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Maternal Psychosocial Risk Profiles in Pregnancy: Associations With Postpartum Maternal Health and Child Outcomes

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Abstract

Previous research on prenatal stress and social support has primarily involved variable-centered approaches, with limited knowledge on whether profiles exist, how early childhood adversity experiences predict these profiles, and whether these profiles are differentially associated with maternal and child outcomes postnatally. Using a pregnancy cohort (N = 1,994), we identify three distinct profiles of maternal stress and maternal social support: low stress–high support (69.4%), moderate stress–moderate support (25.7%), and high stress–low support (4.9%). Mothers in the high stress–low support group experienced more physical/emotional abuse in childhood, whereas mothers in the moderate stress–moderate support group experienced more family dysfunction. The moderate and the high stress groups had poorer reproductive and physical health, and mothers reported their children had poorer developmental outcomes compared with the low stress–high support mothers. Identifying levels of stress and social support in pregnancy and implementing interventions for mothers at risk is crucial in the pursuit to mitigate family-wide deleterious outcomes.

Keywords

maternal stress, social support, adverse childhood experiences, developmental outcomes

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The World Health Organization has deemed maternal mental health problems to be a global public health concern: Between 10% and 20% of women experience mental health difficulties in pregnancy and the postpartum period (O'Hara & Swain, 1996; WHO, 2015). A primary risk factor for developing mental health difficulties in pregnancy is prenatal stress (Melville, Gavin, & Guo, 2010). Prenatal stress, defined as the inability to cope with daily hassles and difficult life circumstances (Bornstein, 2016), can have a cascading influence on maternal physical and psychosocial health, as well as fetal and offspring physical, cognitive, and behavioral developmental health. For example, prenatal stress, operationalized as psychological distress (e.g., anxiety and depression), has been associated with preterm birth and low birth weight (Bussieres et al., 2015; Ding et al., 2014; Dunkel Schetter, 2011; Orr, Reiter, Blazer, & James, 2007; Roy-Matton, Moutquin, Brown, Carrier, & Bell, 2011; Tarabulsy et al., 2014), two salient predictors of morbidity and mortality among newborn infants (D'Onofrio et al., 2013). High levels of prenatal stress are also associated with poor postpartum mental health (Grant, McMahon, & Austin, 2008) as well as poorer cognitive and socioemotional development (Tarabulsy et al., 2014) in offspring. Thus, from a public health standpoint, research examining risk and protective factors associated with prenatal stress is critical.

Perceived stress has not received the same level of inquiry in the literature compared with both prenatal

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depression and anxiety and thus merits further investigation. While anxiety and depression refer to specific psychological symptoms, including worry for anxiety and low mood for depression, stress refers to an individual's perception of an event or experience and the person's own individual resources to manage or deal with the circumstance (Lazarus & Folkman, 1984). Measures of perceived stress capture the individual's negative affect, loss of control, and low perceived ability to manage the situation (Cohen, Kamarck, & Mermelstein, 1983).

Prenatal maternal stress can be, at least partially, mitigated by social support (Dunkel Schetter, 2011; Feldman, Dunkel-Schetter, Sandman, & Wadhwa, 2000). Social support can include emotional as well as tangible resources (e.g., aid, materials) provided by other individuals (Cohen & Wills, 1985). It is well documented that women who receive adequate social support in pregnancy have better emotional health (Feinberg et al., 2016; Morikawa et al., 2015; Rini, Dunkel Schetter, Hobel, Glynn, & Sandman, 2006), secrete lower levels of cortisol (Giesbrecht et al., 2013), and have infants with better birth and developmental outcomes (Feldman et al., 2000). A notable gap in the literature is whether profiles of women can be identified on the basis of levels of prenatal stress and social support, which are intricately linked. Examining prenatal stress and social support in tandem provides a realistic and clinically relevant snapshot of maternal psychosocial risk in pregnancy and can facilitate the identification of women who are most in need of intervention.

Consideration of prenatal stress and social support from a person-centered perspective

The buffering effect of social support has traditionally been examined using moderation models whereby the influence of stress on an outcome differs in accordance with low versus high levels of social support (Cohen & Wills, 1985). Moderation analyses, which use a variable-centered approach, make an important contribution by identifying how estimates of stress and social support at the sample level interact to influence outcomes (Howard & Hoffman, 2017). However, this method does not adequately capture profiles of individuals who may have varying levels of risk and different outcomes based on these levels. Person-centered approaches, such as latent profile analysis (LPA), address this limitation by identifying subgroups or profiles of individuals as well as predictors and outcomes of profile group membership, facilitating the identification of individuals who are particularly at risk (Howard & Hoffman, 2017; Laursen & Hoff, 2006).

Recent work has started to use person-centered approaches to examine stress and mental health in both pregnancy and the postpartum period (Fredriksen, von Soest, Smith, & Moe, 2017; Mukherjee, Coxe, Fennie, Madhivanan, & Trepka, 2017). A study examining stressful life events in pregnancy identified three groups of women including a low-stress class (64%), an illness/death-related class (13%), and a multiple stressors class (22%), indicating that stress in pregnancy is common and can be differentiated across groups of individuals (Mukherjee et al., 2017). Another recent study examined whether depressive symptoms in the perinatal period could be characterized into subgroups; the authors found four latent classes of perinatal depressive symptoms varying by timing and severity of symptoms (Fredriksen et al., 2017). Together, these studies highlight the immense clinical utility of person-centered approaches and provide insight into the presentation and trajectory of stress and mental health in the perinatal period. To our knowledge, no researchers to date have examined profiles of women in pregnancy on the basis of stress and concurrent levels of social support. The identification of subgroups of women on the basis of prenatal stress and social support profiles could inform screening methods used in the clinical setting.

