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CHANGE IN PREVALENCE OF CHRONIC CONDITIONS BETWEEN CHILDHOOD AND ADOLESCENCE AMONG EXTREMELY LOW BIRTH WEIGHT CHILDREN

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Abstract

Context—Extremely low birth weight (ELBW, <1kg) children have high rates of chronic conditions during childhood. Information on their trajectory of health during the critical period of adolescence is needed for health care planning.

Objective—To examine changes in rates of chronic conditions between age 8 and 14 years among ELBW compared to normal birth weight (NBW) controls.

Design, Setting and Participants—Cohort study conducted from 2004 through2009 of 181 ELBW children (weight <1kg) and 115 NBW controls of similar sociodemographic status born 1992 through 1995 in Cleveland, Ohio.

Main Outcome Measures—Rates of chronic conditions overall (measured with the revised Questionnaire for Identifying Children with Chronic Conditions) and rates of asthma and obesity.

Results—The overall rates of chronic conditions did not change significantly between ages 8 and 14 years among ELBW children (75% at age 8 years vs 74% at age 14 years) or NBW controls (37% at 8 years vs 47% at age 14 years). In generalized estimating equations logistic regression, adjusting for sociodemographic status, sex and race, ELBW continued to have higher rates of chronic conditions than NBW controls at age 14 years (74% vs 47%, respectively adjusted odds ratio [AOR],2.8; 95% Confidence Interval {CI},1.7 to 4.6). Rates of asthma requiring medication did not change between 8 and 14 years among ELBW children (23% at both ages), but increased among NBW children from 8% at age 8 years to 17% at age 14 years (p=0.002). Differences in rates of asthma between ELBW and NBW children were no longer significant at the age of 14 years (23% vs 17%, respectively; AOR,1.5; [95%CI,0.8 to 2.8]. Mean z scores for body mass index increased in ELBW children from 0.06 at age 8 yesrs to 0.38 at age 14 years(p<0.001) and rates of obesity increased from 12% at age 8 years to 19% at age 14 years (p=0.02). However, the scores and rates did not change among NBW controls such that at the age of 14 years the differences between ELBW and NBW children in mean z-scores for body mass index (0.38 vs 0.56, respectively; adjusted mean difference −0.2; 95% CI, −0.5 to 0.1) or rates of obesity (19% vs 20%, respectively; AOR,1.1 [95%CI, 0.6to 2.0] were not significant..

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Conclusions—Among ELBW children rates of overall chronic conditions and asthma did not change between the ages of 8 and 14 years but the rates of obesityincreased. Compared with NBW controls, the rates of chronic conditions were higher but there were no significant differences in the rates of asthma or obesity.

Therapeutic changes in perinatal care in the 1990's resulted in improved survival among extremely low birth weight (ELBW) infants (weight < 1kg). The school age outcomes for these children indicate very high rates of chronic health and developmental problems compared with normal birth weight (NBW) controls.[1,2] There have been few reports of the outcomes of ELBW children during adolescence, which is a time of enormous social, health and developmental change.[3,4]

We previously reported significantly higher rates of chronic conditions, functional limitations and special health care needs among 8 year- old ELBW children born 1992 through1995 compared with normal birth weight controls.[1] As part of a longitudinal cohort study, we sought to examine the critical changes in the rates of chronic conditions between the age of 8 years and the age of 14 years (adolescence) according to a noncategorical measure, the Questionnaire for Identifying Chronic Conditions (QUICC-R),[5] and 2specific conditions, asthma and obesity, which are major health problems that are prevalent among children today.

Based on reports of increased rates of chronic conditions during adolescence in normal populations [6] and of adolescent catch-up growth among ELBW children,[7,8] we hypothesized that the high rates of chronic conditions identified at the age of 8 years would increase by the age of 14 years and that catch-up growth would predispose them to obesity.

POPULATION AND METHODS

ELBW Cohort

The population included survivors of the cohort of 344 ELBW children admitted to Rainbow Babies and Children's Hospital, Cleveland, Ohio, 1992 through 1995.[1] Thirteen children (10 with major malformations, 2 with AIDS, and 1 with Tuberous Sclerosis) were excluded. Of the remaining 331 children, 238 survived of whom 181 (76%) were followed at the ages of 8 and 14 years. They did not differ significantly from the 57 children not followed up regarding sociodemographic or birth data; however fewer were male (39% vs 54% respectively) and fewer had Bronchopulmonary Dysplasia during the neonatal period (41% vs 57%)).

