Psychosocial and Academic Characteristics of Extremely Low Birth Weight (≤800 g) Adolescents Who Are Free of Major Impairment Compared With Term-Born Control Subjects

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ABSTRACT. Objective. To compare academic and cognitive ability, attention, attitudes, and behavior of extremely low birth weight (ELBW) adolescents who are free of major impairments at 17 years of age with term-born control subjects.

Methods. Between January 31, 1981, and February 9, 1986, 250 infants of ≤800 g were admitted for intensive care in British Columbia, 98 (39%) of whom survived to late adolescence. Teens with major sensorimotor handicaps and/or IQ <70 were excluded (n = 31). Of the 79 eligible ELBW teens, 53 (67%) were assessed at 17.3 (16.3–19.7) years (birth weight: 720 [520–800] g; gestation: 26 [23–29] weeks). The test battery screened the following areas: cognitive (Wechsler Intelligence Scale for Children; SD, standard deviation; SES, socioeconomic status; WAIS-III, Wechsler Intelligence Scale for Adults, Third Edition; 3 subtests), academic (Wide Range Achievement Test-3), attention (Connors’ Continuous Performance Task), self-report (Harter Self-Perception Profile for Adolescents; Job Search Attitude Inventory), and parent report (Child Behavior Check List). A comparison group of term born control subjects (n = 31) were also assessed (birth weight: 3506 [3068–4196] g; gestation: 40 [39–42] weeks) at age 17.8 (16.5–19.0) years. Multivariate analysis of variance (group × gender) was conducted for each domain (cognitive, academic, self-report, and parent report).

Results. The ELBW group showed lower cognitive scores (vocabulary, block design, and digit symbol) and academic skills (reading and arithmetic) compared with control subjects, with no gender differences. There were no differences in attention between the 2 groups using a repetitive computer task. ELBW teens reported lower scholastic, athletic, job competence, and romantic confidence and viewed themselves as more likely to need help from others in finding a job. In the behavioral domain, parents reported their ELBW teens to display more internalizing, more externalizing, and more total problems than the control teens, with ELBW boys showing more problems. ELBW teens showed a higher percentage of clinically significant behavior problems than control subjects.

Conclusions. In a provincial cohort of unimpaired survivors of birth weight ≤800 g, psychosocial and educational vulnerabilities persist into late adolescence and may complicate the transition to adult life compared with their peers. Pediatrics 2004;114:e725–e732. URL: www.pediatrics.org/cgi/doi/10.1542/peds.2004-0932; premature infants, very low birth weight infants, follow-up studies, developmental disabilities.

ABBREVIATIONS. ELBW, extremely low birth weight; VLBW, very low birth weight; ADHD, attention-deficit/hyperactivity disorder; NICU, neonatal intensive care unit; WISC, Wechsler Intelligence Scale for Children; SD, standard deviation; SES, socioeconomic status; WAIS-III, Wechsler Intelligence Scale for Adults, Third Edition; WRAT-3, Wide Range Achievement Test, Third Edition; CPT, Continuous Performance Task; CBCL, Child Behavior Check List.

In the past 3 decades, major advances in neonatal intensive care technology and the development of functional regionalized perinatal networks have made medical services accessible to the majority of high-risk births and have led to increased survival of infants of extremely low birth weight (ELBW ≤800 g). There is now a significant body of literature describing the psychosocial and educational outcomes of infants of <1000 g birth weight born in the 1980s at school age, which include small numbers of infants of 800 g or less. Long-term neurodevelopmental, behavioral, cognitive, and motor sequelae of prematurity have been documented extensively, including reports that predate the increase in survival of extremely small and sick infants. In addition to children with frank neurologic and sensory impairment, a spectrum of neurodevelopmental and behavioral disorders are more prevalent in formerly premature infants than in their peers throughout infancy and childhood. Sequelae in children followed to school age include deficits in cognition and problems with learning, motor coordination, behavior, and attention. Problems with impulsivity and social control, inability to cope with novel situations, poor adaptive behavior, and specific learning deficits are more prevalent in tiny infant survivors at midchildhood than in matched control subjects, with male children being at higher risk. Higher order executive functions such as focus of attention, independent problem solving, and ability to deal with novel tasks are less well developed in ELBW children, independent of intelligence, compared with control children at 9 years of age. Previous studies of very low birth weight (VLBW) children in adolescence have highlighted persistent deficits in cognitive and academic skills.
difficulties with cognitive, emotional, and social functioning and behavior. Psychiatric symptoms were also more common. Dinesen and Griesen examined quality of life using self- and parent report in VLBW teens at 14 years of age and found a significant difference in objective quality of life between VLBW teens and control subjects but no difference in subjective quality of life. Similarly, Johnson et al found that extremely low gestational age teenagers at 16 years of age had an optimistic view of the future despite academic and health difficulties.