Screening tools are typically used to identify women in pregnancy who have either low or high levels of psychosocial risk on the basis of a predetermined criterion (Austin, Colton, Priest, Reilly, & Hadzi-Pavlovic, 2013; Spyridou, Schauer, & Ruf-Leuschner, 2015). A person-centered approach moves beyond simply identifying women who are, or are not, at risk, effectively identifying groups of women who may experience moderate or subclinical levels of psychosocial difficulties, but who, compared with those at low risk, are likely to experience poor outcomes, such as perinatal physical or emotional health complications. To ensure that women with moderate levels of stress and low social support are not being missed with current screening criteria, it is important to determine whether moderate levels of risk can be identified and, subsequently, to identify predictors of the moderate risk profile. Furthermore, it would be important to determine whether a moderate risk profile is associated with poor outcomes similarly or differently than profiles of women with high risk and low social support.

Predictors of prenatal stress and social support profiles

There are a number of individual and environmental factors that are associated with levels of prenatal stress and social support in pregnancy including ethnic minority status, poverty, a history of emotional problems or

abuse, and previous mental health difficulties (Verreault et al., 2014). Exposure to adversity and abuse in childhood has been identified as a salient predictor of psychosocial difficulties in pregnancy including stress, anxiety, depression, and low social support (Jacobs, 1992; Racine, Madigan, Plamondon, MacDonald, & Tough, 2018; Roberts, O'Connor, Dunn, Golding, & ALSPAC Study Team, 2004; Smith, Gotman, & Yonkers, 2016). Women who grow up in "risky families," characterized by recurrent episodes of aggression, abuse, and neglect, are more vulnerable to deficits in the expression of emotion, social competence, and mental health, all of which are risk factors for stress and low social support in pregnancy (Repetti, Taylor, & Seeman, 2002). Recent research has emphasized the importance of disentangling various types of adverse experiences of childhood (ACEs; e.g., physical abuse, emotional abuse, sexual abuse, and household dysfunction) on adult psychosocial and health outcomes (Bush, Lane, & McLaughlin, 2016). Identifying which sociodemographic factors and types of ACEs are predictive of groups of stress and social support in pregnancy provides the opportunity to tailor treatment to profiles with the most potential for deleterious outcomes.

Maternal postpartum physical health, mental health, and child outcomes

The mechanisms by which maternal psychosocial risk in pregnancy influence maternal mental and physical health and child development in the postpartum period are complex. One possibility is that a negative developmental cascade may be precipitated by prenatal stress and low social support leading to infant health risks and poor postpartum mental health, which subsequently leads to poor child developmental outcomes (Glover, 2014; Goldenberg, Culhane, Iams, & Romero, 2008; Kinsella & Monk, 2009; Madigan et al., 2018).

Maternal stress during pregnancy can have a negative influence on offspring growth and development (Van den Bergh et al., 2017). A meta-analysis of 91 effect sizes by Madigan et al. (2018) demonstrated that prenatal stress is associated with a significantly increased risk of having children with behavioral difficulties. In the first year of life, infants begin to develop skills across multiple domains of development including communication, motor, problem solving, and social domains. The importance of examining the influence of prenatal maternal stress across these domains, particularly in young children, has been highlighted as a critical direction for research (Simcock et al., 2016).

Previous studies have used the Ages and Stages Questionnaire (ASQ) to assess early child development as it is easily used in population-level epidemiological studies and in clinical practice as a result of its ease of administration and cost-effectiveness (Simcock et al., 2016). Despite these strengths, the ASQ is a parent-report questionnaire and thus relies on a single informant. Thus, the child outcomes in the current study are secondary to the maternal mental and physical health outcomes described above. In the current study, we investigate how profiles of prenatal stress and social support are associated with domains of infant development, which often forecast developmental health and functioning in childhood and beyond (Briggs-Gowan & Carter, 2008).

The current study

The current study examines profiles of prenatal stress and social support in pregnancy in a large community-based sample of women who were followed from pregnancy into the postpartum period and when their infants were 12 months of age. The aims of this study were, first, to identify heterogeneous profiles of prenatal stress and social support in pregnancy. Previous research using latent class analysis of stress in pregnancy suggests that at least three classes should be expected (Mukherjee, Coxe, Fennie, Madhivanan, & Trepka, 2017). The second aim was to examine whether types of adversity experienced in childhood as well as concurrent sociodemographic risk indicators (i.e., maternal age, income, maternal education) differentiate profiles. It is hypothesized that belonging to a profile with higher stress and lower social support will be associated with higher levels of adversity in childhood as well as lower maternal age, income, and education. The final aim was to examine whether profile groups would differentiate maternal physical and mental health outcomes in the postpartum period as well as maternal-reported child development outcomes at child age 12 months. It is hypothesized that profiles characterized by high prenatal stress in pregnancy and low social support will be associated with poorer maternal physical and mental health in the postpartum period and that infants of these mothers will demonstrate poorer development.

