Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Multidimensional Maternal Perinatal Stress: Integrating Variable- and Person-Centered Approaches to Improve Risk Identification

Hernán López-Morales

hernanlopezmorales@mdp.edu.ar

National Scientific and Technical Research Council

Julieta Mariel Sosa

National Scientific and Technical Research Council

Eduardo Tomás Cánepa

National Scientific and Technical Research Council

Germán David Schrott

National Scientific and Technical Research Council

Ana Eugenia Faas

National University of Córdoba

Marcela Carolina López

National University of Mar del Plata

Sebastián Urquijo

National Scientific and Technical Research Council

Research Article

Keywords: Maternal perinatal stress, Latent profile analysis, Principal component analysis, Risk identification, Longitudinal study

Posted Date: June 11th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9180794/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Purpose

Maternal perinatal stress is widely studied but remains conceptually fragmented and inconsistently operationalized, limiting its clinical utility for screening and early identification in perinatal care. This study aimed to integrate variable-centered and person-centered approaches to examine the structure and heterogeneity of maternal psychosocial stress across pregnancy and early postpartum.

Methods

A longitudinal study was conducted with 198 mothers recruited from public primary health care centers. Psychological assessments were performed during the second trimester, third trimester, and three months postpartum. Measures included anxiety, depressive symptoms, perceived stress, and pregnancy-related distress. Principal component analyses were used to derive composite stress indices, and latent profile analyses were conducted to identify subgroups of mothers with distinct stress patterns.

Results

Across all time points, psychological indicators converged into a single latent dimension explaining between 72% and 85% of the variance. Latent profile analyses identified three distinct maternal stress profiles characterized by low, moderate, and high levels of perinatal stress. Profiles differed significantly across all psychological indicators but showed no differences in sociodemographic variables.

Conclusions

Maternal perinatal stress can be conceptualized as a coherent multidimensional construct with meaningful interindividual variability. Integrating variable-centered and person-centered approaches may enhance the identification of women at risk and inform the development of more comprehensive screening strategies in perinatal mental health care.

1. INTRODUCTION

Maternal perinatal stress (MPS) has emerged as a central construct in research on women's mental health, given its high prevalence and its implications for both maternal well-being and early developmental risk. Across pregnancy and the postpartum period, women experience substantial biological, psychological, and social changes that increase vulnerability to psychological distress (Nóblega et al., 2024; O'Brien, Gregg & Wittkowski, 2023). Clinical indicators such as anxiety, depressive symptoms, and perceived stress represent the most common manifestations of perinatal mental health problems (Howard et al., 2014), with epidemiological estimates suggesting that up to 20% of women

experience clinically relevant levels of prenatal stress (Dennis, Falah-Hassani & Shiri, 2017). Despite its relevance for clinical screening and early identification in perinatal care, maternal perinatal stress remains a conceptually diffuse and operationally heterogeneous construct.

A major challenge in the field lies in the lack of consensus regarding the definition and measurement of MPS. Rather than representing a unified construct, maternal perinatal stress has been conceptualized as an umbrella term encompassing exposure to adverse life events, chronic stressors, cognitive appraisals such as pregnancy-specific concerns, and emotional responses including anxiety and depressive symptomatology (Evans & Tiemeier, 2021; Wazana, Székely & Oberlander, 2021). These dimensions frequently co-occur and are empirically interrelated, yet they are often examined in isolation, limiting the development of comprehensive and clinically useful screening approaches.

From a developmental psychopathology perspective, pregnancy represents not only a sensitive period for the fetus but also a critical transition for the mother, involving profound neurobiological and psychological adaptations (Howland & Cicchetti, 2021). These include structural and functional changes in the maternal brain (Barba-Müller et al., 2019) and alterations in neural systems associated with emotional regulation, vigilance, and social cognition (Servin-Barthet et al., 2023). While these adaptations support caregiving, they may also increase sensitivity to stress and negative affect (Roos et al., 2012), contributing to heightened vulnerability to perinatal mental health problems.

Empirically, maternal perinatal stress has been operationalized through diverse psychological indicators, including pregnancy-related distress (Alderdice, Lynn & Lobel, 2012), perceived stress (Cohen, Kamarck & Mermelstein, 1983; O'Donnell et al., 2009), and symptoms of anxiety and depression (Van den Bergh et al., 2020). However, most studies rely on single indicators—most commonly perceived stress or depressive symptoms (Kashanian et al., 2021; Kornfield et al., 2022)—which may not fully capture the multidimensional nature of maternal distress. This limitation is particularly relevant for clinical practice, where screening strategies often depend on isolated measures and may overlook the cumulative and overlapping nature of stress-related experiences.

