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ABSTRACT. *Objectives.* **To compare measures of psychometric assessment and school difficulties in a cohort of extremely low birth weight (ELBW) teenagers and term controls, and to determine whether there is stability in psychometric measures between age 8 and the teen years.**

Study Design. **Longitudinal follow-up; geographically defined region. Participants: 150 of 169 (89%) ELBW survivors born between 1977 and 1982 and 124 of 145 (86%) sociodemographically matched term controls between 12 and 16 years of age. Psychometric measures: Wechsler Intelligence Scale for Children-Revised, Wide Range Achievement Test-Revised, and a validated parent questionnaire.**

Results. **Neurosensory impairments were present in 28% of ELBW and 1% of controls. The mean Wechsler Intelligence Scale for Children-Revised scores were ELBW: 89 ± 19 and controls: 102 ± 13. ELBW children did less well on Wide Range Achievement Test-Revised Reading, Spelling, and Arithmetic measures with mean scores in the range from 75 to 85. ELBW children <750 g were more disadvantaged, compared with those ≥750 g. A significantly higher proportion of ELBW children were receiving special educational assistance and/or had repeated a grade (ELBW: 58%; controls: 13%; odds ratio: 9.0). Paired analysis of within-cohort data at age 8 and teen years showed that for both cohorts Arithmetic scores declined, but there were small improvements in other measures, predominantly in the term children.**

Conclusions. **Differences of 13 to 18 points in psychometric measures in ELBW teens compared with controls are both statistically significant and clinically relevant. Decreasing birth weight was associated with increased risk on all measures. The high utilization of special educational resources has economic implications, and the incremental cost attributable to being extremely premature needs to be determined.** *Pediatrics* **2000;105:325–331;** ***extremely low birth weight, follow-up, adolescence.***

ABBREVIATIONS. VLBW, very low birth weight; ELBW, extremely low birth weight; WISC-R, Wechsler Intelligence Scale for Children-Revised; DQ, deviation quotient; WRAT-R, Wide Range Achievement Test-Revised; NSI, neurosensory impairment; CI, confidence interval; OR, odds ratio; SD, standard deviation.

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The sequelae of very low birth weight (VLBW) births seem to be lifelong. First, VLBW is a major contributor of neonatal and infant mortality and childhood neurodevelopmental morbidity.[1,2] Second, VLBW infants experience significant general health problems, recurrent infections and hospitalizations, and poor physical growth compared with their peers.[3–6] Third, behavioral and attentional disorders have been reported more frequently in VLBW children.[7–9] Fourth, a review of the recent literature suggests that VLBW children are more likely to experience difficulties at school in mid-childhood and a high proportion require special educational assistance.[10–29] However, there are limited studies from the recent era on follow-up of preterm children to adolescence[30–34] and none for infants who were <1000 g at birth. Also, many of the available studies suffer from 1 or more methodological problems, such as small sample size, high attrition rates, lack of a suitable comparison group, and single hospital or tertiary care center births.[35] Thus, it is difficult to obtain a true picture of the outcome of the survivors.

We have previously reported on the school-age outcome of a regional cohort of extremely low birth weight (ELBW) children, compared with term controls at 8 years of age.[11] The focus of this article is to describe and compare the academic abilities, school performance, and utilization of special educational resources in the above cohort of ELBW infants who are now teenagers in comparison to same age term peers, and to determine whether there is stability in the academic measures between age 8 and the teen years.

METHODS

Subjects

ELBW Cohort

The ELBW survivors, 501 to 1000 g birth weight, were born between 1977 and 1982 to residents of a geographically defined region in central west Ontario and followed longitudinally from birth. The outcome of the 1977 to 1981 cohort was last reported at 8 years of age[11,12] (the 1982 cohort was assessed at 8 years of age subsequent to the publications). At the time of the present assessment, the children ranged between 12 and 16 years of unadjusted age.