Method

Setting and population

This study was part of a larger prospective pregnancy cohort (All Our Babies/Families; AOB/AOF; McDonald et al., 2013; Tough et al., 2017), which aims to examine the determinants of maternal and infant health outcomes in the child's early years. From May 2008 to December 2010, 3,387 pregnant women were recruited from the community and health care and laboratory

offices in Calgary, Alberta, Canada. Inclusion criteria were (a) less than 25 weeks gestational age, (b) maternal age 18 years or greater, (c) receipt of prenatal care, and (d) fluency in English. Approximately 84% of approached women agreed to participate. Participants included in this secondary analysis of the data were 1,994 women (69% of the eligible sample) who provided data about their history of adverse childhood experiences prior to age 18. Women completed questionnaires in pregnancy (< 25 weeks and 35 weeks) as well as in the postnatal period at 4, 12, 24, and 36 months of age. Time points used in the current study include less than 25 weeks of gestation for baseline demographic and psychosocial variables, 4 and 12 months of age for maternal mental health and child development outcomes, and 36 months of age for the ACEs measurement. At less than 25 weeks of gestation and 4 months postpartum, women completed self-report questionnaires on their health and well-being. When their infants were 12 months of age, women completed a questionnaire about their child's development, and at 36 months women provided a retrospective report of the adversity they experienced in childhood. Additional information about study recruitment, data collection, questionnaires utilized, and attrition are detailed elsewhere (Gracie et al., 2010; McDonald et al., 2013; Tough et al., 2017). The study was approved by the institutional ethics review board at the University of Calgary, and written informed consent was obtained from all participants.

Measures

Prenatal and postpartum stress. Information on prenatal stress was obtained in pregnancy (indicator in the LPA analysis) and at 4 months postpartum (used as an outcome) via maternal self-report using the Perceived Stress Scale (PSS) questionnaire (Cohen et al., 1983). The PSS is a 10-item scale assessing levels of life stress (e.g., ability to cope with unexpected life events, feeling nervous or stressed, and ability to overcome and manage difficulties) and has a total score ranging from 0 to 40 where higher scores are indicative of higher levels of stress. The PSS has an acceptable internal consistency (Cronbach's alpha = .85) and has been established as an appropriate measurement for prenatal stress (Solivan, Xiong, Harville, & Buekens, 2015).

Maternal social support in pregnancy. Maternal social support in pregnancy was operationalized using scores from the Medical Outcomes Study Social Support Survey (MOS-SS; Sherbourne & Stewart, 1991). The MOS-SS is a 19-item self-report measure of functional social support and includes four domains that were included in the current study: emotional/informational support, tangible support, positive social interaction, and affection. The scale developer defines the domains of social support as follows (Sherbourne & Stewart, 1991): (a) Emotional/information support refers the expression of positive affect, demonstrating empathy and encouragement, as well as offering advice, information or feedback; (b) tangible support refers to the provision of material support or behavioral assistance; (c) positive social interaction refers to the availability of other people to socialize and do fun activities with; and (d) affective supports refers to receiving expression of love and affection from another individual. The MOS-SS has been used extensively in perinatal research and has high psychometric properties (Sherbourne & Stewart, 1991). The internal consistency of the MOS-SS was measured with a Cronbach's alpha of .96 in this sample. All four of the subscales were included as indicators in the LPA.

Maternal adverse childhood experiences (ACEs). Mothers were asked to recall any adverse childhood events using a detailed questionnaire that was adapted from the original ACE checklist (Felitti et al., 1998). Consistent with previous research (Felitti et al., 1998), questions assessed exposure to different types of abuse experienced prior to age 18 (i.e., physical abuse, sexual abuse, emotional abuse, parent mental illness, parental substance abuse, parent incarceration, domestic violence, and divorce). Rather than reporting only whether an adversity had occurred or not, for physical, emotional, and sexual abuse questions women reported the frequency as *never* (score of 1), *once* (score of 2), or *more than once* (score of 3). Household dysfunction items were reported as either having occurred (score of 1) or not occurred (score of 0). Using a confirmatory factor analysis, previous work has identified three specific factors among the ACE items (Ford et al., 2014), which map on to a higher order general factor of child maltreatment. Factor 1, Household Dysfunction, consists of five items describing disturbance in the childhood home environment including family mental illness, family alcohol abuse, family drug abuse, parental separation or divorce, and parental incarceration. Factor 2, labeled Physical/Emotional Abuse, consists of three items assessing violent and emotional abuse both toward the child and between parents. The last three items pertained to inappropriate childhood sexual experience, and all load on to a Sexual Abuse factor. For the current study, the same factors were computed by calculating a mean of the corresponding items that were described above. Means were included to capture the data on frequency for the abuse variables. The assessment of ACEs occurred at 36 months of age as interest in this variable by study collaborators was identified only at this time. Previous work has indicated that retrospective

reports of ACEs are valid in adulthood and carry a low rate of false positives (Hardt & Rutter, 2004).

