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Low birth-weight and risk for major depression: A community-based longitudinal study

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ABSTRACT

The current study examines the association between low birth weight and risk for major depression from early adolescence to early adulthood. It accounts for eight documented confounders, and depression within families. Data were analyzed from the National Longitudinal Survey of Youth 1979 on mothers and offspring. Major depression was assessed with the Center for Epidemiologic Studies Depression Scale Short-Form (CES-D-SF) among offspring ($N=3398$) biannually, from 2000 to 2010 (aged 14–25). Competing models were examined with survival analysis and Generalized Estimated Equations (GEE). CES-D-SF based major depression was reported by 33.46% ($n=1137$) of participants. Among persons with very low birth weight (<1500 g), 47.5% ($n=19/40$) were classified with CES-D-SF depression (OR=1.81, 95% CI=0.97, 3.39). Similar results were found with survival analysis (HR=1.97, 95% CI=0.97, 4.01). Among multiple offspring families, GEE modeling showed a similar trend. On aggregate (unadjusted OR=2.46, 95% CI=1.07, 5.63; adjusted OR=2.43, 95% CI=0.94, 6.23), and within families of mothers with CES-D-SF depression (unadjusted OR=2.54, 95% CI=0.55, 11.66; adjusted OR=1.79, 95% CI=0.28, 11.42). Compelling evidence is lacking in favor of an association between very low birth weight (<1500 g), and suspected major depression from early adolescence to early adulthood after accounting for documented confounders.

1. Introduction

Depression has been reported to have an estimated lifetime prevalence of 15% in the US (Kessler et al., 1994), and a mean age of onset of 25.7 in high income nations (Kessler and Bromet, 2013). It is also reported to be the single most costly disorder based on days lost to illness based on the analysis of direct (e.g., treatment), indirect (e.g., absenteeism) and intangible (e.g., reduced quality of life) costs (Berto et al., 2000; Luppa et al., 2007). It impacts on family and employers, is associated with an increased risk of suicide (Barraclough et al., 1974) and is projected to be the second leading cause of disability worldwide by 2020 (Murray and Lopez, 1996). Many studies examine low birth weight (often defined as <2500 g) as a risk factor for depression to test fetal origins theory or "Barker hypothesis" (Barker, 1990). This hypothesis states that fetal under-nutrition indexed commonly and most accurately by low birth weight has significant effects on outcomes in later life (Barker, 1997, 2004). Supporting this hypothesis, studies document an association between low birth weight and risks of altered stress responses (Phillips, 1996), reduced cognitive functioning (Newcombe et al., 2007), and increased suicide (Barker et al., 1995).

Despite the aforementioned reports linking low birth weight to adverse health outcomes, its association with depression is unclear. This ambiguity is highlighted by large-scale epidemiological studies that report significant (Alati et al., 2007) and non-significant (Berle et al., 2006) findings of low birth weight as a risk factor for major depression. Motivated by such mixed findings, a recent meta-analysis (Wojcik et al., 2013) has shown that the odds of depression are slightly greater, yet non-significantly higher, for those of low birth weight (<2500 g) compared to those of normal birth weight (>2500 g) (OR=1.15, 95% CI 1.00, 1.32). Adjustment for publication-bias (i.e., when the published literature is systematically unrepresentative of the population of completed studies; Rothstein et al., 2006), however, made the association not significant. That meta-analytic review concludes that evidence of a weak association between birth weight and depression was found, that may be attributable to publication-bias and vary due to confounders. Also, confounders noted by meta-analysis that do not receive adequate attention are sex, SES, maternal age at childbirth, maternal depression, gestation, maternal alcoholism, and smoking during pregnancy (Wojcik et al., 2013).

With exceptions (Hammen and Brennan, 2003), few epidemiological studies of the association between birth weight and depression account for maternal depression, a reported key risk factor for offspring depression (Wojcik et al., 2013). Also, few studies carefully examine the association within family effects.

