Distributions of birth weight in seven Dublin maternity units

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Abstract

Differences in birthweight distribution among babies born to Dublin residents during one year in seven maternity units were analysed. Large differences were found between the hospitals. The evidence indicated that most of the difference was attributable to the differing socioeconomic profile of the mothers in the hospitals. The socioeconomic gradients shown by the hospitals in the proportions of babies weighing ≤2500 g, ≤3000 g, and 3001-4499 g diverged with increasing socioeconomic disadvantage. Steepest gradients were found in hospitals where the socioeconomic disadvantage was greatest, and vice versa. The differences between the hospitals in the socioeconomic gradient of birthweight performance were tentatively ascribed to some sort of catchment area effect, which added to the disadvantage of the already most disadvantaged mothers. Differences in antenatal care and induction of labour between hospitals were not assessed but were thought unlikely to have made a major contribution to the differences in socioeconomic gradient.

Introduction

A recent report\(^1\) described part of a birthweight study based on 20,698 singleton births in one year to mothers resident in greater Dublin. No previous community-based assessment of birth weight had been made in the Republic of Ireland. Such a study was necessary to permit proper interpretation of results from individual maternity units. The present paper describes the large differences in birthweight distribution among singleton births in the seven maternity units that each delivered over 300 singleton babies to mothers in Dublin in the year of the study (1 April 1978 to 31 March 1979). The analysis excluded 450 cases in which the mother’s husband was in the armed Forces and 38 in which his occupation was unclassifiable. Among the remaining 19,661 cases in the seven units birth weight was obtained in 19,629. The analysis was based on these cases.

The relation between the sequence of socioeconomic group numbers (1-8) and the proportion of babies in each birthweight category (≤2500 g, ≤3000 g (this category includes that of ≤2500 g; it is valuable in providing larger numbers of cases), and 3001-4499 g), and the mean weights all showed a close fit to straight lines with steep gradients.\(^1\) This sequence of socioeconomic numbers therefore seemed likely to provide a strong predictor of birth weight. Thus the extent to which differences between hospitals can be explained in terms of differences in the socioeconomic circumstances of the mothers has been investigated.

Several authors have pointed out the dangers of drawing conclusions from single hospital studies.\(^2,3\) It is often unclear how representative such studies are, particularly in their selection of patients. Bradshaw et al\(^4\) recently illustrated the importance of considering socioeconomic differences between regions when comparing infant mortality. They emphasised the unfairness of comparisons based on a simple league table of mortality.

Some measurement of the important socioeconomic factor is also necessary in any attempt to compare quality of care between hospitals by looking at the outcome of pregnancy or illness. The important, but little understood, “patient factor,”\(^5\) as it influences outcome, rarely receives sufficient attention.

Data and statistical methods

The sources of data have been described.\(^6\) Classification into eight socioeconomic groups was used, the British Registrar General’s social classes I, II, IIIN, IIIM, IV, and V providing socioeconomic groups 1-6 respectively. Group 7 comprised mothers whose husband was unemployed and group 8 unmarried or otherwise unsupported mothers.

The mean socioeconomic number of patients in a hospital was calculated as:

\[ \bar{s} = \frac{\sum (n_s \times s)}{N} \]

where \(n_s\) = number of mothers in socioeconomic group \(s\) and \(N\) = total number of mothers.

Patients who lived outside the greater Dublin area were excluded.
Home addresses of unmarried mothers were not available, and all such mothers delivering in the seven units were included. A total of 257 pairs of twins and six sets of triplets were not included because their birth weights are not comparable with those of singletons in terms of their prognostic value for the infant; they should have been analysed separately, but the numbers were too small for this to be done.

The results of the analyses followed three stages. Firstly, the birthweight and mean birth weight in each of the seven units were analysed in relation to the mean socioeconomic numbers. Secondly, the observed numbers in categorical distributions were provided Spearman's rank correlation coefficient (rs).

Table 1 shows the observed numbers of babies in each of the three mutually exclusive weight categories (<3000 g, 3001-4499 g, and >4500 g). Listed beneath these are the numbers expected on the basis of each of the three hypotheses (i), (ii), and (iii) (see above). For each hospital the χ² values are given with two degrees of freedom. The total χ² value for the table (12 df) was for (i) 102.56, (ii) 48.61, and (iii) 101.77.

Table II summarises the excluded cases and the effect of their exclusion, which was to raise the mean weight by only 3 g; equally insignificant effects were seen on the birthweight distribution. The analysis that follows was based exclusively on socioeconomic groups 1-8.

Table III shows the observed numbers of babies in each of the three mutual exclusive weight categories <3000 g, 3001-4499 g, and >4500 g. Listed beneath these are the numbers expected on the basis of each of the three hypotheses (i), (ii), and (iii) (see above). For each hospital the χ² values are given with two degrees of freedom. The total χ² value for the table (12 df) was for (i) 102.56, (ii) 48.61, and (iii) 101.77.