In addition, substantial variability in prevalence estimates reflects differences in measurement approaches. Diagnostic-based studies report that between 8% and 12% of women meet criteria for a mental disorder during pregnancy (Fisher et al., 2012; Howard et al., 2015), whereas self-report measures suggest that up to 30% experience clinically relevant psychological distress (Loomans et al., 2013). These discrepancies are even more pronounced in low- and middle-income countries, where prevalence may be higher and access to mental health care more limited (Fisher et al., 2012; Herba et al., 2016). In Latin America, and Argentina in particular, the scarcity of epidemiological data further constrains the development of contextually appropriate screening and intervention strategies (Nóblega et al., 2024; Rondon, 2020).

To address these challenges, research has traditionally relied on two distinct methodological approaches. Variable-centered approaches model associations among stress-related variables across individuals, often through regression techniques or latent factor models (Acosta et al., 2023; Cecil et al.,

2014; Cortes Hidalgo et al., 2018; Silveira et al., 2017; Troller-Renfree et al., 2022). These methods provide parsimonious representations of shared variance but may obscure interindividual differences. In contrast, person-centered approaches, such as latent profile analysis, identify subgroups of individuals characterized by distinct configurations of psychological indicators (Li et al., 2022; Luo et al., 2021; Walsh et al., 2019). While these approaches capture heterogeneity, they often rely on a limited set of indicators and do not explicitly model the latent structure underlying observed associations.

Despite their complementary strengths, these approaches have largely been applied independently. This separation limits the development of integrative frameworks capable of simultaneously capturing the structure and heterogeneity of maternal perinatal stress. Such integration is particularly relevant for perinatal mental health care, where improving the identification of women at risk requires both an accurate characterization of the underlying construct and an understanding of how it varies across individuals.

The present study addresses this gap by integrating variable-centered and person-centered approaches within a longitudinal design spanning pregnancy and early postpartum. Grounded in a psychosocial conceptualization of stress as the imbalance between contextual demands and available coping resources (Nast et al., 2013), this study aims to (1) examine the latent structure of maternal psychosocial stress across the perinatal period and (2) identify clinically meaningful subgroups of women based on multidimensional stress indicators. By articulating these complementary analytical strategies, this work seeks to advance the conceptualization of maternal perinatal stress and contribute to the development of more comprehensive and clinically relevant screening approaches in perinatal mental health.

2. METHOD

2.1. Recruitment and sample characteristics

Participants were recruited using a non-probabilistic convenience sampling procedure. The final sample included 198 mothers from singleton, full-term pregnancies (M age = 25.90 years, SD = 5.16), recruited between March 2022 and October 2023 at two public primary health care centers. Clinical trial number: not applicable.

Maternal assessments were conducted at three time points: second trimester (14–26 weeks; M = 18.67, SD = 4.37), third trimester (27–40 weeks; M = 30.35, SD = 4.72), and three months postpartum (M = 95.26 days; SD = 1.42) (Fig. 1).

2.2. Inclusion and exclusion criteria

Women aged 18–45 years with singleton pregnancies were included and enrolled during the second or third trimester. Exclusion criteria comprised severe physical or mental health conditions potentially affecting fetal development (e.g., HIV, Chagas disease, syphilis) and self-reported use of psychotropic

medication, corticosteroids, alcohol, or illicit substances during pregnancy. Sociodemographic and obstetric characteristics are presented in Table 1.

Table 1

Composition and sociodemographic, socioeconomic, and medical characteristics of the total sample.

Variable		**Pregnant women (*n* = 202)**
Maternal age (years)	Mean	25.90
	SD	5.16
	Range	18–41
Highest educational level attained	Incomplete primary	2.9%
	Completed primary	7.5%
	Incomplete secondary	56.7%
	Completed secondary	24.2%
	Incomplete tertiary or university	6.3%
	Completed tertiary or university	2.5%
	Postgraduate	0.0%
Marital status	Single	37.5%
	Cohabiting	45.0%
	Married	16.7%
	Separated	0.8%
	Divorced	0.0%
	Widowed	0.0%
Employment status	Employed	40.8%
	Unemployed	59.2%
Occupational level	Unskilled manual workers	37.9%
	Semi-skilled manual workers	42.1%
	Skilled manual workers	20.0%
Social status	Low	51.2%
	Lower-middle	45.0%
	Middle	3.8%
	Upper-middle	0.0%

Variable		Pregnant women (*n* = 202)
	High	0.0%
Number of children	0	41.3%
	1	32.5%
	2	15.4%
	3	6.7%
	≥ 4	4.2%

2.3. Ethical considerations

Participation was voluntary and based on written informed consent obtained at each assessment wave. The study protocol was approved by the relevant institutional ethics committee. All procedures complied with the Declaration of Helsinki, the American Psychological Association guidelines, and the Convention on the Rights of the Child.

