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Low Birth Weight and Children's Health

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Introduction

On average, most infants weigh approximately 2700 to 4000 grams (6 to 9 pounds) at birth. Low birth weight (LBW) is defined as birth weight less than 2500 grams (or 5½ pounds).¹ Over the past 20 years, the rate of LBW in North Carolina has been increasing, from 8.0 percent in 1990 to 9.1 percent in 2008.² Although similar trends are also seen at the national level, the LBW rate in North Carolina remains above the national average of 8.2 percent. Currently, the lowest LBW rates are found in Alaska (ranked first at 6.0%) and Oregon (ranked second at 6.1%), and the highest rate in Mississippi (ranked 50th at 11.8%). North Carolina ranks 40th in the United States, with a higher rate found among non-Hispanic African American infants (14.4%) and lower rates among non-Hispanic whites (7.7%) and Hispanics (6.2%).

Birth weight is an important predictor of infant morbidity and mortality, as well as long-term health

outcomes.³⁻⁵ LBW infants have an increased risk for health conditions, such as childhood asthma,⁶ as well as increased risks of developing behavioral and emotional problems during childhood and adolescence,⁷ such as depression, anxiety and attention deficit hyperactivity disorders.⁸⁻¹⁰ In addition, children of LBW are also found to perform less well in school and are more likely to receive special education services compared to their normal birth weight (NBW) peers.^{11,12}

The purpose of this report is to examine estimates of LBW by demographic characteristics in North Carolina through the 2005–2007 Child Health Assessment and Monitoring Program (CHAMP). In addition, measures of health status and school performance are compared between LBW and NBW children to examine the relationship between LBW with childhood health and school performance, while controlling for covariates.

Methods

Data

Survey data from North Carolina CHAMP 2005 through 2007 were combined to examine the relationship between birth characteristics and health factors in later childhood. NC CHAMP is an annual telephone survey that assesses health characteristics of children from 0 to 17 years residing in North Carolina. Eligible households are recruited through the North Carolina Behavioral Risk Factor Surveillance System (BRFSS), an annual state-wide telephone survey that uses a random-digit-dial computer-assisted telephone interview to assess health characteristics of non-institutionalized adults age 18 years and older. One child is randomly selected from the household and the adult identified as most knowledgeable about the health of the selected child is called one to two weeks later to complete the CHAMP survey.¹³ From 2005–2007, 47,686 adults participated in the BRFSS. A total of 14,673 (31%) reported a child under age 18 living in the household, of which 9,823 (67%) participated in CHAMP.

Demographic characteristics were assessed through the 2005–2007 NC BRFSS and CHAMP surveys. Federal poverty level (FPL) was estimated through the BRFSS responses to household income and number of individuals living in the household. Birth weight was assessed through parental report of child's weight at birth. All responses were converted into grams and categorized as low birth weight (LBW; <2500 grams) or normal birth weight (NBW; ≥2500 grams).

Children's Health Status includes a general health rating based on parental report of child's health in general ("excellent," "very good," "good," "fair," or "poor"). Adolescent overweight and obesity for ages 10–17 years was estimated from parental reports of child's current height and weight and based on body mass index (BMI) percentiles for age and sex where overweight/obese was defined as greater than or equal to the 85th BMI percentile by age and sex.¹⁴ Asthma was assessed in ages 1 to 17 years and include measures of lifetime asthma (i.e., parental

report that a doctor has ever told them that child has asthma) and current asthma (i.e., child still has asthma).