For the analyses concerning obesity, we excluded 35 children (31 with neurosensory impairment who may have abnormal growth and 4 who had missing growth measures). The 146 children with growth measures compared with the 35 children who were excluded had a significantly higher gestational age (26.5 vs 25.9 weeks, respectively) and fewer were male (35% vs 54%).

Comparison Group

A NBW group of 176 children born at term gestation was recruited at the age of 8 years from the same schools as the ELBW children and of the same sex, race and age within 3 months; of whom 115 children (65%) were reassessed at the age of 14 years.1 They did not differ in sociodemographic factors, sex, rates of chronic conditions. or subnormal IQ from the 61 children who were not followed up. Two children had missing growth measures. Thus, 113 NBW children were considered for the obesity outcome.

Study Protocol

Parent Report Questionnaires—During 2004 and 2009 at the ages of 8 and 14 years, respectively, questionnaires were administered to the parent and included the QUICCC-R[5] and medical diagnoses of whether the child had ever been diagnosed with asthma and, if so, whether medications for asthma had been prescribed during the past 12 months. Race was self-identified by the parent from the list of racial and ethnic categories used for federal reporting.

The QUICCC questionnaire is based on a unified conceptual definition of chronic conditions and incorporates the consequences of these conditions lasting or expected to last 12 months or more. It does not assess specific diagnoses but rather classifies children non-categorically. The original version, which we used when the children were aged 8 years, has 39 questions.[9] A shortened version, the QUICCC-R which has 16 questions was administered when the children were aged 14 and were compared with the same 16 questions administered in the longer version used at age 8 years.[5] Similar to the QUICCC, the QUICCC-R is divided into 3 domains of health-related consequences of chronic conditions: (1) Functional limitations, (2) Dependence on compensatory aids, and (3) Need or use of services above those routinely required by children.

To qualify as having a chronic condition, a child must have at least 1 of the consequences of a chronic condition, and each consequence must be attributable to a condition lasting or expected to last 12 months or longer. The QUICCC has good test-retest reliability[9] and has an 89% agreement (k=0.78) with physician classification of chronic disease.[10] Compared to the QUICCC, the QUICCC-R has a sensitivity of 87% and a specificity of 89% (K = 0.75).[5]

Child Assessment—The children were measured by research assistants who were unaware of their birth weight status. Participants were weighed unclothed at age 8 years but lightly clothed at age 14 years. To correct for this weight of clothing, we subtracted 0.5 kg from the measured weight of females and 1.0 kg from that of males. Height was measured with a Harpenden stadiometer.

Weight and height z scores were computed from the revised Centers for Disease Control and Prevention growth data, which are age- and sex- specific.[11] Body Mass Index (BMI) was calculated as weight in kilograms divided by height in meters squared and the z-scores were computed using the Centers for Disease Control and Prevention norms.[11] Obesity was defined as a BMI in the 95th percentile or higher.[11]

The study protocol was approved by the institutional review Board of University Hospitals Case Medical Center. Written informed consent was obtained from parents when the children were aged 8 and 14 years and written assent from children at 14 years.

Statistical Analyses

Univariate comparisons between groups were made using t-tests for continuous variables. Chi-square tests or logistic regression was used to examine differences in dichotomous outcomes. We considered 3 measures of chronic conditions. First, chronic conditions lasting or expected to last 12 months or longer were analyzed as binary variables (ie, the proportion having one or more consequences) and also as the mean number of consequences. Second, asthma was considered as ever diagnosed, and as requiring medication during the most recent 12 months. Third, obesity was defined using age- and sex-specific BMI z score and rates of obesity.[11] Sample sizes of 181 ELBW childrenand 115 NBW controls provide 80% power to detect odds ratios (ORs) of 3.40, 2.06, and 1.97 when comparing proportions with a binary outcome at each age, assuming rates of 0.05, 0.10, 0.25, and 0.50, respectively in

the NBW group, an increased rate in the ELBW group, and two-sided tests with a significance level of 0.05.