The oldest of these new survivors are now approaching adulthood. The progression from adolescence to adulthood cuts across many domains of life, including developmental shifts in social relationships, achievement transitions from school to work, and changes in perception of self.

As former premature teens begin to make the transition toward adulthood, there is little known about how these high-risk teens function compared with their peers. Tideman et al found that former preterm adolescents who were born at <35 weeks’ gestation showed significantly more somatic health problems at 19 years than term-born control subjects. A recent study of VLBW teens at 19 to 22 years found that although they were involved in fewer risk-taking activities and had similar quality-of-life ratings and social participation as their peer group, overall, they were smaller, had more physical health problems, and had lower academic achievement. Hack et al also found that VLBW young adults at 20 years of age participated in less risk-taking activities but had lower IQ and educational achievement and a higher incidence of chronic health conditions.

There are few studies of ELBW teens (<1000 g) in early adolescence between 12 and 16 years of age. Saigal et al found that parents of ELBW teens reported a higher incidence of depression and attention-deficit/hyperactivity disorder (ADHD), more clumsiness, greater likelihood of failing a grade, and more school difficulties in their children. However, the ELBW teens did not rate themselves differently from control subjects on a measure of self-esteem. The control subjects participated in more risky behaviors and rated themselves higher on athletic competence. Although ELBW teens reported more complex limitations in cognition, sensation, self-care, and pain and have school difficulties that do not ameliorate with age, they showed high self-assessed quality of life similar to control subjects. Saigal et al also reported that decreasing birth weight is associated with lower scores on psychometric measures of cognition and school functioning in adolescence. The lowest birth weight group tested (<750 g) had significantly lower spelling and arithmetic scores compared with the larger birth weight (750–1000 g) and control groups. Doyle et al showed that ELBW children had higher rates of neurosensory impairments and disabilities at 14 years of age; however, their control group did not have significantly different IQ scores than the ELBW teens at age 14. They found that early childhood assessments significantly predicted later disability at 14 years of age.

There is only 1 study that examined a cohort of ELBW teens who were similar in birth weight to our current study sample of ≤800 g; however, their group was slightly younger (13–15 years of age) and had a relatively small sample size (n = 26 per group). The ELBW group had more academic problems, lower functional health status, and increased need for specialized services, compared with term-born control subjects and rated themselves differently from control subjects on a self-perception profile.

The purpose of this study was to compare the psychosocial and academic functioning around the age of school graduation. This study was undertaken to examine factors that are likely to be of relevance to the transition from adolescence to adulthood in ELBW (≤800 g) survivors of high-technology neonatal intensive care. Specifically, the aim was to assess prevalence of cognitive and academic difficulties, sustained attention, behavior problems (by self- and parent report), and vocational independent job-seeking motivation and competence in this population. As the ELBW population has a high prevalence of learning disabilities and behavior problems in elementary school, this study was designed to highlight problematic transition domains and contribute to the understanding of development of youths across transitions and to assist in the provision of improved clinical service of this population.

METHODS

Participants

ELBW Study Group

Between January 31, 1981, and February 9, 1986, 250 infants of birth weight ≤800 g were admitted to the neonatal intensive care unit (NICU) at British Columbia’s Children’s Hospital, which was the provincial tertiary unit for the province of British Columbia. The 250 infants included all infants who were born ≤800 g birth weight in British Columbia and admitted to neonatal intensive care during this time. A total of 148 died in the neonatal period and 4 died after NICU discharge, leaving 98 (39%) who survived to late adolescence. Nineteen of the children in this birth cohort were identified as having 1 or more major impairments at age 8.5 years and were excluded from the present study. For this purpose, major impairments were defined as IQ <70, nonambulatory cerebral palsy, visual impairment worse than 20/200 in the better eye with optimal refractive correction, or sensorineural hearing loss with hearing aids requiring educational adaptation for the hearing impaired.

