person, just as susceptibility to rheumatic fever or tuberculosis varies even among populations whose living conditions predispose them to those diseases.

In order to confirm the hypothesis that the stresses of life experience, together with a subjective vulnerability to these stresses, account for the high incidence of premature deliveries among women of low socio-economic status, it would now be necessary to carry out predictive studies in which pregnant women would be rated at some time before delivery and a prediction made as to the likelihood of carrying the pregnancy to term.

# Environmental and Obstetrical Factors in Prematurity, with Special Reference to Experience in Aberdeen *

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A birth weight of 2500 g is taken as the dividing line between the mature and the premature baby for three main reasons: (1) most babies are weighed at birth; (2) experience shows that under 2500 g more medical and nursing care is needed than with heavier babies and that, despite this, prognosis is less often satisfactory; (3) the length of gestation is not known in a high percentage of cases so that the incidence of premature expulsion of the foetus from the uterus cannot be given accurately.

Some babies are born at term weighing less than 2500 g. When the mother appears to have been clinically well during pregnancy, it is difficult to tell whether the small baby is "normal" for this particular woman or whether foetal growth had been depressed because of some disturbance of pregnancy physiology. Some small babies at term look healthy and well nourished; others seem undernourished, with wrinkled skin and relatively little subcutaneous fat. Very little is known about the variations in reproductive physiology in the human, and although laboratory methods of studying this are now becoming available they are time-consuming and it will be some years before significant facts can be collected.

However, there is much evidence that the incidence of prematurity is greatly influenced by such important general factors as the health, nutrition and physique of the mother. The clinician often finds it difficult to measure such factors accurately, but a valuble indirect estimate can be derived from a classification of the family's social position. The method of classification will necessarily vary from country to country, but in Great Britain the Registrar-General has developed a method of classifying the occupation of the husband which is widely employed in British vital statistics and is used throughout this paper. Broadly speaking, Social Classes I and II comprise the professionally qualified and managerial groups, Class III routine clerical workers and skilled manual workers, and Classes IV and V semi-skilled and unskilled workers. The classification may also be applied to the occupation of the wife's father to give an indication of her childhood environment and to the premarital occupation of the wife herself.

Adult height can also be used statistically as a useful measure of physical well-being. There is much evidence to suggest that in Britain today many short women (less than 5 feet 1 inch, or 155 cm) have not grown to their full potential height because of unfavourable environmental factors and in consequence have reduced reproductive efficiency, which can be demonstrated in a number of ways; for example, a high prematurity rate and high perinatal death-rates from all causes. The percentage of short primigravidae in Aberdeen varies from 7% in Social Classes I and II to 30% in Social Class V.

The effect of these indirect indices of health on the prematurity rate is shown in the following tables, which are based on 10 224 first births, being the total in the City of Aberdeen from 1951 to 1959 inclusive.

Table 1 shows that the lowest rate is found when the mother has been brought up in Social Classes I and II and marries into the same social class (4.3%). It can be seen also that those who go from the

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TABLE 1

PREMATURITY RATE (%) AMONG ABERDEEN PRIMIPARAE (10 224 SINGLE BIRTHS, 1951-59) ACCORDING TO WIFE'S SOCIAL BACKGROUND AND HUSBAND'S SOCIAL CLASS

| Husband's social class | Wife's father's social class | | | All classes |
|---|---|---|---|---|
| | I & II | III | IV & V | |
| I & II | 4.3 | 6.7 | 8.9 | 5.6 |
| III | 5.1 | 6.5 | 7.6 | 6.8 |
| IV & V | 14.0 | 11.1 | 10.9 | 11.0 |
| All classes | 5.4 | 7.1 | 8.7 | 7.6 |

