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Maternal exposure to unexpected economic contraction and birth weight for gestational age

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Abstract

Background—The macro-level economy may affect fetal health via maternal behavioral or physiologic responses.

Methods—We used a multilevel design to examine associations between exposure to state-level unexpected economic contraction during each trimester of gestation and birth weight for gestational age percentile and small for gestational age (SGA), using the National Longitudinal Survey of Youth 1979. We examined differences in observed associations by maternal educational attainment, race/ethnicity, employment status, and poverty status.

Results—Exposure in the first trimester was associated with a 3.7 percentile point decrease in birth weight for gestational age (95% confidence interval [CI]= −6.8 to −0.6). This association appeared stronger for women “keeping house” or with <12 years education. Exposure in the first trimester was also associated with increased odds of SGA (odds ratio= 1.5 [95% CI= 1.1 to 2.1] and term SGA (1.6 [1.2 to 2.3]).

Conclusions—Unexpected economic contraction during early pregnancy may be associated with reduced fetal growth.

Substantial research has investigated effects of economic downturns on health.¹ Mechanisms by which economic contraction may lead to worsened health include behavior change or physiologic stress responses due to job loss, reduced income, fear of job or income loss, and general worry about the economy.^{2–6} Although several studies have examined associations between economic change and birth outcomes, findings have been inconsistent.^{7,8} Most previous research examines low birth weight (LBW), which conflates fetal growth and gestational age, making findings difficult to interpret.

We used a multilevel design to examine associations between unexpected economic contraction in maternal state of residence during the first, second, and third trimester of gestation and birth-weight-for-gestational-age outcomes, using the National Longitudinal Survey of Youth 1979. We also explored differences in observed associations by maternal educational attainment, race/ethnicity, employment, and poverty status.

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Methods

We obtained data on pregnancies and birth outcomes among women in the National Longitudinal Survey of Youth, a prospective cohort study enrolling youth ages 14–22 years in 1979.⁹ The study population included 8,397 gestations among 4,233 women in 50 states, Washington DC, and Puerto Rico from 1982 through 2000. We excluded multiple births (n=115) and births missing data on birth weight or gestational age (n= 1,383) or maternal state of residence during pregnancy (n=184) for an analysis sample of 6,715 gestations.

Economic contraction during pregnancy

We characterized the economy during gestation using monthly state unemployment rates.¹⁰ We defined unexpected economic contractions as months in which the state unemployment rate was higher than its statistically expected value. Because the unemployment rate is known to exhibit autocorrelation (i.e., secular trends, cycles, and oscillations), “position” in time predicts observed values better than the mean of the series. We employed ARIMA modeling to identify autocorrelation and decompose unemployment rates into expected and residual (difference between observed and expected) values.^{11,12} We classified months with residuals significantly above the 99% confidence interval (CI) of expected values as unexpectedly contractive (illustrated in eFigure A1, <http://links.lww.com>). We characterized the first, second, and third trimester of each gestation as “exposed” to unexpected economic contraction if any month of that trimester was unexpectedly contractive.

Birth weight for gestational age outcomes

We removed implausible combinations of birth weight (g) and gestational age (weeks)¹³ and calculated birth-weight-for-gestational-age percentiles (hereafter called “birth-weight percentiles”) using published tables from a U.S. reference group.¹⁴ We classified infants as small for gestational age (SGA) if birth weight was below the 10th percentile for gestational age, and as term SGA if they were SGA at 37 or more weeks gestation.

Statistical methods

We used linear regression models for birth-weight percentiles and logistic regression models for SGA and term SGA. Over the study period, the probability of exposure to unexpected economic contractions during gestation decreased (eFigure 2, <http://links.lww.com>) and the sample aged, leading to potential confounding by coinciding age and period effects. We therefore estimated regression models adjusted for maternal characteristics that may have changed as the sample aged: age (continuous); indicator variables for race/ethnicity, educational attainment, marital status, employment status, poverty status, health limitations, parity, and pre-pregnancy BMI categories; and indicator variables for “missing” data. We included year-of-birth and state-of-residence fixed effects to control for potential confounding by place or time.

