failed to survive, perhaps because those latter infants suffered from prematurity of a degree or causation not materially mitigated by the higher consumption of milk.

Mothers employed out of the home.

The proportion of mothers who worked outside the home for some part of pregnancy was higher than among the mothers of children who failed to survive to age six (28.5 per cent) than among the mothers of premature children who did survive (24 per cent). The difference between the two series was not very great and, as might be expected, was largely related to first pregnancies : the mothers who worked during their first pregnancies were 42 per cent of those whose premature children survived as compared with 53 per cent of those whose premature children died. Among the mothers of children who survived, the proportion employed in shop and office work was relatively high, whereas among the mothers whose premature children died the proportion employed in factory, domestic and transport work was relatively high.

There was no variation with the nature of husband's employment in the proportion of mothers working during pregnancy, irrespective of whether the premature child survived or not. But the percentage of mothers who had worked was higher where the father experienced no unemployment in the course of the 5 years subsequent to the birth of the child and had presumably been relatively free of unemployment previously. Where the premature child survived and the father had escaped unemployment, 25 per cent of the mothers had worked during pregnancy as compared with 12 per cent where the father was unemployed for at least fifteen months in the course of the 5 years subsequent to the birth of the child.

The mothers of premature children that failed to survive had stopped work at an earlier stage in pregnancy. The proportion who had stopped work by the end of the third month was 17.7 per cent where the premature child survived to age six, 30.4 per cent where the child failed to survive to that age. This rather suggests that the health of the mothers of premature children who subsequently failed to survive may have been too bad to allow them to carry on with work during pregnancy. Toxaemia and falls were the factors most commonly associated with premature birth among the mothers of surviving children who gave up work early in pregnancy; among the mothers of premature children who failed to survive to age six ante-partum haemorrhage and toxaemia predominated.

In both series of cases the wives of husbands engaged in unskilled work continued to work to a later stage in pregnancy than the wives of husbands who were in skilled employment. There was no significant relationship between the stage in pregnancy at which the mother stopped work and the severity of unemployment experienced by her husband.

Of premature children that survived, 10 per cent were the children of fathers who had experienced severe unemployment—who were idle at least 15 months in the course of the 5 years subsequent to the birth of the child and had had much unemployment previously—while of children that failed to survive 17 per cent were the children of fathers who had experienced unemployment of this severity.

Fewer mothers who worked out of the home during pregnancy received ante-natal care than among those who were not out at work. Where the infant survived, 5 per cent of the mothers who worked during pregnancy received no ante-natal care, compared with only 2 per cent of mothers who were not out at work: where the infant failed to survive 29 per cent of the mothers who worked had no ante-natal care as against less than 3 per cent of mothers who were not employed out of the home. A relatively high proportion of mothers who worked during pregnancy received ante-natal care at hospital and relatively few at Local Authority clinics.

Crowding in the home.

Nearly half of the premature children covered by this investigation—46 per cent of those who survived and 47 per cent of those who failed to survive—were born into homes in which, when this study was made six years after the birth of the child, there were not more than two persons per room. This indicated a level of crowding less than that prevailing in the city generally, and doubtless due, in part at least, to the high incidence of prematurity in first pregnancies. It seems a fair inference that overcrowding in the home is not, *per se*, a major contributor to prematurity. But there was more overcrowding in the home of those premature children who failed to survive than among those who survived.

Among children who survived, the proportion of premature children who weighed not more than 4½ lbs. at birth was appreciably higher in overcrowded homes, but among children who failed to survive this did not hold.

Among the mothers of surviving premature children who were living in most overcrowded homes anaemia and strain of work were common; and, among the over-crowded mothers of children who died, anaemia was the most frequently reported contributor to prematurity.

The proportion of infants born at home (as distinct from in an institution) was actually higher where there was severe overcrowding in the home. This applied both to children who survived and to children who died (Table 5).

TABLE 5.

Proportion of domicilliary births in relation to severity of crowding in the home.

Persons per room	Percentage of children born at home	
	Where infant survived	Where infant failed to survive
—2	30	25
2—	40	45
3—	58	46

The explanation of this apparent anomaly is again to be found, in part, in the high contribution of first births to prematurity, since a higher proportion of first births take place in hospital.

Survival of the premature child in relation to some etiological factors.

Toxaemia occurred more frequently in pregnancies producing premature children that survived, whereas ante-partum haemorrhage and strain of work occurred more frequently in those pregnancies producing a premature infant which failed to survive. Anaemia and debility were present in almost equal degree in the two groups of cases.

Toxaemia occurred more frequently in first than in later births.

At all parities, ante-partum haemorrhage was more common during the pregnancies which produced a child which did not survive.

Strain of work was rather more frequently associated with prematurity in first than in later pregnancies : and in these pregnancies the premature child often failed to survive.

About one quarter of all the premature infants weighing less than 4½ lbs. at birth who failed to survive were born prematurely following ante-partum haemorrhage : toxaemia, strain of work and anaemia and debility were associated with less mortality among infants weighing 4½ lbs. or less at birth. Among premature babies whose weight at birth ranged between 4 9/16 and 5½ lbs., on the other hand, there was less difference in prospect of survival between those associated with ante-partum haemorrhage and the others.

Where prematurity was associated with strain of work, ante-natal care tended to be sought late in pregnancy, if at all : where with ante-partum haemorrhage, on the other hand, ante-natal care was usually sought early in pregnancy.

Reproductive performance in relation to prematurity.

In the 450 families in which the premature child included in this study survived to age six there were 1781 pregnancies, an average of 4.0 per family : in the 242 families in which the premature child, though born alive, failed to reach that age there were 1116 pregnancies, an average of 4.6 per family. The families in which the premature infants had survived tended to have their pregnancies spread over a greater number of years. Of the surviving children 37.2 per cent were from one or two-children families, as compared with 18.7 per cent of the children

TABLE 6.