Of the 79 eligible ELBW teens, 53 (67%) consented to the study and participated at 17 years of age. There were no significant differences in perinatal characteristics or maternal education between EL BW teens studied at 17 years (N = 53) and the remaining ELBW teens (N = 26) from the original provincial birth cohort who could not be located or refused to participate (see Table 1). However, there were significantly more boys who did not participate at 17 years (P = .012). The midchildhood IQ scores of the ELBW teens who failed to return at 17 years did not differ from those who were in this study. The ELBW teens who were assessed at 17 years of age had a mean Wechsler Intelligence Scale for Children (WISC) full-scale IQ score of 98.68 (standard deviation [SD] = 13.02) at 9 years. Of the 26 teens from the original birth cohort who were not seen at 17 years, 20 had a mean WISC full-scale IQ score of 99.25 (SD = 12.8) at 9 years of age. The remaining 6 children were not assessed at 9 years; however, 1 had a normal IQ at 3 years, 2 had a normal IQ at 4 years, 1 had a low IQ at 4 years, and 2 could not be located.
TABLE 1. Subject Characteristics of ELBW Teens (Studied and Not Studied) and Control Teens: Mean (Range)

<table>
<thead>
<tr>
<th>Subject Characteristics</th>
<th>ELBW Study Group (n = 53)</th>
<th>ELBW Not Studied (n = 26)</th>
<th>Control Group (n = 31)</th>
<th>Control Not Studied (n = 11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at assessment, y</td>
<td>17.3 (16.3–19.7)</td>
<td>NA</td>
<td>17.8 (16.5–19.0)</td>
<td>NA</td>
</tr>
<tr>
<td>Birth weight, g</td>
<td>719 (520–800)</td>
<td>737 (600–800)</td>
<td>3506 (3068–4196)</td>
<td>3638 (3090–4706)</td>
</tr>
<tr>
<td>Gestation, wk</td>
<td>25.8 (23–29)</td>
<td>26.7 (23–38)</td>
<td>40 (39–42)</td>
<td>40 (38–41)</td>
</tr>
<tr>
<td>Girls, %</td>
<td>68</td>
<td>39</td>
<td>45</td>
<td>50</td>
</tr>
<tr>
<td>Ventilation, d</td>
<td>55 (0–127)</td>
<td>49 (0–120)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Oxygen, d</td>
<td>106 (1–320)</td>
<td>80.1 (1–149)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Small for gestational</td>
<td>17%</td>
<td>31%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>education, y</td>
<td>12.3 (6–19)</td>
<td>11.6 (8–17)</td>
<td>11.4 (10–20)</td>
<td>11.9 (7–17)</td>
</tr>
</tbody>
</table>

NA indicates not applicable.

Control Group

A group of 42 children who were born at term between October 1, 1983, and August 31, 1984, were recruited through community health units and recreation centers at 3 years of age and participated as longitudinal control subjects for our studies. Of these 42 control subjects, 31 (74%) consented to the study and participated at 17 years. There were no significant differences in perinatal characteristics between the control teens studied at 17 years (N = 31) and the remaining control teens (N = 11) from the original cohort who could not be located or refused to participate in the study; however, years of maternal education differed (Table 1). The control subjects who were not studied had lower years of maternal education (P = .039) compared with the control teens studied. Control subjects who did not return at 17 years had IQ scores in the average range or above at 9 years.

Measures

The study assessment included cognitive and academic screening by psychometric testing, a computer-based test of attention, self-assessment questionnaires relating to self-perception and job searching, and parental report of behavior. In addition, years of maternal education was collected at ~3 years of age, as a marker of socioeconomic status (SES).

Standardized Psychoeducational Assessment

ELBW and control teens received the same battery of tests and questionnaires. Cognitive and executive function was screened using the Vocabulary, Block Design, and Digit Symbol subtests of the Wechsler Intelligence Scale for Adults, Third Edition (WAIS-III).41 Academic achievement was assessed using the Wide Range Achievement Test, Third Edition (WRAT-III).42 Ability to focus and maintain attention was examined using the computerized Connors’ Continuous Performance Task (CPT),43 which measures vigilance, impulsivity, and sustained attention during problem-solving tasks.