TABLE 3

PREMATURITY RATE (%) AMONG ABERDEEN PRIMIPARAE (10 224 SINGLE BIRTHS, 1951-59) ACCORDING TO MATERNAL AGE AND HUSBAND'S SOCIAL CLASS

| Husband's social class | Maternal age (years) | | | | | All ages |
|---|---|---|---|---|---|---|
| | 15-19 | 20-24 | 25-29 | 30-34 | 35+ | |
| I & II | 4.5 | 5.1 | 4.4 | 8.0 | 13.0 | 5,6 |
| III | 9.4 | 6.0 | 6.7 | 7.0 | 12.9 | 6,8 |
| IV & V | 15.7 | 9.7 | 11.6 | 8.6 | 2.9 | 11,0 |
| All classes | 11.6 | 6.8 | 6.8 | 7.6 | 11.5 | 7.6 |

highest to the lowest social classes on marriage have a higher prematurity rate (14.0%). than those born in the lowest social classes and who remain in the same class at marriage (10.9%). Numbers in this category are small, however, and the circumstances are usually abnormal.

Table 2 shows that the lowest individual rate (3.7%) occurs in women who were in a profession before marriage and who marry a professional man. The exceptionally high rate of 14.7% in fish workers is thought to be due to the fact that in Aberdeen fish workers are a particularly depressed group. The work is heavy and conditions unpleasant and as a result the least well endowed, both physically and mentally, tend to congregate there.

Table 3 shows that the rate is lowest between the ages of 20 and 30 years and is high in the very young and the elderly primigravidae. In all social classes the rate is high in those over 35 years of age, but in the very young it is excessive in Social Classes IV and V. The young wives of unskilled workers who have the high rate of 15.7% have a poor standard of health and physique which is more than sufficient to outweigh any benefit of youth. Over the age of 35 years, however, the incidence of prematurity rises sharply in all social classes. (The low rate of 2.9% in women aged 35 or more in Classes IV and V is an artefact due to small numbers).

Table 4 shows that tall women in Social Classes I, II and III have very low prematurity rates. Height acts to some extent as an extra social variable, subdividing the somewhat heterogeneous classes into social groups in the same way that education or the wife's own occupation does. The lowest rate is in tall women in Classes I and II and the highest in short women in Classes IV and V.

Table 5 gives the percentage distribution of prematures in each gestation group by social class and

TABLE 2

PREMATURITY RATE (%) AMONG ABERDEEN PRIMIPARAE (10 224 SINGLE BIRTHS, 1951-59) ACCORDING TO WIFE'S OCCUPATION AND HUSBAND'S SOCIAL CLASS

| Husband's social class | Wife's occupation | | | | | All classes |
|---|---|---|---|---|---|---|
| | Professional | Clerical | Shop assistant and unskilled manual | Semi- and unskilled | Fisheries | |
| I & II | 3.7 | 6.9 | 6.7 | — | — | 5.6 |
| III | 4.4 | 6.0 | 6.8 | 7.5 | 12.4 | 6.8 |
| IV & V | — | 8.1 | 9.9 | 12.0 | 14.7 | 11.0 |
| All classes | 3.8 | 6.4 | 7.5 | 9.3 | 13.6 | 7.6 |

TABLE 4

PREMATURITY RATE (%) AMONG ABERDEEN PRIMIPARAE (10 224 SINGLE BIRTHS, 1951-59) ACCORDING TO MATERNAL HEIGHT AND HUSBAND'S SOCIAL CLASS

| Husband's social class | Maternal height | | |
|---|---|---|---|
| | Tall (162 cm or more) | Medium (161-156 cm) | Short (155 cm or less) |
| I & II | 4.1 | 5.8 | 8.2 |
| III | 4.2 | 6.4 | 10.8 |
| IV & V | 6.3 | 10.5 | 15.6 |
| Total | 4.6 | 7.2 | 12.0 |

it shows that in Social Classes I and II 5.1% are delivered before the 38th week compared with 9.1% in Classes IV and V. In Classes I and II, 78.3% are delivered at the 40th week or later compared with 70.6% in Classes IV and V.