McNemar tests were used to test significance of within-group changes in the prevalence of chronic conditions in children between the ages of 8 and 14 years; paired t-tests were used to compare the BMI z-scores. Generalized estimating equations logistic regression (using SAS Proc GENMOD, SAS Institute Inc. Cary, North Carolina) was used to compare changes in chronic conditions between the ELBW children and NBW controls at ages8 and 14 years, controlling for the variables of socioeconomic status, race, sex and neurosensory impairment. Interactions between birth-weight status and age at time of study were examined. Analogous analyses were performed on the BMI zscore using linear mixed models with SAS Proc MIXED (SAS Institute Inc) and generalized equation models with identity-link function were used to analyze the total number of chronic conditions because these outcomes had a skewed nonnormal distribution.

Socioeconomic status was defined as the mean of the sample z scores for maternal education and median family income according to the 2000 Census tract of the family's neighborhood. We did not adjust for multiple comparisons. Statistical analyses were conducted using SPSS version 19 (SPSS Inc, Chicago Illinois) and SAS version 9.2 (SAS Institute, Inc) Two-sided tests were used and a p value of less than 0.05 was considered statistically significant.

RESULTS

The ELBW children and NBW controls did not differ significantly in maternal sociodemographic descriptors. Among the ELBW children, neonatal complications included bronchopulmonary dysplasia defined as oxygen dependence at 36 weeks corrected age in 107 children (59%) and a severely abnormal cerebral ultrasound in 44 children (24%). Thirty one ELBW children (17%) had neurosensory impairments.

Compared with NBW controls, ELBW children had significantly higher rates of subnormal IQ and enrollment in individual education programs (IEP) (TABLE 1). The ELBW children were significantly younger than the NBW children at the time of the 8-year follow-up (mean [SD] 8.7 [0.6)]years vs 9.2 [0.8] years respectively) but their ages were similar at the time of the 14 year follow-up (mean [SD] age:14.7 [0.7] years vs 14.8 [0.7] years).

Chronic Conditions

Within the ELBW cohort, the overall rates of chronic conditions did not change between the ages of 8 and 14 years (75% and 74% respectively) (TABLE 2) but there was a significant decrease in the mean number of chronic conditions per child (TABLE 3). Within the domains of the QUICCC-R, the rates of functional limitations decreased significantly from 56% to 46% (P=.02); the rates did not decrease for compensatory dependencies or needs for services. Specific decreases in functional limitations included the parent report of mental or emotional delay. Service needs that decreased included occupational or physical therapy and rehospitalizations (TABLE 4).

Within the NBW cohort, neither the overall rates and numbers of chronic conditions did nor the functional limitations or special health care needs changed. However the rates of compensatory dependencies increased significantly from 22% to 34% (P=.02) due to an increase in prescribed medication.

Group comparisons revealed that the significantly higher rates and numbers of chronic conditions among the ELBW children at age 8 years persisted at age 14 years (74% for ELBW vs vs 47% for NBW controls; adjustd OR [AOR], 2.8 [ninety five percent

confidence interval {CI}, 1.7–4.6) (Tables 2,4). At age 14 years, 46% of ELBW children had functional limitations compared with 16% of NBW controls (AOR, 4.2; 95% CI 2.2–7.9), including mental or emotional delay, trouble understanding simple instructions, and speaking and communicating.

Forty-eight percent of ELBW children had compensatory dependencies compared with 34% of NBW controls (AOR, 1.7; 95% CI, 1.0–2.8), including prescribed medication, and more needs for services such as special arrangements in school. The ELBW children had higher rates of postneonatal hospitalization compared with NBW controls at 8 years but not at 14 years.

Asthma

The rate of ELBW children with asthma requiring medication did not change between the ages of 8 and 14 years (23% at both ages)). For the NBW controls, the rate of asthma increased significantly between the ages of 8 and 14 years from 8% to 17%, respectively P=. 002. The significantly higher rates of asthma among the ELBW compared with the NBW controls at age 8 years persisted at age 14 years when defined as ever- diagnosed asthma (39% vs 21%,respectively; AOR, 2.7 [95% CI, 1.5–4.7]) but were no longer significant when defined as receiving medication during the previous 12 months (i.e, current asthma) (23% vs 17%, respectively; AOR, 1.5 [95% CI 0.8–2.8]). Fifty two percent of ELBW children ever diagnosed with asthma at 8 years had a history of bronchopulmonary dysplasia compared with 34% who had no history of asthma (P =.01).

