Cerebral palsy: social class differences in prevalence in relation to birthweight and severity of disability

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Abstract

Study objective—The aim of the study was to examine the possible influence of social class on the prevalence of cerebral palsy.

Design—The study was a retrospective population based survey of all cases of cerebral palsy.

Setting—The study involved all cases of cerebral palsy born to residents in the Eastern Health Board area of the Republic of Ireland between 1976 and 1981 inclusive.

Patients—There were 289 cases of cerebral palsy during the study period. Thirty-one were excluded because they were attributable to postneonatal brain damage, leaving 258 children for analysis. Cases with uncertain diagnosis were excluded.

Main results—There was a clear social class gradient in the overall prevalence of cerebral palsy, also evident in the individual syndromes of hemiplegia and diplegia. No such gradient was detected in the other syndromes, either singly or in combination. Among cases of low birthweight (<2500 g), the prevalence was the same across the social class range after allowing for the increased low birthweight rate in the lower social class categories. Among normal birthweight cases there was a strong positive association with decreasing social class. Intrauterine growth retardation seemed to be a factor in cerebral palsy in all social class groups. Prevalence of cerebral palsy severe enough to prevent walking by the fourth birthday, but not of cases ambulant by this age, increased with socioeconomic disadvantage.

Conclusions—The clear social class gradients in hemiplegia and diplegia suggest that environmental factors play an important role in the aetiology of these syndromes, but there was no evidence of a contribution from this type of factor in the remaining types of cerebral palsy.

The question of social class has been well researched for low birthweight and perinatal mortality, both of which show steep linear social class gradients in the Irish population (unpublished data, and1), as in many others. In contrast, the relation between social class and cerebral palsy has been largely neglected. There has been no study which has provided data on the prevalence of cerebral palsy by social class in a geographically defined population of births. It is acknowledged that cerebral palsy includes a number of different disease entities, although agreement on the subdivision of the cerebral palsies is still incomplete.

The analysis of health statistics by social class has many critics who understandably dislike the unscientific political overtones of the term. The method is admittedly crude and a measure of level of education coupled with improved recording of occupational histories would be preferable for health studies, but routine questioning as to education might prove even less acceptable than occupation, without offering the added bonus of occupational analysis. To abandon analysis by social class as suggested by some2 will not help to reduce the differentials in health which still clearly exist. The presence or absence of a social class gradient, its steepness, and the incidence in the most favoured group are useful epidemiological descriptors of any disease and provide one of the basic clues to aetiology and prevention.

The present study comprises an analysis of the relation of cerebral palsy, subdivided into the main syndromes, to social class and birthweight in an unselected series of cases of cerebral palsy among births to residents of a geographically defined area in the Republic of Ireland in 1976-1981. Findings in relation to prevalence and birthweight have been presented elsewhere.3 They showed that prevalence of cerebral palsy, excluding cases caused by postneonatal insult, increased from 1.56 to 1.89/1000 livebirths between the two study periods 1976/78 and 1979/81. Increases occurred only among infants with birthweight <2000 g and >3000 g. Among very low birthweight infants (<1500 g) the statistically significant increase in prevalence was caused by increase in severe cases.3 There was a consistent and significant deficit in weight for gestational age throughout the gestational age range, suggesting that prenatal factors were commonly involved in the aetiology of cerebral palsy. The main environmental factors associated with social class differences are likely to have their greatest influence on the occurrence of cerebral palsy in the prenatal period rather than in the neonatal period. Analysis of the relationship with social class therefore seems a logical second step in a systematic search for insights into the aetiology of cerebral palsy.