The two extreme Classes I and II and IV and V are contrasted in Table 6. The table shows separately for each class the composition of the class according to birth weight and gestation period.

Not only is there a higher incidence of early gestation in Classes IV and V but there is also a higher production of small babies at 38 weeks or more and a significantly lower production of babies weighing 7½ pounds (3402 g) or more. In general, therefore, the high prematurity rate of Classes IV and V stems from two factors: more early delivery and a higher incidence of low-weight babies resulting from gestations of 38 weeks or more. The latter is the more important numerically.

TABLE 5

PERCENTAGE DISTRIBUTION OF PREMATURITY AMONG ABERDEEN PRIMIPARAE (10 224 SINGLE BIRTHS, 1951-59) BY GESTATION PERIOD AND HUSBAND'S SOCIAL CLASS

| Husband's social class | Weeks of gestation | | | | | Total |
|---|---|---|---|---|---|---|
| | 35 or less | 36-37 | 38-39 | 40-41 | 42+ | |
| I & II | 1.9 | 3.2 | 16.8 | 55.5 | 22.8 | 100 |
| III | 3.0 | 4.2 | 17.9 | 51.8 | 23.1 | 100 |
| IV & V | 4.4 | 4.7 | 20.4 | 48.0 | 22.6 | 100 |
| Total | 3.2 | 4.2 | 18.3 | 51.5 | 22.9 | 100 |

TABLE 6

PERCENTAGE DISTRIBUTION OF PREMATURITY AMONG ABERDEEN PRIMIPARAE (1951-59) ACCORDING TO BIRTH WEIGHT, GESTATION PERIOD AND HUSBAND'S SOCIAL CLASS

| Birth weight | | Social Classes I & II | | Social Classes IV & V | |
|---|---|---|---|---|---|
| pounds | g | 37 weeks or less | 38 weeks or more | 37 weeks or less | 38 weeks or more |
| Less than 4½ | Less than 2 041 | 1.3 | 0.5 | 2.4 | 0.9 |
| 4½— | 2 041— | 1.6 | 1.5 | 2.2 | 4.3 |
| 5½— | 2 495— | 2.0 | 50.2 | 4.0 | 56.3 |
| 7½+ | 3 402+ | 0.2 | 42.5 | 0.5 | 29.6 |
| Total | | 100 % (1 298) | | 100 % (1 838) | |

Table 7 gives the prematurity rate by gestation period and maternal height, and it can be seen that at all gestation periods there is a much higher prematurity rate in short than in tall women.

The incidence of underweight babies is also influenced by the weight of the mother before pregnancy and by her weight increase during pregnancy. At each level of height the percentage of babies weighing 5½ pounds (2495 g) or less decreases as the pre-pregnancy weight of the mother increases. The incidence of prematurity falls as the mother's weight gain during pregnancy increases, except that

TABLE 7

PREMATURITY RATE (%) AMONG ABERDEEN PRIMIPARAE (10 224 SINGLE BIRTHS, 1951-59) ACCORDING TO GESTATION PERIOD AND MATERNAL HEIGHT

| Maternal height | Gestation period (weeks) | | | | | | All periods |
|---|---|---|---|---|---|---|---|
| | 35 or less | 36-47 | 38-39 | 40-41 | 42+ | Not stated | |
| 162 cm or more | 68.2 | 22.8 | 4.7 | 1.5 | 0.8 | 9.7 | 4.6 |
| 161-156 cm | 80.5 | 32.9 | 8.7 | 2.7 | 0.9 | 13.5 | 7.2 |
| 155 cm or less | 87.3 | 35.9 | 14.9 | 3.9 | 4.9 | 24.1 | 12.0 |
| All cases | 79.8 | 31.4 | 8.9 | 2.6 | 1.7 | 15.7 | 7.6 |