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Specifically, research in support of the association rarely accounts for single and multiple family sibship size and existing research is mixed and based on select samples (Eisenman, 1992; Hällström, 1987; Munro, 1966; Richter et al., 1997). An epidemiological community based study of women, however, has shown that having one or more brothers decreases the likelihood of depression over the age of 30 (Harlow et al., 2002). One theoretical reason for the association is that single children are exposed to greater loneliness (Carballo et al., 2013; Hawkley and Cacioppo, 2010).

No study of the association between very low birth weight and subsequent major depression from early teenage years to mid-20s simultaneously accounts for all the major documented confounders highlighted by the meta-analysis alluded to earlier (Wojcik et al., 2013). Also, studies of the association specifically examine within-family confounders. Finally, to date generally repeated assessments of depression are rare from late-adolescent to early adulthood (Cheung et al., 2002), a key period of depression. To overcome previous shortcomings the current study aims to examine the association between low birth weight and major depression from age 14 to 24 accounting for multiple confounders documented in the literature (maternal depression and within familial effects) in a representative US community sample.

2. Method

2.1. Cohort description

Data were reanalyzed from the National Longitudinal Survey of Youth (NLSY) 1979 survey (Bureau of Labor Statistics, 2008) and NLSY Children and Young Adults (NLSY-CYA) Children and Young Adults cohorts (Bureau of Labor Statistics, 2002). The NLSY 1979 is a widely studied (e.g., Baum II and Ruhm, 2009; Gortmaker et al., 1993; Van Cleave et al., 2010) representative US-based national probability cohort of people born from 1957 to 1964. The NLSY 1979 cohort were interviewed from 1979 to 1994 annually and then bi-annually till 2010. Data on the offspring of NLSY 1979 mothers were collected since 1986 and constitute the NLSY-CYA. The offspring of the respondents in the NLSY-CYA are estimated to represent over 90% of all the children ever to be born to this cohort of women.

The total NLSY-CYA sample consists of 11,504 offspring born from 1970 to 2009. Data collection on offspring began in 1986, hence pre-1985 births were removed, leaving a sample size of 6359. Of these respondents, 4115 were interviewed on at least one occasion on the CES-D-SF from 2000 to 2010 when they were aged from 14 to 24. Cases with missing values on the study variables were removed, leaving a total of 3398 study participants with completely available information. They were born from 1985 to 1995 ($M=1989.05$, S.D.$=2.89$). The complete and analyzed offspring samples did not statistically differ by sex.

2.2. Measures

Depression was assessed with the seven-item Center for Epidemiologic Studies Depression Scale Short Form (CES-D-SF). Symptom severity is measured by asking the frequency of occurrence of each item over the preceding week. Responses range from 0 (rarely or none of the time/one day) to 3 (most or all of the time/5–7 days). This consists of seven items: poor appetite; trouble keeping mind on tasks; depressed; took extra effort; restless sleep; sad; and could not get along. The CES-D-SF has been associated with more marijuana use (Harder et al., 2006), lower earnings (Cseh, 2008) and income (Prause et al., 2009), and age at first birth among mothers (Carlson, 2011). Given its widespread use, the CES-D-SF measure has undergone extensive psychometric validation (including confirmatory factor analysis, item response theory, and concordance with the complete 20 item CES-D). A cutoff score of ≥ 8 has been identified as suspected major depression (for details see Levine, 2013). This cutoff score was used to classify the suspected major depression in the current study. CES-D-SF depression assessments were available on mothers in 1992, and offspring bi-annually from 2000 to 2010 inclusive, when they were aged from 15 to 25.