Obesity

The ELBW children had significantly lower BMI z scores than the NBW controls at age 8 years (0.06 vs 0,43 respectivley; β, −0.4 [95% CI, −0.7 to −0.1]). The mean BMI z scores increased in ELBW children from 0.06 at age 8 years to 0.38 at age 14 years (P<.001) and the rates of obesity increased from 12% at age 8 years to 19% at age 14 years (P= .02). These scores and rates did not change among the NBW controls; at age 14 years, the mean BMI score and rates of obesity did not differ significantly between the ELBW children and NBW controls (Table 2).

In the multivariable analyses, in addition to ELBW status, neurosensory impairments, lower socioeconomic status, and male sex were significantly associated with overall chronic conditions, functional limitations, and greater need for services; male sex was associated with higher rates of ever diagnosed asthma (Table 2 and Table 4). Obesity was not associated with any of the examined variables.

Comment

We previously reported on the high rates of chronic health conditions among ELBW children compared with NBW controls at the age of 8 years and sought to examine possible changes during the critical period of adolescence. Our results reveal that the overall rates of chronic conditions among both ELBW children and NBW controls were relatively stable. During adolescence, ELBW children continue to have significantly higher rates of functional limitations, compensatory dependencies and increased use of or need for services than NBW controls. Rates of asthma among ELBW children also remained stable whereas they increased among NBW controls such that when defined as current asthma, the differences between ELBW children and NBW controls were no longer significant at the age of 14 years.

Of major concern is the significant increase between the ages of 8 and 14 years in mean BMI z scores and rates of obesity among ELBW children when compared with the relatively

stable rates among NBW controls. Our results thus indicate both positive and negative changes in the health trajectories of ELBW children during adolescence.

Reports of adolescent health outcomes of ELBW children born in the 1990s pertain to the early adolescence of children born prior to 26 weeks gestation in Sweden and the United Kingdom.[3,4] Similar to our finding, Farooqi et al [3] reported significantly higher rates of chronic conditions as measured with the QUICCC at 11 to 12 years. Fawke et al [4] reported significantly higher rates of impaired respiratory morbidity in the British Epicure study population at the age of 11 years and a current rate of asthma of 25%, which is similar to our rate of 23%. Longitudinal changes in these outcomes have not been reported.

The studies of children born prior to 1990 similarly reported significantly higher rates of chronic illnesses among ELBW children during adolescence. These pertained mainly to neurocognitive disorders[13,14] and asthma,[15] with functional problems and rehospitalizations resulting from a combination of these respiratory and neurologic conditions.[16,17] Similar to our findings, Saigal et alt[16] reported stability in the rates of chronic conditions among ELBW children born from 1977 through 1982 but reported an increase in medication use between the ages of 8 and 14 years.

Our results among the NBW controls are similar to those reported nationally. Rates of chronic conditions or special health care needs during childhood range from 12% to 37%, depending on the definition,[18–20], Between the ages of 12 and 17 years, the rate of ever diagnosed asthma is 16.6% and the rate of current asthma is 10.2%.[21] Twenty percent of children are obese between the ages of 6 and 11 years and 18% are obese between the ages of 12 and 19 years.[22] Chronic conditions and special healthcare needs are also reported to increase during adolescence.[6] The high rate of chronic conditions in our NBW controls might be due to the low socioeconomic status of our cohort (60% of whom are minorities) and to current parent perceptions of children's health.[20]

Our findings of an increase in the rates of asthma in the NBW population during adolescence reflects epidemiologic studies[23] and national trends.[24] The lack of an increase in our ELBW population during adolescence supports suggestions of a different asthma phenotype among preterm children.[25,,26] The major etiologic determinant of asthma in normative populations is genetic susceptibility to atopic disease, which interacts with environmental factors, whereas the pathophysiology of asthma in preterm children is mainly associated with abnormal lung development, bronchopulmonary dysplasia and obstructive airway disease.[6,26–29] Improvement in pulmonary function[28,29] and stabilization in the rates of asthma during adolescence have been reported among ELBW children[16,29] however, the way in which the trajectory differs from that of NBW children has not been reported.

Our rates of adolescent obesity among the ELBW children and NBW controls reflect the current obesity epidemic.[22] The increase in BMI among ELBW children during adolescence compared with NBW children has been reported previously in addition to the long- term implications of catch-up growth for metabolic and cardiovascular disease. [7.8,30,31]However the considerable catch-up in obesity among ELBW children to the current very high prevalence of NBW children may further intensify the known threat to adult health.