2.4. Measures

2.4.1. Maternal anxiety: State anxiety was assessed using the Argentine adaptation (Leibovich de Figueroa, 1991) of the State Anxiety subscale of the State-Trait Anxiety Inventory (STAI; Spielberger, 1982). The 20-item scale is rated on a 4-point Likert scale (0–3). Internal consistency ranged from α = .89 to .91.

2.4.2. Maternal depression: Depressive symptoms were measured using the Spanish version of the Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden & Sagovsky, 1987; García-Esteve et al., 2003). This 10-item self-report instrument (0–3 scale) showed internal consistency between α = .78 and .82.
2.4.3. Perceived stress: Perceived stress was assessed with the 10-item Perceived Stress Scale (PSS-10; Cohen, Kamarck & Mermelstein, 1983; Remor, 2006), rated on a 5-point Likert scale (0–4). Internal consistency ranged from α = .82 to .84.
2.4.4. Pregnancy-specific distress: Pregnancy-related distress was measured using the Spanish version of the Prenatal Distress Questionnaire (PDQ; Yali & Lobel, 1999; Caparrós-González et al., 2019). This 12-item instrument showed internal consistency of α = .80 (second trimester) and α = .81 (third trimester).
2.4.5. Sociodemographic and medical variables: A structured questionnaire collected information on maternal sociodemographic, socioeconomic, and obstetric characteristics.

2.5. Data analysis

Analyses were conducted using IBM SPSS. All tests were two-tailed ($p < .05$). Normality was assessed via skewness and kurtosis (± 2 acceptable; Field, 2009; George & Mallery, 2016). Missing data were not

imputed due to insufficient completeness (< 80%; Roth, 1994).

Descriptive statistics and Pearson correlations were computed for all variables.

To examine the latent structure of maternal psychosocial stress, four principal component analyses (PCA) were conducted: (1) second trimester, (2) third trimester, (3) 3 months postpartum, and (4) cumulative perinatal scores. Variables were standardized (z-scores). Model adequacy was assessed using determinant values, Bartlett's test, and the Kaiser–Meyer–Olkin (KMO) index (≥ .80). Components explaining ≥ 70% of variance were retained, and component scores were estimated using the regression method.

Latent profile analyses (LPA) were conducted using the snowRMM module in Jamovi (v5.7.4) to identify subgroups based on stress indicators. Model fit was evaluated using AIC, BIC, and entropy (Celeux & Soromenho, 1996), alongside interpretability and class size.

After selecting the optimal model, between-profile differences were examined using ANOVAs (with post hoc tests) and chi-square tests for categorical variables, including sociodemographic and clinical characteristics.

3. RESULTS

3.1. Descriptive statistics

Descriptive statistics for all maternal psychosocial stress indicators across the prenatal and early postnatal periods, including mean perinatal scores, are presented in Table 2 and Fig. 2.

Table 2
Descriptive statistics of the administered assessments.

Variables		**2nd Trimester Prenatal** (***n* = 241**)	**3rd Trimester Prenatal** (***n* = 224**)	**1st Trimester Postnatal** (***n* = 198**)	**Perinatal mean** (***n* = 198**)
Maternal Depression (EPDS)	Mean	9.03	7.59	7.45	7.95
	SD	5.89	5.38	5.68	4.42
Maternal State Anxiety (STAI-S)	Mean	21.91	19.97	17.04	19.7
	SD	10.47	10.14	8.63	6.99
Perceived Stress (PSS-10)	Mean	19.31	16.55	22.97	19.8
	SD	7.50	8.25	8.26	5.41
Pregnancy-Specific Distress (PDQ)	Mean	12.20	9.34	-	10.8
	SD	5.78	5.95		5.33

3.2. Correlations among maternal perinatal stress variables

Pearson correlation analyses (n = 198) revealed moderate to high positive associations among all psychological indicators assessed within each time point (Table 3). Correlations ranged from moderate to strong and were consistently statistically significant (p < .01), supporting the presence of substantial overlap among measures of depression, anxiety, perceived stress, and pregnancy-related distress.