Term Controls

The controls were recruited at 8 years of age from a random list of children obtained through the Directors of the Hamilton Public and Roman Catholic Separate School Boards and matched for sex, age, and social class to each index child (1977–1981 births).[11]

Assessment Measures

Tests of Cognition

An abridged version of the Wechsler Intelligence Scale for Children-Revised (WISC-R)[36] was administered to all children. The following subscales were included: 1) Verbal tests: Similarities, Mental Arithmetic, and Vocabulary; and 2) Performance tests: Picture Arrangement and Block Design. These items provide a deviation quotient (DQ) score (mean: 100 ± 15); the correlation of the DQ scores with the full-scale WISC-R IQ is .96.[37] Children with blindness (n = 7) were tested only on the verbal items of the WISC-R. Severely impaired children who were untestable were assigned the lowest obtained study score minus 1.[11]

Test of Academic Achievement

Wide Range Achievement Test-Revised (WRAT-R),[38] consists of 3 subtests: Reading, Spelling, and Arithmetic. Scores are obtained for each of the 3 subtests (mean: 100 ± 15). The psychometric tests were administered in a standardized manner by 2 research psychometrists who were trained and supervised by a psychologist and blind to the group status.

Grade Failure

Information on grade failure in the last 2 years was obtained from the parents.[39] However, it should be noted that the philosophy of the Separate School Board is to keep all children in the same class as their age-matched peers, regardless of academic performance.

Special Educational Assistance

The parents completed a comprehensive inventory of school performance validated on a population of children between 4 and 15 years of age (Ontario Child Health Study).[39] The questionnaire provided information on grade repetition and utilization of special remedial resources. For the purpose of this study, we expanded the questionnaire in consultation with the superintendent of the Hamilton Board of Education to provide more specific details of the type, duration, and area of special remedial assistance (regular class with appropriate assistance, regular class with withdrawal for special program, special class in regular school, and special class in special school). Resource help was provided to the children based on the recommendations by the classroom teacher. Generally, children with disabilities are mainstreamed into regular schools.

School Difficulties

Children were considered to have school difficulties if they repeated a grade and/or utilized special educational resources,[9] based on information obtained from the parents through a validated structured questionnaire.[39]

Neurosensory Impairments (NSIs)

Children were considered to have NSI if they had cerebral palsy, microcephaly, hydrocephalus, blindness, deafness, and/or mental retardation identified during previous clinical assessments by the same investigators.[1,11] Children without NSIs and with IQ ≥85 were considered to be "apparently normal."

Sociodemographics

Parents completed the Ontario Child Health Study[39] questionnaire, which provided information on sociodemographic factors such as education, occupation, and ethnic status. Social class was classified according to the Hollingshead 2-factor social class index.[40] Maternal education was classified as follows: less than high school, high school graduate, some college or university/college graduate, and university graduate. Although demographic variables were available at the teenage assessment, we elected to take the maternal education obtained at the age 8-year assessment into consideration in the analyses to determine its effect while the child was growing up.

Informed Consent

The study was approved by the Ethics Committee of Hamilton Health Sciences Corporation and written informed consent was obtained from the parents of all subjects.

Statistical Analysis

Psychometric Assessment of Teenage Subjects

The ELBW and control subjects were compared as a group with respect to their cognitive scores and academic achievement measures using Student's t tests to determine differences in measures; 95% confidence intervals (CIs) were calculated around differences in mean scores for the major outcome variables to estimate the magnitude of difference. A P value of $<.05$ was considered to be significant. Bivariate analyses relied on χ^2 analyses with odds ratio (OR) and 95% CIs where appropriate.[41]

Psychometric data were examined as follows: χ^2 analysis was performed to look at the proportion of children with DQ and WRAT-R scores of <70 (>2 standard deviation [SD] below mean), between 70 and 84 (1 SD below mean) and ≥85 (within 1 SD of mean and above). Analysis of variance was used to look at mean differences in outcomes within 3 birth weight strata: smaller ELBW (<750 g), bigger ELBW (750–1000 g), and full-term controls.

Finally, a stepwise multiple regression procedure was performed with the psychometric scores at adolescence as the dependent variable and a number of independent variables, such as maternal education, birth weight, gender, and 8-year psychometric scores. We created 3 dummy variables for maternal education (high school, post-high school, and university with less than high school as the reference category); 2 dummy variables for birth weight (750–1000 g and full term ≥2500 g, with <750 as the reference category). Gender (0 = males and 1 = females) and the 8-year psychometric scores were also entered into the models. The regression analyses were run separately for the 4 teen outcome variables (DQ, Reading, Spelling, and Math) to explore the role of the independent variables on the performance at adolescence.