Our findings of a significant association of neurosensory impairments and lower socioeconomic status with functional limitations and need for services indicates both biologic and sociodemographic influences on children's health in both NBW and preterm children. The significant association of male sex with functional limitations, need for services in childhood asthma has been reported.[20,24,27,32]

Strengths of this study include our longitudinal design and use of both noncategorical and specific diagnostic categories of chronic illness, each of which has important epidemiologic and clinical implications. Our use of a generic or noncategorical approach, independent of diagnoses, provides an assessment of the multiple chronic sequelae of preterm birth and also incorporates a functional classification as suggested by the World Health Organization [33]

Children's special health care needs are used for the identification and planning of federal aid and services and also provide an indirect measure of the enormous cost of providing health care and education for these children of whom preterm survivors constitute an important subgroup.[34–36] We chose to examine longitudinal changes in the rates of asthma and obesity because asthma is a common consequence of preterm birth and obesity may have long term metabolic and cardiovascular implications [30]

We did not consider cerebral palsy or cognitive impairment, which are chronic conditions that are also prevalent among preterm children, because their rates are fairly stable after middle childhood[37]; however, the QUICCC-R does include parent report of developmental problems and need for special education.

Possible limitations of our study include the fact that our population is based on birth weight rather than gestational age based and that our sample of ELBW children represents an urban perinatal center and is not representative of theentire United States. The follow-up rate of the NBW controls is lower than that of the ELBW children, which is probably due to their lesser commitment to the study. However, there were no sociodemographic differences between the 2 groups.

We excluded children with neurosensory abnormalities from the examination of obesity as they tend to grow poorly, which might have influenced outcomes. Fewer of the ELBW children followed up had bronchopulmonary dysplasia compared with those children who were not followed up, which might have influenced their rates of asthma.

Our results are based mainly on parent report, which may be biased and inconsistent between periods. However the QUICCC has been validated as a parent measure of child health.[10] Some outcomes has small numbers of events which was reflected in the wide 95% CIs. There is always the possibility of detection bias among ELBW children; however, the detection of an increased rate of asthma in NBW controls argues against this. Finally, because the QUICCC-R provides a noncategorical measure of chronic health conditions, specific diagnoses aside from asthma and obesity were not examined.

Because mortality of ELBW infants has reached a plateau with the majority of infants currently surviving, the residual rates of neonatal morbidity and resultant chronic illness become critical. [38]. Rates of neonatal morbidity have decreased since 2000 but there is, as yet, no evidence of improved health outcomes.

Our results may thus have relevance to current survivors. The ELBW status may be considered a marker for the risk of multiple chronic conditions which warrant closer than average health surveillance during adolescence. In addition to therapy for neurodevelopmental disorders, ELBW children with asthma or obesity should receive interventions such as smoking prevention and exercise encouragement to reduce the consequences of these conditions and to possibly enhance their long-term adult outcomes.[39,40]

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Dr. Hack supervised the study, had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Drs. Hack, Taylor, Drotar and Schluchter developed the study concept and design.

Drs. Hack and Andreias acquired the data.

Drs. Hack, Schluchter, Taylor, Drotar, Cuttler, Andreias and Margevicius participated in the analysis, including statistical analysis and interpretation of the data.

Dr. Hack drafted the first version of the manuscript and all the co-authors participated in the critical revision of the manuscript and approve its submission for publication.

None of the authors have any conflicts of interest.

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Table 1

Maternal Demographic Risk Factors, Perinatal Data and 14 Year Neurodevelopmental Outcome

	Extremely Low Birth Weight n=181	Normal Birth Weight n=115
Maternal Demographic Data[#] Age (years)[•] Married	43 ± 6 79 (44%)	41 ± 6[a] 63 (55%)
Education <High school High school[+] >High school	13 (7%) 57 (32%) 111 (61%)	12 (10%) 22 (19%) 81 (70%)
Race White[○] Black	73 (40%) 108 (60%)	39 (34%) 76 (66%)
Mean percent below poverty level[*] Family income (mean dollars ± SD)[**]	13 ± 12% 44.3 ± 19	15 ± 13% 40.2 ± 19
Perinatal Data Birth weight (gm ± SD) Gestational age (wk ± SD) Female sex Multiple birth	815 ± 124 26.4 ± 2 111 (61%) 32 (18%)	3260 ± 524 ≥ 37 wks 73 (64%) 0
14 year Neurodevelopmental Outcome Neurosensory impairment[▽] IQ < 70 Individualized Education Program (IEP) Children on Supplemental Security Income (SSI)	31 (17%) 32 (18%) 88 (49%) 38 (21%)	0 4 (4%)[c] 11 (10%)[c] 7(6%)[c]

[#]Unless otherwise stated refers to primary caregiver which for 156 (86%) of the extremely low birth weight and 103 (90%) of the normal birth weight groups was the biologic or adoptive mother.