Children with Special Health Care Needs (CSHCN) includes five screening measures which are coded as affirmative if endorsed regarding any health, medical, behavioral, or other health condition that has lasted or is expected to last at least 12 months: 1) Elevated need for/use of services—child currently needs or uses more medical care, mental health or educational services than is usual for most children of the same age; 2) Prescription medication use—child currently needs or uses medicine prescribed by a doctor, other than vitamins; 3) Limited in abilities—child is limited or prevented in any way in his or her ability to do the things most children of the same age do; 4) Special Therapy—child needs or gets special therapy, such as physical, occupational, or speech therapy; and 5) Treatment/counseling—child has any kind of emotional, developmental, or behavioral problem for which he or she needs treatment or counseling. Only the first and second CSHCN screening items were assessed in the CHAMP 2005 survey. All five CSHCN screening items were assessed in the CHAMP 2006 and 2007 surveys. For the purposes of this study, CSHCN was defined as those who endorsed the first and second screening items, and thus includes those children who currently need or use prescription medications or currently need or use more medical care, mental health or educational services than is usual for most children of the same age due to a medical, behavioral, or other health condition that has lasted or is expected to last for at least 12 months.

School performance was assessed among children currently enrolled in school (age 4–17 years) through three measures: 1) parental report whether child has ever had to repeat a grade since starting kindergarten; 2) parental report that child receives services from a program called Special Educational Services or has an Individualized Education Plan; and 3) parental rating of how well child has performed in school during the past 12 months ("excellent," "above average," "average," "below average," or "poor"). Parental rating of child's school performance was only assessed in the CHAMP 2005 and 2006 surveys.

Statistical Analysis

CHAMP data are weighted to represent the child population of North Carolina. SAS 9.2 (Cary, North Carolina) and SUDAAN 10.0 software survey procedures were used to account for the complex survey design. Analyses incorporated the sample weights and variance estimators derived from the survey design. All descriptive analyses report weighted percentages and all multivariate statistics reflect survey weights. The χ^2 statistic was used to assess whether sample characteristics differed by child's birth weight. Logistic regression models were used to examine differences in child health and school performance by child's birth weight after accounting for other covariates and to generate model-based standardized estimates (i.e., predictive margins) and model-adjusted risk ratios.^{15,16} Due to significant demographic differences in bivariate analyses, all multivariate models control for race, parental education, household federal poverty level, and child sex.

Results

Sample Characteristics

Birth weight data were available for 9,221 children, of which 9.4 percent [95% CI 8.6, 10.1] were categorized as LBW. Demographic characteristics for LBW and NBW children are presented in **Table 1**. LBW rates (**Figure 1**) were found to be greater among African American children (14.7% [95% CI 12.6, 16.8]) compared to whites (7.4% [95% CI 6.7, 8.2]) and other racial groups (9.4% [95% CI 7.1, 11.7]). LBW decreased as parental education increased: 11.2 percent [95% CI 7.7, 14.7] of parents with less than a high school education had a LBW child compared to 7.5 percent [95% CI 6.5, 8.5] of parents with a college degree. LBW rates were greater among lower income (12.6% [95% CI 11.0, 14.2]) compared to higher income households (7.1% [95% CI 6.3, 8.0]). LBW was also associated with child sex in that females (10.3% [95% CI 9.1, 11.4]) were more likely to be LBW compared to males (8.5% [95% CI 7.4, 9.5]).