Questionnaires

Teen Self-Report

The Self-Perception Profile for Adolescents44 examines how a teen views him- or herself compared with other teens (“What am I like”) and how important the teen perceives each domain to be (“How important are each of these things to you?”). The domains include Social Acceptance, Athletic Competence, Physical Appearance, Behavioral Conduct, Job Competence, Romantic Appeal, and Close Friendship. The Job Search Attitude Inventory45 is another self-report measure that examines key attitudes toward finding a job. Attitudes are measured on 4 composite scales: Luck versus Planning, Involved versus Uninvolved, Self-Directed versus Other-Directed, and Active versus Passive.

Parent Report

A parent completed the Child Behavior Checklist (CBCL) for ages 4 to 18 years46; for 89% of the ELBW teens and 94% of controls, the mother completed the questionnaire. In the CBCL, the parent provides ratings of his or her teen’s behavior, which permits identification of behavior problems by a score above a defined clinical cutoff for Withdrawal, Somatic Complaints, Anxiety/Depression, Social Problems, Thought Problems, Attention Problems, Delinquent Behavior, and Aggressive Behavior. Three overall factor scores for Internalizing, Externalizing, and Total Behavior Problems are also derived.

Procedures

In accordance with the protocol approved by the Clinical Research Ethics Board of the University of British Columbia and the Research Review Committee of the Children’s and Women’s Health Centre of British Columbia, ELBW and control subjects were contacted by mail. Written informed consent was obtained from each teen and from a parent. ELBW and control teens were seen individually in the Neonatal Follow-Up Program at British Columbia’s Children’s Hospital, for psychometric assessment and completion of the study questionnaires.

Data Analysis

First, maternal education was compared in the 2 groups, as SES is an important potential confounder in determining outcome. The groups differed significantly in years of maternal education (ELBW: 12.3 ± 2.3; control: 14.2 ± 2.7); years of maternal education was included as a covariate in the data analyses. Multivariate analysis of variance was used (group [ELBW, control] × gender) for each domain (cognitive academic, attention, self-report, and parent report). Overall significance on each multivariate analysis of variance was followed by univariate tests. Statistical significance was set at P < .05.

RESULTS

Cognitive and Academic Achievement

The results of cognitive and academic assessments of the 2 groups are given for boys and girls in Table 2. On the WAIS-III, a measure of cognitive ability, the ELBW group scored significantly lower than the control group on all 3 subtests: Vocabulary (P = .002), Block Design (P = .0001), and the Digit-Symbol (P = .006). On the measure of academic ability (WRAT-III), the ELBW group scored significantly lower than the control subjects on the Arithmetic (P = .0001) and the Reading subtests (P = .01), but the 2 groups did not differ significantly in spelling ability. Surprising, we found no gender differences in the cognitive or academic measures.

To examine clinical significance, we calculated the percentage of each group who scored ≤1 SD on the WAIS-III and WRAT-3 subtests shown in Fig 1. We chose this cutoff because teens with IQ <70 were already excluded from this study, and students with IQ ≤1 SD (ie, IQ 71–85) are at a disadvantage in school. On the Block Design subtest of the WAIS-III, 21% of ELBW teens scored ≤1 SD compared with none of the control subjects, and 43% of ELBW teens scored ≤1 SD on the Arithmetic subtest of the WRAT-3 compared with 10% of the control subjects.
Attention (CPT)
There were no overall group differences in CPT t scores. Gender differences (with girls showing more attentional difficulties than boys) were found for commission errors \( (P < .03) \), variability in speed of response \( (P = .02) \), perceptual sensitivity \( (P < .01) \), and risk taking \( (P = .02) \).

Self-Report Questionnaires
On the Self-Perception Profile for Adolescents, the ELBW teens rated themselves lower in Scholastic Competence \( (P < .04) \), Athletic Competence \( (P = .0001) \), Job Competence \( (P = .03) \), and Romantic Confidence \( (P = .04) \). It is interesting that these same items were also rated significantly less important to the ELBW teens than they were to the control subjects (Scholastic Competence: \( P = .04 \); Athletic Competence: \( P = .004 \); and Job Competence: \( P = .05 \)). There were no group differences in the self-ratings in Social Competence, Appearance, Self-Conduct, Close Friend, or Global Self-Worth.