Comparison of Age Eight and Teenage Data

For this analysis, only children who were seen at both ages were included for paired analyses. To illustrate the magnitude of differences in the mean psychometric scores, we used a Repeated Measures Model, in which the within-subject variables were WISC-R IQ/DQ and WRAT-R standard scores (ie, tests) at time 1 (age 8) and time 2 (teen years), and the between-subject variable was the group status (ELBW and term).

RESULTS

Study Participants

ELBW Children

Between 1977 and 1982 inclusive, 179 ELBW children survived to hospital discharge (survival rate: 48%);[1] 10 children subsequently died, leaving 169 available survivors. Of these, 8 were lost (1 NSI), 6 refused (2 NSI), and 5 lived too far away (2 NSI). Overall, the outcome is reported on 150 of 169 (89%) ELBW teens; 42 (28%) of ELBW teens assessed had NSIs and included 1 or more of the following conditions: cerebral palsy (n = 19), hydrocephalus (n = 6), significant cognitive impairments (n = 14), autism (n = 5), unilateral blindness (n = 5), bilateral blindness (n = 9), and sensorineural deafness (n = 2). However, 9 of the above 42 children with NSI were considered untestable and were assigned a DQ and WRAT scores as specified earlier. The remaining 141 ELBW teenagers, including 33 with NSI, participated in the formal psychometric assessments.

Control Children

A total of 145 term controls were recruited at 8 years of age. Of these, 10 children were lost to follow-up (1 NSI), 9 refused, and 2 lived too far away. The remaining 124 (86%) participated in the study (1 NSI) and were administered the same psychometric tests as the ELBW cohort.

Demographic Data

Table 1 shows demographic data on both ELBW and control children. The mean birth weight of the ELBW cohort was 833 g and 40 (36%) children were <750 g at birth. A significantly higher proportion of the ELBW teens had NSIs. There were no significant differences in social class, maternal education or proportion with 2-parent families between the 2 groups; 91% of the subjects were white. The mean age at assessment of the ELBW cohort was 14.0 ± 1.6 years versus 14.4 ± 1.3 years for controls ($P = .01$).

Results of Psychometric Tests

The mean WISC-R DQ and WRAT-R scores for ELBW (<750 and ≥750 g) and control subjects (>2500 g) are illustrated in Fig 1. These data include 33 ELBW children with NSIs and 9 untestable children who were assigned DQ scores of 44. Decreasing birth weight was associated with lower scores on all measures (1-way analysis of variance DQ: $F = 22.0$, $P = < .0001$, $df = 2$, $df_2 = 271$; Reading: $F = 27.7$, $P = < .0001$, $df_1 = 2$, $df_2 = 258$; Spelling: $F = 33.3$, $P = < .0001$, $df_1 = 2$, $df_2 = 258$; and Arithmetic: $F = 39.2$, $P < .0001$; $df_1 = 2$, $df_2 = 258$).

The mean DQ for all ELBW teens (501–1000 g) was 13 points lower than for controls; 95% CIs around differences in mean scores are given in Table 2. ELBW children performed significantly less well (between 16 and 18 points lower) than their peers on all 3 WRAT-R subtests ($P < .0001$). Within the ELBW cohort, the smaller birth weight teens had significantly lower scores in Spelling and Arithmetic compared with their bigger counterparts ($P < .05$), with mean scores between 7 and 9 points lower on achievement measures. Multivariate analysis of variance showed that there were no significant differences in achievement scores by gender; however, there was significant interaction of birth weight and gender for DQ, with ELBW boys performing significantly less well than girls, ($F = 4.614$; $df_1 = 1$; $df_2 = 257$; $P = .03$).

