



Housing conditions and birth outcomes: The National Child Development Study^{☆,☆☆}



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ARTICLE INFO

Keywords:

Housing
Birthweight
Gestational age
Fungi
Crowding

ABSTRACT

Background: Despite their importance to respiratory and other health outcomes, housing conditions have been little-studied with respect to perinatal outcomes.

Methods: 1927 participants in the British National Child Development Study reported on housing conditions and pregnancy outcomes, including presence/severity of mold/dampness; type of heating; and whether remodeling of various sorts had been conducted. Crowding, based on the number of people in the residence and the number of rooms, was also considered. Outcomes assessed were low birthweight (< 2500 g), preterm birth (< 37 weeks), and small-for-gestational-age (< 10th percentile for gestational age). Multiple logistic regression with adjustment for maternal, sociodemographic, and housing factors was conducted.

Results: Women who reported serious problems with mold were more likely to give birth to a low birthweight (adjusted OR 1.98, 95% CI 1.13–3.47) or small-for-gestational-age (2.06, 1.25–3.38) baby; no consistent associations were seen with preterm birth. Crowding was associated only with small-for-gestational-age (1.73, 1.11–2.76).

Conclusions: Exposure to mold or dampness, and housing conditions generally, is a potentially important but under-investigated aspect of women's lives during pregnancy. Future studies should more thoroughly investigate housing characteristics and their relationship with birth outcomes.

1. Introduction

Reduced fetal growth (often indicated by low birth weight [LBW, birth weight < 2500 g]) and preterm birth (PTB) (gestational age at birth < 37 weeks) are important causes of morbidity and mortality in children (Moster et al., 2008), and suboptimal growth in utero has been linked to an increased risk of long-term health problems, including type 2 diabetes and cardiovascular disease (Barker et al., 2002). Both LBW and PTB are more common in disadvantaged groups; in the U.S., this particularly applies to African-Americans, but also children born in poverty or to mothers with low education (Blumenshine et al., 2010). However, well-studied risk factors like prenatal care and smoking have to date have failed to fully explain the persistent disparities in poor pregnancy outcomes associated with poverty and African-American race/ethnicity (Hogue and Bremner, 2005).

One possible contributor to adverse birth outcomes is poor housing and living conditions (Struening et al., 1990). Housing conditions are

strongly socioeconomically patterned and associated with health conditions (Jacobs et al., 2009; Krieger, 2012; Shaw, 2001, 2004). Poor housing quality is associated with increased susceptibility to a number of health conditions, most notably infectious diseases (Cantwell et al., 1998; Ziegelbauer et al., 2012) and respiratory conditions (Dales et al., 1991; Gunnbjornsdottir et al., 2003; Mendell et al., 2011), but also blood pressure and cardiovascular disease (Aylin et al., 2001). A number of projects have attempted to improve pediatric health by improving housing quality, largely concentrated on lead reduction, asthma/allergen control, and reducing risk of injury (Sandel et al., 2004). However, despite their importance to pediatric health, housing conditions have not been studied extensively with respect to birth outcomes. We found only two individual-level studies with this as a major focus: a study in Brazil found that poor housing conditions (defined by crowding, sanitation, and construction materials) were associated with LBW and PTB (Vettore et al., 2010), while another in Russia found that crowded living conditions were associated with poor birth

Abbreviations: LBW, low birthweight; PTB, preterm birth; aOR, adjusted odds ratio

^{*} North Thames Multi-Centre Research Ethics Committee approved the original surveys and the current analysis was judged exempt by the Institutional Review Board of Tulane University.

^{**} No external funding was provided for this analysis.

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<https://doi.org/10.1016/j.envres.2017.11.012>

Received 29 August 2017; Received in revised form 27 October 2017; Accepted 4 November 2017

Available online 14 November 2017

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outcomes (Grjibovski et al., 2004). Other neighborhood-level analyses have examined quality of the housing stock as a risk factor for poor birth outcomes (Nowak and Giurgescu, 2017). This analysis thus aimed to examine if there is an association between poor housing/living conditions and undesirable birth outcomes such as LBW and PTB.

2. Methods

Data for this analysis were obtained from the National Child Development Study (NCDS). The NCDS began in 1958 as the Perinatal Mortality Survey. Sponsored by the National Birthday Trust Fund, the survey was designed to examine the social and obstetrics factors associated with stillbirths and deaths in early infancy among children born in Great Britain. NCDS was designed as a cohort study of children born in Britain during one week of March 1958. Originally, 17,638 participants were enrolled (with an additional 920 immigrants added before age 16), and participants have been followed up at ages 7, 11, 16, 23, 33, 41, 46, 50 and 55. 73% of the original cohort participated at either age 33 or 41, with a small bias towards losses from the unskilled manual labor social class. Data from the 33 year survey were used for this analysis. Women were included in the analysis if they reported at least one birth while living in their current residence. If they reported more than one, the latest one was used.