There were no significant group \( \times \) gender interactions. However, taking the ELBW and control subjects together, there were gender differences. Girls rated themselves higher than the boys in Self-Conduct \( (P = .01) \), and boys rated themselves higher than the girls in Appearance \( (P = .01) \) and Athletic Competence \( (P = .0001) \). In rating the relative importance of these characteristics, girls perceived Scholastic Competence \( (P = .004) \), Job Competence \( (P = .04) \), and Self-Conduct \( (P = .001) \) to be more important than the boys. Conversely, boys in both groups rated athleticism as more important than the girls \( (P = .004) \).

Results were very similar in the 2 groups on the Job Search Attitude Inventory. The only significant difference was on the Help From Others versus Self-Help scale \( (P = .01) \). The ELBW group viewed themselves as more prone to needing help from others in finding a job; however, the mean values for both groups were within the “Highly Self-Directed” range for this scale. Gender differences were found in the Passive versus Active scales, with the girls presenting as more active and self-directed.

Behavior
On the CBCL, parents of ELBW teens reported that their teens showed more Internalizing \( (P = .003) \), Externalizing \( (P = .005) \), and Total Problems \( (P = .001) \) than the control subjects (see Table 3). ELBW teens showed significantly more problems above the clinical cutoff for Total, Internalizing, and Externalizing Problems (Fig 2). As well as these broad factor scores, there were differences in parent report in a number of behavior domains. Compared with parents of control subjects, parents of ELBW teens reported significantly lower Social \( (P = .03) \) and School competence \( (P = .01) \) and more Withdrawal \( (P = .01) \), Social Problems \( (P = .001) \), Thought Problems \( (P = .001) \), Attention Problems \( (P = .0001) \), and Delinquent \( (P = .003) \) and Aggressive behavior \( (P = .04) \). There was a significant overall gender difference in the Delinquent behavior scale, with boys reported to show more delinquent behavior than girls \( (P = .004) \).

<table>
<thead>
<tr>
<th>Measures</th>
<th>ELBW Teens</th>
<th>Control Teens</th>
<th>Group</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boys</td>
<td>Girls</td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td>WAIS-III</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vocabulary</td>
<td>12.06 (3.1)</td>
<td>12.08 (2.6)</td>
<td>14.06 (2.2)</td>
<td>14.38 (2.0)</td>
</tr>
<tr>
<td>Block Design</td>
<td>9.59 (2.8)</td>
<td>10.19 (2.9)</td>
<td>12.94 (2.7)</td>
<td>13.00 (3.0)</td>
</tr>
<tr>
<td>Digit Symbol</td>
<td>9.29 (2.0)</td>
<td>10.39 (2.9)</td>
<td>11.71 (2.7)</td>
<td>12.46 (3.2)</td>
</tr>
<tr>
<td>WRAT-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading</td>
<td>102.47 (12.7)</td>
<td>104.61 (9.0)</td>
<td>110.41 (13.2)</td>
<td>110.77 (6.5)</td>
</tr>
<tr>
<td>Spelling</td>
<td>97.47 (16.2)</td>
<td>101.50 (12.2)</td>
<td>102.47 (15.6)</td>
<td>108.08 (8.1)</td>
</tr>
<tr>
<td>Arithmetic</td>
<td>91.12 (16.0)</td>
<td>91.57 (12.5)</td>
<td>106.65 (14.8)</td>
<td>105.92 (14.1)</td>
</tr>
</tbody>
</table>

NS indicates not significant.
* \( P < .01 \).
† \( P < .001 \).
‡ \( P < .05 \).

![Scores < or = 1 SD on the WAIS-III and WRAT-3 Subtests](image-url)

Fig 1. Percentage of ELBW versus control teens who scored \( \leq 1 \) SD on the WAIS-III and WRAT-3 subtests.
There were a number of group × gender interactions, with less difference between the ELBW and control girls and more difference between the ELBW and control boys (Withdrawn: \(P = .04\); Thought problems: \(P = .01\); Total problems: \(P = .04\); and Internalizing problems: \(P = .02\)).

**DISCUSSION**

In late adolescence, we found that ELBW teens continued to display multiple areas of vulnerability in cognitive, academic, behavioral, and social domains on objective testing, difficulties that are reflected in their own self-assessment and in assessment by their parents.