Antepartum health risk. The Antepartum Risk Score is based on a 39-item questionnaire that is used by health care providers (e.g., physician, nurse, or midwife) to evaluate the medical risk of women giving birth (Parboosingh, 1986). The Antepartum Risk Score includes prepregnancy risk factors, past obstetrical risk factors, problems in the current pregnancy, and other risk factors. Example items include age at delivery, maternal weight, diabetes, heart disease, hypertension, chronic renal disease, other medical disorders (e.g., epilepsy, severe asthma, lupus, Crohn's disease), previous neonatal death or stillbirth, history of abortion, history of cesarean section, bleeding in current pregnancy, gestational hypertension, poor weight gain, smoking, and substance abuse. In the current study, a health care provider (i.e., physician, nurse, or midwife) completed the Antepartum Risk Score at the time of the child birth in the health care setting. A weighted value is assigned for each condition in the risk assessment tool, with a higher value used for more severe conditions, and the total score is the sum of all the weighted values. According to the initial validation (Parboosingh, 1986), pregnancies with risk scores of 0 to 2 are considered low risk, scores of 3 to 6 indicate moderate risk, and any risk score above 6 indicates a higher risk pregnancy. The score can range from a low of 0 to a high of 90 if every potential risk item was endorsed.

Maternal postpartum depression. Maternal postpartum depression at 4 months postpartum was assessed using the Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987), which is a 10-item questionnaire related to symptoms of depression including sadness, anhedonia, and difficulty sleeping. Scores range from 0 to 30 with higher scores indicating higher depressive symptomatology. The EPDS has demonstrated excellent reliability and validity and is extensively used in the perinatal literature (Bergink et al., 2011).

Maternal physical and mental health. The SF-12 was used to operationalize maternal physical and mental health at 4 months postpartum. The SF-12 (Ware, Kosinski, & Keller, 1996) measures health-related quality of life with 12 items and is summed into two scales: the physical component summary score and the mental component summary score. The physical health component summary score includes items related to physical functioning, being limited by physical ability, bodily pain, and general health. The mental health summary score includes items related to energy/vitality, social functioning, being limited by emotional difficulties, anxiety, and sadness. Higher scores indicate better quality of life (Ware et al., 1996). The raw scores of each item are coded, weighted, and summed into the two scales with higher scores indicating better health and mental-health. Scores are standardized to a mean of 50 with a standard deviation of 10. The SF-12 has been extensively used in longitudinal studies and provides summary scores that are reliable with longer questionnaire (Jenkinson et al., 1997).

Child development outcome. Mothers reported on their child's developmental functioning at 12 months of age using the Ages and Stages Questionnaire, Third Edition (ASQ-3; Squires, Twombly, Bricker, & Potter, 2003). The ASQ-3 is a screening measure completed by parents to identify developmental delays in five domains of child development including: communication, gross motor, fine motor, problem solving, and personal-social. The questionnaire comprises 30 items where mothers either indicated *yes* (10 points), *sometimes* (5 points), or *not yet* (0 points) on a question asking about a child's ability to perform a task. Scores on each of the five domains of child development range from 0 to 60, and higher scores indicate better development. The ASQ-3 has been recommended for routine screening use and it has good psychometric properties (Schonhaut, Armijo, Schonstedt, Alvarez, & Cordero, 2013).

Covariates. Demographic information, including maternal education, income, and maternal age, was collected via a self-report questionnaire at the baseline assessment ($<$ 25 weeks survey). Demographic information on these covariates is found in Table 1.

Statistical analysis

Analyses were conducted in Mplus Version 8 (Muthén & Muthén, 1998–2016) and in SPSS Version 24. We used LPA, which identifies subgroups from large numbers of continuous variables. In the current analyses, the total scores for prenatal stress, emotional/informational support, tangible support, positive interaction support, and affective support were used as indicators in the LPA. A maximum likelihood estimator with robust standard errors was used. Full information maximum likelihood (FIML) was used, and thus all 1,994 participants were included in the classes with fully estimated data (Graham, 2009). FIML has been recommended for situations where missing data exceeds 10% (Little, Jorgensen, Lang, & Moore, 2014). In the current study, missing data for the LPA indicators, predictors, and covariates were all less than 4%. For the maternal outcome variables, missing data were less than 11%, and for the child development outcomes missing data ranged between 49.2% and 50.7%. The large portion of missing data for the child outcome was the result of timing of the survey

Table 1. Study Characteristics

Variable	Characteristics	*n* (%)
Maternal ethnicity	White	1,631 (81.8)
	Black/African American	24 (1.2)
	Indigenous	9 (0.5)
	Asian	159 (7.9)
	Latino/Latin American	31 (1.6)
	Mixed/other	129 (6.5)
	Missing	11 (0.5)
Child sex	Female	936 (46.9)
	Male	1,018 (51.1)
	Missing	40 (2.0)
Maternal education	Some elementary school or high school	46 (2.3)
	Graduated from high school	116 (5.8)
	Some college or university	245 (12.3)
	Graduated from college or university	1,250 (62.7)
	Some graduate school	51 (2.6)
	Completed graduate school	275 (13.8)
	Missing	11 (0.6)
Household income	$39,999 or less	117 (5.8)
	$40,000–79,999	406 (20.4)
	$80,000 or more	1,394 (69.9)
	Missing	77 (3.9)
Maternal age (years), *M* (*SD*)		30.87 (4.40)

administration and ethics; thus the data are deemed to be missing completely at random (i.e., the reason for missing data is not the values themselves or characteristics of the participants but rather an event external to the participants). To confirm the pattern of missing data, we examined whether there was an association between missingness on the ASQ and study variables with a Bonferroni correction for multiple comparisons. There was no difference between missing and nonmissing participants on household income, maternal age, number of ACEs, the Antepartum Risk Score, level of education, maternal prenatal stress, tangible support, affective support, interaction support, or emotional support. The mechanisms for the missing data have been found to be more important than the proportion of missing data when it comes to reducing bias, and FIML has been deemed the most appropriate approach for treating high levels of missing data (Dong & Peng, 2013).