TABLE 1. Sociodemographic Variables on ELBW and Control Teens

	ELBW ($n = 150$)	Control ($n = 124$)
Gestation (wk), mean (SD)	27 (24)	Term
Birth weight (g), mean (SD)	833 (126)	3395 (483)
Birth weight <750 g: ≥750 g (n)	40:110	—
Neurosensory impairments (%)	28.0	1.0*
Gender: male/female (n)	70/80	55/69
Family status (2 parents, %)	88	90
Social class[40]		
I, II (%)	20	27
III (%)	38	39
IV, V (%)	42	34
Maternal education (%)		
<High school	33	24
Completed high school	31	25
Postsecondary	23	31
Completed university	13	20
Age assessed (y), mean (SD)	14.0 (1.6)	14.4 (1.3)

* $P = \leq .0001$.

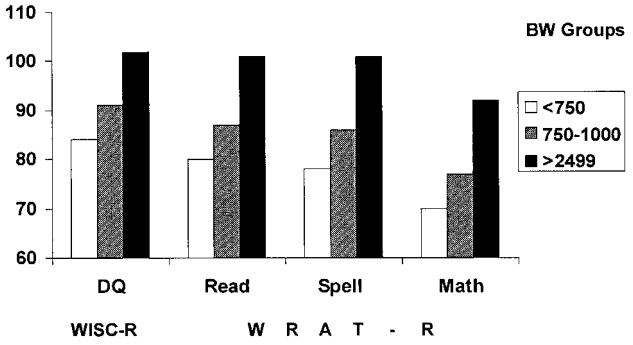

Fig 1. Mean WISC-R DQ and WRAT-R scores for ELBW and control subjects by birth weight cohorts: <750 g, 750 to 1000 g, and >2500 g.

Apparently Normal Teens

When children with NSIs and IQ < 85 were excluded, 85 of 150 ELBW (57%) and 113 of 124 controls (91%) remained (Table 2). In comparison to children born at term, the apparently normal ELBW cohort still scored 5 points lower on DQ ($P < .001$) and between 8 to 11 points lower on tests of achievement ($P < .0001$). However, there were no significant differences between the smaller and bigger apparently normal ELBW children on any of the psychometric measures.

Table 3 shows the proportion of ELBW and control teens who had scores in the normal (≥85) and subnormal range (70–84) on psychometric tests and the ORs and 95% CIs for scores <85 in comparison with children born at term. Between 23% and 50% of the children <750 g and 12% and 32% of those 750 to 1000 g birth weight had scores in the abnormal range (<70), with poorest performance on the Arithmetic subtest. Another 12% to 36% of ELBW children had scores between 70 and 84. In comparison, the term children had a much lower proportion with scores in the subnormal range except in Arithmetic in which 29% scored <85. Thus, on most psychometric measures, the OR for scores <85 were 7.9- to 12.7-fold higher for the children with birth weight <750 g and 3.5 to 5.6 fold higher for those ≥750 g, compared with the term cohort. It is important to point out that less than half of the smaller ELBW children scored in the normal range (≥85) on most psychometric tests, and less than one quarter of these performed in the normal range in Arithmetic. In comparison, nearly two thirds of the bigger ELBW children performed in the normal range, except for Arithmetic, in which only one third had scores in the normal range.

School Performance and Special Educational Assistance

School Difficulties

Table 4 describes school problems in ELBW and control teens as obtained through a structured, parent-completed questionnaire. A significantly higher proportion of ELBW children had repeated a grade in the last 2 years (χ^2: 18.1; $P < .0001$). By parental report, nearly half of the ELBW teens were receiving special educational assistance compared with 10% of control teens (χ^2: 45.0; $P < .0001$) of these, 22% of ELBW teens required full-time educational assis-