Families in which there had been at least one premature child ; the outcome of pregnancies (*a*) where the premature child included in this study survived to age 6 : (*b*) died before reaching that age : and (*c*) in the two series combined.

Outcome of pregnancy	Family in which premature child on which this study is based				Both series combined	
	Survived		Did not survive			
		%		%		%
Full-term pregnancy, child survived to age 6	814	(45.8)	547	(49.0)	1361	(47.0)
,, ,, child died before age 6	104	(5.8)	89	(8.0)	193	(6.7)
Premature birth, child survived to age 6 ..	586	(36.9)	61	(32.6)	647	(35.2)
,, ,, child died before age 6 ..	71		303		374	
Still-birth	65	(3.6)	30	(2.7)	95	(3.3)
Miscarriage or abortion	141	(7.9)	86	(7.7)	227	(7.8)
	1781	100.0	1116	100.0	2897	100.0

who did not survive : on the other hand, 4.7 per cent of the survivors belonged to families of ten or more children as compared with 6.5 per cent of those who did not survive.

The outcome of all the pregnancies in these two series of families is shown in Table 6.

Mortality among the full-term children was 11.3 per cent where the premature infant included in this study survived, 14.0 per cent where it failed to survive. The proportion of pregnancies terminating in still births was rather higher in the series in which the premature infant survived.

When the parities of the full-term children in these families were compared with the parities of the premature children, there was found to be an excess of premature infants among first births and again—to a lesser extent—at the seventh and eighth pregnancies (Table 7).

TABLE 7.

Serial number in relation to outcome of pregnancy : births at each serial number stated as percentage of all births in group.

Outcome of pregnancy	Serial number of pregnancy									
	1	2	3	4	5	6	7	8	9	10+
Full-term child	21.1	34.1	16.1	13.8	8.5	5.5	3.4	2.2	1.8	3.1
Premature child, child survived to age 6 . .	34.1	22.4	13.3	6.3	7.2	4.9	5.1	2.6	1.7	2.4
child died before age 6	30.4	23.4	12.2	4.5	6.6	4.6	3.6	3.0	1.3	3.3

Though mothers under 20 and over 30 years of age had more than their share of premature children, it is worthy of note that 56 per cent of all the premature children in this study were born to mothers between 20 and 29 years of age.

The risk of prematurity of infants was related to the interval between pregnancies. Considering all the children born alive in those two groups, totalling 691 families, in which there had been at least one premature child, the proportion of infants born prematurely was lowest (28 per cent) where the interval between pregnancies was two years : where the interval between pregnancies was less than two years 38 per cent of live births were premature ; where the interval was three years, 34 per cent of births were premature ; four years, 40 per cent ; and five years, 56 per cent.

In these families premature births occurred least frequently among mothers between the ages of 20 and 29, where 36 per cent were premature : among mothers under the age of 20, 44 per cent of births were premature and the proportion of premature births rose from 42 per cent among mothers whose age fell between 30 and 34 years to 63 per cent at ages over 40.

The incidence of prematurity was lowest in third and fourth pregnancies (about 31 per cent), higher at earlier and later pregnancies.

The proportion of full-term children who were still alive six years after birth increased with increasing length of gap between pregnancies. When the gap was one year, 78 per cent survived ; two years, 90 per cent ; three years, 94 per cent ; four years, 95 per cent ; five years or more 97 per cent. Among premature infants the proportion of survivors was highest where the gap between pregnancies was three years (74 per cent) : above and below a three-year gap the results were appreciably worse.

Among full-term children in these families where there had been at least one premature child the proportion surviving to age six increased steadily with the age of the mother ; among premature children the curve was less regular, but the highest level of survivorship was reached among infants born to mothers upwards of 35 years of age.

The survival of full-term children bore no significant relationship to the serial number of the pregnancy in its family : among premature children the proportion surviving was lower among first and second children that at later parities (Table 8).

TABLE 8.

Age of mother, serial number of pregnancy, and interval between pregnancies in relation to incidence of prematurity and survival of children : live births only.

	Age of mother at birth of child					
	−20 (159)	20/24 (844)	25/29 (740)	30/34 (486)	35/39 (263)	40− (83)
Percentage of births that were premature	44	36	36	42	49	63
Percentage of children surviving to age 6						
Full-term	80	86	89	90	90	100
Premature	64	60	65	62	70	71

	Serial number of pregnancy				
	1 (641)	2 (575)	3 (426)	4 (290)	5+ (643)
Percentage of births that were premature	50	40	32	30	38
Percentage of children surviving to age 6					
Full-term	90	90	83	90	89
Premature	52	57	67	64	66

	Interval between pregnancies (years)					
	−1 (21)	1− (597)	2− (657)	3− (292)	4− (154)	5+ (213)
Percentage of births that were premature	38	38	28	34	40	56
Percentage of children surviving to age 6						
Full-term	—	78	90	94	95	97
Premature	—	62	69	74	51	41

The pregnancy preceding that producing a premature child.

Where there had been an earlier pregnancy than the one producing the premature child on which this study was based, the earlier pregnancy yielded a lower proportion of full-term births, a slightly higher proportion of premature infants and an appreciably higher proportion of still-births and miscarriages than came of the pregnancy preceding one that resulted in a full-term child (Table 9).

TABLE 9.

Outcome of pregnancy in relation to outcome of immediately preceding pregnancy.

Outcome of pregnancy	Outcome of immediately preceding pregnancy			
	Full-term child	Premature child	Still-birth	Abortion or miscarriage
Full-term child (2136)	61.7%	29.8%	2.4%	6.1%
Premature child (698)	51.8%	32.2%	5.4%	10.6%

Where the premature child survived to age six, 50.7 per cent of the children born in the immediately preceding pregnancy were full-term, 45.1 per cent surviving to age six and 5.6 not surviving: where the premature child did not survive, 53.4 per cent children of the preceding pregnancy had been full-term, 45.5 per cent surviving to age six and 7.9 per cent failing to survive. Similarly, the proportion of premature children of the preceding pregnancy who had survived was found to have been greater where the premature child in this study survived (Table 10).