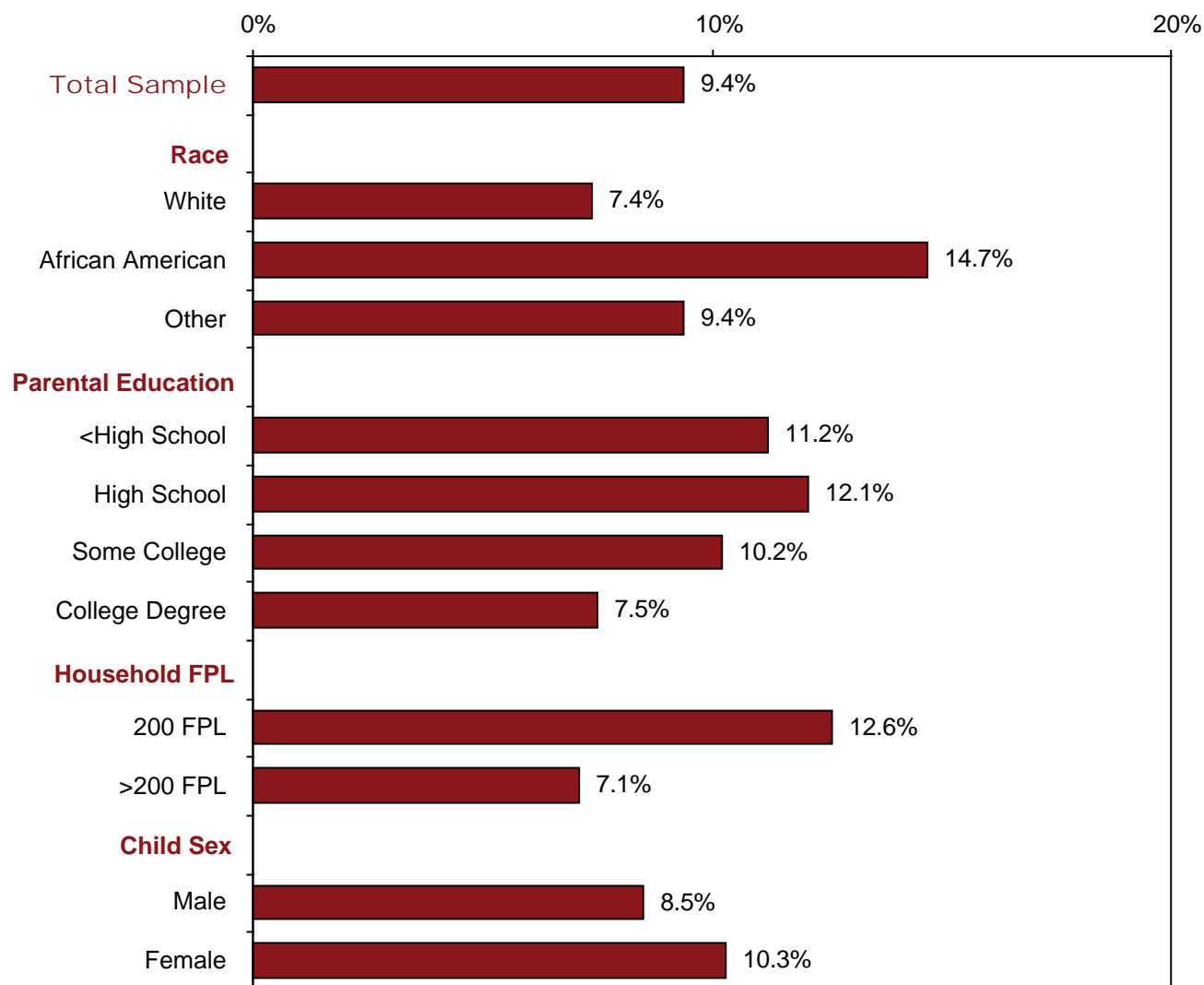
Table 1
Demographic Characteristics by Child's Birth Weight, NC CHAMP 2005-2007

Demographic Variable	Low Birth Weight (LBW) (<2500 grams)		Normal Birth Weight (NBW) (≥2500 grams)	
	N	Weighted % (95% CI)	N	Weighted % (95% CI)
Total	810		8,411	
Race*				
White	480	53.3 (49.0, 57.6)	6,067	68.2 (67.0, 69.4)
African American	218	36.9 (32.5, 41.2)	1,346	22.0 (20.9, 23.2)
Other	109	9.8 (7.4, 12.2)	981	9.7 (8.9, 10.5)
Parent Education*				
Less than High School	69	7.5 (5.1, 9.9)	552	6.1 (5.5, 6.8)
High School	212	26.1 (22.4, 29.9)	1,691	19.6 (18.6, 20.7)
Some College	225	28.3 (24.3, 32.1)	2,122	25.5 (24.3, 26.6)
College Degree	301	38.2 (34.0, 42.3)	4,032	48.8 (47.5, 50.0)
Household FPL*				
≤200% FPL	331	48.9 (44.4, 53.4)	2,402	33.7 (32.4, 35.0)
>200% FPL	397	51.1 (46.5, 55.6)	5,389	66.3 (64.9, 67.6)
Child Sex*				
Male	382	46.4 (42.1, 50.8)	4,341	51.8 (50.4, 53.1)
Female	428	53.6 (49.2, 57.9)	4,070	48.2 (46.9, 49.6)

