

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

Amanda M. Mitchell^{1,2} · Lisa M. Christian^{1,2,3,4}

Received: 16 June 2016 / Accepted: 22 November 2016 / Published online: 13 December 2016
© Springer-Verlag Wien 2016

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;

✉ Lisa M. Christian
Lisa.Christian@osumc.edu

¹ Department of Psychiatry & Behavioral Health, The Ohio State University Wexner Medical Center, Columbus, OH, USA

² Institute for Behavioral Medicine Research, The Ohio State University Wexner Medical Center, 460 Medical Center Drive, Room 112, Columbus, OH 43210, USA

³ Department of Psychology, The Ohio State University, Columbus, OH, USA

⁴ Department of Obstetrics and Gynecology, The Ohio State University Wexner Medical Center, Columbus, OH, USA

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	<i>p</i> value	Coefficient	SE	95% CI	<i>p</i> 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 <i>R</i> 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 <i>R</i> 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.

Acknowledgments We appreciate the contributions of our Clinical Research Assistants and students to data collection. We would like to thank our study participants and the staff at the OSU Clinical Research Center and Wexner Medical Center Prenatal Clinic.

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

Financial disclosures This study was supported by the National Institutes of Health (R01 NR01366). The project described was supported by Award Number Grant UL1TR001070 from the National Center for Advancing Translational Sciences. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Center for Advancing Translational Sciences or the National Institutes of Health.

Conflicts of interest The authors declare that they have no conflicts of interest.

References

- Alderdice F, Lynn F, Lobel M (2012) A review and psychometric evaluation of pregnancy-specific stress measures. *J Psych Obstet Gynecol* 33:62–77
- Beddoe AE, Lee KA (2008) Mind-body interventions during pregnancy. *J Obstet Gynecol Neo Nurs* 37:165–175