TABLE 10.

Relationship of prematurity and survival age in 'present' and preceding pregnancy.

Outcome of pregnancy	Outcome of immediately preceding pregnancy					
	Full-term child		Premature child		Still-birth	Abortion or miscarriage
	Surviving to age 6	Not Surviving to age 6	Surviving to age 6	Not Surviving to age 6		
Premature child surviving to age 6 .. (432)	45.1%	5.6%	22.5%	11.3%	5.8%	9.7%
Premature child, not surviving to age 6 (266)	45.5%	7.9%	13.2%	16.5%	4.9%	12.0%

The pregnancy subsequent to that producing a premature child.

One third of the premature children on whom this study is based were not followed by another child during the period of six years following

the birth of the premature child—the point at which this study closed. Nineteen per cent of the full-term children in the series were similarly 'last' children in their families, while no other pregnancy supervened during the period of observation after 19 per cent of still-births and 16.3 per cent of abortions. Of the premature children who survived to age six 39.9 per cent were 'last' children in their families, but only 21.7 per cent of the premature children who did not survive were 'last' children in their families.

During the period subsequent to the birth of the premature child 33 of the mothers and 28 of the fathers died and a number of the homes were disrupted by circumstances other than death.

Where there was a pregnancy subsequent to that which yielded a premature child, a larger proportion of the resulting children were premature than was the case in pregnancies following one that had produced a full-term child (Table 11).

TABLE 11.

Outcome of pregnancy in relation to outcome of immediately succeeding pregnancy.

Outcome of pregnancy	Outcome of immediately succeeding pregnancy			
	Full-term child	Premature child	Still-birth	Abortion or miscarriage
Full-term child .. .. .. (1257)	60.6%	28.7%	2.6%	8.0%
Premature child .. .. (683)	53.9%	33.1%	4.0%	9.1%

In both groups a higher proportion of the children born of the succeeding pregnancy survived the first year of life when the gap between the two pregnancies was not less than two years. The period elapsing between the birth of the premature child and the succeeding pregnancy was shorter where the premature child had died ; this held true irrespective of the cause of the prematurity.

When the premature child studied survived to age six, 53.5 per cent of the children born in the succeeding pregnancy were full-term, 49.4 per cent surviving the first year of life and 4.1 per cent not surviving. When the premature child did not survive, 54.6 per cent children of the succeeding pregnancy were full-term, 52.6 per cent surviving the first year of life and only 2.0 per cent failing to survive. Where the pregnancy immediately following that which had produced the premature child included in this study again produced a premature child, that child's prospect of surviving the first year of life was appreciably better where the premature child which preceded it had survived (Table 12).

TABLE 12.

Relation of prematurity and survival age in 'present' and succeeding pregnancy.

Outcome of pregnancy	Outcome of immediately succeeding pregnancy					
	Full-term child		Premature child		Still-birth	Abortion or miscarriage
	Surviving first year of life	Not surviving first year	Surviving first year of life	Not surviving first year		
Premature child surviving to age 6 .. (647)	49.4%	4.1%	24.9%	9.0%	3.1%	9.5%
Premature child not surviving to age 6 (374)	52.6%	2.0%	16.7%	15.0%	5.1%	8.5%

Pattern of family in relation to prematurity.

Of the 691 families in which these premature births occurred some 95 per cent fell into one or other of seven broad groups.

1. Families in which one (or two) premature children occurred in the course of the family, with full-term surviving children earlier and later, suggesting that the prematurity was associated with some transient factor interrupting the ordinary course of events: 118 families fell into this group.

This family pattern was not often associated with toxaemia. The time between the premature birth and that preceding it was usually short. Where the premature child survived, this pattern was frequently found in association with anaemia, strain of work and ante-partum haemorrhage, in that order; where the premature child died, with ante-partum haemorrhage, falls and anaemia. When the premature birth followed that preceding at an interval of three years or longer it had often been induced, or by Caesarean section, or had occurred following some obstetrical manipulation, *e.g.*, version.

Examples:

634. Mother 30 years of age when premature child was born in 1944: child weighed 3¾ lbs. at birth.

Reproductive history:*	1940	1944	1945
	1	4	1

At the third month of pregnancy this mother was treated for eight days as a hospital in-patient for ante-partum haemorrhage: she had been employed as a kitchen-maid, but gave up work at the end of the first month of pregnancy. She had a good deal of sickness during her pregnancy, and the child was delivered by Caesarean section on account of placenta praevia. The child was jaundiced and lived for ten days.

* In these summaries the upper line indicates the year in which the birth took place: in the lower line the results of the pregnancies are coded—(1) full-term child survived to age 6; (2) Full-term child died before age 6; (3) Premature child, survived to age 6; (4) Premature child, died before age 6; (5) Still-birth; (6) Abortion or miscarriage.

201. Mother 34 years of age in 1943 : child weighed 4½ lbs. at birth.

Reproductive history :	1930	32	34	38	40	43	45	46
	1	1	1	1	1	3	1	1

This mother suffered from eclampsia during her 1943 pregnancy. She subsequently died (in 1947) from pulmonary tuberculosis. The husband was an unskilled labourer who suffered much unemployment ; he was out of work for one of the five years between 1945 and 1950.

120. Mother 36 years of age at birth of premature child in 1943 : child 5½ lbs. in weight.

Reproductive history :	1933	37	41	43	45	47
	1	1	2	3	6	1

During the war years this mother was doing heavy munition work : in 1943 she was lifting heavy shells to the seventh month of pregnancy, shortly before the child was born.