Table IV summarises the excluded cases and the effect of their exclusion, which was to raise the mean weight by only 3 g; equally insignificant effects were seen on the birthweight distribution. The analysis that follows was based exclusively on socioeconomic groups 1-8.
while being a good overall predictor, the socioeconomic composition does not explain all the variations between hospitals.

The assumption that each socioeconomic group would show the same birthweight distribution in each of the hospitals as it did in the population as a whole formed the basis of the prediction in hypothesis (ii). The results from hospitals C and F show that this assumption is not fully vindicated. An investigation of the performance of the various socioeconomic groups in the different hospitals was therefore indicated. Hospitals C, D, E, and F had adequate numbers for such investigation. Hospital B had extremely small numbers of cases in socioeconomic groups 5, 6, and 7 and had to be omitted, while A and G were too small to permit breakdown by socioeconomic group.

The proportions of cases in the three weight categories <2500 g, 2500-3000 g, and 3001-4499 g showed the usual straight-line relation with the socioeconomic groups (1-8) within each of the four hospitals as confirmed by the high correlation coefficients $r$ (table IV). The figure shows regressions on socioeconomic group of the proportions of cases in each of the three birthweight categories, and of the mean birth weight, for each socioeconomic group. These provide the best available approximation to the socioeconomic gradients in birthweight performance in the four hospitals.

Comparison of the slopes (regression coefficient) of these lines using Student's $t$ test $(df = 2n - 4)$ showed that the gradients were significantly different as follows: proportion of babies weighing <2500 g: hospital $E$ showed the steepest gradient at hospital $F$ and $G$ showed the steepest gradient at hospital $A$. These differences were not independent and served to confirm one another. Regressions of mean weight on socioeconomic group also showed the steepest gradient at hospital $F$. The gradients at the three other hospitals were similar, but an overall difference in mean weight was evident between hospital C and the others.

Table IV provides detailed comparison of mean weights between hospitals. All eight socioeconomic groups showed a higher mean weight at hospital $C$ than at hospital $D$ (all eight achieving significance at $p < 0.01$, average difference $97 \pm 13$ g) and at hospital $E$ than at hospital $F$ (five achieving significance at $p < 0.01$ and one at $p < 0.05$, average difference $69 \pm 12$ g). Seven of the eight socioeconomic groups showed a higher mean weight at hospital $C$ than at hospital $F$ (five with significance at $p < 0.01$, average difference $111 \pm 28$ g). Mean weight was consistently higher at hospital $E$ than at hospital $D$, but this difference failed to reach significance except in socioeconomic group 6. Examination of table IV shows that the largest differences in mean weight between these pairs of hospitals occurred in socioeconomic groups 6, 7, 8, and, surprisingly, 1. The large differences in this last group served to reduce the differences in socioeconomic gradient in mean weight that would otherwise have emerged between hospitals C and D and E.

**Discussion**

The mean socioeconomic number provided a good overall predictor of the birthweight performance to be expected from each hospital studied. It provides a single measure of social-class composition that should be of value in comparing results from different hospitals. The more detailed calculation of expected numbers on the basis of the socioeconomic composition of the mothers in each hospital and the performance of the socioeconomic groups in the population as a whole confirmed this impression.

The study drew attention to two hospitals that showed some further variation. Hospital $C$ showed a better, and hospital $F$ a worse, birthweight distribution than predicted. Analysis of the socioeconomic gradient in birthweight distribution was possible for four hospitals and showed significant differences. Birthweight distribution into the three lighter categories showed straight-line trends diverging with rising socioeconomic number from similar values for the non-manual groups 1 to 3. The socioeconomic gradient in distribution of birth weights was thus steeper in some hospitals than in others. Hospital $F$ showed the steepest gradients, hospitals $D$ and $E$ showed closely similar performances, and hospital $C$ consistently showed the least steep gradient. This order reflects the order of descending mean socioeconomic numbers, although hospital $D$ had a significantly lower mean socioeconomic number than hospital $E$. Hospital $F$

**TABLE IV—Birthweight distribution by socioeconomic group in four largest maternity units. Correlation coefficients $r$ with socioeconomic numbers indicate closeness of fit to straight line**