First, latent profiles of prenatal stress and social support were identified using LPA without covariates included in the model (Oberski, 2016). The appropriate number of profiles was established by comparing models with an increasing number of profiles and stopping when the fit indices were no longer significant (Nyland, Asparouhov, & Muthén, 2007). The following fit indices were used to identify the optimal number of groups in the current study: Akaike information criteria (AIC), the Bayesian information criteria (BIC), and the adjusted Bayesian information criteria (aBIC), where a lower number indicates better fitting models. We also examined the entropy value for each model (Celeux & Soromenho, 1996), where greater values indicate better fit. Finally, we used the Lo-Mendell-Rubin likelihood ratio test (LMR-LRT), where a nonsignificant p value indicates that the previous k–1 model with fewer classes and a significant p value is preferable. We also examined the bootstrapped likelihood ratio test (BLRT) as the BIC and BLRT have demonstrated the best performance in identifying the correct number of classes (Nyland et al., 2007).

Once the best fitting model and number of classes were identified, the association between predictors and the identified classes was examined. We used the three-step manual approach for including predictors in the model as a one-step approach to LPA has several identified shortcomings (Collier & Leite, 2017). Covariates were simultaneously entered into the model and a multinomial logistic regression was used to predict class membership. The reference category was changed from Class 3 to Class 2 in the last comparison in Table 3 for ease of reporting. These classes were saved to use in the final step to examine outcomes.

Last, using the classes identified in the manual three-step approach, we tested mean differences using multiple testing among classes for the maternal outcomes (antepartum risk, maternal depression, maternal physical health, maternal mental health, and maternal stress) and

the five child development outcomes (communication, gross motor, fine motor, problem solving, and personal-social). A conceptual model for the analyses in the current study is represented in Figure S1 in the Supplemental Material available online.

Results

Table 1 presents sample characteristics and descriptive statistics for all study variables are found in Table 2. A detailed description of the ACEs questions and proportions found in the current study are reported elsewhere (Racine et al., 2018).

Prenatal psychosocial risk profiles identified through LPA

The model fit indices for the class solutions of the LPA are presented in Supplementary Table 1. Given the AIC, BIC, aBIC, entropy, and BLRT estimates, the model fit was best for a three-class solution. Figure S2 in the Supplemental Material shows the *z*-scores of each

Table 2. Descriptive Statistics for All Study Variables

Variable	*M* or Percentage	*SD*	Range	% Missing
Prenatal stress	13.23	6.14	0–36	1.4
Tangible social support	80.68	19.26	0–100	0.7
Affective support	94.41	12.68	0–100	0.8
Interactive support	87.59	17.06	0–100	0.6
Emotional/informational support	87.31	16.47	0–100	0.8
Covariates				
Income		—	1–11	3.9
1. <$10K	0.8%			
2. $10K–$19.9K	1.1%			
3. $20K–$29.9K	1.5%			
4. $30K–$39.9K	2.6%			
5. $40K–$49.9K	3.4%			
6. $50K–$59.9K	4.0%			
7. $60K–$69.9K	5.5%			
8. $70K–$79.9K	7.5%			
9. $80K–$89.9K	8.8%			
10. $90K–$99.9K	8.5%			
11. > $100K	52.7%			
Maternal education		—	1–6	0.6
1. Some elementary or high school	2.3%			
2. Graduated from high school	5.8%			
3. Some college/university	12.3%			
4. Graduated from college/university	62.7%			
5. Some graduate school	2.6%			
6. Completed graduate school	13.8%			
Maternal age	30.87	4.40	18–45	2.7
Maternal sexual abuse	1.11	0.34	1–3	0.26
Maternal physical/emotional abuse	1.39	0.56	1–3	0.21
Maternal household dysfunction	0.16	0.22	0–1	0.21
Child outcomes				
Infant communication	48.65	10.80	0–60	49.2
Infant gross motor	45.88	15.88	0–60	49.2
Infant fine motor	52.83	7.73	0–60	50.8
Infant problem solving	47.77	11.19	0–60	49.3
Infant personal/social	45.40	11.39	0–60	50.7
Maternal outcomes				
Antepartum Risk Score	1.92	1.99	0–90	11.4
Postpartum physical health	54.48	5.86	0–100	2.5
Postpartum mental health	51.72	7.77	0–100	2.5
Postpartum depression	4.17	4.22	0–30	2.6
Postpartum stress	11.62	6.54	0–40	3.4