**Cognitive and Academic Achievement**

ELBW teens showed more difficulties in both cognitive and academic abilities, with particular difficulties in arithmetic. Our findings at 17 years are consistent with the majority of studies of heavier birth weight former preterm teens (\(\geq 1500\) g), which demonstrate that academic and cognitive problems persist into adolescence and early adulthood.\(^{20,47-49}\)

Little is known, however, about how ELBW (\(\leq 800\) g) teens perform during the adolescent years. Similar to our findings, slightly younger ELBW teens (\(< 750\) g) at 12 to 16 years of age had lower scores on all measures of cognitive and academic performance.\(^{37}\) In that study, the ELBW group had significantly lower spelling and arithmetic scores, whereas we found no significant differences in spelling. Conversely, at 14 years of age, IQ in ELBW (\(< 1000\) g) teens did not differ compared with term-born control subjects.\(^{31}\) Our findings are consistent with a recent study by Hack et al\(^{50}\) that reported that ELBW (\(< 1 \) kg) young adults at 20 years had lower IQ and academic functioning than VLBW and normal birth weight control subjects.

Our results demonstrate clinical and functional significance of continuing psychoeducational difficulties in this population. In the nonverbal cognitive task, \(>20\%\) of the ELBW teens had visual-perceptual difficulties (Block Design), compared with none of the control subjects; moreover, as a group, the ELBW teens scored 1 SD below the control subjects. Clinically, there was half a SD difference between the ELBW and control groups on the vocabulary and digit symbol cognitive tasks as well as reading. Academically, arithmetic stood out as a significant area of difficulty for \(43\%\) of the ELBW teens, compared

**TABLE 3.** Parent-Reported Behavior Problems on the CBCL for the ELBW Versus Control Teens: Mean (SD)

<table>
<thead>
<tr>
<th>CBCL</th>
<th>ELBW Teens</th>
<th>Control Teens</th>
<th>Group</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boys</td>
<td>Girls</td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td><strong>Problem scales</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Withdrawn</td>
<td>62.56 (11.2) 54.88 (6.4)</td>
<td>52.53 (4.5) 53.92 (8.3)</td>
<td>*</td>
<td>NS</td>
</tr>
<tr>
<td>Somatic complaints</td>
<td>60.69 (9.3) 55.94 (6.9)</td>
<td>54.41 (6.5) 56.17 (6.5)</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Anxious/depressed</td>
<td>56.94 (7.5) 56.15 (8.3)</td>
<td>51.47 (3.6) 56.75 (9.3)</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Social problems</td>
<td>59.50 (10.5) 55.82 (9.5)</td>
<td>50.82 (2.4) 51.08 (2.6)</td>
<td>†</td>
<td>NS</td>
</tr>
<tr>
<td>Thought problems</td>
<td>60.00 (8.4) 53.70 (6.4)</td>
<td>51.24 (2.8) 54.08 (3.6)</td>
<td>†</td>
<td>NS</td>
</tr>
<tr>
<td>Attention problems</td>
<td>61.63 (9.3) 55.94 (7.7)</td>
<td>52.29 (4.0) 50.75 (2.0)</td>
<td>†</td>
<td>NS</td>
</tr>
<tr>
<td>Delinquent behavior</td>
<td>60.56 (9.0) 54.33 (7.0)</td>
<td>53.59 (6.3) 51.17 (2.3)</td>
<td>†</td>
<td>*</td>
</tr>
<tr>
<td>Aggressive behavior</td>
<td>54.37 (6.2) 53.55 (6.3)</td>
<td>52.24 (4.0) 50.67 (1.6)</td>
<td>*</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Factor scores</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total problems</td>
<td>58.00 (13.3) 51.61 (10.5)</td>
<td>43.18 (12.5) 47.42 (10.7)</td>
<td>†</td>
<td>NS</td>
</tr>
<tr>
<td>Internalizing problems</td>
<td>58.00 (13.1) 53.09 (10.5)</td>
<td>43.18 (11.0) 51.42 (12.0)</td>
<td>†</td>
<td>NS</td>
</tr>
<tr>
<td>Externalizing problems</td>
<td>53.81 (11.5) 48.39 (11.1)</td>
<td>45.12 (10.7) 42.58 (6.9)</td>
<td>†</td>
<td>NS</td>
</tr>
</tbody>
</table>

\* \(P < .05\).

† \(P < .01\).

‡ \(P < .001\).