<table>
<thead>
<tr>
<th>Socioeconomic group</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital $C$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No of cases</td>
<td>397</td>
<td>698</td>
<td>929</td>
<td>1530</td>
<td>1715</td>
<td>184</td>
<td>360</td>
<td>580</td>
</tr>
<tr>
<td>Mean weight (g)</td>
<td>3610</td>
<td>3567</td>
<td>3585</td>
<td>3545</td>
<td>3504</td>
<td>3485</td>
<td>3516</td>
<td>3342</td>
</tr>
<tr>
<td>SD of mean</td>
<td>528</td>
<td>332</td>
<td>389</td>
<td>578</td>
<td>566</td>
<td>574</td>
<td>542</td>
<td>577</td>
</tr>
<tr>
<td>Hospital $D$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No of cases</td>
<td>256</td>
<td>645</td>
<td>852</td>
<td>2103</td>
<td>625</td>
<td>453</td>
<td>351</td>
<td>305</td>
</tr>
<tr>
<td>Mean weight (g)</td>
<td>3500</td>
<td>3504</td>
<td>3521</td>
<td>3469</td>
<td>3422</td>
<td>3352</td>
<td>3360</td>
<td>3266</td>
</tr>
<tr>
<td>SD of mean</td>
<td>504</td>
<td>545</td>
<td>573</td>
<td>546</td>
<td>558</td>
<td>614</td>
<td>579</td>
<td>603</td>
</tr>
<tr>
<td>Hospital $E$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No of cases</td>
<td>239</td>
<td>572</td>
<td>621</td>
<td>1881</td>
<td>705</td>
<td>573</td>
<td>377</td>
<td>365</td>
</tr>
<tr>
<td>Mean weight (g)</td>
<td>3502</td>
<td>3536</td>
<td>3526</td>
<td>3489</td>
<td>3458</td>
<td>3424</td>
<td>3298</td>
<td>3220</td>
</tr>
<tr>
<td>SD of mean</td>
<td>558</td>
<td>557</td>
<td>603</td>
<td>596</td>
<td>572</td>
<td>628</td>
<td>562</td>
<td>687</td>
</tr>
<tr>
<td>Hospital $F$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No of cases</td>
<td>93</td>
<td>125</td>
<td>592</td>
<td>233</td>
<td>265</td>
<td>213</td>
<td>251</td>
<td></td>
</tr>
<tr>
<td>Mean weight (g)</td>
<td>3407</td>
<td>3611</td>
<td>3536</td>
<td>3414</td>
<td>3416</td>
<td>3342</td>
<td>3341</td>
<td>3197</td>
</tr>
<tr>
<td>SD of mean</td>
<td>580</td>
<td>520</td>
<td>534</td>
<td>571</td>
<td>560</td>
<td>575</td>
<td>655</td>
<td>520</td>
</tr>
</tbody>
</table>

Significance of $r$: $* p < 0.05$, $** p < 0.01$, $*** p < 0.001$. 

![BRITISH MEDICAL JOURNAL VOLUME 284 26 JUNE 1982](http://www.bmj.com/ Br Med J [Clin Res Ed]: first published as 10.1136/bmj.284.6333.1901 on 26 June 1982. Downloaded from http://www.bmj.com on 29 April 2022 by guest. Protected by copyright.)
drew its patients from the most disadvantaged area, hospitals D and E from intermediate areas, and hospital C from the most favoured area of the region.

This difference between hospitals in the performance of the socioeconomic groups is probably mostly attributable to some sort of "area" effect. This may result from differences in attitudes and customs as much as in the physical attributes of the areas themselves. These differences may derive from social deprivation, especially in exchange of ideas, information, and behavioural norms. Whatever it was, this area factor had the effect of steepening the gradient in birthweight performance associated with social class by worsening the plight of the lower socioeconomic groups; it had little effect on socioeconomic groups 1 and 2, but even these may be experiencing some reduction in birth weight in the disadvantaged areas.

The alternative explanation that some hospitals are having more success than others in reducing the socioeconomic gradients in birthweight performance may also have contributed to the results obtained. It must, for instance, be possible to give more time and attention to antenatal advice for the most socially deprived mothers in a hospital where the proportion of such mothers is low.

Induction of labour may influence birth weights, though it is difficult to see how it might alter socioeconomic gradients.

Miller et al noted that the key to the strong influence of socioeconomic condition on the outcome of pregnancy may lie among attitudes and practices rather than housing and unemployment. Alberman urged that, ideally, most preventive effort should be applied before conception in the promotion of good health and healthy behaviour. Recent important studies are pointing to a key role for nutrition, particularly vitamins and trace elements, in determining the quality of outcome of pregnancy. Baric et al made a useful start in analysing the factors influencing health behaviour relevant to pregnancy. Much more needs to be done. Planners and educators, public health nurses, social workers, and even the Church need to be aware of the crucial influence of social, behavioural, and nutritional factors acting before conception to determine the mental and physical health of the next generation.

I thank A Kinsella, lecturer in statistics at the Dublin Institute of Technology, for statistical advice, and Professor B O'Donnell and masters of maternity hospitals for access to medical records.

Note. The names of hospitals A-G are available from VMD on request. Since the data include only those patients resident in the Dublin area, they are therefore not fully representative of any of the hospitals.

References


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