Population based, controlled study of behavioural problems and psychiatric disorders in low birthweight children at 11 years of age

I Elgen, K Sommerfelt, T Markestad

OBJECTIVE: To evaluate the risk of long term behavioural problems and psychiatric disorders associated with being born with low birth weight.

Design/study groups: A population based, controlled follow up study at 11 years of age of 130 low birthweight (LBW) children weighing less than 2000 g at birth who were without major handicaps, and a random sample of 131 normal birthweight (NBW) children born at term weighing over 3000 g.

Main outcome measures: Validated questionnaires addressing behaviour completed by mothers and teachers and child evaluation by child psychiatrist using a semistructured interview.

Results: Behavioural problems, as defined by abnormal scores on more than four of 32 measures, were found in 40% of LBW children compared with 7% of NBW children (odds ratio (OR) 8.2, 95% confidence interval (CI) 3 to 25, p = 0.001). A psychiatric disorder was diagnosed in 27% of the LBW children compared with 9% of the NBW children (OR 3.1, 95% CI 1.5 to 6.5, p = 0.001). The LBW children were more often inattentive, had social problems, and low self esteem. None of the pre-, neo-, or peri-natal variables in the LBW group were statistically significant predictors of behavioural outcomes or the presence of psychiatric disorders. Behavioural problems and psychiatric disorders were as common in those with birth weight less than 1500 g as those with birth weight 1500–2000 g.

Conclusion: An increased risk of behavioural problems and psychiatric disorders persists in LBW adolescents.

Behavioural problems and psychiatric disorders are more common in low birthweight (LBW, birth weight < 2500 g) and very low birthweight (VLBW, birth weight < 1500 g) children than those of normal birth weight. Studies, mainly at preschool and early school age, have reported that behavioural profiles associated with VLBW range from externalising behavioural problems (hyperactivity, inattention) to internalising behavioural problems (low self esteem, impaired social skills, withdrawal, depression, and anxiety). Psychiatric disorders such as attention deficit hyperactivity disorder (ADHD) and anxiety disorders have been reported in early adolescence.

The aims of this study were: (a) to test the hypothesis that non-disabled 11 year old children with birth weight less than 2000 g more commonly have behavioural problems and psychiatric disorders than their normal birthweight peers, and to describe the behavioural profile; (b) to evaluate the degree to which behavioural differences, if present, are confounded by parental factors and to control for such factors; (c) to investigate, in explorative analyses, whether identifiable pre-, peri-, or neo-natal factors are predictive of behavioural problems in LBW children; (d) to evaluate whether such behavioural differences are independent of the child’s intelligence quotient (IQ).

METHODS
The study and control groups have been more fully described in a previous study (Table 1). All surviving children weighing less than 2000 g born in the County of Hordaland, Norway, between 1 April 1986 and 8 August 1988, and without major handicaps such as cerebral palsy, blindness, deafness, multiple malformations, or chromosomal aberrations, were the basis of this study. Of the 217 liveborn LBW children, 21 were excluded because of major handicaps (12 cerebral palsy, eight chromosomal aberration, and one blind). The control children were partly based on a random sampling from a defined geographical region (non first born), and partly as every 40th child born at the regional hospital. In addition, birth weight had to be above 3000 g, length of gestation more than 37 weeks, and there had to be no requirement for transfer to the neonatal unit. The regional ethics committee on medical research approved the project protocol, and written consent was obtained from all children and parents.

Cerebral ultrasound was performed on all infants with birth weight less than 1500 g (n = 50) at two days, one week, and two to three weeks, and cerebral haemorrhage was classified as described by Papile et al (Table 1). To focus specifically on attention deficit disorder (ADD) and ADHD, the psychometric scales of the Yale children’s inventory were administered to mothers. Social skills, in terms of Asperger or autism related problems, were investigated using the psychometric scale of the Asperger syndrome diagnostic interview (ASDI), consisting of 27 items (see data supplement on www.archdischild.com).

The first author performed a semistructured interview of all children according to the children assessment schedule (CAS). This interview generates scores for 11 areas of the child’s life: school, friends, activities, family, worries, anxieties, self esteem, behavioural mood, somatic complaints, aggressive behaviour, and thought problems. The individual

Abbreviations: LBW, low birthweight; VLBW, very low birthweight; ADHD, attention deficit hyperactivity disorder; IQ, intelligence quotient; ADD, attention deficit disorder; ASDI, Asperger syndrome diagnostic interview; CAS, children assessment schedule.
The child psychiatrist was blinded to birthweight status in all cases.