- Blair L, Porter K, Leblebicioglu B, Christian L (2015) Poor sleep quality and associated inflammation predict preterm birth: heightened risk among African Americans. *Sleep* 38:1259–1267
- Blumenshine P, Egarter S, Barclay CJ, Cubbin C, Braveman PA (2010) Socioeconomic disparities in adverse birth outcomes: a systematic review. *Am J Prev Med* 39:263–272
- Breslau N, Chilcoat H, DelDotto J, Andreski P, Brown G (1996) Low birth weight and neurocognitive status at six years of age. *Biol Psychiatry* 40:389–397
- Christian LM, Franco A, Glaser R, Iams JD (2009) Depressive symptoms are associated with elevated serum proinflammatory cytokines among pregnant women. *Brain Behav Immun* 23:750–754. doi:10.1016/j.bbi.2009.02.012
- Christian LM, Franco A, Iams JD, Sheridan J, Glaser R (2010) Depressive symptoms predict exaggerated inflammatory responses to an in vivo immune challenge among pregnant women. *Brain Behav Immun* 24:49–53. doi:10.1016/j.bbi.2009.05.055
- Cohen S, Kamarck T, Mermelstein R (1983) A global measure of perceived stress. *J Health Soc Behav* 385–396
- Conger RD, Ge X, Elder GH, Lorenz FO, Simons RL (1994) Economic stress, coercive family process, and developmental problems of adolescents. *Child Dev* 65:541–561
- Coussons-Read ME et al (2012) The occurrence of preterm delivery is linked to pregnancy-specific distress and elevated inflammatory markers across gestation. *Brain Behav Immun* 26:650–659
- Dailey DE, Humphreys JC (2011) Social stressors associated with antepartum depressive symptoms in low-income African American women. *Public Health Nurs* 28:203–212
- Dunkel Schetter C, Lobel M (2010) Pregnancy and birth: a multilevel analysis of stress and birth weight. In: Revenson TA, Baum A, Singer J (eds) *Handbook of health psychology*. Psychology Press, New York, pp 431–464
- Dunkel Schetter C, Tanner L (2012) Anxiety, depression and stress in pregnancy: implications for mothers, children, research, and practice. *Curr Opin Psychiatry* 25:141
- Friedman EM, Herd P (2010) Income, education, and inflammation: differential associations in a national probability sample (the MIDUS study). *Psychosom Med* 72:290
- Georgiades A, Janszky I, Blom M, László KD, Ahnve S (2009) Financial strain predicts recurrent events among women with coronary artery disease. *Int J Cardiol* 135:175–183
- Gissler M, Meriläinen J, Vuori E, Hemminki E (2003) Register based monitoring shows decreasing socioeconomic differences in Finnish perinatal health. *J Epidemiol Community Health* 57:433–439
- Grote NK, Bledsoe SE (2007) Predicting postpartum depressive symptoms in new mothers: the role of optimism and stress frequency during pregnancy. *Health Soc Work* 32:107–118
- Gruenewald TL, Cohen S, Matthews KA, Tracy R, Seeman TE (2009) Association of socioeconomic status with inflammation markers in black and white men and women in the coronary artery risk development in young adults (CARDIA) study. *Soc Sci Med* 69:451–459
- Hamilton BE, Hoyert DL, Martin JA, Strobino DM, Guyer B (2013) Annual summary of vital statistics: 2010–2011. *Pediatrics* 548–558
- Hayes AF (2013) Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. Guilford Press
- Hoffman S, Hatch MC (2000) Depressive symptomatology during pregnancy: evidence for an association with decreased fetal growth in pregnancies of lower social class women. *Health Psychol* 19:535
- Husain N, Cruickshank K, Husain M, Khan S, Tomenson B, Rahman A (2012) Social stress and depression during pregnancy and in the postnatal period in British Pakistani mothers: a cohort study. *J Affect Disord* 140:268–276
- Kessler RC, Turner JB, House JS (1988) Effects of unemployment on health in a community survey: main, modifying, and mediating effects. *J Soc Issues* 44:69–85
- Koster A et al (2006) Association of inflammatory markers with socioeconomic status. *J Gerontol Ser A Biol Med Sci* 61:284–290
- Lobel M, Cannella DL, Graham JE, DeVincent C, Schneider J, Meyer BA (2008) Pregnancy-specific stress, prenatal health behaviors, and birth outcomes. *Health Psychol* 27:604
- Loucks EB, Pilote L, Lynch JW, Richard H, Almeida ND, Benjamin EJ, Murabito JM (2010) Life course socioeconomic position is associated with inflammatory markers: the Framingham Offspring Study. *Soc Sci Med* 71:187–195
- Matte TD, Bresnahan M, Begg MD, Susser E (2001) Influence of variation in birth weight within normal range and within sibships on IQ at age 7 years: cohort study. *BMJ* 323:310–314
- Matthews KA, Gallo LC (2011) Psychological perspectives on pathways linking socioeconomic status and physical health. *Annu Rev Psychol* 62:501
- Mattison DR, Damus K, Fiore E, Petrini J, Alter C (2001) Preterm delivery: a public health perspective. *Paediatr Perinat Epidemiol* 15:7–16
- Meades R, Ayers S (2011) Anxiety measures validated in perinatal populations: a systematic review. *J Affect Disord* 133:1–15
- Morozink JA, Friedman EM, Coe CL, Ryff CD (2010) Socioeconomic and psychosocial predictors of interleukin-6 in the MIDUS national sample. *Health Psychol* 29:626
- Paarberg KM, Vingerhoets J, Passchier J, Dekker GA, Heinen AG, Geijn HP (1999) Psychosocial predictors of low birthweight: a prospective study. *BJOG: Int J Obst Gynaecol* 106:834–841
- Palta P, Szanton SL, Semba RD, Thorpe RJ, Varadhan R, Fried LP (2015) Financial strain is associated with increased oxidative stress levels: the women's health and aging studies. *Geriatr Nurs* 36:S33–S37
- Preacher KJ, Hayes AF (2008) Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav Res Methods* 40:879–891
- Price RH, Choi JN, Vinokur AD (2002) Links in the chain of adversity following job loss: how financial strain and loss of personal control lead to depression, impaired functioning, and poor health. *J Occup Health Psychol* 7:302
- Radloff LS (1977) The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Meas* 1:385–401. doi:10.1177/014662167700100306
- Ranjit N, Diez-Roux AV, Shea S, Cushman M, Ni H, Seeman T (2007) Socioeconomic position, race/ethnicity, and inflammation in the multi-ethnic study of atherosclerosis. *Circulation* 116:2383–2390
- Richards M, Hardy R, Kuh D, Wadsworth ME (2001) Birth weight and cognitive function in the British 1946 birth cohort: longitudinal population based study. *BMJ* 322:199–203
- Samuel LJ, Szanton SL, Weiss CO, Thorpe RJ, Semba RD, Fried LP (2012) Financial strain is associated with malnutrition risk in community-dwelling older women. *Epidemiol Res Int*
- Shippee TP, Wilkinson LR, Ferraro KF (2012) Accumulated financial strain and women's health over three decades. *J Gerontol Ser B Psychol Sci Soc Sci* 67:585–594
- Sørensen HT, Sabroe S, Olsen J, Rothman KJ, Gillman MW, Fischer P (1997) Birth weight and cognitive function in young adult life: historical cohort study. *BMJ* 315:401–403
- Sorokin Y et al (2010) Maternal serum interleukin-6, C-reactive protein, and matrix metalloproteinase-9 concentrations as risk factors for preterm birth <32 weeks and adverse neonatal outcomes. *Am J Perinatol* 27:631
- Steer RA, Scholl TO, Hediger ML, Fischer RL (1992) Self-reported depression and negative pregnancy outcomes. *J Clin Epidemiol* 45:1093–1099
- Villalbí JR, Salvador J, Cano-Serral G, Rodríguez-Sanz MC, Borrell C (2007) Maternal smoking, social class and outcomes of pregnancy. *Paediatr Perinat Epidemiol* 21:441–447
- Vinokur A, Caplan RD (1987) Attitudes and social support: determinants of job-seeking behavior and well-being among the unemployed. *J Appl Soc Psychol* 17:1007–1024

- Vinokur AD, Price RH, Caplan RD (1996) Hard times and hurtful partners: how financial strain affects depression and relationship satisfaction of unemployed persons and their spouses. *J Pers Soc Psychol* 71:166
- Wright RJ et al (2010) Prenatal maternal stress and cord blood innate and adaptive cytokine responses in an inner-city cohort. *Am J Respir Crit Care Med* 182:25–33
- Yali AM, Lobel M (1999) Coping and distress in pregnancy: an investigation of medically high risk women. *J Psych Obstet Gynecol* 20:39–52
- Zambrana RE, Dunkel-Schetter C, Collins NL, Scrimshaw SC (1999) Mediators of ethnic-associated differences in infant birth weight. *J Urban Health* 76:102–116
- Zhao Y, Kershaw T, Ettinger AS, Higgins C, Lu MC, Chao SM (2015) Association between life event stressors and low birth weight in African American and White populations: findings from the 2007 and 2010 Los Angeles Mommy and Baby (LAMB) Surveys. *Mater Child Health J* 1–11
- Zimmer-Gembeck MJ, Helfand M (1996) Low birthweight in a public prenatal care program: behavioral and psychosocial risk factors and psychosocial intervention. *Soc Sci Med* 43:187–197