2. Families in which there were one (or two) premature births at the beginning of the family, followed by a series of full-term children : there were 143 families in this group.

Where the premature child survived, toxaemia was a frequent feature of these cases, as were histories of continuous worry, falls and strain of work. Where the premature child died, prematurity was often attributed to strain of work.

Examples :

762. This mother was 19 years of age at the birth of her first child, which weighed only two pounds and survived for a few hours. There have since been four pregnancies, all full-time. The mother worked as a packer, with heavy lifting, into the seventh month of her pregnancy ; she was working right up to the day the child was born. She tried to conceal her pregnancy and had no ante-natal care. The home is poor ; the husband, a storeman, was often out of work and was unemployed for three years of the five between 1945 and 1950.

13. Mother 23 years of age when premature child was born in 1943. Child weighed 4½ lbs. at birth. The mother had eclamptic fits in the course of this pregnancy ; her next child, full-term, was born six years later.

3. Families in which one (or two) premature children were born at the end, after a series of full-term children : there were 148 families in this—the largest—group.

In this group toxaemia was the most persistent feature, followed by ante-partum haemorrhage ; a number of cases were associated with abnormalities of the foetus and maternal organs (fibroids, prolapse, etc.). Among the parents in this group of families 24 (14 mothers and 10 fathers) died between the birth of the child and completion of this study six years later, an excess not wholly accounted for by the higher age range of the parents concerned.

Examples :

707. Mother 35 years of age when premature child born ; child weighed 5 lbs. at birth.

Reproductive history :	1935	1937	1939	1944
	2	2	1	4

Version had been performed prior to the birth of the premature child.

782. Mother 31 years of age when first premature child born in 1943. This child weighed 2½ lbs. at birth and did not survive. A subsequent premature child, born in 1945, also weighed 2½ lbs. at birth and has survived.

Reproductive history :	1932	35	36	37	41	43	45
	2	1	1	1	2	4	3

This mother had suffered from anaemia and debility for some years. She developed an ovarian cyst which was regarded as the probable cause of the premature births. The husband, a lamplighter, was unemployed for half of the time between 1945 and 1950 and has always been in more or less casual employment.

4. Families in which the child included in this study was the only child. Fifty-three children fell into this category, apart from thirteen illegitimate children. In eight of the families one of the parents died between the birth of the child and completion of this study six years later, while seven of the families had been disrupted by factors other than death.

Toxaemia and strain of work were often encountered in this group of mothers ; anaemia played no part.

Examples :

105. Mother 19 years of age : child weighed 3½ lbs. at birth. The mother is small and was herself a premature baby. She was doing heavy lifting-work in a store to the fifth month of pregnancy and overstrained herself.

390. Mother 33 years of age at birth of premature child. Child weighed 4½ lbs. at birth. The mother was employed as a shop assistant to the seventh month of pregnancy ; she had also heavy domestic responsibilities. She had a good deal of worry throughout her pregnancy and fell shortly before the child was born by Caesarean section following ante-partum haemorrhage. The parents subsequently separated.

5. Families in which there were several children (ranging from two to six), all premature : there were fifty-seven families in this group.

More than a third of these mothers had had toxaemia symptoms ; some had hyperemesis at each pregnancy. Anaemia was another prominent feature, but ante-partum haemorrhage was uncommon in this group. These mothers were often of small stature, weighing little over six stones, and several had a three-week menstrual cycle. Sometimes there was a history of other members of the mother's family having a series of premature children.

Examples :

15. Mother 35 years of age at time of birth of premature child ; child weighed 4 lbs. 10 ozs.

Reproductive history :	1938	1943	1946
	3	3	3

The mother threatened abortion at the third month of her 1943 pregnancy and had ten days hospital treatment at that time. She suffers from anaemia of long-standing and has a three-weeks menstrual cycle. All her three babies weighed between four and five pounds. Her mother's three children were all premature.

140. Mother was 31 years of age when her third premature child, the first to survive, was born in 1943. The child weighed 5 lbs. 4 ozs. at birth.

Reproductive history :	1937	1938	1943
	4	4	3

The mother has suffered from hypertension at each of her three pregnancies.

169. Mother 27 years of age at time of birth of fourth premature child in 1943 : child weighed 5 lbs. at birth.

Reproductive history :	1939	1941	1942	1943	1944	1949
	4	3	4	3	4	3

The mother was anaemic and the baby jaundiced at birth. All her premature infants have weighed between 2½ and 5 lbs. except the second, which was heavier.

237. Mother 37 years of age at birth of fourth premature child in 1944. Child weighed just over 3 lbs. at birth.

Reproductive history :	1932	1937	1939	1944	1945
	3	4	3	3	3

The mother has had some prolapse since the birth of her first child and this was thought to have played a part in the etiology of the subsequent premature births.

6. Families in which some of the pregnancies resulted in premature children and the others in either still-births or abortions : thirty-seven families fell into this group.

114. Mother was 29 years of age at the time of her sixth pregnancy : the baby weighed 4½ lbs. at birth.

Reproductive history :	1934	36	37	38	39	43	46	47	49
	6	6	4	3	4	3	4	3	3

This mother had her right tube removed in 1934 (ectopic gestation). During her 1943 pregnancy she was in bed for about six months on account of uterine haemorrhage. She fainted frequently during the pregnancy. All seven deliveries were breech presentations.

226. Mother 28 years of age at birth of third premature child in 1944. Child weighed 4 lbs.

Reproductive history :	1938	1941	1942	1943	1944
	3	4	6	6	3

This mother had suffered from pyelitis on previous occasions and from the first month of this pregnancy. Twice she threatened miscarriage, in the first and fourth months. Breech presentation ; labour induced. Baby was jaundiced ; the premature infant born died of jaundice on the eighth day : no information is available about Rh factor.