Table 3. Predictors of Class Membership

	High stress–low support vs. low stress–high support		Moderate stress–moderate support vs. low stress–high support		High stress–low support vs. moderate stress–moderate support	
Predictor	OR	95% CI	OR	95% CI	OR	95% CI
Income	**0.66****	0.60, 0.71	**0.83****	0.78, 0.87	**0.79****	0.73, 0.86
Maternal age	**1.12****	1.06, 1.18	**1.06****	1.03, 1.10	1.05	0.99, 1.11
Maternal education	0.91	0.71, 1.17	1.06	0.95, 1.19	0.86	0.67, 1.11
Sexual abuse	1.50	0.84, 2.67	1.36	0.97, 1.92	1.10	0.63, 1.93
Physical/emotional abuse	**2.33****	1.58, 3.45	1.22	0.97, 1.54	**1.91****	1.27, 2.85
Household dysfunction	**0.21***	0.06, 0.78	1.59	0.87, 2.90	**0.14***	0.04, 0.50

Note: Boldface type indicates statistically significant results. OR = odds ratio; CI = confidence interval.
*$p < .05$. **$p < .01$.

indicator across the three classes. The first class, which comprised 4.9% of the sample, was labeled high stress–low support (Class 1) because there were elevated levels of stress in pregnancy and lower levels of support on all four indicators of social support. The stress level in this group was one standard deviation above the mean for the rest of the sample, indicating elevated levels of stress. The second group, which accounted for 25.7% of the sample, had moderate stress levels and moderate levels of social support. We labeled this class moderate stress–moderate support (Class 2) because there were moderate levels of stress in pregnancy and moderate levels of support on all four indicators of social support. The third group had participants with low levels of stress and high levels of support across all four domains of support and accounted for 69.4% of the sample. This group was labeled low stress–high support (Class 3) because the stress levels were below the mean and the four social support indicators were above the mean. The stress levels for the moderate stress–moderate support and low stress–high support groups were below the one standard deviation cutoff. The means for each of the latent groups are presented in Table S2 in the Supplemental Material.

Predictors of latent group membership

Women with higher income were less likely to be members of the high stress–low support group (Class 1) than the low stress–high support group (Class 3) or the moderate stress–moderate support group (Class 2). Women with high income were less likely to be in the moderate stress–moderate support group (Class 2) than the low stress–high support group (Class 3). Women who were older in pregnancy were more likely to be in the high stress–low support group (Class 1) and the moderate stress–moderate support group (Class 2) than in the low stress–high support group (Class 3). With regard to exposure to early ACEs, women who had experienced higher levels of physical/emotional abuse as children were more likely to be in the high stress–low support group (Class 1) than the low stress–high support group (Class 3) and the moderate stress–moderate support group (Class 2). With regard to exposure to family dysfunction in childhood, women in the high stress–low support group (Class 1) were less likely to have experienced high levels of family dysfunction than both the low stress–high support group (Class 3) and the moderate stress–moderate support group (Class 2). Odds ratios for the predictors are presented in Table 3.

To better display latent groups' differences related to household dysfunction and emotional/physical abuse in childhood (without controlling for covariates), we compared the means of the different groups (see Table S3 in the Supplemental Material). Results for household dysfunction indicated that the mean for Class 2 was significantly greater than the mean for Class 3. Examining the means for physical/emotional abuse, the mean for Class 1 was greater than the mean for Class 2 and 3, whereas the mean for Class 2 was greater than the mean for Class 3.

Latent group membership and postpartum maternal outcomes

We examined differences in mothers' health risk at the birth of their children, as well as their physical health, mental health, depression, and stress at 4 months postpartum among the latent groups of maternal stress and social support in pregnancy after controlling for covariates. Mean differences in outcomes among the groups are reported in Table 4. For antepartum health risk when the child was born, mothers who had high stress and low support in pregnancy as well as moderate stress and moderate support in pregnancy had higher pregnancy risk than mothers who had low stress and high levels of support. At 4 months postpartum, both mothers in the high stress–low support and mothers in

Table 4. Differences in Outcome Means Across Class Membership Adjusted for Covariates

Outcome	Means (*SE*) for latent classes		
	High stress–low support	Moderate stress–moderate support	Low stress–high support
Infant outcomes			
Communication	$45.75\ (2.04)_{a,b}$	$47.53\ (0.68)_{a}$	$49.24\ (0.39)_{b}$
Gross motor	$44.75\ (2.66)_{a}$	$46.05\ (0.98)_{a}$	$45.88\ (0.60)_{a}$
Fine motor	$50.00\ (1.40)_{a}$	$51.88\ (0.48)_{a}$	$53.35\ (0.28)_{b}$
Problem solving	$44.35\ (2.09)_{a}$	$46.39\ (0.73)_{a}$	$48.48\ (0.40)_{b}$
Personal/social	$39.12\ (2.35)_{a}$	$43.35\ (0.74)_{b}$	$46.54\ (0.40)_{c}$
Maternal outcomes			
Antepartum risk score	$2.43\ (0.28)_{a}$	$2.17\ (0.10)_{a}$	$1.79\ (0.05)_{b}$
Postpartum physical health	$52.73\ (0.72)_{a}$	$53.96\ (0.28)_{a}$	$54.79\ (0.15)_{b}$
Postpartum mental health	$46.71\ (1.20)_{a}$	$49.35\ (0.37)_{b}$	$52.94\ (0.19)_{c}$
Postpartum depression	$7.08\ (0.62)_{a}$	$5.62\ (0.20)_{b}$	$3.45\ (0.10)_{c}$
Postpartum stress	$17.05\ (0.83)_{a}$	$14.29\ (0.26)_{b}$	$10.27\ (0.17)_{c}$

Note: Means that share subscripts do not differ significantly at $p \leq .05$.

the moderate stress–moderate support group had lower physical health than mothers in the low stress–high support group. Mothers in the low stress–high support group had lower levels of mental health difficulties, depression, and stress at 4 months postpartum than the other two groups.