The magnitude of heterogeneity across sub-groups was estimated using interaction terms between unexpected economic contractions and sets of maternal race/ethnicity, educational attainment, employment status, and poverty status indicator variables. We examined Wald tests of statistical significance for each set of interaction terms with a cut-off of $P=0.20$.¹⁵

We also estimated associations between birth-weight-percentile outcomes and exposure to unexpected economic expansion (i.e., unemployment rate significantly below the 99% CI of expected values), positive and negative residuals of the unemployment rate, exposure to unexpected economic contraction in the three months before and after pregnancy, and exposure to unexpected contraction by month in the first trimester. We examined associations between unexpected economic contraction in each trimester and offspring who

were large for gestational age (LGA, >90th percentile). We compared findings from our original models, which used missing indicator variables, to complete case analysis and to models using multiple imputation for covariates.

Results

Table 1 describes characteristics of the study sample. The mean birth-weight percentile was lower when pregnancies had been exposed to unexpected economic contractions in the first trimester (44.5 vs. 49.8 for unexposed pregnancies) but more similar for pregnancies exposed or unexposed in the second and third trimester (48.2 vs. 49.6, and 49.0 vs. 50.0, respectively). The proportion of SGA was higher among pregnancies exposed to economic contractions in the first or second trimesters (16.1% vs. 11.0% and 14.4% vs. 11.0%, respectively), but lower among those exposed in the third trimester (9.0% vs. 11.3%).

In multivariable models, exposure to unexpected economic contraction in the first trimester was associated with a 3.7% decrease in mean birth weight for gestational age percentile (95% CI = -6.8 to -0.6), while exposure in the second and third trimesters was associated with differences of <1 percentile point (Table 2). Exposure to unexpected contraction in the first and second trimesters were associated with increased odds of SGA of 1.5 (95% CI = 1.1 to 2.1) and 1.3 (0.95 to 1.8), respectively (Table 2). Findings for term SGA were similar to those for SGA (Table 2).

The association between unexpected economic contraction in the first trimester and birth-weight percentile differed by maternal educational attainment ($P = 0.12$) and employment status ($P = 0.09$) but not race/ethnicity or poverty status ($P = 0.90$ and $P = 0.44$, respectively). Among women with less than 12 years of education, unexpected economic contraction in the first trimester was associated with an 8.8 point decrease in birth weight percentile (95% CI = -14.6 to -2.9) (Table 3). Among women keeping house, unexpected economic contraction in the first trimester was associated with a 6.9 point decrease in birth weight percentile (95% CI = -12.1 to -1.8) (Table 3).

Birth-weight percentile, SGA, and term SGA were not associated with unexpected economic expansion, the positive or negative residuals, or unexpected economic contractions in the three months before or after pregnancy (eTable 1–4, <http://links.lww.com>). Exposure to unexpected contraction was most strongly associated with birth-weight percentile in the second two months of the first trimester (eTable 5, <http://links.lww.com>) and was not associated with LGA (eTable 6, <http://links.lww.com>). Results from models using multiple imputation were similar to original models, and results from complete case analysis were slightly attenuated (eTables 7 and 8, <http://links.lww.com>).

Discussion

We found evidence of lower mean birth-weight-for-gestational-age percentile and higher odds of SGA and term SGA among pregnancies exposed to state-level unexpected economic contraction during the first trimester of pregnancy, in a sample of U.S. births between 1982 and 2000. Births to women with less than 12 years of education and those keeping house had larger decreases in birth-weight percentiles following exposure to unexpected contraction in the first trimester compared with births to women with 12 years or more than 12 years of education, and to women who were employed, unemployed, or out of the labor force.