799. This mother was 26 years of age at the birth of her second premature child in 1943. The child weighed 5½ lbs. at birth.

Reproductive history :	1940	1943	1946	1947
	3	4	6	Died undelivered.

This mother suffered from toxaemia of pregnancy ; labour was induced. In 1947 in the course of another pregnancy she developed uraemia and died. The husband died in 1946 of heart disease.

7. Families in which the reproductive history was very bad, with many pregnancies that failed to produce a surviving child and a wide diversity of grouping of premature births, still-births and abortions ; many of the full-time children born alive failed to sruvive. There were eighty-six families in this group.

Among these mothers three main etiological factors seemed to operate about equally : there were (1) toxaemia, (2) ante-partum haemorrhage and (3) anaemia.

Examples :

721. Mother 37 years of age when premature child was born in 1944. Child weighed 4½ lbs. at birth.

Reproductive history :	1924	26	29	31	34	34	35	36	37	38	39
	1	1	1	1	1	6	6	6	6	6	2
	40		41		44		46		48		
	2		2		4		3		2		

This mother suffered from anaemia and had a heavy load of domestic work. She had a repair operation in 1934.

644. Mother 39 years of age when seventh premature child was born in 1944. Child weighed 3½ lbs. at birth.

Reproductive history :	1921	23	29	31	32	33	35	36	37
	1	1	2	4	6	4	4	4	1
	39		39		40		41		44		48
	1		4		4		1		4		5

This mother suffered from anaemia. The husband, a labourer, had experienced much unemployment and the home was poor.

840. Mother 22 years of age, two years married when this premature child was born of her third pregnancy in 1943. Child weighed 4¾ lbs. at birth.

Reproductive history :	1941	42	42	43	44	45	46	47	48
	4+4	2	6	4	1	6	1	1	3

This prematurity was associated with ante-partum haemorrhage. The father, a Lascar ship's stoker, was unemployed for four of the five years between 1945 and 1950.

240. Mother 27 years of age when her fifth premature child was born in 1944. The child was just under 5 lbs. in weight.

Reproductive history :	1937	38	40	41	44	47	48
	3	3	3	3	3	3	1

This mother, also, was anaemic. All six premature infants weighed under 5 lbs. Before the seventh birth, which produced a full-term child, the mother was rested for three months in hospital and given a blood transfusion.

A premature child's prospect of survival was best where the child was an only child or, second best, where all the children in the family were premature ; it was poor in families of very bad reproductive history (Group 7) and where the prematurity was an isolated event in a family, with full-term children before and after the premature child.

Premature children who survived to age six.

Nearly 25 per cent of surviving premature children had received hospital treatment before reaching their sixth birthday for conditions

other than prematurity *per se*. Among the children who had the greatest measure of hospital treatment were those born of pregnancies in which the mother suffered from anaemia and debility. The proportion receiving hospital treatment was high among infants who had weighed not more than 4½ lbs. at birth.

Fully 5 per cent of the surviving premature children had congenital defects of varying severity though often comparatively slight—chiefly mental handicap, congenital heart disease or skeletal defect. The incidence of the ordinary defects found at routine medical inspection (bronchitis, impetigo, squint, etc.) was rather higher among premature children than among the generality of school entrants.

Height and Weight of surviving premature children, as determined at routine medical inspection on school entry. The average measurements of these premature children have been adjusted to a uniform age of 5 4/12 years, to conform with comparable figures available for all school entrants in the City of Glasgow : the results are summarized (Table 13).

TABLE 13.

Height and weight of premature children compared with corresponding data for all entrants to city schools : in each group figures have been adjusted to a uniform age of 5 years 4 months.

	Average height		Average weight	
	Males	Females	Males	Females
Premature children	42.03″	41.10″	40.81 lbs.	38.46 lbs.
All school entrants	42.36″	41.98″	42.05 lbs.	40.41 lbs.

The premature children were a fraction of an inch shorter and a pound or two lighter than the average figures for all children entering Glasgow schools. Comparatively few of the premature children of high serial number in their families were over 42.5 lbs. in weight.

In general, weight at age five ran broadly parallel to weight at birth (Table 14).

TABLE 14.

Premature children : weight at school entry in relation to weight at birth.

Birth weight	Weight at 5 years 4 months			
	—38 lbs.	38½—42 lbs.	42½ lbs.—	
—4½ lbs. . .	52.2	29.7	18.1	—100.0
4 9/16—5½ lbs. . .	45.4	28.6	26.0	—100.0
5 9/16 lbs.—	31.1	42.5	26.4	—100.0

Among these surviving premature children the importance of birth weight in shaping the weight of the premature child at school entry is clear enough: but some adverse social factors tended to aggravate differences in birth weight. Examples of adverse social circumstances that acted in this way are severe unemployment of the father and severe overcrowding in the home.

The proportion of children weighing 42½ lbs. or more at school entry was greater among the premature children of fathers employed in skilled manual work (27.7 per cent) than among the children of semi-skilled fathers (22.1 per cent) or the children of fathers in unskilled work (15.3 per cent).

The position in relation to the group of surviving premature children studied may be summarized: their pre-school medical history showed a rather-more-than-average morbidity, reflected in a heightened incidence of hospital treatment: congenital abnormalities were more numerous than in ordinary full-term children, though much less than among premature children who failed to survive; defects noted at routine medical inspection on school entry were rather more numerous than among school entrants as a whole; while, in relation to height and weight, surviving premature children were a fraction of an inch shorter and a pound or two lighter than the average figures for all children entering Glasgow schools.

Premature children who failed to survive.

Of 242 premature children who failed to survive, 43 per cent were registered as having died from 'prematurity' without further qualification and 21.9 per cent from prematurity plus some other cause: the remaining 35.1 per cent were certified as having died from other cause without reference to prematurity (Table 15).