Latent group membership and child development outcomes

Five different developmental domains were examined as outcomes at 12 months of age: communication, gross motor abilities, fine motor abilities, problem solving, and personal-social. Mean differences in outcomes among the groups are reported in Table 4. Across all five developmental domains, a similar pattern emerged: Children of mothers with low stress and high support in pregnancy generally had higher scores than children of mothers in the other two groups.

Discussion

This prospective longitudinal cohort study used LPA to identify profiles of women on the basis of patterns of maternal prenatal stress and social support. We subsequently investigated whether sociodemographic factors and ACEs were predictive of these profiles, as well as whether these profiles were associated with differences in postpartum maternal and child outcomes. The LPA identified three distinct profiles of women in pregnancy; one characterized by high levels of stress in pregnancy and low social support, the second profile displayed moderate levels of stress and moderate levels of support, and the third profile was characterized by low levels of stress and high levels of support. The identification of profiles of prenatal maternal stress and social support makes a novel contribution by demonstrating that these profiles are differentially predicted by sociodemographic factors and maternal childhood adversity. Furthermore, these profiles are associated with different maternal and child outcomes in the postpartum period. From a public health perspective, the identification of these profiles permits the targeting of prevention and intervention strategies for mother-child dyads who have the greatest constellation of risks (Cabaj, McDonald, & Tough, 2014).

A substantive finding in the current study was the differential associations of types of childhood adversity with the prenatal stress and social support profiles. As expected, the group that had the highest level of prenatal stress and lowest levels of social support had been exposed to the highest levels of physical and emotional abuse as children. These findings are consistent with the "risky families" hypothesis (Repetti et al., 2002) suggesting that individuals who grow up within the context of abuse are more likely to be vulnerable to deficits in socioemotional competence, to experience mental health difficulties, and to lack emotional support later in life (Kingston, Sword, Krueger, Hanna, & Markle-Reid, 2012; Smith et al., 2016). The high stress–low support profile also had the highest maternal mental health difficulties in the postpartum period. Our findings extend the literature showing that women who experience maltreatment have higher levels of postpartum

depression and psychopathology in a low-risk sample (McDonnell & Valentino, 2016). Thus, a subset of women who are at risk of poor mental health outcomes in the postpartum period could be identified in early pregnancy as requiring more support. Our lack of findings related to maternal childhood sexual abuse may be the result of lower rates and severity of sexual abuse in the current community sample.

Interestingly, a unique element of the moderate stress–moderate support profile was that these women experienced higher levels of household dysfunction in childhood than the low stress–high support group. Though levels of household dysfunction for the moderate stress–moderate support profile were not statistically different than the high stress–low support profile when we examined mean differences, experiencing high levels of household dysfunction appeared to be a hallmark of the moderate stress–moderate support profile. The different prenatal stress and social support profiles based on maternal adversity can also be understood by considering the nature of the adversity experienced in childhood, specifically whether the experiences were characterized primarily by threat or deprivation (McLaughlin, Sheridan, & Lambert, 2014). Threat experiences include events that involve serious injury or harm to the individual (e.g., physical abuse, sexual abuse, exposure to domestic violence), whereas deprivation experiences involve the absence of appropriate cognitive and social stimuli (e.g., neglect, institutionalization; McLaughlin et al., 2014). Deprivation experiences can occur in the context of household dysfunction and often co-occur with poverty.

When examining the predictors of the LPA model, we found that household dysfunction was not a characteristic of the high stress–low support group. One reason for this may have been the strong association between household dysfunction and other indicators that were already included as predictors of the profiles, namely education and household family income. Indeed, maternal education and household dysfunction were associated ($r = -.21$, $p < .005$), which may have influenced the overall results of the model examining predictors of the LPA.

Maternal physical and mental health in the postpartum period were found to differ across profiles after controlling for maternal ACEs and sociodemographic factors when determining the profiles. Both the high stress–low support and moderate stress–moderate support profiles, generally had higher maternal physical health difficulties in the postpartum period than the low stress–high support group. Child development outcomes were generally reported to be lowest by mothers in the high stress–low support group and the moderate stress–moderate support group. For the communication domain, high stress–low support mothers did not differ statistically from the low stress–high support mothers. One possible explanation for this finding is that mothers who are experiencing high levels of stress have been shown to overestimate the language development of their children (Willinger et al., 2011). It is hypothesized that mothers who are experiencing high levels of parental stress (including mental health difficulties, low support, spousal relationships, or social isolation) may view their child's language performance as an examination of their own parenting performance, thus leading to an overreport of their child's abilities (Willinger et al., 2011).

