

Financial strain and birth weight: the mediating role of psychological distress

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Abstract The effects of financial strain during pregnancy have received limited attention. In addition, data examining the pathways by which SES indicators contribute to birth weight are lacking. The objective of the current study was to examine the potential pathway of psychological distress in the relationship between financial strain and birth weight. Participants consisted of 138 pregnant women who completed measures assessing financial strain, depressive symptoms, pregnancy-specific distress, perceived stress, and general anxiety during pregnancy (mean gestational age = 18.5, SD = 7.2). Birth outcome data were obtained via medical record review. Simple and parallel mediation models were conducted using PROCESS. Simple mediation models showed that depressive symptoms (95% CI -24.65, -0.90) and pregnancy-specific distress (95% CI -37.31, -5.91), but not perceived stress (95% CI -31.17, 4.69) or anxiety (95% CI -25.84, 5.57), served as mediators in the relationship between financial strain and birth weight. When depressive symptoms and pregnancy-specific distress were included in the same mediation model, only pregnancy-specific distress remained significant. Financial strain was positively associated with all facets of psychological distress and negatively associated with birth

weight during pregnancy. The current study demonstrated the mechanistic role of pregnancy-specific distress in the link between financial strain and birth weight in a racially diverse sample. Interventions targeting pregnancy-specific distress may mitigate the effects of financial strain on birth weight. Studies examining whether pregnancy-specific distress accounts for the relationship between other types of stressor exposures and birth weight would be informative.

Keywords Financial strain · Pregnancy-specific distress · Depressive symptoms · Birth weight · Pregnancy · Mediation

Introduction

Low birth weight is associated with serious health implications and affects 8.1% of births in the USA (Hamilton et al. 2013; Mattison et al. 2001). One key contributor to the delivery of low birth weight babies is socioeconomic status (SES). Of note, a systematic review with US and international samples found that 93 of 106 studies reported a significant association between various SES measures (e.g., income, employment) and low birth weight, preterm birth, or small for gestational age; adverse birth outcomes were most prevalent in women with low SES (Blumenshine et al. 2010). Thus, evidence suggests that SES is important to consider in this clinically relevant outcome.

Financial conditions (e.g., income) are commonly associated with financial pressure or strain (Conger et al. 1994). Financial strain is considered a stressor exposure with significant mental and physical health effects. For example, studies have shown that financial strain contributes to adverse health outcomes in women, such as increased oxidative stress levels, greater malnutrition risk, lower self-rated health, and recurrent coronary events (Georgiades et al. 2009; Palta et al. 2015;

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Samuel et al. 2012; Shippee et al. 2012). However, data examining the effects of financial strain during pregnancy are limited. These data may be especially important given the relationship between other SES measures (e.g., income) and adverse birth outcomes.

The pathways linking SES indicators to physical health are not well-delineated (Matthews and Gallo 2011). Conceptually, psychological distress has been posited to play a mediating role in the relationship between stressor exposures (e.g., low SES) and birth outcomes (Dunkel Schetter and Lobel 2010; Dunkel Schetter and Tanner 2012); this may be a promising link between financial strain and birth weight. In particular, financial strain may contribute to increased subjective psychological distress which in turn negatively affects birth weight.

In terms of general psychological distress, emerging research demonstrates a relationship between financial strain and antenatal as well as postpartum depressive symptoms (Dailey and Humphreys 2011; Grote and Bledsoe 2007; Husain et al. 2012). Moreover, depressive symptoms have been linked with birth weight, with stronger effects found in women with low SES (Hoffman and Hatch 2000; Paarlberg et al. 1999; Steer et al. 1992; Zimmer-Gembeck and Helfand 1996). In addition, perceived stress and general anxiety are other facets of general distress that may serve as mediators. Data examining the relationship between financial strain and pregnancy-specific distress are lacking; however, this contextually specific anxiety has been shown to play a unique role in contributing to birth outcomes (Lobel et al. 2008). These distinct facets of distress show varying strength in their relation with birth weight (Dunkel Schetter and Lobel 2010); thus, simple and parallel examinations of their potential mediating roles are warranted.