TABLE 8

OBSTETRICAL COMPLICATIONS AMONG MOTHERS OF LEGITIMATE, LIVE-BORN ABERDEEN INFANTS (1951-59) ACCORDING TO HUSBAND'S SOCIAL CLASS [a]

| Condition in pregnancy | Husband's social class | | | All classes |
|---|---|---|---|---|
| | I & II | III | IV & V | |
| **Single births** | | | | |
| Normal | 31 (48.4) | 176 (51.2) | 122 (63.5) | 329 (54.8) |
| Moderate and severe toxaemia | 8 (12.5) | 76 (22.1) | 21 (10.9) | 105 (17.5) |
| Mild toxaemia | 12 (18.8) | 46 (13.4) | 24 (12.5) | 83 (13.7) |
| Antepartum haemorrhage | 7 (10.9) | 28 (8.1) | 14 (7.3) | 49 ( 8.2) |
| Malformation | 4 (6.3) | 6 (1.7) | 2 (1.0) | 12 (3.0) |
| Maternal diseases | 2 (3.1) | 12 (3.5) | 9 (4.7) | 23 (3.8) |
| Total | 64 (100) | 344 (100) | 192 (99.9) | 600 (100) |
| **Twin births** | | | | |
| Normal | 6 (42.9) | 17 (29.8) | 14 (58.3) | 37 (38.9) |
| Moderate and severe toxaemia | 1 (7.1) | 17 (29.8) | 4 (16.7) | 22 (23.2) |
| Mild toxaemia | 3 (21.4) | 15 (26.3) | 2 (8.3) | 20 (21.1) |
| Antepartum haemorrhage | 2 (14.3) | — — | 2 (8.3) | 4 (4.2) |
| Malformation | — — | — — | — — | — — |
| Maternal diseases | 2 (14.3) | 8 (14.0) | 2 (8.3) | 12 (12.6) |
| Total | 14 (100) | 57 (99.9) | 24 (99.9) | 95 (100) |

[a] Figures in parentheses show the percentage distribution.

it rises again when the gain becomes very large, owing to the fact that a high proportion of the prematures in the groups with the high weight gain are the result of pre-eclampsia.[a]

In view of the great importance of these general factors in determining the incidence of prematurity it is difficult to disentangle the effect of obstetrical complications such as pre-eclampsia and to measure it quantitatively.

Table 8 shows the percentage of cases where a recognizable obstetrical complication occurred during pregnancy. In Social Classes IV and V the pregnancy was free from clinically recognizable complications in 63.5% of cases, and in Social Classes I and II in 48.4% of cases. Thus in Social Classes I and II a higher percentage of all prematures is related to the occurrence of clinically recognizable complications of pregnancy than in Social Classes IV and V, amongst whom the general level of health and physique of the mother is relatively a more important factor. There is little doubt that severe pre-eclampsia, antepartum haemorrhage, malformation of the foetus and maternal disease predispose to low birth weight, but it has been shown[b] that mild pre-eclampsia, i.e., rise of blood pressure to 140/90 mm occurring for the first time after the 20th week of pregnancy with not more than a trace of albumin in the urine, has little or no effect on the birth weight of the baby. In fact, in the present study, the 82 cases of prematurity, occurring in 2080 cases where mild pre-eclampsia was the only detectable obstetrical abnormality, represented the very low prematurity rate of 3.9%.

The 105 cases of prematurity attributed to moderate and severe pre-eclampsia (Table 8) occurred out of 493 cases of the disease, an incidence of 22.3%.

[a] Thomson, A. M. & Billewicz, W. Z. (1957) *Brit. med. J.*, 1, 243.

[b] Baird, D., Thomson, A. M. & Billewicz, W. Z. (1957) *J. Obstet. Gynaec. Brit. Emp.*, 64, 370.