TABLE 15.

Cause of death, as registered.

Prematurity alone	43.0%				
" + congenital abnormality	2.5%	8.3%	Prematurity + gastro-enteritis	4.5%	13.6%
Congenital abnormality alone	5.8%		Gastro-enteritis alone ..	9.1%	
Prematurity and birth trauma	0.8%	0.8%	Prematurity + pneumonia	2.1%	8.7%
Birth trauma alone ..	—		Pneumonia alone ..	6.6%	
Prematurity + cerebral haemorrhage	2.5%	5.0%	Prematurity + other infections	0.4%	2.9%
Cerebral haemorrhage alone	2.5%		Other infectious diseases alone	2.5%	
Prematurity + debility	7.0%	12.8%	Prematurity + other miscellaneous causes ..	2.1%	5.0%
Debility alone	5.8%		Other miscellaneous causes alone	2.9%	
					100.0%

Apart from prematurity, the causes of death most frequently recorded were gastro-enteritis, pneumonia and congenital abnormality and debility: gastro-enteritis was as important as a cause of death as congenital abnormality and cerebral haemorrhage combined. The proportion of deaths from congenital abnormalities and from cerebral haemorrhage was greater in first than in subsequent children, while the proportion of deaths from gastro-enteritis was smaller in first children.

In the above list of registered causes of death of premature children, 8.3 per cent are shown as having died from congenital abnormality, alone or in association with prematurity. But there is other evidence that among the children who died the incidence of congenital defects—not all themselves causes of death—was about twice as high as that appearing on the death certificates; the principal defects among the premature children who died were congenital heart disease, gross defects of the central nervous system and skeletal defects.

Age of premature infant at death. Of the premature infants who failed to survive to age six, 31.4 per cent died on the day of birth or the day immediately following: 56 per cent died within a week and 77 per cent within four weeks of birth: only 2.5 per cent lived more than one year.

Up to the end of the first month the majority of deaths were attributed to prematurity or to prematurity plus some other cause: thereafter the 'infective' diseases assumed chief importance. Thirty per cent of the deaths attributed to prematurity alone occurred on the day of birth and a further 18 per cent on the following day: 79 per cent had occurred by the end of the first week and 85 per cent by the end of the first month.

Age at death in relation to the most commonly certified cause of death is shown in Table 16; sometimes more than one cause appeared on the death certificate.

TABLE 16.

Certified cause of death in relation to age at death.

Certified cause of death	Age at death							
	Died same day as born	Lived 1 day	2- days- 7 days	8-14 days	15-28 days	—3 mths.	3—12 mths.	Over 1 year
Prematurity alone ..	67%	63%	53%	40%	27%	17%	—	—
Prematurity + some other cause ..	18%	24%	29%	23%	41%	22%	—	—
Debility	13%	17%	12%	17%	27%	9%	—	—
Cerebral haemorrhage	2%	3%	12%	13%	9%	—	—	—
Congenital abnormality	11%	—	8%	7%	5%	13%	8%	33%
Pneumonia	—	3%	2%	17%	—	17%	36%	33%
Gastro-enteritis ..	—	—	7%	17%	27%	30%	36%	33%

The factor regarded as chiefly responsible for prematurity in each case has been considered in relation to the registered cause of death of the premature child (Table 17).

TABLE 17.

Factors considered responsible for prematurity.

Factor thought to have been responsible for prematurity	Registered cause of death		
	Prematurity only	Prematurity + other cause	Other cause only
Oedema, high blood pressure, toxaemia	28%	28%	44%
Ante-partum haemorrhage ..	48%	17%	36%
Anaemia and debility ..	42%	25%	33%
Strain of work	56%	25%	22%

The proportion of deaths registered as due to prematurity only was high where prematurity was associated with strain of work and low where prematurity was associated with toxaemia. Where the mother had experienced no illness during pregnancy, 52 per cent of the infants were certified as having died from prematurity ; 21 per cent from prematurity plus some other cause ; and 27 per cent from some cause other than prematurity.

Of the children born at home who failed to survive, the registered cause of death was ' prematurity ' in 41 per cent ; prematurity plus some other cause in 18 per cent ; and some cause other than prematurity in 41 per cent. Of the children born in hospital who failed to survive, the registered cause of death was ' prematurity ' in 44 per cent, prematurity plus some other cause in 24 per cent and some cause other than prematurity in 32 per cent.

Of infants who died of prematurity only, 72 per cent had been born in hospital or had received hospital treatment : of infants who died of prematurity plus some other cause, 77 per cent ; and of premature infants whose deaths were registered as due to some cause other than prematurity, 82 per cent.

Of premature infants who died within a week of birth, 73.5 per cent received hospital treatment and of the infants who died after that period, 80 per cent received hospital treatment. All the children who survived for more than six months had received hospital treatment before death.

Where the mother had received no ante-natal care, 61 per cent of infant deaths, a high proportion, were registered as due to prematurity alone, as compared with a corresponding figure of 43 per cent for all the

non-surviving infants covered by this study. This finding may not be due so much to the effect of lack of ante-natal care as to the possibility that the cases which failed to receive ante-natal care were those in which post-natal care was likely to be poor.

Where the fathers of premature children who died were engaged in skilled manual work, 26 per cent of the death certificates bore no reference to prematurity ; where the fathers were in semi-skilled work, 38 per cent ; and where the fathers were in unskilled jobs, 41 per cent. Infective conditions figured more prominently as causes of death of infants whose fathers were employed in semi-skilled and unskilled work. Where the father had experienced little unemployment the proportion of deaths registered as due to gastro-enteritis was lower than where the father had lost a great deal of working time. Where the premature infant had come from a home assessed by an experienced social worker as ' fair ' or ' bad,' the proportion of deaths registered as due to pneumonia and gastro-enteritis was high.

