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Reproductive history and physical functioning in midlife: The Bogalusa Heart Study

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ABSTRACT

Objective: To examine the relationship between reproductive history, pregnancy complications, and later physical function.
Study design: The Bogalusa Heart Study is a long-running study of cardiovascular health in a semirural community. 761 women were interviewed about their pregnancy history and complications, and underwent tests of physical function. Logistic models for dichotomous outcomes and linear models for continuous outcomes were used, adjusted for covariates.
Main outcome measures: Overall scores on the Short Physical Performance Battery (SPPB), which combines scores for balance, gait speed, and chair stands. Additional tests were a 6-min walk, knee extension strength, grip strength, and a pegboard challenge.
Results: Nulliparity was associated with lower scores on the walking and balance portions of the SPPB, less distance covered in the 6-min walk, less knee and grip strength, and higher pegboard time, especially among premenopausal women. A history of gestational diabetes was associated with more problems on the walk portion of the SPPB (aOR 2.44, 1.06–5.65), higher chair stand time, and lower knee strength. Young age at first birth (< 16 or 18 years) was associated with a shorter chair stand time and a better pegboard score.
Conclusions: Nulliparity was associated with worse physical functioning, while high parity and early pregnancy were not, suggesting that fertility is associated with better health later in life. Pregnancy complications were associated with worse physical functioning, even after controlling for body mass index. Future studies should attempt to establish the pathways by which reproductive health relates to overall physical functioning.

1. Introduction

Pregnancy affects all aspects of a woman's body, often permanently. The increased weight, unusual weight distribution, and joint laxity of pregnancy [1] could lead to permanent harm to joints and associated movement issues. The increased cardiometabolic risk associated with pregnancy complications might also lead to physical disability [2]. However, relatively few studies have empirically addressed the question of whether pregnancy and reproductive history affects later physical function. Very high parity (usually 4+ births) and adolescent pregnancy have been associated with increased disability [3,4], worse physical role functioning [5,6], and physical decline [6]. Most previous studies have been conducted in women aged 65+. Both nulliparity and high parity [7] as well as pregnancy complications [8,9] are associated with increased cardiometabolic risk later in life. Given the associations between cardiometabolic risk and physical function [10], it is likely that complications such as gestational diabetes and pre-eclampsia, or giving birth to a low birthweight baby, are also associated with reduced physical function. Infertility may be an indicator of worse underlying health [11], which can reveal itself in worsened physical function later in life.

In this analysis, we explored whether reproductive history (parity, fertility) and pregnancy complications (pregnancy-induced hypertension, gestational diabetes, preterm birth, low birthweight) are associated with indicators of physical health in midlife, in a community-based, biracial cohort. We hypothesized that 1) high parity would be most strongly associated with functional outcomes associated with mobility, possibly due to associated joint changes; 2) infertility would be associated with overall worse functioning; and 3) pregnancy-induced hypertension and gestational diabetes, the complications most strongly

Abbreviations: BMI, body mass index; BHS, Bogalusa Heart Study; BiCEPS, Brain, CognitivE and Physical performance Study; GDM, gestational diabetes mellitus; SPPB, Short Physical Performance Battery; aOR, adjusted odds ratio

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associated with later cardiometabolic health, would be most strongly associated with physical function, largely mediated by BMI.

2. Methods

The Bogalusa Heart Study is a series of studies of cardiovascular risk, in a semirural, biracial population (65% white and 35% black), founded by Dr. Gerald Berenson in 1973. This analysis combines results from two follow-up studies conducted in 2011–2016: Bogalusa Babies, which examined reproductive outcomes within the BHS, and BiCEPS (Brain, CognitivE and Physical performance Study), which links vascular risk factors across the lifespan with cognitive and physical performance. 1651 women participated in Bogalusa Babies; of those, 761 also participated in BiCEPS and had data on at least one exposure and outcome. The most common reason for not participating in both was not being available to visit the clinic and in most cases women completed both studies on the same day, although this was not a requirement. Compared to those who participated in Babies but not BiCEPS, the group who also participated in BiCEPS were more likely to be postmenopausal (58% vs. 46%, $p < 0.01$, mostly due to age), previous smokers (38% vs. 21%, $p < 0.01$), and were less likely to have higher education (26% vs. 33%, $p < 0.01$). Pre-pregnancy BMI was somewhat higher (22.4 vs. 21.5, $p < 0.01$). There were no differences with respect to parity, race, smoking during pregnancy, or age at first pregnancy.