It is therefore obvious that the more severe forms of pre-eclampsia increase the prematurity rate considerably. The incidence of moderate or severe pre-eclampsia in Social Classes I and II, III, and IV and V is 4.6%, 6.3% and 5.2% respectively and the incidence of prematurity in these cases of pre-eclampsia in the three social class groups is 4.8%, 17.4% and 18.4% respectively. These social class differences between the incidence of pre-eclampsia and of the consequent prematurity rate suggest that very good physical health and growth of the mother can modify the deleterious effect of the condition on the baby. There may be a similar social class influence in antepartum haemorrhage and maternal diseases but this is unlikely to apply in the case of malformations of the foetus.

The influence of twinning must also be taken into account. Out of 695 babies of 5½ pounds (2495 g) or less born alive to Aberdeen primiparae in the years 1951-59, 95 were the result of a twin pregnancy (13.6%). The lower half of Table 8 shows that 38.9% of twin pregnancies were uncomplicated compared with 54.8% in single pregnancies. Moderate and severe pre-eclampsia occurred in 23.2% of twin pregnancies compared with 17.5% in single pregnancies. The comparable figures for mild pre-eclampsia were 21.1% and 13.7% respectively. It is clear therefore that the contribution of twinning to the total of premature babies is substantial and out of all proportion to the incidence of twinning. Although in a high proportion of cases an obstetrical abnormality necessitates admission to hospital for treatment, it is possible that more might be done to decrease the risk of premature labour by early diagnosis of twins and subsequent rest in bed in hospital over the critical period.

Considerable improvement has occurred in the death-rate of premature babies in recent years. Table 9 shows that between two periods, 1948-53 and 1954-59, in all primiparae in the City of Aberdeen the death-rate in live-born babies in the first week has fallen from 15.8 to 10.2 per 1000. In babies of less than 5½ pounds (2495 g) the death-rate has fallen from 148 to 94 per 1000 and in those of 5½ pounds or more from 6 to 4 per 1000. Thus in both groups the death-rate in the second five years has been reduced by about one-third. The death-rate is still high amongst babies weighing 3½ pounds (1588 g) or less at birth. In almost all of these cases the very low birth weight is the result of a very short gestation and further progress must depend on the prevention of premature onset of labour rather than on advance in the treatment of the very premature infant.

The above figures are produced against the background that practically all primigravidae are delivered in one teaching maternity hospital where a high standard of obstetrical care is practised. In about one-third of all prematures there is an obvious associated obstetrical or medical condition and ample antenatal in-patient accommodation is available for treating such cases. Indeed about one-third of all primigravidae are admitted to the antenatal wards of the hospital at least once during pregnancy. In the present state of knowledge little further decrease in the prematurity rate or in the mortality from prematurity can be anticipated by intensifying obstetrical and paediatric care. The incidence of prematurity in the City of Aberdeen is related much more to social than to obstetrical factors. Social policy directed to raising standards of health and physique should in time be more effective.

TABLE 9

RATES OF FIRST-WEEK DEATHS [a] PER 1000 SINGLE LIVE-BIRTHS AMONG ABERDEEN PRIMIPARAE (1948-59)

| Years | Birth weight | | | | | | | Under 5½ lbs (—2495 g) | 5½ lbs and over (2495 g +) | All |
|---|---|---|---|---|---|---|---|---|---|---|
| | Under 3½ lbs (—1588 g) | 3½-4½ lbs (1588-2041 g) | 4½-5½ lbs (2041-2495 g) | 5½-6½ lbs (2495-2948 g) | 6½-7½ lbs (2948-3402 g) | 7½-8½ lbs (3402-3856 g) | 8½ lbs and over (3856 g +) | | | |
| 1948-53 | 644 (38) | 229 (16) | 28 (8) | 7 (9) | 7 (17) | 3 (4) | 8 (4) | 148 (62) | 6 (34) | 15.8 (96) |
| 1954-59 | 448 (26) | 122 (10) | 15 (4) | 6 (7) | 4 (10) | 2 (4) | 5 (3) | 98 (40) | 4 (24) | 10.2 (64) |
| 1954-59 data as percentage of 1948-53 data | | | | | | | | 63 | 68 | 65 |

[a] Figures in parentheses show the numbers of deaths.