Abbreviations: low birth weight (LBW); normal birth weight (NBW); confidence interval (CI); federal poverty level (FPL).

* p<.05 comparing LBW vs. NBW.

Figure 1
Prevalence of Low Birth Weight by Demographic Characteristics



Abbreviation: federal poverty level (FPL).

Source: 2005–2007 North Carolina Child Health Assessment and Monitoring Program (NC CHAMP).

Children’s Health Status and School Performance by Birth Weight

Frequency and prevalence rates for children’s health status and school performance by child’s birth weight are presented in **Table 2**. Children’s general health rating was found to be significantly associated with birth weight such that LBW children were less likely to receive a rating of “excellent” health (47.8% vs. 56.8%) and more likely to be rated in “good,” “fair,” or “poor” health (26.2% vs. 17.8%) compared to NBW children. Similar rates of

adolescent overweight/obesity were found among LBW and NBW children (29.7% vs. 32.7%; $p=.35$). LBW children were more likely to have ever been told by a doctor that they have asthma (27.2% vs. 15.9%) as well as to currently suffer symptoms of asthma (18.6% vs. 9.9%). LBW children were also more likely to currently need more medical care, mental health or educational services than is usual for most children of the same age (15.4% vs. 8.4%), need prescription medication (22.6% vs. 17.6%), experience limitations in abilities to do the things

Table 2
Frequency, Prevalence Rates, Estimated Percentages and Adjusted Risk Ratios
for Children's Health Status and School Performance by Child's Birth Weight,
NC CHAMP 2005–2007.

Survey Item	LBW (<2500 grams)			NBW (≥2500 grams)			Model-Adjusted Risk Ratio ^{a,b} (95% CI)
	N	Weighted % (95% CI)	Average Marginal Prediction ^a % (SE)	N	Weighted % (95% CI)	Average Marginal Prediction ^a % (SE)	
Children's Health Status							
General health rating good/fair/poor	206	26.2 (22.3, 30.0)	22.0 (1.9)	1,505	17.8 (16.8, 18.8)	17.6 (0.6)	1.25* (1.04, 1.49)
Adolescent overweight or obese	109	29.7 (23.9, 35.5)	27.0 (2.9)	1,226	32.7 (30.8, 34.6)	33.0 (1.0)	.82 (.66, 1.02)
Ever asthma (lifetime)	187	27.2 (23.0, 31.3)	25.8 (2.2)	1,226	15.9 (14.9, 16.9)	16.2 (0.6)	1.59* (1.33, 1.90)
Current asthma	119	18.6 (14.9, 22.4)	16.9 (1.8)	726	9.9 (9.0, 10.7)	10.0 (0.5)	1.70* (1.35, 2.14)
Elevated need for/use of services	107	15.4 (12.1, 18.7)	16.4 (1.8)	690	8.4 (7.7, 9.2)	8.6 (0.4)	1.91* (1.51, 2.43)
Prescription medication use	165	22.6 (18.8, 26.3)	23.2 (2.0)	1,483	17.6 (16.5, 18.6)	17.8 (0.6)	1.31* (1.09, 1.57)
Limited in abilities	53	11.4 (7.7, 15.0)	10.5 (1.9)	211	4.3 (3.6, 5.0)	4.2 (0.4)	2.48* (1.66, 3.68)
Special therapy	36	9.1 (5.7, 12.5)	9.0 (1.8)	146	3.3 (2.7, 4.0)	3.3 (0.4)	2.73* (1.76, 4.25)
Treatment/counseling	39	7.6 (4.8, 10.3)	7.7 (1.5)	295	5.9 (5.0, 6.7)	5.9 (0.4)	1.29 (.85, 1.96)
CSHCN	205	28.8 (24.7, 32.9)	30.0 (2.2)	1,686	20.2 (19.1, 21.3)	20.4 (0.6)	1.47* (1.26, 1.71)
School Performance							
Ever repeated a grade	118	22.1 (17.7, 26.5)	19.7 (2.1)	679	13.0 (11.8, 14.1)	13.0 (0.6)	1.52* (1.21, 1.91)
Special education services	78	11.5 (8.5, 14.5)	11.4 (1.6)	454	7.0 (6.3, 7.8)	7.3 (0.4)	1.58* (1.16, 2.14)
School performance rating below average/poor	34	11.8 (7.6, 16.0)	10.2 (2.0)	260	6.0 (5.1, 6.8)	6.0 (0.5)	1.70* (1.13, 2.55)