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3. Assessment of the exposure

Exposure data were taken from the “Your life” survey which was administered at age 33 years. As part of the survey, participants were asked to provide a residential history that included all the houses they had lived in, including their current residence. During the interview, a number of questions about housing conditions were asked. These included the presence and severity of mold or dampness in the home and whether remodeling of various sorts had been conducted (a list of possible remodeling options was provided). Women were asked the following questions: “Have you ever had serious problems with dampness/mold in any room? If so, in which room did you have problems with dampness or mold?” Self-reporting indicators of home dampness is a standard approach to measuring exposure to mold and dampness in the home in survey research (Bornehag et al., 2004; Kanchongkittiphon et al., 2015; Salo et al., 2008). Crowding was calculated based on the number of children, adults, and total people per room living in the residence at the time the survey was administered. Overcrowding was defined as more than one person/room. Housing conditions were modeled individually

4. Assessment of the outcome

At the 33-year follow-up survey, each cohort member was asked if they had ever been pregnant, and if so, the outcome of each pregnancy (miscarriage, abortion, stillbirth, livebirth), the gestational age, and the birthweight of the baby. Three outcomes were analyzed: 1) low birthweight (LBW), defined as a birthweight below 2500 g; 2) preterm birth (PTB), delivery more than 3 weeks prior to the estimated due date (this should correspond to birth before 37 weeks’ gestation; the question was asked as 1. whether the baby was early, late, or on time, and 2. if early or late, number of weeks early or late); 3) small-for-gestational-age (SGA), birthweight less than 10th percentile for sex (Villar et al., 2014). If more than one pregnancy had occurred at the current residence, the latest pregnancy was used (to minimize the time between the housing measures and the pregnancy).

5. Confounders and adulthood mediators

Confounders of the housing-birth outcome association were considered to be age at the time of pregnancy, year of birth, measured BMI at age 33 years, smoking during any trimester of the pregnancy, gravidity at the time of the birth, social class at the time of the birth (calculated from own or partner’s occupation, using the Registrar General’s Social Class classification 1–5), partnership status at age 33 (married/living with partner/not), and educational level (indicated by qualifications: primary or less, less than O-level, O-level or equivalent, A-level, or higher). Housing-related factors included: rent/ownership status, type of housing, length of time living in the house at the time of the birth (tenure), and lifetime number of residences as an adult.

6. Statistical analysis

Logistic models were used for dichotomous outcomes (LBW/PTB). Multiple imputation, using SAS’s PROC MI and PROC MIANALYZE, was used to impute missing values for confounders; results are presented using these imputed values. Less than 10% of the data were missing for all covariables. All analyses were done with SAS version 9.1.

7. Results

The study population included 1927 women who reported at least one pregnancy while living in their current house (Table 1); the majority of the cohort was married (88%), had their first pregnancy between ages 22 and 32 (73%), and did not smoke (71%). Compared to other women in the cohort who reported at least one pregnancy at any point ($n = 3231$), included women had more children (32.5% with 3 or more children, vs. 25.6%, $p < 0.01$). There was no difference in social class at age 33. Median time in the house was 7.0 years and median time between interview and birth was 2.5 years. They also lived in fewer residences since age 16, on average (10.0% with 9 or more residences, compared to 14.8% in those not included), were more likely to own their house (85% vs. 72%, $p < 0.01$), and to have central heat (88% vs. 85%, $p < 0.01$). There was no difference in the proportion of women reporting mold or dampness in the home, the different types of heat, renovations due to mold or dampness, after taking into account home ownership and time in the house. All covariates were correlated with the exposures at $r < 0.20$.

In adjusted models, women who reported mold/dampness anywhere in the home or serious problems with mold or dampness were more likely to give birth to a LBW baby (Table 2, aOR for mold/dampness anywhere 1.98, 1.13–3.47; for serious mold, 2.42, 95% CI 1.20–4.86); no consistent associations were seen with PTB, although ORs were sometimes raised (aOR for serious mold 1.60, 0.79–3.23). Mold anywhere was also associated with SGA (aOR 2.06, 1.25–3.38). Crowding was not associated with LBW or PTB (aOR for LBW 1.18, 0.71–1.97; for PTB, 1.36, 0.85–2.17), but was associated with an increased risk of SGA (aOR 1.73, 1.11–2.76).

Home renovations were not associated with LBW; renovations against damp (aOR 0.32, 0.12–0.89) or to the roof (aOR 0.25, 0.10–0.62) were associated with reduced risk of preterm birth (Table 3).

8. Discussion

In this study, women who reported problems with mold or dampness in their household were more likely to give birth to a LBW or SGA baby, but no associations were found with PTB. We are unaware of previous studies examining mold and damp with respect to birth outcomes, although mold has been linked to respiratory and gastrointestinal diseases, aches and pains, and fever (Kanchongkittiphon et al., 2015; Platt et al., 1989), and constant respiratory conditions or gastrointestinal symptoms could reduce the oxygen or nutrients

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