2.1. Exposures

All reproductive history variables in this analysis were self-reported, although women were encouraged to consult a baby book, if they had one. During the interview, women were asked whether they had ever been pregnant, the outcome of each pregnancy, complications, and whether they took any fertility drugs or received any medical procedures to help them get pregnant. Women were also asked whether they ever tried to get pregnant and were unable to. Women who answered "yes" to any one of the fertility-related questions were considered to have reported fertility difficulties. Reliability between self-reported use of fertility treatment and medical records has been found to be fairly high [12], and though self-report may underestimate clinical fertility difficulties, it provides a reasonable estimate of infertility burden with high specificity [13]. Reproductive history assessed included number of pregnancies, number of births, and adolescent pregnancy (< 16 or < 18 years at first pregnancy).

Pregnancy complications assessed included low birthweight (< 2500 g), preterm birth, gestational diabetes mellitus (GDM), and miscarriage. Pre-eclampsia and pregnancy-related hypertension were combined for a hypertensive disorders of pregnancy outcome. Mothers remember the birthweight and gestational age of their infants quite well, even after many years [14,15]. Recall has been shown to be highly specific (> 90%) for hypertensive disorders [16] and accurate for reports of gestational diabetes (GDM) (specificity = 98%, sensitivity = 92%) [17]. Miscarriage is mostly accurately recalled when it occurs late in pregnancy or requires medical attention [18]; still, there is no other plausible source of information for history of early miscarriage besides self-report. All exposures were defined as the occurrence at any pregnancy, so if a woman had multiple pregnancies but reported the outcome in only one, she was defined as having had a history of the complication.

2.2. Outcomes

The main outcome was the Short Physical Performance Battery (SPPB), which combines scores on balance (side-by-side, semi-tandem, and tandem stands), gait speed (better of two times at usual pace over a 4-m course), and chair stands (time for 5 chair stands, arms crossed, without using arms, done as quickly as possible). Scores were computed based on the instructions for the SPPB [19]. The full SPPB is scored from 0 to 12, with 12 being the best function. Components of the SPPB were each scored from 0 to 4, then dichotomized as listed in Tables 3 and 4. Alternate dichotomizations were also analyzed, and results were similar except where presented below.

Additional indicators of physical function included distance travelled during the 6-min walk, knee extension strength (repeated three times per leg and averaged), grip strength (averaged across both hands), and time completing a pegboard challenge with the dominant and non-dominant hands. If a task was attempted but not completed, it was recorded as 1 more or less than the maximum or minimum (depending on whether higher or lower numbers were associated with worse function). As time to complete the pegboard task was highly skewed, it was log-transformed for analysis.

2.3. Analysis

Each exposure was examined as a predictor of the SPPB score, components of the SPPB, and the other physical function indicators. Models of fertility and parity were first adjusted for age at interview, menopausal status (self-defined as having gone 12 months without a period), race, education, and smoking, and the next set of models were also adjusted for BMI at time of outcome measure (a potential intermediate as well as confounder). Models of pregnancy complications were also adjusted for age at first pregnancy. Logistic models for dichotomous and linear models for continuous outcomes were used with multiple imputation to account for missing data on covariates; most commonly missing was age at first pregnancy (1.6%). Interactions with menopausal status were examined, and where significant, results were stratified as indicated.

The BiCEPS and Bogalusa Babies studies were approved by the Institutional Review Board of Tulane University.

3. Results

Given the relatively young age of the sample, the large majority had the highest category of performance for each of the three components of the SPPB (Table 1), though approximately 10% scored in the lower categories for each outcome. 12% had < 10 on total SPPB, which indicates impaired functioning for a relatively young age group. Mean age at interview was 47.7 years (Table 2), and about a third of the study population was black and two-thirds white. A fairly large number had a birth at a young age (22% before 18 years), and the history of low birthweight (18%), preterm birth (15%), and gestational diabetes (10%) are consistent with general population estimates. 58% reported being in menopause; 12 (1.6%) women reported use of hormone therapy.

As both nulliparity and high parity have been associated with adverse health, parity was considered as a nominal variable (Table 3). For the SPPB, we found an interaction with menopausal status: among pre-menopausal women, nulliparity was associated with lower scores on the total, chair, walking and balance portions of the SPPB; among post-menopausal women, this held true only for balance. Among pre-menopausal women, there was also some indication that higher parity was associated with lower balance scores; in post-menopausal women, the association, if any, when in the opposite direction. Among post-menopausal women, higher parity was also associated with lower scores on the walk portion, but adjustment for confounding reduced the association. For the other indicators of physical performance (Table S1), there was no interaction with menopausal status, and nulliparity was associated with less distance covered in the 6-min walk, lower knee and grip strength, and higher pegboard time; there was no evidence for higher parity being associated with worse performance on these measures of performance.

History of gestational diabetes (Tables 3 and S2) was associated with more problems on the walk portion of the SPPB (aOR 2.44,

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