Abbreviations: low birth weight (LBW); normal birth weight (NBW); confidence interval (CI); standard error (SE); Children with Special Health Care Needs (CSHCN). CSHCN defined as children who need prescription medications or have an elevated need for medical, mental health, or educational services due to a chronic medical, behavioral, or other health condition.

^a Results were adjusted for the complex survey design as well as model covariates (race, parental education, federal poverty level, and child sex) using LOGISTIC procedure of SUDAAN.

^b Model-adjusted risk ratio for LBW group in comparison with NBW (reference group).

* p<.05.

most children of the same age do (11.4% vs. 4.3%), and need special therapy (e.g., physical, occupational, or speech therapy; 9.1% vs. 3.3%) due to a chronic medical, behavioral, or other health condition, compared to NBW children. LBW children were more likely to be defined as CSHCN compared to NBW children (28.8% vs. 20.2%). Rates of receiving treatment or counseling for a chronic emotional, developmental, or behavioral problem were non-significantly different between LBW and NBW (7.6% vs. 5.9%; $p=.20$). Regarding school performance, LBW children were more likely to have repeated a grade (22.1% vs. 13.0%), more likely to receive special education services (11.5% vs. 7.0%), and also more likely to receive “below average” or “poor” ratings on performance in school during the past 12 months (11.8% vs. 6.0%), compared to NBW children.

Children’s Health Status and School Performance by Birth Weight—Adjusted for Covariates

Although significant differences were found between LBW and NBW children on measures of health status and school performance, the weighted prevalence estimates do not take into account the significant differences found between LBW and NBW children for a number of demographic characteristics which may also influence child outcomes. Thus, logistic regression models were used to examine model-adjusted risks and risk ratios, controlling for race, parental education, household federal poverty level, and child sex (i.e., Average Marginal Predictions and Model Adjusted Risk Ratios presented in Table 2). Results suggest that for children’s general health status, birth weight was statistically significant ($p=.02$ via a Wald F test). LBW children were significantly more likely to be rated in “good,” “fair,” or “poor” general health rather than rated as in “excellent” or “very good health” compared to NBW children (model adjusted risk ratio: $RR=1.25$ [95% CI 1.04, 1.49]). Additionally, for children’s general health status the effects of race, parental education, FPL were also statistically significant ($p<.0001$ via Wald F

tests). For adolescent overweight/obesity, a trend was observed where LBW was associated with a decreased risk of overweight/obesity ($RR=.82$ [95% CI .66, 1.02]; $p=.07$); however, the effects of race ($p=.0003$), parental education ($p=.01$), FPL ($p<.0001$), and child sex ($p=.003$) were highly significant for adolescent overweight/obesity. Regarding asthma, birth weight was statistically significant for both lifetime ($RR=1.59$ [95% CI 1.33, 1.90]; $p<.0001$) and current asthma ($RR=1.70$ [95% CI 1.35, 2.14]; $p<.0001$). In addition, for lifetime asthma the effects of race ($p=.0001$), parental education ($p=.04$), FPL ($p=.004$), and child sex ($p<.0001$) were statistically significant. For current asthma, the effects of race ($p<.0001$) and FPL ($p=.001$) were also statistically significant.