Interesting variations—not always easy of explanation—were found when the recorded cause of death was set against the number of children alive in the family when this study was made (Table 18).

TABLE 18.

Registered cause of death related to surviving children in family.

Registered cause of death of premature infant*	Number of children alive in family six years after the birth of the premature child.				
	None	1	2	3	4+
Prematurity alone	41%	24%	44%	48%	52%
Prematurity plus some other cause	18%	24%	18%	21%	27%
Cerebral haemorrhage	12%	11%	2%	2%	2%
Congenital abnormality	9%	15%	11%	5%	2%
Pneumonia .. .. .. } Gastro-enteritis	12%	22%	26%	23%	

* Sometimes more than one cause of death appeared on the death certificate.

Cause of death varied with the season of the year in which the premature infant was born. The proportion of infants who died of prematurity alone was high in the cold first and fourth quarters of the year, low in the second quarter. The proportion of deaths attributed to gastro-enteritis was highest in first and fourth quarters, the proportion due to pneumonia was highest in the second half of the year. The proportion of premature infants who died within a week of birth was highest in the first and fourth quarters of the year.

The serial number of a premature child in his family mattered little in relation to length of survival; 34 per cent of premature children who were first children died on the day of birth or the day immediately following, as compared with 30 per cent of premature children who came later in their families.

Period of survival was closely related to the weight of the premature infant at birth. The six infants in the series who weighed under $2\frac{1}{2}$ lbs. at birth all died within fourteen days, and the 28 who weighed under $3\frac{1}{2}$ lbs. at birth all died within three months (Table 19).

TABLE 19.

Survival of premature child related to birth weight.

Duration of life of premature children who failed to survive to age 6	Weight at birth		
	Under $4\frac{1}{2}$ lbs.	$4\frac{1}{2}$—$5\frac{1}{2}$ lbs.	$5\frac{9}{16}$ + lbs.
Died on day of birth or following day ..	31.9%	22.7%	18.7%
" within a week of birth	66.7%	40.0%	41.7%
" " a month "	89.9%	69.3%	60.4%
" " 3 months "	97.1%	81.3%	70.8%
" " 1 year "	98.6%	94.7%	97.9%

The children said to have been born prematurely though weighing over $5\frac{1}{2}$ lbs. at birth did not fare significantly better than those weighing between $4\frac{1}{2}$ lbs. and $5\frac{1}{2}$ lbs. at birth.

Similarly, the age of the child at death was directly related to the duration of the pregnancy; indeed, the correlation with duration of pregnancy was rather better than that with weight at birth among the more mature children (Table 20).

TABLE 20.

Survival of premature child related to duration of pregnancy.

Duration of life of premature children who failed to survive to age 6	Duration of pregnancy		
	−28 weeks	28−32 weeks	33+ weeks
Died on day of birth or following day ..	47.3%	21.0%	10.0%
" within a week of birth	74.6%	44.0%	33.3%
" " a month "	91.8%	71.0%	46.7%
" " 3 months "	95.5%	85.0%	63.3%
" " a year "	100.0%	96.0%	93.3%

Where the mother had received no ante-natal care the premature infant died a little earlier than where the mother had received ante-natal care ; but there is no evidence that the stage in pregnancy at which care was instituted bore any relation to the duration of life of the child.

Among infants who failed to survive, the children of skilled manual workers tended to die earlier than the children of unskilled workers : a higher proportion died in the first month of life, largely from prematurity *per se*, congenital abnormality and the like. Relatively few of the children of skilled fathers died after the first month, when the infections so often associated with poor environment play a leading part in determining mortality. The same kind of considerations were probably reflected in the relatively high incidence of deaths in the first month among the children of fathers who had wholly escaped unemployment as compared with the children of fathers who had experienced severe unemployment.

Neo-natal mortality among these premature infants was scarcely influenced by severity of crowding in the home (in any case, many were born in hospital and died there) ; but among those who survived the first month, mortality occurred earlier in the more overcrowded homes. Thus, in families living less than three persons per room, 38 per cent of the infants who died between the end of the first month and the end of the first year died between the end of the first and third months of life, whereas in families living three or more persons per room, 64 per cent died between the end of the first and the end of the third months.

DISCUSSION.

Duration of pregnancy and weight at birth are obviously conditions of fundamental importance in determining the survival of a premature child, as is the standard of care which the premature child receives ; the results of this study demonstrate anew that survival is also influenced to an appreciable extent by social and environmental circumstances. The effects of some of these circumstances were predominantly post-natal in operation ; many of the premature children who failed to survive did not live long enough to be greatly affected by them. Thus, though neo-natal mortality among these premature infants was scarcely affected by severity of overcrowding in the home, among those who survived the first month of life but subsequently died, mortality occurred earlier in the more crowded homes. Only 10 per cent of surviving premature infants were the children of fathers who had suffered severe unemployment, as compared with 17 per cent in the group of children who failed to survive ; but there was the apparent anomaly that death, when it did occur, often occurred at later ages among the premature children of the fathers who had experienced severe unemployment. The reason was that where the fathers had escaped unemployment the premature children

who were going to die usually died within a few days of birth, from 'prematurity' or from congenital abnormalities; whereas many of the children of fathers who had experienced severe unemployment died later from infections, in addition to those who died during the neo-natal period.

Prematurity was associated with much ill-health among the parents, particularly the mothers. Among the parents of premature children who survived to age six, 4.2 per cent of the mothers and 3.3 per cent of the fathers died in the course of the six years between the birth of the premature child and the closure of this study: among the parents of premature children who failed to survive the corresponding proportions were 5.4 per cent and 5.4 per cent. Of the 33 mothers who died, 13 died of tuberculosis and 10 of cardio-vascular disease; of the 28 fathers who died, 7 died of tuberculosis and 7 of cardio-vascular disease. While the number of premature children studied and the numbers of parents who died are too small to warrant firm conclusions on the subject, there is reason to believe that the mortality experience of these parents of premature children during the six years following the birth of the premature child—and especially where the premature child failed to survive—was higher than that prevailing at comparable ages among the population generally.