To address gaps within the literature, the current study examined the mediating roles of depressive symptoms, pregnancy-specific distress, perceived stress, and general anxiety in the link between financial strain and birth weight in a racially diverse sample of 138 pregnant women.

Materials and methods

Study design This study included 146 pregnant women who were recruited largely from faculty, staff, and students at the Ohio State University (OSU) and OSU Wexner Medical Center (OSUWMC). Women were also recruited from the OSUWMC Prenatal Clinic and surrounding community of Columbus, Ohio. Data collection occurred from October 2013 to September 2015. The broader study consisted of two visits (baseline and 30 days later) and three blood draws (baseline, 30 days later, and delivery) examining the immunogenicity of pregnant women after receiving the influenza vaccine. Secondary analyses in the current examination utilize

psychosocial data from baseline (prior to vaccination) and birth outcomes obtained via medical record review.

Participants Exclusion criteria included multi-fetal gestation, diagnosed fetal anomaly, chronic conditions (e.g., cancer, systemic lupus erythematosus) or use of medications (e.g., progesterone) with implications for immune function, illicit drug use other than marijuana, and consumption of >2 alcoholic beverages per week per self-report or medical record at time of enrollment. Women were also excluded if they were beyond 30 weeks gestation, reported weight and height consistent with a pre-pregnancy body mass index (BMI) >50, or did not intend to deliver at OSUWMC. Women reporting acute illness, such as cold- or flu-like symptoms, or antibiotic use within 10 days of a study visit were rescheduled. Five women were excluded from the current analyses because their medical records were unavailable. Written informed consent and HIPAA authorizations were obtained from all participants and each received modest compensation. The study was approved by the OSU Biomedical Institutional Review Board.

Demographics and birth outcomes Age, race, marital status, education level, annual household income, employment status of participant, number of prior births (parity), and current smoking status (yes/no to current use) were collected by self-report. Gestational age at delivery and birth weight were obtained via medical record review.

Financial strain This index is comprised of three items which assess financial strain: “How difficult is it for you to live on your total household income right now?,” “In the next two months, how likely is it that you and your family will experience actual hardships, such as inadequate housing, food, or medical attention?,” and “How likely is it that you and your family will have to reduce your standard of living to the bare necessities in life?” (Kessler et al. 1988; Vinokur and Caplan 1987). Participants responded to items on a 5-point scale and items were summed to calculate a total score. Cronbach’s alpha for this measure in this sample was 0.83, which is consistent with non-pregnant samples (Price et al. 2002; Vinokur et al. 1996). This index has been used to assess financial strain in prior prenatal samples (Wright et al. 2010).

Psychological distress The Center for Epidemiologic Studies Depression Scale (CES-D) is a well-validated 20-item measure of cognitive emotional and somatic symptoms of depression (Radloff 1977). The CES-D is predictive of perinatal health and birth outcomes (Christian et al. 2009, 2010; Hoffman and Hatch 2000). The Revised Prenatal Distress Questionnaire (NUPDQ) is a 17-item measure of maternal stress associated with pregnancy, which has been shown to predict birth outcomes (Lobel et al. 2008; Yali and Lobel 1999). The 10-item Perceived Stress Scale (PSS) assesses a

construct independent of depressive symptomatology and has been associated with birth outcomes in perinatal populations (Cohen et al. 1983; Zambrana et al. 1999). The State-Trait Anxiety Inventory (STAI) measures general anxiety and has shown strong criterion, discriminant, and predictive validity in perinatal populations (Meades and Ayers 2011). The state portion of this measure was used in the current study.