For the majority of CSHCN items, birth weight was statistically significant. LBW children were more likely to currently need more medical care, mental health, or educational services than is usual for most children of the same age ($RR=1.91$ [95% CI 1.51, 2.43]; $p<.0001$), need prescription medication ($RR=1.31$ [95% CI 1.09, 1.57]; $p=.005$), experience limitations in abilities ($RR=2.48$ [95% CI 1.66, 3.68]; $p<.0001$), and need special therapy ($RR=2.73$ [95% CI 1.76, 4.25]; $p<.0001$) due to a chronic health, medical, behavioral, or other health condition, compared to NBW children. LBW children were more likely to be defined as CSHCN compared to NBW children ($RR=1.47$ [95% CI 1.26, 1.71]; $p<.0001$). In addition, results for need of more medical care, mental health, or educational services suggest that the effects of race ($p=.005$), parental education ($p=.04$), FPL ($p=.007$), and child sex ($p<.0001$) were also statistically significant. For prescription medication, the effects of race ($p=.0005$), parental education ($p=.0007$), FPL ($p=.05$), and child sex ($p<.0001$) were also significant. Results for limitations in abilities suggest that the effects of FPL ($p=.03$) was also statistically significant. Results for need special therapy suggest that the effects of race ($p=.03$) and child sex ($p=.008$) were also statistically significant. For CSHCN, the effects of race ($p=.002$), parental education ($p=.004$), FPL ($p=.02$), and child sex

($p < .0001$) were also statistically significant. Regarding need of treatment or counseling, as expected from univariate analyses, the effect of LBW conditional on other variables in the model was not statistically significant ($p = .23$); however, the effects of race ($p = .001$), parental education ($p = .02$), FPL ($p = .04$), and child sex ($p < .0001$) were significant for need of treatment or counseling for an emotional, developmental, or behavioral problem.

Results for ratings on performance in school during the past 12 months indicate that after controlling for covariates, birth weight was statistically significant; LBW were more likely to receive “below average” or “poor” school performance ratings, compared to NBW (RR=1.70 [95% CI 1.13, 2.55]; $p = .01$). In addition, for ratings on school performance the effects for FPL ($p = .0003$) and child sex ($p < .0001$) were also significant. In regards to repeating a grade in school, LBW children were significantly more likely to have repeated a grade compared to NBW children (RR=1.52 [95% CI 1.21, 1.91]; $p = .0005$). In addition, the effects of race ($p = .002$), parental education ($p < .0001$), FPL ($p < .0001$), and child sex ($p < .0001$) were also statistically significant. Results for special education services suggest that LBW children were more likely to receive special education services compared to NBW children (RR=1.58 [95% CI 1.16, 2.14]; $p = .004$). The effects of race ($p = .04$), FPL ($p = .01$), and child sex ($p < .0001$) were also statistically significant for special education services.

Discussion

Key Findings

Birth weight is a key factor in children’s long-term health and wellness. The current study shows that children with a low birth weight have an increased risk for poor health and educational outcomes. When compared to children with a normal birth weight, LBW children were more likely to receive lower health ratings from their parent/caregiver, to have asthma, and to have special health care needs due to a chronic condition, including elevated need for medical care, mental health, or educational services, need for prescription medications, limitations in

abilities, and need for special therapy (e.g., speech therapy). LBW children were also more likely to have repeated a grade in school, receive special education services, and receive lower school performance ratings. LBW rates significantly varied by race, parental education, household income, and child sex; however, the associations between LBW and child health and education outcomes remain significant even after controlling for these demographic characteristics.