In previous research, the associations between unemployment and LBW have ranged from positive to negative⁷; these studies are limited by use of LBW as an outcome. Recent work has reported an association between the state unemployment rate and increased risk of

preterm LBW; however, differences in the exposure and outcome preclude direct comparison.⁸

Our study defines economic shocks based on theory that “unexpectedness” of environmental stimuli affects the degree to which people respond.^{16,17} We used conservative ARIMA methods to model the unemployment rate and classify months as unexpectedly contractive. These data also allowed us to examine a wider range of individual-level confounders than previous studies and to explore potential sources of heterogeneity by maternal characteristics.

The self-reported nature of these data may induce bias if women differ in recall of birth weight or gestational age by exposure status. Approximately 17% of births were missing data on birth weight or gestational age, leading to potential selection bias. Our examination of heterogeneity by maternal characteristics may be limited by small sample sizes in some categories.

Our finding that birth-weight-percentile outcomes were more strongly associated with economic contraction in the first trimester could be driven by early physiologic processes (e.g., implantation or trophoblast invasion) that affect fetal growth,^{18–20} a more active maternal stress response in early pregnancy,²¹ or a longer time frame necessary for exposure to affect maternal behavior or physiology. Other research has shown similar associations between exposure to terrorist attacks²² in early pregnancy and birth weight. Stronger associations between economic contraction and fetal growth among women with less education may result from greater vulnerability to job loss during economic downturns.²³ Women who “keep house” may also be more vulnerable if households depend on only one income.

Future research should explore pathways connecting exposure to economic shocks and birth outcomes, such as individual job or income loss, maternal behavior change, and physiologic stress.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Characteristics^a of study sample: Singleton births between 1982 and 2000 to women in National Longitudinal Survey of Youth 1979 with available data on birth weight, length of gestation, and state of maternal residence (n=6,715).

Birth weight for gestational age percentile; mean (SD)	49.6 (29.3)
Maternal age (years); mean (SD)	26.8 (4.7)
Exposed to unexpected contraction	
First trimester	360 (5.4)
Second trimester	383 (5.7)
Third trimester	321 (4.8)
SGA	754 (11.2)
Term, SGA (among term births [n=5,916] only)	677 (11.4)
Maternal age (years)	
<20	279 (4)
20–30	4577 (68)
30–40	1842 (27)
≥40	17 (<1)
Maternal race/ethnicity	
Non-Black/non-Hispanic	3764 (56)
Black	1674 (25)
Hispanic	1277 (19)
Maternal educational attainment ^b	
< 12 years	1324 (20)
12 years	2838 (43)
> 12 years	2421 (37)
Mother married ^b	3930 (60)
Maternal employment status ^b	
Employed	2928 (48)
Unemployed	333 (6)
Keeping house	2166 (36)
Out of the labor force	639 (11)
Mother below federal poverty level ^b	1397 (23)
Maternal health limitation reported in year of birth ^b	765 (14)
Nulliparous mother	2494 (37)
Maternal pre-pregnancy BMI (kg/m ²) ^b	
<18.5	470 (8)
18.5–24.9	3961 (67)
25.0–29.9	934 (16)
≥30	540 (9)

^aNo. (%), unless otherwise indicated.

^bData were missing on maternal education for 132 women; for marital status, 126; for employment status, 649; for poverty level, 739; for maternal health limitation, 1121; and for BMI, 810.

BMI indicates body mass index.