Statistical analyses All analyses were conducted in SPSS 22.0. Outliers ($n = 3$), as defined by ± 3 standard deviations from the mean, were removed, resulting in a final analytic sample of 138. Descriptive statistics were calculated for all women. Partial correlations were conducted to examine the relationship between financial strain and birth weight. Bivariate correlations were used to assess the relationships among psychological distress variables. To examine whether depressive symptoms, pregnancy-specific distress, perceived stress, and/or general anxiety served as mediators in relationship between financial strain and birth weight, the widely used approach developed by Preacher and Hayes was employed (Preacher and Hayes 2008). In adhering to this approach, PROCESS macros were used to estimate indirect effects and bootstrap confidence intervals were examined to determine statistical significance (Hayes 2013). Indirect effects, rather than direct effects, were examined because in cases characterized by competitive mediation (i.e., indirect effect has significant opposing signs), a direct effect may not be significant when a mediation is present (28). All mediation models were adjusted for the following covariates: annual household income, employment status, education level, race, smoking status, and gestational age at delivery.

Results

Sample characteristics Demographics, psychological characteristics, and birth weight are summarized in Table 1. Women were between 5 and 31 weeks gestation at the time of assessment (mean = 18.4, SD = 7.2). The average age was 29.3 (SD = 4.9, range 19–42), 61% ($n = 84$) were white, 61% ($n = 84$) were married, and 59% ($n = 82$) reported having some type of college degree.

Financial strain and birth weight A partial correlation was utilized to examine the relationship between financial strain and birth weight, after adjusting for gestational age at delivery. As expected, greater financial strain was negatively associated with birth weight ($r = -0.22$, $p = 0.01$).

Relationships among psychological distress variables Bivariate correlations among depressive symptoms (CES-D), pregnancy-specific distress (NUPDQ), perceived stress (PSS), and general anxiety (STAI) are described in Table 2. All facets

Table 1 Demographic characteristics

	($n = 138$)
Weeks gestation at visit (mean (SD))	18.4 (7.2)
Age (mean (SD))	29.3 (4.9)
Race (n (%))	
White	84 (60.9)
Black	42 (30.4)
Asian	2 (1.4)
Multiracial	10 (7.2)
Marital status (n (%))	
Married	84 (61.3)
In a relationship	33 (24.1)
Single	20 (14.6)
Education (n (%))	
High school graduate or less	22 (15.9)
Some college	34 (24.6)
College degree	38 (27.5)
Graduate school	44 (31.9)
Income (n (%))	
<\$15,000	34 (24.6)
\$15,000–\$29,999	18 (13.0)
\$30,000–\$49,999	17 (12.3)
\$50,000–\$74,999	19 (13.8)
\$75,000–\$99,999	23 (16.7)
>\$100,000	27 (19.6)
Employment status (n (%))	
Employed	93 (67.4)
Unemployed	45 (32.6)
Parity (# of prev. births) (n (%))	
0	50 (36.2)
1	49 (35.5)
2 or more	39 (28.3)
Smoking status (n (%))	
No current use	120 (87.0)
Current use	18 (13.0)
Birth weight (g) (mean (SD))	3281 (546.8)
Low birth weight (<2500 g) (n (%))	11 (8.0)

of psychological distress were positively associated with each other ($r_s = 0.52$ to 0.82 , $p_s < 0.001$).

Mediation models All mediation models were adjusted for income, employment status, education level, race, smoking status, and gestational age at delivery. First, each facet of psychological distress was examined in simple mediation models. Consistent with expectations, depressive symptoms (95% CI -24.65 , -0.90) served as a mediator in the relationship between financial strain and birth weight (Tables 3 and 5). In addition, pregnancy-specific distress (95% CI -37.31 , -5.91) mediated the link between financial strain and birth weight

Table 2 Correlations among psychological distress variables

	Depressive symptoms	Pregnancy-specific distress	Perceived stress	General anxiety
Depressive symptoms	–			
Pregnancy-specific distress	0.54***	–		
Perceived stress	0.75***	0.52***	–	
General anxiety	0.75***	0.57***	0.82***	–

*** $p < 0.001$

(Tables 3 and 5). In contrast, perceived stress (–31.17, 4.69) and general anxiety (–25.84, 5.57) did not serve as mediators in the link between financial strain and birth weight (Tables 4 and 5). Second, given that both depressive symptoms and pregnancy-specific distress served as significant mediators, a parallel multiple mediator model was conducted. Pregnancy-specific distress (–33.20, –0.39) but not depressive symptoms (–20.70, 4.18) remained as a significant mediator when both facets of distress were included in the same model.