TABLE 2. Psychometric Test Scores on ELBW and Control Teens

Variables	ELBW		All ELBW 500 to 1000 g Mean (SD)	Control >2500 g Mean (SD)	All ELBW Versus Controls	
	<750 g Mean (SD)	750 to 1000 g Mean (SD)			*P*	95% CI of Differences
All teens						
WISC-R DQ	86 (20)	91 (18)	89 (19)	102 (13)	<.0001	8.8–16.6
WRAT-R						
Reading	79 (21)	86 (21)	85 (21)	101 (15)	<.0001	11.8–20.8
Spelling	77 (21)	86 (20)*	83 (20)	101 (15)	<.0001	12.7–21.4
Arithmetic	70 (17)	77 (18)*	75 (18)	92 (15)	<.0001	13.3–21.3
Apparently normal teens†						
WISC-R DQ	100 (8)	99 (9)	99 (9)	104 (11)	<.001	2.1–7.9
WRAT-R						
Reading	96 (17)	94 (16)	94 (16)	102 (15)	<.0001	3.8–12.6
Spelling	90 (22)	92 (16)	91 (17)	102 (13)	<.0001	6.2–14.8
Arithmetic	84 (11)	84 (14)	84 (13)	94 (14)	<.0001	6.3–14.1

* $P < .05$.
† Apparently normal teens are children with no NSIs and IQ ≥85 (ELBW: $n = 85$; controls: $n = 113$).

TABLE 3. Proportion of ELBW and Control Teens Performing Within and Below the *Normal Range on Psychometric Measures

Psychometric Measures	Birth Weight Groups		
	<750 g %	750 to 1000 g %	Term %
WISC-R DQ			
<70	22.5	11.8	.0
70–84	25.0	11.8	8.1
≥85	52.5	76.4	91.9
OR <85	10.3	3.5	1.0
(95% CI)	(4.2–25.3)	(1.6–7.7)	—
WRAT-R			
Reading			
<70	38.2	18.4	2.4
70–84	20.6	18.4	8.9
≥85	41.2	63.2	88.7
OR <85	11.2	4.6	1.0
(95% CI)	(4.7–27.1)	(2.3–9.1)	—
Spelling			
<70	41.2	19.4	2.4
70–84	20.6	22.3	8.9
≥85	38.2	58.3	88.7
OR <85	12.7	5.6	1.0
(95% CI)	(5.2–30.8)	(2.9–11.1)	—
Arithmetic			
<70	50.0	32.0	4.8
70–84	26.5	35.9	24.2
≥85	23.5	32.1	71.0
OR <85	7.9	5.2	1.0
(95% CI)	(3.3–19)	(2.9–9.1)	—

* ≥85 represent scores within the normal range.

TABLE 4. School Difficulties in ELBW and Control Teens

Variables	ELBW ($n = 150$)	Control ($n = 124$)	OR (95% CI)
Grade repetition (%)	25	6†	5.5 (2.3–12.8)
Special education (%)	49	10†	8.0 (4.1–15.4)
Part-time (%)	28	10	
Full-time (%)	22	0	
*School difficulties (%)	58	13†	9.0 (4.9–16.8)
<750 g	72	—	
750–1000 g	53	—	2.3 (1.0–5.0)
Type of class (%)			
1 = regular class	57	94	
2 = regular and special assistance	9	3	
3 = regular and special program	17	3	
4 = special class, regular class	9	0	
5 = special school	6	0	
6 = other	2	0	
Days absent/y (ill health) (%)			
<10 d	93	89	
11–20 d	3	7	
>20 d	3	4	

* School difficulties indicate special education and/or grade repetition in the last 2 years.
† $P < .0001$.

tance compared with none of the control teens. A higher proportion of the smaller ELBW cohort were receiving special educational assistance than those ≥750 g birth weight (65% vs 43%; χ^2: 5.82; $P = .02$; OR: 2.5; CI: 1.2–5.3).

The risks of having school difficulties (grade repetition and/or special education) was significant for ELBW children in comparison with controls (ELBW: 58%; controls: 13%; χ^2: 56.8; $P < .0001$). Within the ELBW cohort a higher proportion of teenagers below 750 g birth weight had school difficulties compared with those ≥750 g birth weight (χ^2: 4.29; $P = .04$). In terms of school placement, 57% of ELBW versus 94% of controls were in regular classes. A higher proportion of ELBW teens were in special classes or were receiving some form of special educational assistance. Even apparently normal ELBW teens were having significantly more school difficulties than control children (ELBW: 46%; controls: 11%; χ^2: 30.8; $P < .0001$; OR: 7.0; CI: 3.4–14.6). There were no differences in the number of days on which the teens were absent from school for reasons of ill health.