Table 2

Estimated associations of exposure to unexpected economic contraction in each trimester and of individual covariates with birth weight for gestational age outcomes, from multivariable adjusted linear regression models (n=6,715).^a

	Difference in birth weight percentile (95% CI)	Odds ratio for SGA (95% CI)	Odds ratio for term SGA ^b (95% CI)
Unexpected economic contraction			
First trimester	-3.7 (-6.8 to -0.6)	1.5 (1.1 to 2.1)	1.6 (1.2 to 2.3)
Second trimester	-0.1 (-3.1 to 2.9)	1.3 (1.0 to 1.8)	1.2 (0.9 to 1.7)
Third trimester	0.6 (-2.7 to 3.9)	0.7 (0.5 to 1.1)	0.8 (0.5 to 1.2)
Maternal age (years)	-0.3 (-0.6 to 0.1)	1.0 (1.0 to 1.1)	1.0 (1.0 to 1.1)
Maternal race/ethnicity			
Non-Black/non-Hispanic ^c	1.0	1.0	1.0
Black	-11.3 (-13.3 to -9.3)	2.2 (1.8 to 2.8)	2.1 (1.7 to 2.7)
Hispanic	-3.3 (-5.5 to -1.1)	1.0 (0.8 to 1.4)	1.0 (0.8 to 1.4)
Maternal educational attainment (years)			
< 12	-2.9 (-4.9 to -0.8)	1.2 (1.0 to 1.5)	1.2 (0.9 to 1.5)
12 ^c	1.0	1.0	1.0
> 12	2.9 (1.2 to 4.6)	0.6 (0.5 to 0.8)	0.6 (0.5 to 0.8)
Mother married	4.1 (2.4 to 5.7)	0.7 (0.5 to 0.8)	0.6 (0.5 to 0.8)
Maternal employment status			
Employed ^c	1.0	1.0	1.0
Unemployed	-0.7 (-4.0 to 2.6)	1.0 (0.7 to 1.5)	1.1 (0.8 to 1.6)
Keeping house	-1.2 (-3.0 to 0.5)	1.2 (1.0 to 1.5)	1.2 (1.0 to 1.5)
Out of the labor force	-1.1 (-3.8 to 1.5)	1.2 (0.9 to 1.6)	1.2 (0.9 to 1.7)
Mother below federal poverty level	-1.7 (-3.9 to 0.5)	1.0 (0.8 to 1.3)	1.0 (0.8 to 1.3)
Maternal health limitation reported in year of birth	-1.4 (-3.6 to 0.8)	0.9 (0.7 to 1.2)	0.9 (0.7 to 1.2)
Nulliparous mother	-4.7 (-6.2 to -3.1)	1.3 (1.0 to 1.5)	1.3 (1.0 to 1.5)
Maternal pre-pregnancy BMI (kg/m ²)			
<18.5	-5.0 (-7.8 to -2.3)	1.5 (1.1 to 1.9)	1.6 (1.2 to 2.1)
18.5-24.9 ^c	1.0	1.0	1.0
25.0-29.9	4.6 (2.5 to 6.6)	0.7 (0.5 to 0.9)	0.7 (0.5 to 0.9)
>=30	9.7 (7.1 to 12.3)	0.6 (0.4 to 0.8)	0.5 (0.4 to 0.8)

^aModels additionally adjusted for sampling characteristics (economically disadvantaged or military at baseline), state and year fixed effects

^bModels included only term births (SGA vs. non-SGA); n=5,916

^cReference category

Table 3

Difference in birth weight for gestational age percentile among women exposed to unexpected economic contraction in first trimester compared with unexposed women, in groups defined by maternal educational attainment and employment status.^a

Difference in birth weight percentile (95% CI)	
Educational attainment (years)	
<12	-8.8 (-14.6 to -2.9)
12	-2.4 (-7.3 to 2.5)
>12	-1.1 (-6.4 to 4.1)
Maternal employment	
Employed	-1.8 (-6.1 to 2.5)
Unemployed	7.2 (-5.1 to 19.4)
Keeping house	-6.9 (-12.1 to -1.8)
Out of the labor force	-9.1 (-18.9 to 0.8)

^aModels additionally adjusted for maternal age, race/ethnicity, educational attainment, marital status, poverty status, parity, year of birth, sampling characteristics (economically disadvantaged or military at baseline), state and year fixed effects