Conclusions

The current study demonstrated that financial strain contributed to birth weight in a racially diverse sample of 138 pregnant women. These data extend prior research operationalizing financial stress in terms of traditional SES indicators (e.g.,

income) by showing that greater financial strain is positively associated with depressive symptoms, pregnancy-specific distress, perceived stress, and general anxiety as well as negatively associated with birth weight after adjustment for gestational age. This is consistent with prior data showing a positive relationship between financial strain and depressive symptoms during pregnancy and postpartum (Dailey and Humphreys 2011; Grote and Bledsoe 2007; Husain et al. 2012). In addition, financial strain was linked with birth weight via depressive symptoms and pregnancy-specific distress; further examination showed that this mediation was driven by pregnancy-specific distress.

Prior research has largely examined the direct influence of SES (e.g., employment) on adverse birth outcomes or its role as a moderator with other sociodemographic risk factors (Hoffman and Hatch 2000; Lobel et al. 2008; Paarlberg et al. 1999; Steer et al. 1992; Zimmer-Gembeck and Helfand 1996).

Table 3 Simple mediation analyses for models with depressive symptoms and pregnancy-specific distress

Predictors	Coefficient	SE	95% CI	<i>p</i> value	Coefficient	SE	95% CI	<i>p</i> value
Dependent variable	Depressive symptoms				Birth weight			
Income	–0.50	0.67	–1.82, 0.81	0.45	7.05	33.65	–59.53, 73.63	0.83
Education	0.35	0.96	–1.55, 2.25	0.72	30.53	48.46	–65.35, 126.41	0.53
Employment status	–2.08	2.13	–6.29, 2.12	0.33	–46.32	107.57	–259.14, 166.51	0.67
Race	0.62	0.84	–1.05, 2.29	0.47	16.36	42.65	–68.02, 100.74	0.70
Smoking status	–2.64	2.41	–7.40, 2.13	0.28	–266.59	122.00	–507.97, –25.21	0.03
Length of gestation	–0.12	0.07	–0.26, 0.01	0.07	32.44	3.50	25.53, 39.36	<0.001
Financial strain	1.09	0.29	0.51, 1.68	<0.001	0.17	15.49	–30.47, 30.82	0.99
Depressive symptoms	–	–	–	–	–9.25	4.42	–18.00, –0.50	0.04
Total R^2	0.27			<0.001	0.50			<0.001
Dependent variable	Pregnancy-specific distress				Birth weight			
Income	0.58	0.37	–0.14, 1.30	0.11	22.92	33.73	–43.82, 89.66	0.50
Education	0.38	0.53	–0.66, 1.42	0.47	34.69	48.28	–60.84, 130.22	0.47
Employment status	–0.09	1.17	–2.39, 2.22	0.94	–28.73	106.62	–239.69, 182.21	0.79
Race	0.44	0.46	–0.48, 1.35	0.34	19.11	42.48	–64.95, 103.17	0.65
Smoking status	1.56	1.32	–1.05, 4.17	0.24	–212.13	121.46	–452.44, 28.17	0.08
Length of gestation	–0.03	0.04	–0.10, 0.05	0.45	33.03	3.44	26.22, 39.84	<0.001
Financial strain	1.00	0.16	0.69, 1.32	<0.001	9.41	16.71	–23.64, 42.47	0.57
Pregnancy-specific distress	–	–	–	–	–19.28	8.03	–35.16, –3.40	0.02
Total R^2	0.32			<0.001	0.51			<0.001

Table 4 Simple mediation analyses for models with perceived stress and general anxiety