Comparison Age Eight and Teen Psychometric Scores

For this comparison, 8 ELBW children were excluded because they were not assessed at both ages. Table 5 shows the mean IQ and WRAT scores at age 8 and teen years by paired *t* tests. Statistically significant differences refer to changes between the 2 ages within each of the cohorts. Overall, ELBW children showed minimal improvement in mean scores in Spelling; control children showed improvement in Reading and Spelling but some decline in the DQ

TABLE 5. Paired Analyses of Psychometric Scores for ELBW and Control Children at Age Eight and Teen Years

Tests	Group	*n*	Age	
			8 Years of Age Mean (SD)	Teen Mean (SD)
WISC-R	ELBW	(142)	90 (19)	90 (18)
	Control	(124)	105 (12)	102 (13)*
WRAT-R				
Reading	ELBW	(127)	85 (19)	86 (20)
	Control	(124)	97 (17)	101 (15)***
Spelling	ELBW	(127)	82 (19)	84 (20)*
	Control	(124)	95 (17)	101 (15)***
Arithmetic	ELBW	(126)	80 (18)	76 (17)**
	Control	(124)	95 (13)	92 (15)**

Children with NSIs included. Statistics refer to differences between children 8 years of age and teens within cohorts: * $P < .05$; ** $P < .01$; and *** $P < .0001$.

scores. However, mean Arithmetic scores were significantly lower in both cohorts in the teen years.

The repeated measures model showed significant changes in test scores over time ($F = 30.50$; $P = .0001$) and in tests over time by group status ($F = 5.24$; $P = .001$). Except for IQ, there were positive changes in scores over time in the Reading and Spelling subtests in ELBW children. These positive differences were more marked in the term children. However, in Arithmetic, both ELBW and control children showed a decrease in scores between the 2 time periods. On the whole, the changes were small and ranged between just above zero and a maximum mean difference of 6 points.

Effect of Eight-Year Psychometric Measures, Maternal Education, Birth Weight, and Gender on Teen Psychometric Measures

Table 6 shows the β-weights (P values) of each predictor variable as well as the percent of variance explained by the variables used in the stepwise regressions to predict the psychometric scores in adolescence. The stepwise regression models were able to explain 77% of the variance in scores for DQ, 70% in Reading, 64% in Spelling, and 59% in Arithmetic. As expected, the best predictor is 8-year performance on psychometric measures. Maternal education played a role in all the models, birth weight in the models predicting achievement scores, whereas gender contributed only somewhat to the model for Reading.

DISCUSSION

Although being ELBW has been shown by several investigators to be an important risk factor in early childhood,[1,2,7,10–12,18,19,22,23,26,28,32] it is not certain whether the effects on cognitive development remain life-long or ameliorate with age. This longitudinal study of children to their adolescent years has shown that as a group, ELBW teenagers continue to function significantly less well in their intellectual and achievement measures compared with their age-matched peers. These differences were in the range of 1 SD, which is not only statistically significant but clinically relevant. Stratification by birth weight revealed that the <750 g ELBW cohort performed less well than their heavier ELBW counterparts (750–1000 g) on all measures of cognition and achievement, and less than half of this cohort had scores in the normal range. Although the outlook for the apparently normal ELBW cohort was somewhat better than the overall ELBW group, they still scored significantly lower on all psychometric measures and utilized more remedial resources than the term group.

ELBW children in this study performed particularly poorly in Arithmetic, and only one quarter of those <750 g and one third of those ≥750 g performed in the normal range. Even the apparently normal ELBW children scored 10 points lower than controls in Arithmetic. Although problems with Arithmetic were less remarkable at the earlier assessments of this cohort at 8 years of age,[11,12] it is likely that difficulties at the older age may be a function of the more complex conceptual tasks and the change from simple oral math to written calculations. This might also explain the relatively poor performance in Arithmetic of the matched controls. In the 1960s, Wiener and colleagues[20] considered math a sensitive marker of impairments in their longitudinal studies of VLBW children. Difficulties in math have also been reported by several recent investigators[11,17,20–22,30,32] and were independent of IQ scores.[17,21,32]