Methods

The data base consisted of all 289 cases of cerebral palsy born between 1976 and 1981 inclusive to residents of the Eastern Health Board's area of the Republic of Ireland. For the purposes of this analysis the 31 cases attributable to a recognised postneonatal insult were excluded. Cases with
definite clinical manifestations of spasticity or
dyskinesia in the form of atetosis, dystonia
(almost invariably with spasticity), or ataxia were
included. Cases where these signs were absent, or
there was doubt about their presence, were
excluded. The problem of the cut off point at the
mild end of the severity range has been
discussed.3 The sources of cases, ascertainment
procedures, and a listing of inclusions and
exclusions have already been described.3
Classification into type of cerebral palsy follows
that of Hagberg.6

The father’s occupation was coded for a regular
one in three sample of the notifications of all
150 189 births to residents of the study area
between 1976 and 1981. Notifications provided a
one or two word description of the husband’s
occupation. Where a mother was not married, no
occupation was recorded. Occupations were
coded for this study according to the British
Registrar General’s (1978) listing of social classes
into the following categories: 1/2 = higher and
lower professional; 3N = other non-manual;
3M = skilled manual; 4/5 = semi- and unskilled
manual. In order to provide valid prevalence rates
the same classification of occupation was used for
cases as for the source population. Unmarried
mothers were placed in a separate group. Military,
unemployed and unknown were placed together
in a final group. This last heterogeneous group
of largely unknown composition was excluded from
the analysis of social class patterns, leaving 237
cases among social classes 1 to V and unmarried
mothers. These social class groups were directly
comparable with those used in a previous analysis
of the relation between birthweight, social class,
and birth order among 20 698 singleton births to
Dublin residents in 1978/9, which showed a clear
social class gradient in low birthweight. Infants of
unmarried mothers, even within birth order
categories, had a higher incidence of low
birthweight (≤ 2500 g),1 and higher perinatal
mortality rates (unpublished data) than all other
groups. To allow comparison with the commonly
studied indicators of adverse pregnancy outcome,
this group of mothers has been included as the last
of the “social class” groups. The birthweight
distribution for singleton infants by social class
has been taken from this large population of births
in the middle of the present study period to
provide a standard for the calculation of the
cerebral palsy rates expected on the basis of the
birthweight distribution in the several social
classes.

A clear social class gradient in the incidence of
low birthweight (≤ 2500 g) has been
demonstrated in the Dublin population, 1978/9.1
This alone might be expected to give rise to a
gradient in prevalence of cerebral palsy as a result
of the well known association of cerebral palsy
with low birthweight, clearly confirmed in the
present study.1 In order to examine the effect of
birthweight distribution alone, the expected
population prevalence of low birthweight cases
was calculated for each social class, except the
reference class 1/2, as follows: (1) the prevalence
of low birthweight cases of cerebral palsy among
all births in social classes 1/2 was taken as the
standard prevalence; (2) the expected prevalence
of low birthweight cases of cerebral palsy in each

of the other social classes was obtained by
multiplying the standard prevalence by the ratio
of the proportion of low birthweight births in the
appropriate social class to the proportion in social
classes 1/2. The calculations were repeated to
provide the expected population prevalence of
normal birthweight (> 2500 g) cerebral palsy.

All cases were followed from the time of
ascertainment to at least age five years and all
available pre-existing records were also
examined. This provided an invaluable historical
picture of the development of each child including
information as to whether he or she had achieved
independent walking by the fourth birthday. This
gave a crude but robust indicator of the severity of
a motor impairment. Very severe cases who died
before four years were classified as non-ambulant.
Non-ambulant cases will be referred to as severe.

STATISTICAL METHODS

Spearman’s rank correlation coefficient (r_s) was
computed to test for the presence of a significant
trend in prevalence with social class. Significance
of the difference between two prevalences was
tested with the following methods: x^2 for 2 × 2
tingency tables with 1 df, the Student t test
for the difference between two proportions,7 and
comparison of the 95th confidence limits for the
difference between two proportions with the
observed difference.8 Results have been recorded
as significant if probability of a similar result
occurring by chance was < 0.05 except where
multiple testing was applied (between pairs of
social classes in relation to the same variable), for
which the significance requirement was raised to
p < 0.025. On the one occasion where the three
tests did not agree the treatment was treated as
non-significant.