**Fig 2.** Clinically significant behavior problems by parent report on the CBCL for ELBW versus control teens.

www.pediatrics.org/cgi/doi/10.1542/peds.2004-0932
with 10% of control subjects; the groups differed by 1 SD. These persistent areas of difficulty are in line with findings of multiple studies at younger ages.

The present study revealed no gender differences on the cognitive or academic measures, which was unexpected because gender differences were found at 9 years in an earlier study on the same cohort.1 However, in a different study of younger adolescents, no gender differences were found.37 Perhaps gender differences ameliorate with age, particularly in the late teen years. Currently, no studies of cognitive and academic abilities in ELBW teens in late adolescence include a large enough sample size to examine gender as an independent variable; thus, multisite studies are needed. Another future direction would be to look longitudinally at neurodevelopment from childhood to the teen years in ELBW children, as a recent study has highlighted a deterioration in cognitive function over time.51

Attention

Attentional problems in premature children have been described extensively in the literature, including a higher incidence of attention problems and ADHD in childhood,1,2,5,29 at 12 to 16 years in ELBW teens, and small for gestational age term-born girls.53 Given these previous findings, we expected attention as measured by the CPT to differ between our ELBW and control groups. However, studies of preterm adolescents have rarely used the CPT as the measure of ADHD and/or attentional problems. The CPT involves a tedious repetitive task that may not adequately engage teen subjects and therefore may not have been sufficiently sensitive to pick up differences.

In this study, the lack of differences in attention on the CPT contrasted with the findings by the parent-report measure of attention on the CBCL, which showed ELBW teens to have more attention problems than control subjects. This finding is consistent with a study of low birth weight children (<2000 g) who were born at term and had more attention problems on the CBCL at 11 years, as well as more teacher-reported attention problems.54 The CBCL taps different aspects of attention than the CPT, reflecting a broad variety of attention problems within the social realm, with the ELBW boys being identified as less competent as expected. Earlier findings1,55 suggest that ELBW children back off when confronted by cognitive demands that seem novel or complex. Research is needed to examine higher order attention and executive processing in teens who were born extremely premature.

Self-Report Questionnaires

ELBW teens demonstrated less confidence in their abilities relating to activities that are important to teens, such as athletics, school achievement, and romantic and job competence. These factors are likely the most important areas of competence to a teen as success in these areas provides a structure for maintenance of self-esteem. These lower scores may be a result of ELBW teens’ insecurities compared with their peers and reflect realistic self-appraisal, given their long-term difficulties in motor, academic, and social functioning. Brown et al40 administered the same self-perception profile to 13- to 15-year-old teens who were born ≤800 g but examined only 4 of the 8 domains (scholastic competence, social acceptance, athletic competence, and global self-worth). In that study, the ELBW teens did not report differences in self-confidence compared with term-born control subjects, but the sample size was small (n = 26). In a study of VLBW (≤1500 g) teens at age 18 to 20 years,56 a self-report measure evaluating quality of life showed self-perceived differences in school performance in mathematics, foreign language, general learning ability, and ability to concentrate, with the VLBW teens scoring lower than the full birth weight group. In contrast, there are a number of studies that found no differences in self-reported competence between ELBW, VLBW, and control teens,20 whereas others showed differences only in athletic competence30 or appearance.27

The gender effects in the self-perception profile in this study are interesting as the boys in both groups rated themselves higher in appearance and athletic abilities than the girls of each group. Saigal et al30 found similar gender effects in that both groups of boys rated themselves higher than both groups of girls on athletic competence and physical appearance. This may reflect peer pressure in the teen culture on boys at this age to be athletic. Teenage girls are much more critical of their bodies and therefore less likely to score themselves highly on appearance. Our ELBW teens rated the areas in which they judged themselves less competent (athletics, school achievement, and romantic and job competence) to be less socially important to them than did the control subjects. Perhaps this could be interpreted as an appropriate coping strategy in defense of self-esteem, but the ELBW teens’ perception of themselves might be at variance with how their peers see them.

Like Saigal’s ELBW teens at age 12 to 16 years,30 our ELBW teens at 17 years did not rate their overall global self-worth differently than the control teens. Despite self-reported acknowledged deficiencies in various functional areas of importance to teens, the ELBW group still rated themselves as having a global self-worth equivalent to their teen peers.

