Section of Epidemiology and Preventive Medicine

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Preventive Medicine in the Perinatal Period

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Early Prediction of Perinatal Risk

The post-war period has seen a steady output of epidemiological studies dealing with complications of pregnancy and particularly with perinatal death. The National Survey of 1946 (Royal College of Obstetricians & Gynæcologists and Population Investigation Committee 1948) was followed by a series of studies based on the 1951 census and associated mainly with Morris (1955) and Heady & Heasman (1959). More recently we have received the first results of the Perinatal Mortality Survey conducted by the National Birthday Trust (Butler & Bonham 1963). Throughout this period a continual stream of articles issued from the Departments of Social Medicine in Birmingham and of Obstetrics in Aberdeen. In no other period, and no other country, has perinatal mortality been better recorded. The results, however, are as yet only half assimilated, and the gains in practice have been limited.

We are at the beginning of another burst of epidemiological studies dealing with complications of pregnancy, the problem this time being not perinatal death, but the long-term consequences of obstetric events for the later functioning of the surviving child. In this country we have already had a series of major studies (Douglas 1956), McDonald (1962), Drillien (1964) and Stott (1957, 1961); Aberdeen has added and is adding its quota (Fairweather & Illsley 1960, Illsley 1961), and many others are in progress. This is a different clinical problem, involving a different combination of medical and other specialists but the social processes involved are similar, so that perinatal mortality experience can be profitably employed to illuminate current pædiatric studies.

Sociologically, the most intriguing finding of the earlier studies was the persistent association with social class differences, noted by Titmuss (1943) and strikingly documented and illustrated by Morris & Heady (1955). Despite improvements in obstetric techniques, medical services and standards of living, the stillbirth, neonatal and post-neonatal death rates of all social classes fell at the same rate so that, at the low rates now prevailing, the relationship of rates in one class to those in another, is the same as when these rates first became available in 1911. A similar consistency marked the various findings on age and number of pregnancy. The lowest stillbirth rates occurred among women having a second or third baby in the middle of the childbearing period; high rates were characteristic of the youngest mothers, particularly if they were multiparous, and of the older mothers, particularly if they were primiparous. The complex association seemed to result from two forces: the physiological effects of ageing and the social correlates of early, rapid and repeated childbearing. In post-neonatal mortality the picture was less complicated. The rates fell with increasing age and with decreasing parity, a pattern characteristic of middle-class habits. Perinatal mortality showed a more complex blend of intra- and extra-uterine influences, of social and physiological causation. Despite their relationship to social class, age and parity did little to produce class differences, which existed in all age and parity groups. Similarly, neither age, parity nor social class, singly or in combination, accounted for the low rates prevailing in the more prosperous regions of Britain or the high rates of the poorer industrialized regions.

The Perinatal Mortality Survey confirmed on a national basis the results which had poured out of Aberdeen for many years demonstrating high fœtal mortality in short women. It is now quite clear that lower social groups and poor regions contain a high proportion of short women and that young mothers, high multiparæ and women with high parity for age are also unduly short. We thus have a cluster of factors, inter-acting and reinforcing each other, which are characteristic of the parous poor.

The consistency of these results from study to study, period to period, area to area, is in marked contrast to the results of investigations linking mortality to social factors operative during the period of pregnancy itself. Studies of dietary intake in pregnancy, energy expenditure on paid work or domestic responsibilities, housing facilities, psychological stress, the duration of ante-natal care, have yielded either weak or inconsistent associations. Whilst each is statistically associated with perinatal mortality or birth weight, systematic control for the kind of socio-demographic factors mentioned above tends to reduce the association to negligible proportions. The pregnancy habit most consistently related to fœtal growth and morbidity, cigarette smoking, has not yet produced unequivocal results on perinatal death.

In the context of this symposium the most important implication of this body of epidemiological work, to me, as a sociologist, is its demonstration of the potency of long-term influences on the outcome of pregnancy. The adult social class of a woman, like her height and physique, reflects her environmental experience from birth onwards. Age and parity, and particularly age-for-parity have a social as well as a biological significance, since they act as obstetric indicators of education, social aspirations, marital habits and the role of planning in the life of the family. Region, like social class, acts as a general indicator of environmental influences.

The strength of these associations with perinatal mortality is illustrated in Table 1, which presents some results of the 1958 Perinatal Mortality Survey. If the perinatal death rate for Great Britain is taken as 100, the mortality ratio ranges from 58 among tall women (65 in. and over) resident in the Southern areas of Britain and married to men in professional or managerial occupations, to 153 among short women (under 62 in.) living in the Midland region and married to semi-skilled or unskilled workers. Between these extremes the rates vary remarkably regularly with socio-economic group, maternal height and region. Whilst these factors are clearly inter-related and jointly related to other general environmental factors, each of the three factors seems to contribute separately an additional quota to the range of differences.