LBW children were significantly more likely to be identified as having special health care needs compared to NBW children. Children with special health care needs (CSHCN) are defined as those who have or are at increased risk for a chronic physical, developmental, behavioral, or emotional condition and who also require health and related services of a type or amount beyond that required by children generally.¹⁷ Examples of the most common conditions of CSHCN consist of allergies, asthma, Attention Deficit Disorder (ADD)/Attention Deficit Hyperactivity Disorder (ADHD), depression/anxiety, mental retardation and autism. CSHCN are often diagnosed with more than one condition, and frequently experience several functional difficulties, including respiratory problems, learning or behavior problems, difficulty with gross or fine motor skills, chronic pain, or difficulty in making and keeping friends. To identify CSHCN, NC CHAMP uses a non-condition specific screening tool based on parental report that focuses on the health consequences a child experiences as a result of having an enduring chronic health condition rather than on a specific diagnosis, thus allowing for a more comprehensive assessment. Among the total 2005–2007 CHAMP sample, 21.0 percent were defined as CSHCN. The prevalence rate of CSHCN was found to be significantly greater among LBW children (28.8%). Controlling for demographic characteristics, LBW children were one and a half times more likely to be CSHCN, as well as two and a half times more likely to have functional limitations, compared to their normal birth weight peers. These results support previous studies that report significantly increased rates of chronic conditions among children and adolescents with a

LBW, including functional limitations, compensatory dependency needs, and services above those routinely required by children.^{18,19} Specifically, LBW children have been found to have higher rates of cerebral palsy, neurosensory impairment, asthma, ADHD, anxiety, and depression.^{6–10}

In addition to long-term health problems, LBW children have been found to exhibit poorer performance in motor skills, visual perception, learning skills, adaptive functioning, and academic performance compared with controls.^{20,21} In the current study, LBW children were one and a half times more likely to have repeated a grade or receive special education services compared to their normal birth weight peers, even after controlling for demographic characteristics. Grade repetition, participation in special school programs, and deficits in cognitive function and achievement among LBW school-aged children and adolescents have been reported by several studies.^{11–12,20–22} Although outcomes may vary considerably among LBW children, there is substantial evidence indicating long-term health and educational needs of these children. Parents and educators should be informed of the potential for disability and special health care needs of LBW children, particularly for those of very low birth weight (1000–1499 grams) or extremely low birth weight (<1000 grams). Early developmental interventions have been found to significantly impact cognitive development during infancy and preschool age, with those programs that focus on the parent-infant relationship along with infant development found to be the most efficacious.^{23–25} However, persistent benefits from early interventions fail to demonstrate sizeable differences on cognition and behavior over the long-term.^{23–24,26} The modest long-term outcomes attributed to early intervention programs reinforce the importance of focusing efforts to reduce the overall incidence of LBW.

Reducing the Rate of Low Birth Weight

Reducing LBW is an important public health goal, as illustrated by the Healthy People 2020 objective aiming for a 5 percent improvement over the next