Results

The number of cases and of births in each of the
several social classes is given in table 1. The
prevalence of cerebral palsy increased with
descending social class status (fig 1). Spearman’s
correlation analysis showed that this upward
trend was significant (r_s = 1-0, p < 0.01).
Prevalence was 1-23 in social classes 1/2, 2-02 in
social classes 4/5 and 2-45/1000 births in the
unmarried mothers. Prevalence was significantly
lower in social classes 1/2 than in social classes 4/5
(p < 0.025) and the unmarried (p < 0.01) (difference
between social classes 1/2 and 3M: p < 0.05). The same rising trend in prevalence
with increasing socioeconomic disadvantage was
clear both in 1976/8 (r_s = 0-8, p < 0.05) and in
1979/81 (r_s = 1-0, p < 0.01). There was no change
in prevalence among social classes 1/2 but all of

<table>
<thead>
<tr>
<th>Social class</th>
<th>Births</th>
<th>Prevalence of CP (number of cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>27 685</td>
<td>1.23 (34)</td>
</tr>
<tr>
<td>3N</td>
<td>22 831</td>
<td>1.40 (32)</td>
</tr>
<tr>
<td>3M</td>
<td>44 784</td>
<td>1.38 (78)</td>
</tr>
<tr>
<td>4/5</td>
<td>31 176</td>
<td>2.02 (63)</td>
</tr>
<tr>
<td>Unmarried</td>
<td>9785</td>
<td>2.45 (24)</td>
</tr>
<tr>
<td>Others</td>
<td>13 928</td>
<td>1.51 (21)</td>
</tr>
<tr>
<td>Total</td>
<td>150 189</td>
<td>1.72 (258)</td>
</tr>
</tbody>
</table>
Social class differences in cerebral palsy

the other four groups suffered increases, and the social class gradient became steeper. None of the individual social class increases reached the required level of statistical significance.

The prevalence of both hemiplegia and diplegia (combined spastic and ataxic types) showed significant upward trends with descending social class (fig 2), Spearman’s coefficients with social class (n = 5) for hemiplegia and diplegia being 0.9 (p < 0.01), and 1.0 (p < 0.01) respectively. Prevalence of hemiplegia (62 cases) was 0.32 in the non-manual groups, 0.53 in the manual, and 0.61/1000 births in the unmarried, and equivalent rates for diplegia (106 cases) were 0.44, 0.92 and 1.43/1000 births. The prevalence of hemiplegia was significantly lower in social classes 1/2 than in 3M (p < 0.025) (difference between social classes 1/2 and unmarried: p < 0.05). Prevalence of diplegia was significantly lower in social classes 1/2 than in 3M, 4/5 and the unmarried, and in 3N than in the unmarried, all four differences being highly significant (p < 0.005). There was no evidence of any social class gradient in any of the other types of cerebral palsy, either separately or taken together as a group, and no significant difference between any pair of social classes.

The social class gradient in prevalence was evident in severe cerebral palsy (fig 3). Prevalence was significantly higher in the unmarried than in each of social classes 1/2, 3N and 3M (all p < 0.005) (difference between social classes 1/2 and 4/5: p < 0.05). There was no evidence of a consistent trend in prevalence of cases who were able to walk by their fourth birthday. The only significant difference was between social classes 1/2 and 3M (p < 0.025).

Spearman’s coefficient of correlation between the social class groups, and the prevalence of all types of cerebral palsy (fig 2) was 1.0. The presence of hemiplegia (62 cases) was 0.32 in the non-manual groups, 0.53 in the manual, and 0.61/1000 births in the unmarried, and equivalent rates for diplegia (106 cases) were 0.44, 0.92 and 1.43/1000 births. The prevalence of hemiplegia was significantly lower in social classes 1/2 than in 3M (p < 0.025) (difference between social classes 1/2 and unmarried: p < 0.05). Prevalence of diplegia was significantly lower in social classes 1/2 than in 3M, 4/5 and the unmarried, and in 3N than in the unmarried, all four differences being highly significant (p < 0.005). There was no evidence of any social class gradient in any of the other types of cerebral palsy, either separately or taken together as a group, and no significant difference between any pair of social classes.