Predictors	Coefficient	SE	95% CI	p value	Coefficient	SE	95% CI	p value
Dependent variable	Perceived stress				Birth weight			
Income	0.69	0.48	-0.24, 1.62	0.15	18.17	34.13	-49.36, 85.69	0.60
Education	0.39	0.68	-0.95, 1.73	0.56	31.01	48.90	-65.73, 127.75	0.53
Employment status	-1.10	1.50	-4.07, 1.87	0.47	-37.37	108.27	-251.59, 176.84	0.73
Race	0.78	0.60	-0.41, 1.95	0.20	17.87	43.18	-67.57, 103.30	0.68
Smoking status	-2.13	1.70	-5.49, 1.24	0.21	-262.23	123.17	-505.92, -18.54	0.04
Length of gestation	0.02	0.05	-0.08, 0.11	0.69	33.76	3.48	26.87, 40.65	<0.001
Financial strain	1.24	0.21	0.83, 1.64	<0.001	1.73	16.78	-31.44, 34.91	0.92
Perceived stress	-	-	-	-	-9.41	6.31	-21.91, 3.08	0.14
Total R ²	0.26			<0.001	0.49			<0.001
Dependent variable	General anxiety				Birth weight			
Income	0.31	0.78	-1.24, 1.86	0.69	12.98	34.01	-54.31, 80.27	0.70
Education	1.60	1.13	-0.64, 3.83	0.16	33.87	49.40	-63.88, 131.62	0.49
Employment status	-0.71	2.50	-5.66, 4.25	0.78	-29.96	108.52	-244.67, 184.75	0.78
Race	0.82	0.99	-1.14, 2.79	0.41	14.02	43.19	-71.44, 99.48	0.75
Smoking status	-2.30	2.84	-7.91, 3.31	0.42	-251.63	123.24	-495.46, -7.80	0.04
Length of gestation	0.002	0.08	-0.16, 0.16	0.98	33.59	3.49	26.68, 40.50	<0.001
Financial strain	2.08	0.34	1.40, 2.76	<0.001	-1.37	16.87	-34.74, 32.00	0.94
General anxiety	-	-	-	-	-4.11	3.80	-11.63, 3.41	0.28
Total R ²	0.28			<0.001	0.49			<0.001

Zhao and colleagues examined smoking during pregnancy, second-hand smoking, drinking, substance use, and gestational weight gain as potential mediators in the link between financial stress, as measured by SES indicators and inability to pay bills, and delivering babies of low birth weight among 2053 African American women (2015). Results did not support these health behaviors as serving mediating roles (Zhao et al. 2015). The current study extends this literature by showing the mechanistic role of pregnancy-specific distress in the link between financial strain and birth weight. Replication of these findings will help elucidate whether this model applies to the relationship between other types of stressor exposures (e.g., discrimination) and birth weight, as posited in the literature (Dunkel Schetter and Lobel 2010; Dunkel Schetter and Tanner 2012).

Pregnancy-specific distress and depressive symptoms both served as mediators in the link between financial strain and

birth weight in separate models; however, when included in the same model, only pregnancy-specific distress remained significant. This was over and beyond the effect of smoking status, a known contributor to reduced birth weight (Gissler et al. 2003; Villalbí et al. 2007). While pregnancy-specific measures demonstrate convergent validity with other types of distress, they assess a distinct construct in the context of pregnancy (Alderdice et al. 2012). In fact, prior studies show a particularly potent effect of pregnancy-specific distress on adverse birth outcomes (Dunkel Schetter and Lobel 2010; Dunkel Schetter and Tanner 2012; Lobel et al. 2008). The current study provides support for these studies by showing that pregnancy-specific distress is a primary factor linking financial strain and birth weight.