On all behavioural scales and items, a higher score indicated more problematic behaviour. For all scales a score higher than the 90th centile for the control children of the same sex was classified as abnormal.

Psychometric intelligence was assessed using four subscales from the WISC-R. The LBW children had a mean prorated IQ that was significantly lower than that of the controls: 96 and 101 IQ points respectively (95% confidence interval (CI) for the difference 2.1 to 7.7, p = 0.001).

Psychometric intelligence was assessed using the Raven progressive matrices administered at the time of the five year follow up examination (see table 2).

Statistical analysis
The main statistical analyses were performed as in the study at 5 years of age and in seven stages. First, the numbers of LBW and control children with abnormal behavioural scores were compared using χ² tests. Second, the odds ratios (ORs) from these analyses were adjusted for confounding by parental factors using multiple logistic regression analyses (SPSS 10). Third, interactional effects between parental factors and birth weight were investigated, with total problem score as outcome variable. Fourth, to investigate whether LBW children were more at risk than control children when more than one parental risk factor was present, a cumulative parental risk score was computed. Interaction between this variable and birth weight was examined. Fifth, the proportions of LBW boys and girls with abnormal behavioural scores were compared. Sixth, the proportion of children with abnormal total problem scores was compared for LBW children with birth weight less than or above 1500 g. Seventh, the relation between the identifying by parental pregnancy, birth and neonatal variables and abnormal total problem score among LBW children was investigated using multiple logistic regression analysis.
Children were examined at a mean age of 11.3 years (SD 1.5) of 217 live born) were still eligible at 11 years of age according to the stated criteria. A total of 130 of 174 (75%) eligible children from the study at 5 years of age (174 eligible LBW children and 130 of 170 (76%) eligible control children were examined. These parents were comparable with the control children (data supplement on www.archdischild.com). More than four abnormal scores for boys and girls represented the 90th centile cut off level for having an abnormal total problem score. Forty per cent of the LBW children and 7% of the controls had abnormal total problem scores, with little change after adjusting for confounding parental factors or child IQ (data supplement on www.archdischild.com).

Thirty three (27%) LBW children met the clinical criteria for a child psychiatric disorder compared with 12 (9%) controls (OR 3.1, 95% CI 1.5 to 6.5, p = 0.001) according to the CAS. For 13 of the 33, the psychiatric disorder was ADHD (table 3). No comorbid disorder (more than one psychiatric disorder) was diagnosed within the ADHD group. Of the 101 LBW children with available total problem score and CAS psychiatric evaluation, 40 had an abnormal total problem score, with approximately half of these having a psychiatric disorder (table 4). Every fourth LBW child had an attention problem according to the children behaviour check list, but only every fourth of these was in turn classified with hyperactivity disorder by the child psychiatrist. Four (4%) of the LBW children were referred to a child psychiatric outpatient clinic (all were diagnosed as having ADHD according to the clinic) compared with three (2%) of the control children (OR 1.5, 95% CI 0.3 to 6.7, p = 0.62).

Those children behaviour check list scales with significant differences between LBW and control children were investigated further to assess overlap of behavioural problems. The highest correlation was found between the attention scale and the social problem scale (r = 0.7, p = 0.0001).

There were no significant differences in the proportion of LBW boys compared with LBW girls with abnormal outcome measures except that 15% of LBW boys and 5% of girls had an ADHD diagnosis (OR 2.2, 95% CI 0.8 to 6.1, p = 0.054) according to the CAS.

No significant interactions were found between birth weight and parental factors. In univariate analyses, a higher level of maternal psychological distress and parental stress, lower family income, single parent family status, and higher parental stress somewhat related to having abnormal total problem scores. Forty per cent of the LBW children and 7% of the controls had abnormal total problem scores, with little change after adjusting for confounding parental factors or child IQ (data supplement on www.archdischild.com).

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There was no significant interaction between the risk score and birth weight. Among the LBW children, neither having a VLBW (<1500 g) nor abnormal neonatal cerebral ultrasound was associated with increased frequency of abnormal total problem scores. Mean prorated IQ was similar in LBW children with normal and abnormal total problem scores.

In the multiple logistic regression analysis, none of the prenatal or neonatal variables were predictors of behavioural problems or psychiatric disorders at age 11.

**DISCUSSION**

In this study, 40% of the LBW children compared with 7% of the control children were classified as having behavioural problems. Mothers indicated that the LBW children more often had attention, social, and anxiety problems, whereas teachers indicated delinquency, social, and attention problems. The findings were similar for LBW girls and boys. Behavioural problems were not associated with lower IQ. The child psychiatrist found that three times as many LBW as control children had psychiatric disorders, with ADHD as the main disorder. Adjusting for confounding parental factors did not influence these findings substantially.