These, and other basic demographic variables, e.g. age, parity and marital status, can be utilized in two ways:

(1) Without making any assumptions about causal mechanisms they can be regarded as efficient statistical predictors of obstetric risk and used for planning the level and distribution of maternity services and the selection of patients for different types of obstetric care. To some extent this has already occurred, either by deliberate planning or from the cumulative decisions of individual doctors and patients. The extent of our failure to achieve a rational relationship between needs and provision, however, is illustrated in Table 2.

Table 1

Perinatal mortality ratios by socio-economic group, zone of residence and maternal height (Great Britain = 100).
(Perinatal Mortality Survey of Great Britain 1958)

Husband's socio-economic group	*Zone of residence*	*Maternal height* Tall (65 in. and over)	Medium	Short (under 62 in.)
Professional	South	58	62	75
	Central	62	73	84
	North	65	89	102
Non-manual	South	51	77	64
	Central	80	88	107
	North	95	77	101
Skilled	South	79	85	82
	Central	85	88	103
	North	85	98	125
Semi-skilled and unskilled	South	77	96	132
	Central	82	100	153
	North	104	115	136

It is clear that the regional distribution of services and the selection of patients for hospital care within each region by no means coincide with the obstetric needs of patients as measured by perinatal mortality. The greatest reduction in perinatal wastage in the near future could be achieved by an improved distribution of maternity services based on perinatal risk rates, by a system of selection for hospital care based on obstetric criteria, and, most difficult of all, by persuasion of the at-risk groups to accept hospital care.

(2) They can be regarded as indicators of causal processes which, because of their long-term nature, will have implications not only for obstet-

Table 2

Percentage booked for domiciliary confinement
(Perinatal Mortality Survey of Great Britain 1958)

Husband's socio-economic group	*Zone of residence*	*Maternal height* Tall (65 in. and over	Medium	Short (under 62 in.)
Professional	South	38	35	38
	Central	36	33	35
	North	32	26	21
Non-manual	South	35	36	29
	Central	52	44	38
	North	30	35	24
Skilled	South	45	38	35
	Central	48	50	40
	North	41	44	34
Semi-skilled and unskilled	South	46	38	37
	Central	55	55	46
	North	64	48	38

rics, but also for child health and social and educational policy.

A different kind of risk is that of damage to the surviving fœtus. Most complications of pregnancy have, at some time or other, been cited as possible causes of malfunctioning in children. I shall consider only one of these relationships, the association between birth weight and intelligence test score. The evidence that children of low birth weight have relatively low mean intelligence test scores is now overwhelming. Table 3 presents data on the whole range of birth weights and indicates a continuous relationship with IQ from very low birth weights up to 8½–9 lb. The data relate to all children born in Aberdeen between October 1950 and September 1955 who were still resident in the city at the age of 7. Test scores, based on the Moray House Picture Test were obtained during the routine testing programme carried out by Aberdeen schools on all children at the age of 7. Similar results were obtained using a different test on the same children at the age of 9. For the total population and for each birth-weight category, scores varied with social class, parity and maternal height, being lower at each birth weight for children born to mothers from the lower social classes and women of short stature or high parity. The relationship is, of course, more complicated than this brief statement indicates. Preliminary results suggest, for example, that the association between birth weight and test score holds at each period of gestation, but that for each birth-weight group the maximum mean IQ occurs at a different gestation period. Thus babies of low birth weight show a peak at 37–38 weeks, with a sharp drop in mean IQ if they were born earlier or later; for babies of 8 lb the maximum mean IQ occurs at about 42 weeks with, again, a lower level for earlier or later (post-mature) babies.

This complex association between birth weight, length of gestation and test score may be indicative of true physiological intra-uterine factors affecting the mental development of the fœtus. One can distinguish a number of distinct subgroups, e.g. small babies delivered prematurely or at term, and within these subgroups causal processes operate, some leading to low birth weight, others being the consequence of low birth weight. Remembering, however, the indirect and long-term causal influences on perinatal mortality, I want to stress the variety of inter-related processes which might influence the correlation of IQ with birth weight. Mean birth weight, like the frequency of perinatal death, varies with social class, age, parity, and other factors, resulting in a set of birth-weight categories with differing social characteristics. This might not be so important if our criteria of intelligence were independent of

Table 3

Mean intelligence test score at age 7 by birth weight (Aberdeen births 1950–55)

Birth weight (lb)	*Mean test score*	*No. of children*	*Birth weight (lb)*	*Mean test score*	*No. of children*
Under 3½	93·6	18	6½–	106·3	1,760
3½–	94·1	25	7–	107·6	2,094
4–	100·7	53	7½–	108·5	1,859
4½–	100·3	102	8–	109·0	1,386
5–	103·2	283	8½–	109·6	802
5½–	104·4	596	9+	109·5	681
6–	105·1	1,198			

cultural influences. In fact we know that intelligence tests contain a considerable cultural component. Moreover, intellectual functioning cannot be reliably estimated until the child is several years old and has therefore been exposed to the parental environment, with the possibility that the child's intellectual development will be moulded by the same type of environment which has affected the mother's reproductive functioning. Fig 1 gives a highly simplified model of alternative ways in which a statistical correlation might arise between complications of pregnancy and intellectual functioning of the child. What might appear as a direct correlation could in fact be mediated through the parallel effect of environmental influences on reproductive health and on the cultural background of the children. Such an interpretation only becomes possible when we recognize that the physiological events of pregnancy have been partially pre-determined by those same environmental forces which have shaped the mother's education, habits and attitudes; and that intellectual ability is influenced by cultural factors operating throughout childhood. Thus it is not surprising to find (Baird 1959) that the IQ of pregnant mothers is correlated with the birth weight of their babies, or that this in turn is related to the IQ of the child.