In the current study, perceived stress and general anxiety did not mediate the relationship between financial strain and birth weight. This is consistent with prior studies showing

Table 5 Simple mediation models

Mediation models	95% CI estimates
Financial strain → depressive symptoms → birth weight	(-24.65, -0.90) ^a
Financial strain → pregnancy-specific distress → birth weight	(-37.31, -5.91) ^a
Financial strain → perceived stress → birth weight	(-31.17, 4.69)
Financial strain → general anxiety → birth weight	(-25.84, 5.57)

* Significant effect

^a Pregnancy-specific distress (95% CI -33.20, -0.39), but not depressive symptoms (95% CI -20.70, 4.18), remained as a significant mediator when both facets of distress were included in the same model

small and non-significant effects in the relationship between perceived stress and birth weight as well as general anxiety and birth weight (Dunkel Schetter and Lobel 2010; Dunkel Schetter and Tanner 2012). While these facets of distress may be associated with other types of health outcomes during pregnancy, if efforts are aimed at improving adverse birth outcomes, it seems particularly important to focus attention on pregnancy-specific distress.

The current findings are of clinical relevance. Interventions targeting pregnancy-specific distress may mitigate the effects of financial strain on birth weight in pregnant women. Evidence has shown that some therapeutic interventions targeting distress, such as relaxation techniques, improve birth outcomes (e.g., Beddoe and Lee 2008). Examination of the reduction of pregnancy-specific distress as a mechanism of change in improving these outcomes would be fruitful. In addition, the unique aspects of pregnancy-specific distress should be considered in the development and evaluation of clinical screenings and interventions associated with improving birth weight outcomes. This recommendation is consistent with prior literature summarizing the predictive value of pregnancy-specific distress on preterm birth (Alderdice et al. 2012).

Birth weight was examined as a continuous outcome in the current study. Consistent with rates in the larger US population (Hamilton et al. 2013), clinically defined low birth weight (<2500 g) affected 8% ($n = 11$) of infants in the current study which did not provide statistical power to utilize this variable dichotomously. However, continuous assessment of birth weight has been associated with both child and adult health outcomes, including cognitive functioning (Breslau et al. 1996; Matte et al. 2001; Richards et al. 2001; Sørensen et al. 1997). Thus, information gleaned from these analyses is applicable to the larger literature base. However, replication of these findings in a larger cohort with sufficient power to examine clinically low birth weight would be informative.

In addition, mechanistic research including biomarkers would be fruitful in describing more comprehensive models. Low SES, as defined by traditional SES indicators such as income, has been linked with heightened concentrations of serum proinflammatory markers, including interleukin-6, tumor necrosis factor- α , and C-reactive protein (Friedman and Herd 2010; Gruenewald et al. 2009; Koster et al. 2006; Loucks et al. 2010; Morozink et al. 2010; Ranjit et al. 2007). Data examining the relationship between financial strain and cytokines is lacking, despite the fact that maternal inflammatory markers have been implicated in adverse birth outcomes (Blair et al. 2015; Coussons-Read et al. 2012; Sorokin et al. 2010). Thus, data on the role of biomarkers would further elucidate the relationship between financial strain and birth weight.

This study did not examine outcomes beyond birth weight. As described earlier, financial strain has been shown to

contribute to a myriad of adverse health outcomes in women, including increased oxidative stress levels, greater malnutrition risk, lower self-rated health, and recurrent coronary events (Georgiades et al. 2009; Palta et al. 2015; Samuel et al. 2012; Shippee et al. 2012). Research within the context of pregnancy and postpartum has primarily operationalized financial stress utilizing traditional SES indicators (e.g., income) and financial events (e.g., loss of employment). This study provides support for the inclusion of financial strain in studies examining clinically relevant outcomes during pregnancy.

In sum, this study provides novel data on the role of financial strain in contributing to lower birth weight among a racially diverse sample of 138 pregnant women. These findings demonstrate that pregnancy-specific distress and depressive symptoms, but not perceived stress or general anxiety, serve as mediators in the relationship between financial strain and birth weight in pregnant women. In addition, the current data showed that only pregnancy-specific distress remained as a significant mediator when included in a multiple mediator model with depressive symptoms. Thus, future studies examining the impact of interventions reducing pregnancy-specific distress on the relationship between financial strain and birth weight are warranted. In addition, examination of whether psychological distress accounts for the relationship between other types of stressor exposures and birth weight would be informative.

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Compliance with ethical standards The study was approved by the OSU Biomedical Institutional Review Board.

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