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Seventeen cases who were twins were excluded from analysis of prevalence in relation to birthweight, leaving 220 singleton cases of cerebral palsy. The weight-specific prevalence of cerebral palsy in singleton low birthweight infants showed no consistent pattern with social class and no two social classes differed significantly (table II). In contrast, prevalence among normal birthweight children ( > 2500 g) increased with decreasing social class (Spearman’s rs = 1.0, p < 0.01).

Table II  Birthweight specific prevalence of cerebral palsy (1000 births) among singleton infants ≤ 2500 g and > 2500 g

<table>
<thead>
<tr>
<th>Social class</th>
<th>≤ 2500 g</th>
<th>&gt; 2500 g</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>9.4</td>
<td>0.89</td>
</tr>
<tr>
<td>3N</td>
<td>14.8</td>
<td>0.91</td>
</tr>
<tr>
<td>3M</td>
<td>8.1</td>
<td>1.37</td>
</tr>
<tr>
<td>4/5</td>
<td>9.8</td>
<td>1.48</td>
</tr>
<tr>
<td>Unmarried</td>
<td>12.6</td>
<td>1.56</td>
</tr>
</tbody>
</table>

* See text for method of calculation

The observed pattern of population prevalence of low birthweight cases of cerebral palsy was similar to the predicted pattern (fig 4). There was therefore no evidence of a social class gradient in low birthweight cerebral palsy apart from that caused by the different incidences of low birthweight births in the social classes. In contrast, the observed prevalence of normal birthweight cerebral palsy differed from the predicted pattern. Rates were significantly higher than predicted on the basis of birthweight distribution alone in social classes 3M and 4/5. The highest observed prevalence was among the unmarried mothers but small numbers precluded statistical significance. The observed overall social class gradient therefore resulted mainly from the gradient in the prevalence of cerebral palsy in the large majority of the population of babies who weighed more than 2500 g at birth.
If the prevalence in social classes 1/2 is accepted as the lowest that can at present be achieved, 69.6 of the 237 cases are attributable to the action of social class related factors, a population attributable risk for social class of 29%. The 95% confidence interval of the difference between the observed prevalence and the prevalence expected if all social classes had the same prevalence as social class 1/II was ±29%. The population attributable risks for diplegia and hemiplegia were 54% (95% CI, 23%) and 52(30)% respectively.

In each of the non-manual, manual and unmarried groups, 37%-40%, of singleton cases were in the lowest 25th centile of weight for gestational age, birth order and sex of the source population. There was therefore a deficit in weight for dates in all social class groups but no major differences between them.

**Discussion**

**UNMARRIED MOTHERS**

During the study period unmarried pregnancy was severely frowned upon and one quarter of unmarried mothers giving birth in Dublin hospitals in the year to March 1979, 80% of whom were under 25 years old, spent the last months of their pregnancies in homes for unmarried mothers or with families who had taken in after they had to leave their own homes (unpublished observations). To choose to have a baby without marrying was rare, and unmarried mothers were a disadvantaged group, suffering educational, social and economic hardship greater than any others. Dissemination of information about contraception and abortion was illegal so that among the sexually active, avoidance of unwanted pregnancy and termination abroad were probably more or less restricted to the most educated groups, thus increasing the overall level of disadvantage among births to the unmarried. The unmarried group suffered a higher incidence of low birth weight and of perinatal mortality (unpublished observations) than any of the other social class groups and this pattern was repeated in the prevalence of hemiplegia and diplegia.