10 years to achieve a national LBW average of 7.8 percent.²⁷ One of the major risk factors for LBW is preterm birth, or birth of less than 37 weeks gestational age. In 2008, North Carolina ranked 40th among the states with a preterm birth rate of 13.7 percent; however, the rate of occurrence is significantly greater among LBW babies.² In the NC CHAMP 2005–2007 sample, 64 percent of LBW children were also a preterm birth compared to only 6.8 percent of NBW children. Currently, the Division of Public Health’s Women’s Health Branch provides services that protect the health and well-being of women during their reproductive years to assist in reducing the incidence of preterm birth and LBW, including the 17P Program, the Healthy Beginnings program, and the Baby Love Plus program. The 17P Program, managed by the UNC Center for Maternal and Infant Health, provides low-income medically-eligible pregnant women who have had a prior preterm birth weekly injections of 17 alpha hydroxyprogesterone caproate (17P), which has been found to reduce the risk of a repeat preterm birth by one-third. Healthy Beginnings, NC’s Minority Infant Mortality Reduction program, provides lay health advisor outreach, care coordination, and support activities for minority pregnant women up until two years after delivery. The Baby Love Plus program activities include outreach, case management, depression screening, and health education for pregnant women and new mothers up to two years after delivery. The goals of these programs are to improve the overall health of women as well as reduce infant morbidity and mortality.

Certain lifestyle factors or medical conditions during pregnancy may increase the risk of preterm birth and/or LBW, such as maternal obesity, high blood pressure, diabetes, tobacco use, lack of prenatal care, or high levels of stress.²⁸ Although not all the factors that contribute to premature birth and LBW are completely understood, prenatal care programs as well as strategies focused on preconception and interconception health among women promote healthy birth outcomes. There is a growing body of evidence that supports the direct relationship of the health of women during childbearing years to the health of

their children.²⁹ Addressing women's health across the lifespan can improve women's health, pregnancy health, birth outcomes, and child health. Preconception and interconception care offer women screening and assessment for behavioral risks and medical conditions; interventions for identified risks; and counseling about reproductive life planning and healthy birth spacing. The North Carolina Preconception Health Strategic Plan 2008–2013 outlines priority areas as well as goals and strategies for improving the health of men and women of childbearing age and improving birth outcomes in the state.³⁰ Through state workgroups, an interactive reproductive life planning tool has been developed that includes a self-assessment of risk behaviors, chronic conditions, and medical history that may affect current health and later pregnancy outcome, as well as provides helpful tips and resources to promote health during the childbearing years. In addition, the state workgroups have compiled a recommended list of health care provider resources that include clinical protocols, CME opportunities, self-assessment tools and educational materials for patients and are available at the Women's Health Branch website (<http://whb.ncpublichealth.com/provPart/pubmanbro.htm>). Across the state many agencies have made efforts to incorporate preconception care in various programs, including Title V, Title X and federal Healthy Start programs. Through a collaborative focus on women's wellness, North Carolina will continue to strive to improve the health of young men and women and their children.

Study Limitations

The current study results are based on state-wide cross sectional surveys of parental reports on children between 0 and 17 years of age. Child's birth weight is based on parental report as opposed to observational measures; however, parental report on child's birth weight has been found to be accurate and reliable,^{31,32} and the prevalence rates for low birth weight among the CHAMP sample were found to be comparable to North Carolina vital statistics based on birth certificate data.² One limitation of the study is that CHAMP is a landline telephone survey; thus exclusion of households without telephone

service or cell phone only households may lead to certain demographic subpopulations being under-represented. However, demographic weighting adjustments have been found to greatly reduce possible biases to within the margin of sampling error (less than 2 percentage points) for the majority of health indicators.³³ Also note, an observational study such as this supports an association between LBW and childhood outcomes but does not determine causality.

Conclusions

Approximately 9.4 percent of children in North Carolina are born at a low birth weight, placing the state among the top 10 states with the highest LBW rates in the nation. Clearly, there is a continuing need to reduce the incidence of low birth weight and improve pregnancy outcomes in our state. Low birth weight can have a life-long impact on children's health and wellness. Compared with their normal birth weight peers, LBW infants have an increased risk for poorer health and educational outcomes through childhood and adolescence. LBW children are more likely to have special health care needs, and require additional medical care or health and educational services. Support for programs and strategies aimed at improving the health of women as outlined in our state preconception health plan³⁰ may lead to healthier pregnancies and better pregnancy outcomes, ultimately improving the long-term health of children in North Carolina.

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