[•]Biologic mothers only.

[+]Includes GED

[○]Includes 2 Asian ELBW mothers.

[*]Mean percentage of families below the poverty level according to the 2000 Census tract neighborhood in which the families lived.

[**]Mean of median family income in 1000's of dollars according to the 2000 Census tract neighborhood in which the families lived.

[a]p<0.05,

[c]p<0.001

[▽]Includes 27 children with cerebral palsy, 1 blindness and 3 deafness requiring a hearing aid.

Table 2

Description of Chronic Conditions at 8 and 14 Years of Age

	ELBW NBW No (%) [95% CI]				ELBW VS NBW Odds Ratio (95% CI)[#]		Significant Predictors Odds Ratio (95% CI)[#]
Age of child	**8 yrs**	**14 yrs**	**8 yrs**	**14 yrs**	**8 yrs**	**14 yrs**	
	(n =181)		(n =115)				
Chronic Conditions	136 (75) [68,81]	134 (74) [67,80]	43 (37) [29,47]	54 (47) [38,56]	**4.3(2.6,7.3)**[a]	**2.8(1.7,4.6)**[a]	Neuro: 25.8(3.4,195.0)[a]; SES: 0.7(0.5,0.9)[a]
Functional Limitations	**101(56) [48,63]**	**84(46) [39,54]**[a]	17(15) [9,23]	18(16) [10,24]	**6.0(3.3,11.0)**[a]	**4.2(2.2,7.9)**[a]	Male: 1.9(1.2,2.9)[a]; Neuro: 10.2(4.3,23.9)[a] SES: 0.6(0.5,0.8)[a]
Compensatory Dependencies	79(44) [36,51]	87(48) [41,56]	**25(22) [15,30]**	**39(34) [25,43]**[a]	**2.6(1.5,4.5)**[a]	**1.7(1.0,2.8)**[a]	
Service Needs or Use	113(62) [55,70]	104(58) [50,65]	24(21) [14,29]	28(24) [17,33]	**5.2(2.9,9.0)**[a]	**3.4(1.9,5.8)**[a]	Neuro: 26.5(6.4,110.1)[a]; SES: 0.7(0.5,0.9)[a]
Asthma							
Ever diagnosed	67(37) [30,45]	71(39) [32,47]	**17(15) [9,23]**	**24(21) [14,29]**[a]	**3.6(2.0,6.7)**[a]	**2.7(1.5,4.7)**[a]	Male: 1.9(1.2,3.0)[a]
Asthma medication[+, 0]	43(24) [18,31]	41(23) [17,29]	**9(8) [4,14]**	**19(17) [10,25]**[a]	**3.7(1.7,8.1)**[a]	1.5(0.8,2.8)	
Obesity	n=146	n=146	n=113	n=113			
BMI z-score (95% CI)[+]	**0.06 (−0.15,0.27)**	**0.38**[a] **(0.20,0.56)**	0.43 (0.21,0.64)	0.56 (0.35,0.78)	**β-0.4(−0.7,−0.1)**[a]	β-0.2(−0.5, 0.1)	
BMI ≥ 95th percentile	**17(12) [7,18]**	**28(19) [13,27]**[a]	18(16) [10,24]	23(20) [13,29]	1.4(0.7, 2.9)	1.1(0.6,2.0)	

ELBW – Extremely low birth weight, NBW – Normal birth weight CI – Confidence Interval

[#]Obtained from a generalized estimation equations logistic regression model simultaneously analyzing data from ELBW and NBW children at both time points (8 and 14 years) adjusting for socioeconomic status (SES), race, sex. Adjusted also for neurosensory impairment In analyses concerning chronic conditions

[a]p<0.05,

[0]Interaction age by study group, p=0.004

[+]Asthma medication received during last 12 months

† Results are β=estimated difference in mean BMI z-score obtained for ELBW – NBW obtained from a mixed model analysis, adjusting for SES, race and sex.