In the transition from adolescence to adulthood, attitudes to job seeking are an important factor for success, given that ELBW teens are in direct competition with “controls” (the general population) in the job marketplace. As ELBW teens rated their job competence lower than the control group and also rated having a job as less important, we expected to find differences in their attitudes to finding a job. However, both groups had scores in the highly self-directed category on the job search attitude inventory, reflecting positive and motivated attitudes. The small difference found between the groups reflects ELBW teens’ perception of their being more prone to needing, seeking, or getting help from others in the process of job seeking. These findings may reflect subtle differences in attitudes and self-assuredness in ELBW teens, who may be realistically more doubtful.
of their own abilities and aware that they need guidance to approach challenges in general.

**Behavior**

Parents reported that ELBW teens had more behavior problems overall and were less competent in scholastic and social abilities compared with the control teens. The specific problems identified in many of the ELBW teens would significantly disrupt social functioning, such as more aggression, delinquent behavior, attention problems, social problems, thought problems, and being socially more withdrawn than the control teens. Clinically significant levels of internalizing problems (based on parent ratings on the CBCL) occurred in 30% of our ELBW teens (disproportionately in boys), which was >4 times higher than the control subjects. Importantly, externalizing problems above the clinical cutoff were less common (18%); however, none of the control subjects reached the diagnostic threshold for externalizing problems.

Our findings are consistent with the literature examining behavior problems in former VLBW teens younger than in the present study. Behavioral and emotional problems have been reported in VLBW children at 8 and 14 years of age, 13 to 14 years of age,22 and 12 to 16 years of age on parent ratings.29 The overall risk of behavior disorder in the VLBW population has been estimated at 2% to 3%,57; however, in our perinatally higher risk cohort, we found a much higher prevalence. In contrast, a number of studies have reported no behavioral differences in VLBW adolescents using the CBCL20 or in ELBW teens using the Parent Rating Scales of the Behavior Assessment System for Children.40

**Limitations**

One of the principal limitations of this study is the loss of 33% of the eligible patients. In conducting this study, we followed a protocol that required voluntary informed consent from the teens in both groups in accordance with our Clinical Research Ethics Board. The “appointment contract” was with the teen, rather than the parent, which was a change from previous follow-up appointments of this longitudinally followed cohort.

Saigal58 and others have stressed that the patients who are unavailable for study are likely to have a greater risk of disabilities and cognitive deficits as a result of psychosocial disadvantage. There were no differences in perinatal, sociodemographic, or cognitive factors between ELBW teens who participated and those who did not, but there was an excess of boys in the ELBW group who were unavailable for the study, which may have influenced our ability to find gender differences. Therefore, our study may provide a minimal estimate of overall cognitive, academic, and behavior problems in the ELBW population.

Maternal education (our marker of SES) was higher in the control group. We recruited the control subjects at 3 years of age from community health units and recreation centers in neighborhoods of comparable SES to our ELBW children. However, we speculate that parents of relatively higher SES may be the ones who volunteered to participate. A number of recent studies have challenged traditional thinking on the associations between SES and preterm birth.59,60 However, genetic, environmental, and social factors together influence developmental trajectories. We controlled statistically for differences in years of maternal education; however, this may not have sufficiently “corrected” for the complex environmental impact of SES on these individuals from conception to adulthood. Nevertheless, regardless of whether these outcomes were determined by environmental and/or biological mechanisms, ELBW teens showed continuing difficulties in academic and cognitive areas.

The data presented here underestimate the problems faced by the total surviving population of ELBW teens because those with impairments were not included in the study. We excluded children with major neurosensory, motor, and/or cognitive impairments evident at 9 years, as the objective of this study was to compare ELBW teens who are free of impairment with their peers. Because of changes in perinatal and neonatal care permitting the survival of larger numbers of infants of lower birth weight and shorter gestational age since the 1980s, data from our study inform but are probably not directly applicable to the long-term outcomes of the birth cohort of survivors of 800 g birth weight or less, currently being discharged from NICUs.

**CONCLUSIONS**

Psychosocial and educational vulnerabilities of former ELBW children as a group persist into late adolescence and are expected to complicate their transition to adult life in a high-technology society, where they will have to compete for employment in a workplace with increasing focus on technical jobs that require education, flexibility, and social adaptability. It is important that health clinicians, educators, and policy makers recognize the additional challenges that these former ELBW teens face in moving toward social and economic independence.

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