A behavioural profile with attention and social problems was most common among the LBW children with behavioural problems in this study. In a study of VLBW children and controls at 12 years of age, Botting et al. found that 28% had a psychiatric disorder, which is comparable to the findings of our study. In that study, every fourth VLBW child was classified as having an ADD, but no differentiation was made between those with and without hyperactivity. In our study a very similar proportion of children were inattentive, but few (one in ten) were hyperactive. This supports previous research suggesting that attention problems without hyperactivity (ADD) are more typical than "classical" ADHD in LBW children.

Like Botting et al. and Szatmari et al., we found no increased risk of comorbid conduct disorders for the LBW children with ADHD and ADD. Lack of social skills and difficulties in relating to peers have been described in previous studies. These findings were affirmed by our study. However, we found only one LBW child with Asperger syndrome according to the ADI-R questionnaire, indicating that the lack of social skills is not similar to Asperger/autism. A high correlation between social problems and attention problems in terms of distractibility, impulsivity, and lack of adaptability in our study may indicate that inattention may be the primary issue for the LBW child. Possibly having difficulties with adaptability, impulsivity, and sustaining attention is the cause of difficulties in relating to peers and the cause of lower self-esteem and lower social activity level in the present study.

Only 4% of the LBW children had previously been referred to a psychiatric specialist. As 40% of the LBW children had abnormal total problem scores, this may indicate that many have behavioural problems that are difficult to detect or are different from or less severe than those thought to benefit from psychiatric referral. It should be emphasised that the abnormal total problem score is a statistical construct and not validated in terms of severity of the behavioural problems. The abnormal total problem score OR of 8 compared with the individual subscales with OR of 2–5 may indicate that, even though attention deficits and social problems are the most common problems, no specific pattern of behavioural problems is present. The large variety of behavioural problems in LBW children is a challenge to parents, teachers, and social workers who have to provide help for the individual child.

In this study, we found three times as many LBW as control children suffering from a psychiatric disorder, which is similar to previous findings. However, we did not find more severe psychiatric disorders, such as psychotic disorders and manic-depressive disorders. Such disorders are uncommon at this age. Precursors of such disorders may be thought problems, anxiety, and withdrawal, which in this study were 2–4-fold higher in LBW than control children. Further studies when the children are older are needed to disclose such problems.

Our findings do not support an interaction between birth weight and parental risk factors, which is in accordance with previous studies. We did not evaluate the significance of genetic factors as they are notoriously difficult to investigate. Genetic factors are another strong factor of individual variation in child development. In the last decade, the role of genetic influences in child psychopathology has been emphasised; in particular, ADHD and autism have been shown to have strong heritable components.

A calculation based on the numbers from this study indicates that there would be about 43 new LBW children with behavioural problems every year in our county, but 420 new normal birth weight children with comparable problems. We maintain that the focus should be on identifying and alleviating behavioural problems in all children, regardless of birthweight group.

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Child psychiatric diagnoses according to DSM-III-R from the CAS interview</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diagnosis</strong></td>
<td><strong>No &lt;2000 g (%)</strong></td>
</tr>
<tr>
<td>Depression</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Separation anxiety</td>
<td>3 (2)</td>
</tr>
<tr>
<td>Phobia</td>
<td>9 (7)</td>
</tr>
<tr>
<td>Enuresis</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Encopresis</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Attention deficit hyperactivity disorder</td>
<td>13 (10)</td>
</tr>
<tr>
<td>Oppositional defiant disorder</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Conduct disorder</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Total number of diagnoses</td>
<td>33 (27)</td>
</tr>
</tbody>
</table>

*Adjusted for paternal education, maternal education, child rearing practices (nurturance), smoking in pregnancy, sex, life events, and maternal psychological distress.


<table>
<thead>
<tr>
<th>Table 4</th>
<th>Child psychiatric diagnoses for the low birthweight children with behavioural problems*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Children with abnormal total problem score</strong></td>
<td><strong>No</strong></td>
</tr>
<tr>
<td>Children with psychiatric disorder</td>
<td>55</td>
</tr>
<tr>
<td>No</td>
<td>64</td>
</tr>
<tr>
<td>Total</td>
<td>61</td>
</tr>
</tbody>
</table>

*Only those with available total problem score and psychiatric evaluation were included.

†Two had enuresis, two encopresis, and two phobia.
ACKNOWLEDGEMENTS

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