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Table 3

Mean Number of Functional Limitations, Compensatory Dependency, and Services above Routine Associated with a Chronic Condition

	ELBW (n =181)		p value	NBW (n =115)		p value	Difference in Adjusted Means ELBW minus NBW: Estimates (95% CI)		Significant Predictors β(95% CI)
Age of child	**8 yrs**	**14 yrs**	**8 vs 14 yrs**	**8 yrs**	**14 yrs**	**8 vs 14 yrs**	**8 yrs**	**14 yrs**	
Chronic Conditions[O]									
Mean ± SD	3.12±2.79	2.77±2.74	0.02	0.83±1.45	1.00±1.40	0.28	**1.68(1.23,2.13)**[a]	**1.19(0.76,1.62)**[a]	Neuro: 3.59(2.71,4.46)[a]
Median (IQR)	3(1,5)	2(0,5)		0(0,1)	0(0,2)				SES: −0.35(−0.62,−0.08)[a]
									Male: 0.69(0.24,1.13)[a]
Functional Limitations [*]									
Mean ± SD	1.23±1.50	0.97±1.32	0.004	0.23±0.65	0.21±0.55	0.43	**0.75(0.51,0.98)**[a]	**0.53(0.34,0.72)**[a]	Neuro: 1.52(1.02,2.03)[a]
Median (IQR)	1(0,2)	0(0,2)		0(0,0)	0(0.0)				SES: −0.21(−0.36,−0.06)[a]
									Male: 0.33(0.11,0.55)[a]
Compensatory Dependencies									
Mean ± SD	0.49±0.61	0.55±0.64	0.24	0.27±0.57	0.46±0.74	0.004	**0.19(0.05,0.33)**[a]	**0.06(−0.11,0.23)**	
Median (IQR)	0(0,1)	0(0,1)		0,(0,0)	0,(0,1)				
Service Needs Or Use									
Mean ± SD	1.39±1.37	1.25±1.37	0.09	0.32±0.71	0.33±0.65	0.92	**0.75(0.53,0.96)**[a]	**0.60(0.39,0.82)**[a]	Neuro: 1.88(1.53,2.24)[a]
Median (IQR)	1(0,2)	1(0,2)		0(0,0)	0(0,0)				SES: −0.17(−0.29,−0.04)[a]
									Male: 0.28(0.07,0.48)[a]

ELBW – Extremely low birth weight, NBW – Normal birth weight

[#]Obtained from generalized estimating equations linear regression model with identity link function, simultaneously analyzing data from ELBW and NBW children at both time points (8 and 14 years) adjusting for socioeconomic status (SES), race, sex and neurosensory impairment

CI – Confidence interval

IQR – Inter Quartile Range

[O]Interaction Age by Study Group, p=0.01

* Interaction Age by Study Group, p=0.048

a p<0.05

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Table 4

Description of Functional Limitations, Compensatory Dependence, and Services above Routine Associated with a Chronic Condition of 12 Months or More