The large number of surviving premature infants born to toxaemic mothers who took extra milk during pregnancy was in striking contrast to the much lower proportion of survivors where the mothers did not take extra milk; and the contrast can scarcely be explained merely on the score of better maternal care, because the same difference in survival did not occur with the take-up of vitamin supplements.

Comparatively few of the mothers of these premature children had no ante-natal care—only 2.2 per cent where the child survived to age six and 9.5 per cent where it failed to survive: but in 18.3 per cent of the first pregnancies which produced a premature child that failed to survive, there had been no ante-natal care and the younger mothers had least of all. This often arose from desire to conceal an illegitimate pregnancy, though some of the older mothers who had already borne many children did not seek ante-natal care. Where the mother had had no ante-natal care and the premature infant died, 61 per cent of the deaths were registered as having been due to prematurity *per se*, a high figure. No difference was found between the groups of surviving and non-surviving premature children in the stage of pregnancy at which ante-natal care was instituted; in both groups of expectant mothers 17 per cent first sought care before the end of the third month of pregnancy and 10-11 per cent after the end of the sixth month.

The proportion of mothers who worked outside the home for some part of pregnancy was rather higher among the mothers of children who

failed to survive to age six (28.5 per cent) than among the mothers of premature children who did survive (24 per cent) ; the difference affected chiefly first pregnancies. The mothers of premature children who failed to survive had given up work at an earlier stage in pregnancy, perhaps because their health may have been too bad to allow them to carry on. Mothers who worked out of the home during pregnancy received less ante-natal care than those who were not out at work : where the infant failed to survive, 29 per cent of the mothers who went out to work had no ante-natal care as against only 3 per cent of mothers who were not employed out of the home. A relatively low proportion of the mothers who were out at work received ante-natal care at Local Authority clinics.

In 53 of the 691 families studied the premature child was the only child ; in 57 families there were several children, ranging from two to six, all premature, while in another group of 37 families some of the pregnancies resulted in premature children and the others in either still-births or abortions. In families in which there were full-term children as well as the premature child studied, it often happened that one or two premature children were born at the end, after a series of full-term children : there were 148 families in this group. Sometimes the premature birth took place at the beginning of the family and was followed by a series of full-term children : there were 143 such families. In 118 families the prematurity occurred in the course of the family, with full-term surviving children earlier and later, suggesting that the prematurity in this group of cases was associated with some transient factor interrupting the ordinary course of events. In 86 families the reproductive history was very bad, with many pregnancies that failed to produce a surviving child and a wide diversity of grouping of premature births, still-births and abortions ; in these families many of the full-term children born alive failed to survive.

Where the premature children included in this study survived, 11.3 per cent of all the full-term children born in their families had died, whereas where the premature children failed to survive to age six, 14.0 per cent of the full-term children in their families had died.

There was an excess of premature births in first pregnancies and, to a lesser extent, in seventh and eighth pregnancies. Mothers under 20 years of age and over 30 years of age had more than their share of premature infants, but 56 per cent of all the premature infants were born to mothers between 20 and 29 years of age. In the families covered by the study the proportion of premature births was lowest (28 per cent) where the interval between pregnancies was two years : where the interval was less than two years, 38 per cent of pregnancies produced a premature child ; where it was 3 years, 34 per cent ; 4 years, 40 per cent and 5 or more years, 56 per cent. The proportion of premature infants surviving to age six was greatest (74 per cent) where the birth of the premature child

followed that of the previous child after an interval of three years; above and below that length of interval fewer premature infants survived.

The pregnancies immediately preceding those which produced a premature child yielded a lower proportion of full-term children, a slightly higher proportion of premature infants and a higher proportion of still-births and abortions than did pregnancies preceding those which produced a full-term child. Where the premature child studied survived to age six, the proportion of children born of the preceding pregnancies who had survived was higher than where the premature child studied failed to survive.

The pregnancies immediately subsequent to those which produced a premature child yielded a larger proportion of premature infants than did pregnancies following those which had produced full-term children. Where the subsequent pregnancy again produced a premature child, that premature infant's prospect of surviving the first year of life was appreciably better when the premature child which preceded it had survived.

The pre-school medical histories of the premature children who survived showed an above-average record of morbidity; nearly 25 per cent had received hospital treatment for conditions other than prematurity *per se*. The proportion of congenital abnormalities noted on medical examination at school entry was greater than that prevailing among school entrants as a whole. The ordinary defects noted at routine medical inspection were also rather more numerous than among the generality of school entrants; while, in relation to height and weight, surviving premature children were a fraction of an inch shorter and a pound or two lighter than the average figures for all children entering Glasgow schools.

Of premature children who failed to survive to age six death was registered as due to prematurity *per se* in 43 per cent, to prematurity *plus* some other cause in 22 per cent and to some cause other than prematurity in 35 per cent. Apart from prematurity the causes of death most frequently registered were gastro-enteritis and pneumonia. In 8.3 per cent the registered cause of death was congenital abnormality, alone or in association with prematurity; but there is reason to believe that the real incidence in this group of non-surviving premature infants of congenital abnormality was considerably above that figure, the defects affecting chiefly the heart, central nervous system and the skeleton.

Thirty-one per cent of these infants who died did so on the day of birth or the day following; 56 per cent died within a week of birth and 77 per cent within four weeks of birth; only 2.5 per cent lived for more than a year. Period of survival was closely related to birth weight.

The proportion of deaths registered as due to prematurity *per se* was high when prematurity was associated with strain of work and low when it was associated with toxaemia.

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