A bourgeoning area of research examines how maternal adversity in childhood is transmitted from mothers to their infants. These studies have demonstrated that maternal exposure to higher levels of cumulative adversity are transmitted via both biological and psychosocial mechanisms (Madigan, Wade, Plamondon, Maguire, & Jenkins, 2017; McDonnell & Valentino, 2016; Racine, Plamondon, Madigan, McDonald, & Tough, 2018; Sun et al., 2017). Our findings make a novel contribution to the literature by identifying that women of both high and moderate psychosocial risk in pregnancy are at risk of reporting that their children have relatively lower developmental outcomes. Importantly, our research demonstrates that pregnancy may provide a window of opportunity to identify at-risk mothers (Yelland & Brown, 2014). Prevention efforts for women who have inadequate support and stress in pregnancy are especially needed. In the current study, the lowest level of support for the high stress–low support group was tangible support, which includes material or behavioral support. It may be especially helpful to identify resources to meet these needs of at-risk women in pregnancy or, ideally, in the preconception period. There is opportunity for health care providers to encourage use of supportive resources that may exist in a woman's personal or familial network and in the community during the perinatal period.

Women who were characterized by the high stress–low support profile had higher postnatal mental health difficulties than women in the moderate stress–moderate support group, over and above differences in sociodemographic and exposure to early adversity. Although statistically this could have led to suppressor effects, from a clinical perspective women who are most at risk can be identified through questions about stress and social support and these difficulties can be addressed by providing practical strategies such as emotion regulation and coping skills (Korotana, Dobson, Pusch, & Josephson, 2016) rather than population-based screening for ACEs, which has been identified as premature given the current state of the evidence with regard to its utility and potential for negative outcomes (Finkelhor, 2017). Moreover, asking questions about current levels

of stress and social support in pregnancy may be less stigmatizing for some women than asking about childhood adversity, especially in the context of brief interactions that occur during prenatal medical appointments.

Limitations

Findings from the current study should be interpreted in the context of some limitations. The majority of the mothers who participated in the study were well educated and had high household family incomes, reducing the generalizability of the findings to populations with extreme sociodemographic risks. Similarly, women and children in the current study were not at high risk of mental health difficulties or developmental delay, and thus some of the differences observed on the outcomes did not demonstrate clinically significant differences. With the exception of maternal health information collected at birth, consistent with large epidemiological studies, the majority of measures used in the current study were self-report, introducing the possibility that associations may the result of shared method variance. Thus, caution must be used when interpreting the child development findings in the current study as they may reflect maternal perception rather than the child's objective developmental level. However, this is consistent with how information is predominantly collected with regard to infants in the health care setting. The current study did not measure maternal age at first pregnancy or the intervals between pregnancies, both of which could be confounded with maternal ACEs and are associated with risks of adverse perinatal outcomes and may have influenced results (Dietz et al., 1999; Zhu, Rolfs, Nangle, & Horan, 1999). Furthermore, maternal adversity in the current study was based on retrospective maternal reports of the trauma they experienced in childhood, which has been shown to underestimate the actual occurrence of adversity experienced in childhood (Hardt & Rutter, 2004); however, a recent study showed that prospective and retrospective reports of child adversity produced similar findings, allaying concerns of recall bias (Patten et al., 2015). Last, as is typical in longitudinal cohort studies (Young, Powers, & Bell, 2006), retention rates were between 69% and 81% depending on the eligible population and follow-up time point.

Conclusion

The current study provides a person-centered perspective on the influence of prenatal stress and social support in pregnancy on maternal-child outcomes in the postpartum period. By using an LPA approach with continuous variables, we were able to identify three profiles of mothers based on prenatal stress and social support that were differentially predicted by early maternal adversity. Of note, we identified a group of women with moderate stress and moderate social support who reported that their children were equally at risk for (relatively) low developmental outcomes compared with children of mothers who experienced the highest levels of stress and lowest levels of social support. An important finding to emerge from this work is that the moderate stress–moderate support group is most at risk for being missed by standard screening tools that use standard cutoffs, despite having outcomes that are similar to the high stress–low support group. Identification and implementation of supports prior to and during pregnancy for women who have high levels of stress and currently have low levels of support are needed. Future research should identify what type of supports for pregnant women are most successful in mitigating poor child development and pinpointing the ideal timing for implementation.

Action Editor

Erin B. Tone served as action editor for this article.

Author Contributions

S. Tough is the primary investigator and S. McDonald is a coinvestigator of the All Our Families Study. S. McDonald and S. Tough contributed to the design and structure of the cohort. S. Tough selected the data-collection instruments and time points and supervised and managed data collection. N. Racine, S. Madigan, and A. Plamondon contributed to the conceptualization of the study and analyses of the data. All the authors participated in interpretation of findings. N. Racine, S. Madigan, and A. Plamondon drafted the manuscript. S. Madigan, A. Plamondon, E. Hetherington, S. McDonald, and S. Tough critically reviewed and revised the manuscript. All the authors approved the final version of the manuscript for submission and agree to be accountable for all aspects of the work.

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The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

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Supplemental Material

Additional supporting information can be found at http://journals.sagepub.com/doi/suppl/10.1177/2167702618788863

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