	ELBW NBW No (%) [95% CI]				ELBW VS NBW Odds Ratio (95% CI)#		Significant Predictors Odds Ratio (95%CI)#
Age of child	**8 yrs**	**14 yrs**	**8 yrs**	**14 yrs**	**8 yrs**	**14 yrs**	
	(n =181)		(n =115)				
Functional Limitations							
Physical Delay	35(19) [14,26]	25(14) [9,20]	2(2) [0,6]	0(0) [0,3]	**9.7(2.2,42.3)** *1,a*	NA	Neuro: 5.3(2.2,13.1) *1,a*
Mental or emotional delay	**48(27) [2,34]**	**32(18)** *a* **[12,24]**	4(3) [1,9]	3(3) [1,7]	**8.6(3.1,24.1)** *a*	**6.7(2.0,21.9)** *a*	Neuro: .5(1.5,7.8) *a*; SES: 0.5(,0.3,0.9) *a*
Reduced effort in activity	35(19) [14,26]	37(20) [15,27]	6(5) [2,11]	7(6) [2,12]	2.5(0.9,6.4)	2.3(0.9,5.6)	Neuro: 8.4(4.0,17.5) *a*
Difficulty seeing ^x^	15(8) [5,13]	16(9) [5,14]	1(1) [0,5]	3(3) [1,7]	7.0(0.9,55.8)	2.5(0.7,9.0)	Neuro: 4.2(1.6,11.4) *a*
Difficulty hearing ^x^	17(9) [6,15]	13(7) [4,12]	1(1) [0,5]	2(2) [0,6]	6.5(0.8,52.0)	2.3(0.5,11.0)	Neuro: 7.1(2.7,18.3) *a*
Trouble understanding simple instructions	**38(21) [15,28]**	**23(13)** *a* **[8,18]**	7(6) [2,12]	5(4) [1,10]	**4.9(2.0,11.6)** *a*	**3.9(1.4,10.7)** *a*	SES: 0.5(0.3,0.8) *a*
Trouble speaking/ communicating	35(19) [14,26]	30(17) [11,23]	6(5) [2,11]	4(3) [1,9]	**3.6(1.4,9.1)** *a*	**4.7(1.4,9.1)** *a*	Neuro: 2.7(1.2,5.8) *a*; Male: 2.0(1.1,3.6) *a*
Compensatory Dependencies							
Regular prescribed medication	72(40) [33,47]	86(48) [40,55]	**19(17) [10,25]**	**38(33)** *a* **[25,42]**	**3.0(1.7,5.5)** *a*	**1.7(1.0,2.8)** *a*	
Life-threatening allergy ^x^	7(4) [2,8]	4(2) [1,6]	4(3) [1,9]	6(5) [2,11]	1.0(0.3,3.6)	0.4(0.1,1.4)	*a* White race: 2.9(1.2,7.5)
Physician ordered special diet ^x^	10(6) [3,10]	10(6) [3,10]	8(7) [3,13]	9(8) [4,14]	0.8(0.3,2.0)	0.7(0.3,1.8)	
Service Needs or Use							
Visits a physician or specialist on a regular basis	42(23) [30,53]	53(29) [23,36]	9(8) [4,14]	10(9) [4,15]	2.0(0.9,4.5)	**2.7(1.2,5.8)** *a*	Neuro: 9.7(4.9,19.8) *a*
Visits counselor, psychiatrist, psychologist or social worker ^x^	16(9) [5,14]	17(9) [6,15]	5(4) [1,10]	9(8) [4,14]	2.1(0.8,6.0)	1.4(0.5,2.8)	
Receives physical/occupational,	**56(31) [24,38]**	**42(23)** *a* **[17,30]**	3(3) [1,7]	0(0) [0,3]	**8.3(2.4,28.4)** *a*	NA	Neuro: 59.6(13.3,268.1) *a*

	ELBW NBW No (%) [95% CI]				ELBW VS NBW Odds Ratio (95% CI)[#]		Significant Predictors Odds Ratio (95%CI)[#]
or other therapy							
Ever been hospitalized[+]	**49(27) [21,34]**	**22(12)[a] [8,18]**	9(8) [4,14]	3(3) [1,7]	**3.1(1.4,7.0)[a]**	3.3(0.9,11.8)	Neuro: 5.2(2.6,10.4)[a]; SES: 0.6(0.4,0.9)[a]
Unable to get medical or mental health services[×]	7(4) [2,8]	11(6) [3,11]	1(1) [0,5]	5(4) [1,10]	4.6(0.6,37.8)	1.4(0.5,4.2)	
Special arrangements in school[2]	82(45) [38,53]	81(45) [37,52]	10(9) [4,15]	11(10) [5,16]	**6.9(3.4,14.1)[a]**	**6.2(3.1,12.4)[a]**	Neuro: 9.1(3.8,21.9)[a]; SES: 0.6(0.5,0.9)[a]

[#]Generalized estimating equations logistic regression model simultaneously analyzing data from ELBW and NBW children at both time points (8 and 14 years) adjusting for socioeconomic status (SES), race, sex, and neurosensory impairment. When the total number of events was <50, only significant predictors determined by backward selection were adjusted for in the model.
CI – Confidence Interval

[1]Logistic regression

[a]p<0.05

NA – Unable to calculate odds ratio due to zero cell count. Interaction between birth weight group and year was not statistically significant using an alternative test statistic.[42]

[+]Postneonatal hospitalizations prior to age 8 years compared to hospitalizations between age 8 and 14 years

[2]Modified schedule, classroom made accessible, special lunch, transportation, tutoring

[×]Model only adjusts for predictors significant at p<0.05; if no predictors were significant then reported odds ratios comparing ELBW vs NBW at each age are unadjusted.