Full explanation of correlations between complications of pregnancy and functioning of

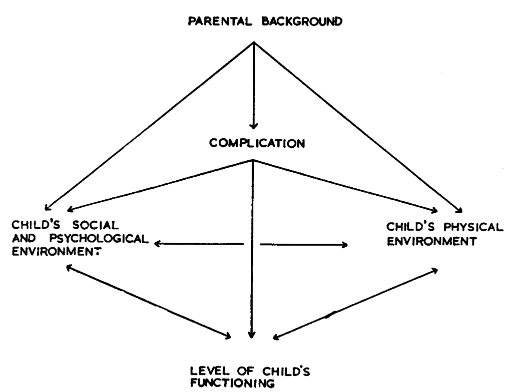

Fig 1 *Alternative causal pathways producing a statistical correlation between pregnancy complications and functioning of the child*

Table 4
Mean test score of 7-year-old children by socio-economic group and birth weight

Father's socio-economic group	*Birth weight (lb)*				
	Under $5\frac{1}{2}$	$5\frac{1}{2}$–	$6\frac{1}{2}$–	$7\frac{1}{2}$–	$8\frac{1}{2}$–
Professional	117·5	118·8	119·0	120·7	120·0
Non-manual	108·1	111·6	113·0	114·5	115·1
Skilled	102·7	106·6	108·1	109·3	114·4
Semi-skilled and unskilled	97·5	100·0	102·5	103·1	103·7

the child requires a many-sided approach involving the concepts of social transmission, genetic inheritance and organic impairment. Until this is fully understood we are in danger of attributing more weight to perinatal risk than the facts warrant. It is interesting, for example (Table 4), that the correlation between birth weight and IQ is most marked in the lower socio-economic groups and almost disappears among the children of professionally qualified people. The reason for this difference between socio-economic groups is not clear. Possibly the ætiology of low birth weight differs in the two groups so that in effect we are studying two different clinical categories, one of which has little significance for the later functioning of the child; an alternative hypothesis is that cultural conditions in the upper social groups offset potential intra-uterine damage, or that in both groups birth weight *per se* is a causally irrelevant correlation in a process of social transmission. Whatever the underlying causes may be, it seems that variations in birth weight are not inevitably linked with variations in intelligence test score.

Retardation of physical and mental growth is most frequent and severe in the lower socio-economic groups. Children in these groups are simultaneously at greater risk to organic impairment before, during and after birth and to material and cultural deprivation during their growing years. Without painstaking and sophisticated measurements of neurological functioning it is frequently difficult to determine which causes are primarily involved. If we wish to determine how a particular complication of pregnancy relates to the functioning of the child and thus to predict fœtal risks, it would seem simpler to concentrate on the upper socio-economic groups. In so doing, however, it is important to bear in mind that the crude categories of clinical events which we commonly use (low birth weight, pre-eclampsia, fœtal distress) may have different meanings in other socio-economic groups, or in combination with other complications.

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Obstetric Aspects of Preventive Medicine in the Perinatal Period

Our recognition of the obstetric hazards which may handicap the subsequent life of the newborn baby is to a large extent based upon the study of perinatal mortality. The causes of perinatal mortality are better known now than ever before as the result of the recent survey conducted by the National Birthday Trust (Butler & Bonham 1963). We ought to examine critically, however, whether we can safely extrapolate from perinatal death to subsequent ill health in the survivors. Our interest, after all, is with the living and not with the dead.

In looking through obstetrical records the difficulties of classification are apparent as soon as one recognizes that causative factors seldom operate singly and that it is a matter of opinion which is the primary component. For example, a case of antepartum hæmorrhage may be associated with prematurity and with pre-eclamptic toxæmia, may suffer the hazards of a failed induction with a long, and possibly infected, interval between induction and delivery, may be delivered by Cæsarean section, with difficulties in anæsthesia, and the child may have to fight for its life in the next few days because of atelectasis and the respiratory distress syndrome. In addition, there may be a poor social background and bad genetic antecedents. This is a subject in which dogmatism is dangerous and it is often far from certain to what extent the adventitious factors in obstetrics, as distinct from genetic factors, influence healthy survival of the infant.

Categories at Risk

Sir Dugald Baird and his colleagues have long taught us the association between high-risk cases and poor social background. This, to some extent, is related to genetic factors; as Baird