**PREVALENCE OF CEREBRAL PALSY**

There was a significant rising trend in the overall prevalence of cerebral palsy with decreasing social class status. Hemiplegia and diplegia both showed significant gradients, most marked in diplegia. No other type of cerebral palsy, or the remaining types taken together as a single group, showed any trend in prevalence with social class. The results suggest that some social class related factor, or group of factors, influenced the occurrence of hemiplegia and diplegia but had little or no effect on the other types. Such an influence may be superimposed on a basic level attributable to other factors. Search for environmental factors may yield valuable information for hemiplegia and diplegia but prove fruitless for the remaining one third of cases of cerebral palsy, the mixed athetoid/spastic types and the pure athetoid and pure ataxic types.

There was a strong social class gradient in prevalence of severe but not of mild (ambulatory) cases of cerebral palsy. This difference was evident and very similar in both low birthweight and normal birthweight cases. There may be some tendency toward underutilisation of paediatric health services and a reluctance to follow up initial referrals for assessment among the lowest socioeconomic groups. This would reduce the ascertainment of the mildest cases of cerebral palsy in these groups but it is unlikely that such an effect was large enough to account for the observed difference.

There was a real social class gradient in prevalence of cerebral palsy cases of normal birthweight (> 2500 g). There was no gradient in low birthweight cases of cerebral palsy beyond that which was expected from the proportion of low birthweight births of the source population. It is, however, possible that the factors which cause premature delivery, including some related to social class, may also cause growth failure and predispose to cerebral palsy.

**OTHER STUDIES**

The available information about the relationship between social class and cerebral palsy is limited and conflicting, and there has been a conspicuous lack of data on social class differences in prevalence. Many observations have been limited by small numbers. McDonald et al. collected 1081 survivors < 1800 g birthweight including 57 with spastic diplegias (using a wider definition than in the present paper). She found no significant difference in social class distribution between all births and births < 1800 g, but a suggestion that, among the low birthweight sample, the manual groups had more cases of diplegia than expected (19 instead of 11.5). Atkinson and Stanley et al. were only able to obtain the father's occupation for 70% of 198 cases of spastic diplegia born in 1956-1975, and for the population of births from 1968-75. Reliable population birthweights were available for 1968-75. They considered that the only significant difference was an excess of labourers among the fathers of the low birthweight cases, but pointed out that the coding...
of father’s occupation in Western Australia made it difficult to discriminate clearly between social class categories. Dunn and his colleagues followed 335 children with birthweights < 2041 g and found that the social class distribution among the 27 cases of cerebral palsy did not differ significantly from the rest of the low birthweight group. This last finding accords with the present results, showing no social class gradient in low birthweight cerebral palsy beyond that attributable to the gradient in incidence of low birthweight itself.

Drillien and colleagues, using a clinic based sample of cases of diplegia, noted a significantly higher percentage of social classes 1/2 among diplegics of birthweight >2-4 kg, and of social classes 4/5 in those < 2-0 kg compared with hospital controls of similar weight. The controls were not fully comparable and those of low birthweight had a significant deficit of social class 4/5 compared with the general population of Scottish births. The almost universal use of percentages, often with small numbers of cases, in the few analyses of social class and cerebral palsy which are available, is unhelpful. Prevalences must be obtained for a proper assessment. Taylor and colleagues found no significant differences from the source population in the proportional distribution among the social classes of 12 cases, the numbers being too small for this purpose. Lagergren’s Swedish data on 182 cases born in 1960–1972 showed a higher percentage of cases in the highest of three social groups than in the Swedish population in general. The present results do not confirm this observation but are more correctly based on the population of births only.

No consensus has emerged from earlier studies on the relationship of cerebral palsy and social class, but there has been an absence of adequate studies designed specifically to answer this question. The present results have shown a definite social class gradient, exhibiting increasing prevalence of hemiplegia and diplegia, but not of the other types of cerebral palsy, with increasing socioeconomic disadvantage in Ireland. The social class effect seemed to be concentrated among normal birthweight children and to affect the severe cases more than the milder cases.

We wish to record our appreciation of financial support from the Scientific and Research Committee of the Central Remedial Clinic, Dublin, and of the professional advice which has been freely available throughout the study from the paediatric and physiotherapy teams at the clinic, as well as from many physicians and physiotherapists in the Eastern Health Board area.