From 1980, during the interview and after birth, mothers reported offspring birth weight in ounces. For consistency with the literature (Strobino et al., 1995), birth weight was converted into grams and categorized as very low: <1500 g, and low: <2500 g; 2500–3000 g; 3000–3500 g; 3500–4000 g; 4000–4500 g; >4500 g. Very low birth weight (<1500 g) was chosen to elaborate on the existing literature on the association between low birth weight and depression. Research on depression predominantly examines low birth weight (<2500 g), and in other domains highlights demonstrable deficits occurring at very low birth weight levels. These deficits include neurological, psychiatric and neuropsychological problems (Hack et al., 2005), lower IQ and academic performance (Hack et al., 2002), and autism (Boulet et al., 2011; Lampi et al., 2012). Documented controlled confounders were birth year, child sex, SES, maternal depression, maternal age at child birth, gestation, and during pregnancy maternal alcohol and smoking use (Wojcik et al., 2013). Mothers reported their cigarette smoking as number of packs of 20 cigarettes smoked per day during pregnancy, and alcohol consumption as number of drinks per month during pregnancy (Strobino et al., 1995). Specifically, women reporting a new birth were asked: "Did you drink any alcoholic beverages, including beer, wine, or liquor, during the 12 months before [child] was born?" If yes, "How often did you usually drink alcoholic beverages during (your/that) pregnancy?" Parallel smoking use items followed (Bobo et al., 2006). Gestational age (in weeks) was determined by their health care providers, or was calculated using the mothers' last pre-pregnancy menstrual period before giving birth. Gestational age was categorized into term (>37 weeks), late preterm (34–36 weeks) and early preterm birth (<34 weeks) consistent with, for instance, CDC reports. To measure parental SES, a composite standardized mean score was calculated from paternal or maternal highest grade of formal education, father's Duncan index and family income (Ganzach, 1998; Walsh et al., 2012). This composite parental SES score was split into low (under 0.042) and high (over 0.041) groups based on Z-scores.

2.3. Analytical approach

The data analysis consisted of the following four rounds. First, missing values analysis was computed. Second, descriptive statistics were computed to compare groups with and without suspected major depression (based on a CES-D-SF cutoff value of ≥ 8 at any age) on all study variables. Third, the time (defined by age 14–24 censored) to the first suspected major depression was reported (based on the CES-D-SF cutoff of ≥ 8) was examined using Kaplan–Meier (unadjusted) and Cox (adjusted) regression modeling. In the Cox model, adjustments were made for birth year, sex, SES, maternal age at childbirth, maternal depression in 1992, gestational length, and maternal alcoholism and smoking during pregnancy. Fourth, four competing Generalized Estimating Equations (GEE) were computed among families with at least 2 offspring to account for the within family correlations. These were: (1) all families unadjusted for confounders; (2) all families adjusted for the aforementioned confounders; (3) families with a depressed mother unadjusted for confounders; and (4) families with a depressed mother adjusted for the aforementioned confounders. In the GEE models suspected major depression was based on the CES-D-SF cutoff value of ≥ 8 at each assessment.

Two rounds of specificity analyses were computed. First, specificity analysis was computed to examine the effect of low birth weight (>2500 g) on time to onset with survival models, and GEE models of within family risk computed in a similar manner to the primary analysis. Birth weight groups were computed as a gradient ranging from low birth weight (<2500 g), as a single group for comparability with prior research, to >4000 g, as a single group due to sample size considerations. Second, it has been suggested that the severity of depression can influence the association between low birth weight and subsequent depression (Wojcik et al., 2013). Accordingly, specificity analysis was computed to examine continuous CES-D-SF scores using GEE modeling nesting individuals at each age unadjusted and adjusted for confounders.

3. Results

3.1. Missing value analysis

Cases with missing values on the study variables were removed, leaving a total of 3398 study participants with completely available information. They were born from 1985 to 1995 ($M=1989.05$, S.D.$=2.89$). Based on χ^2 tests, compared with those omitted, those included in the study did not significantly ($P>0.05$) differ by sex. On the remaining study variables, however, compared with those not included, in the study those included were statistically ($P<0.05$) more likely to be high on SES (48.3%), have mothers with CES-D-SF depression (23.8%), have mothers who gave birth before the age of 20 (67.9%), be late preterm on gestational age (9.17%), have alcoholic mothers (59.2%), have a mother who smoked (35.24%), and were born 1500–2500 g (8.52%). Missing value analysis showed that the data significantly deviated from the assumption of being missing at random, hence suggesting that bias was present due to missing values (Little's MCAR test: $\chi^2=7839.38$, d.f.$=308$, $P<0.05$).

The study sample described in Table 1 shows that, based on the CES-D-SF cutoff score of ≥ 8 to classify depression, 33.46%