We considered children to have school difficulties if they repeated a grade and/or were currently receiving remedial assistance. The high utilization of special educational resources by nearly half of the ELBW cohort is by itself disconcerting, but there was also a significant shift in the proportion from part-time to full-time assistance between age 8 and teen years. The OR for school difficulties among ELBW teens compared with term controls were considerable (OR: 9.0) and were much higher than those reported in previous studies to mid-childhood.[14,17,18,26] Furthermore, a higher proportion of

TABLE 6. Stepwise Multiple Regression Analyses for Prediction of Psychometric Scores at Adolescence

Teen Scores	DQ		Reading		Spelling		Arithmetic	
Constant	15.390		21.694		26.196		20.359	
β-weights	β	P	β	P	β	P	β	P
8-year scores	.856	<.001	.743	<.001	.700	<.001	.674	<.001
Maternal education university	.080	<.010	.170	<.001	.100	<.010	.086	<.040
Full-term			.141	<.001	.174	<.001	.139	<.003
Gender			−.086	<.015				
Percentage of variance explained	77		70		64		59	

teenagers below 750 g birth weight had school difficulties in comparison to their heavier counterparts.

Other investigators have also reported a high prevalence of grade failure and utilization of special educational resources.[14–19,21–32] However, few investigators have reported the outcome to the teen years. Rickards et al[30] followed a cohort of VLBW children born in the late 1960s to 14.5 years of age and reported that 54% of ELBW children experienced some difficulty at school compared with 20% of normal birth weight children. Recently, Botting et al[32] have shown that even nondisabled VLBW children required significantly more assistance at school at 12 years of age in comparison to matched classroom peers.

Some interesting differences were noted in our study between the assessments at age 8 and teenage years. At 8 years of age, no differences were noted in the IQ or reading scores within the smaller and heavier ELBW children.[11] However, differences between birth weight cohorts became apparent in the teenage period, with the smaller birth weight children performing significantly less well. Also, at the 8-year assessment, although there were no differences in psychometric scores between the apparently normal ELBW cohort and the controls, they were reported by their classroom teacher to be performing less well and were using significantly more remedial resources.[12] At the teenage assessment, however, the apparently normal children performed significantly less well than controls on psychometric measures and continued to require more remedial resources than the controls. Bottings et al[32] also reported that the gap in cognitive performance of VLBW widens as they become older.

At an individual level, the 8-year measures obtained by us in this cohort[11] seem to be useful predictors of subsequent performance for tests of intelligence, achievement, and special educational requirements in the teen years. Paired analyses of data at age 8 and teen years showed that in both cohorts there were small improvements within individuals in most measures except for Arithmetic, but the magnitude of improvement in scores was greater for term children. A review of the ELBW children who required special remedial resources at 8 years of age showed that many of the same children (70%) continued to have difficulties in adolescence.

In this report, we have elected to provide the psychometric data on all ELBW children, including those with NSIs, to provide a global picture of the entire cohort. The prevalence of specific learning disabilities[11,22] in the children who are intellectually and neurologically normal will be addressed separately.[42] The strengths of our study are clearly the population-based nature of our cohort, large sample size, low attrition rate, and the availability of a comparison group of term children. The longitudinal nature of our study, with measures at age 8 and teen years, provide important information for counseling parents of ELBW children regarding subsequent school difficulties. We have also been able to report specific details of remedial education, which could serve as a basis for calculation of the incremental educational costs attributable to low birth weight.[43] To date, there are few population-based studies[19,28,29] and no other studies on ELBW survivors to teenage years.

Despite the fact that our study is population-based, the generalizability of the data to current survivors is limited by the number of years that have elapsed since the birth of these children. Our ELBW cohort was born in the early years of improved survival of tiny infants. As such, they were not beneficiaries of the recent innovations in neonatal intensive care. However, the infants were cared for in a well-developed, publicly-funded regional perinatal program with over 90% utilization of tertiary care services.[1] It is reassuring that with improved survival in recent years, the prevalence of NSIs has not increased for survivors.[44] Ongoing methodologically rigorous longer-term follow-up studies of the recent survivors of neonatal intensive care to follow their progress are warranted.[2,35] In addition, intervention strategies to ameliorate school difficulties require further investigation.[45]

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