Table 3. *Pearson correlations among the different maternal perinatal stress variables.*

	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Maternal Prenatal Depression (2nd Trimester)	.553	.486	.868	.754	.357	.203	.642	.718	.264	.185	.568	.675	.453	.630
2. Maternal Prenatal Depression (3rd Trimester)		.244	.751	.646	.805	.057	.732	.628	.760	.160	.746	.550	.826	.761
3. Maternal Postnatal Depression (3 Months)			.739	.356	.095	.619	.479	.286	.065	.552	.434	.364	.235	.328
4. Maternal Perinatal Depression				.754	.524	.377	.783	.711	.452	.382	.738	.681	.635	.725
5. Maternal Prenatal Anxiety (2nd Trimester)					.637	.164	.869	.814	.465	.099	.657	.752	.632	.775
6. Maternal Prenatal Anxiety (3rd Trimester)						.041	.780	.568	.822	.123	.736	.487	.820	.724
7. Maternal Postnatal Anxiety (3 Months)							.474	.045	.079	.564	.277	.074	.002	.044
8. Maternal Perinatal Anxiety								.703	.593	.346	.793	.649	.708	.750
9. Prenatal Perceived Stress (2nd Trimester)									.494	.042	.716	.684	.607	.725
10. Prenatal Perceived Stress (3rd Trimester)										.089	.777	.379	.731	.615
11. Postnatal Perceived Stress (3 Months)											.559	.047	.120	.087
12. Perinatal Perceived Stress												.531	.706	.684
13. Pregnancy-Specific Distress (2nd Trimester)													.641	.903
14. Pregnancy-Specific Distress (3rd Trimester)														.908
15. Prenatal Pregnancy-Specific Distress														

$p<.05$ $p<.01$

3.3. Principal component analyses (PCA)

Four principal component analyses were conducted to examine the latent structure of maternal psychosocial stress across the perinatal period.

In the second trimester, all indicators were strongly intercorrelated (r = .67–.81, p < .01), with adequate sampling (KMO = .84) and a significant Bartlett's test (χ^2 = 691.36, df = 6, p < .001). A single component was extracted, explaining 80.02% of the variance, with factor loadings ranging from .88 to .93.

In the third trimester, correlations remained high (r = .73–.82, p < .01), with similar adequacy indices (KMO = .84; Bartlett's χ^2 = 759.77, df = 6, p < .001). A single component explained 84.51% of the variance, with loadings between .90 and .94.

At 3 months postpartum, moderate correlations were observed (r = .55–.62, p < .01), with acceptable sampling adequacy (KMO = .71) and a significant Bartlett's test (χ^2 = 203.68, df = 3, p < .001). One component was retained, explaining 71.96% of the variance, with loadings ranging from .83 to .86.

Finally, the cumulative perinatal PCA, based on mean scores across time points, showed high intercorrelations (r = .68–.79, p < .01), meritorious sampling adequacy (KMO = .85), and a significant Bartlett's test (χ^2 = 627.70, df = 6, p < .001). A single component explained 80.95% of the variance, with loadings between .88 and .93.

Across all analyses, results consistently supported a unidimensional structure of maternal psychosocial stress.

3.4. Latent profile analysis (LPA)

Latent profile analyses were conducted to identify subgroups of women based on multidimensional stress indicators across the perinatal period.

Model fit indices (Table 4) indicated that solutions with an increasing number of profiles showed improved statistical fit, reflected in lower AIC and BIC values and higher entropy. Although the four-profile solution showed slightly better fit indices, it included a very small class (n = 12), raising concerns regarding stability and interpretability. Therefore, the three-profile solution was retained as the most parsimonious and clinically meaningful model.

Table 4
Values of the main fit indices in both models.

Model 1					**Model 2**				
Profile	**LogLik**	**AIC**	**BIC**	**Entropy**	**Profile**	**LogLik**	**AIC**	**BIC**	**Entropy**
1	-3290	6623	6697	1.000	**1**	-1201	2418	2445	1.000
2	-2887	5841	5955	0.923	**2**	-1005	2036	2080	0.849
3	-2730	5552	5707	0.823	**3**	-919	1874	1934	0.870
4	-2531	5178	5373	0.749	**4**	-893	1833	1910	0.873

The three profiles comprised 21.2% (n = 45), 34.4% (n = 73), and 44.3% (n = 94) of the sample, respectively. As shown in Table 5 and Fig. 3, profiles were clearly differentiated across all psychological

indicators (p < .001). Profile 1 was characterized by high levels of stress across all measures, Profile 2 by low levels, and Profile 3 by moderate levels.

Table 5
One-way ANOVA for the different variables included in the model separated by profiles.

Perinatal depression	**Profile 1**	**Profile 2**	**Profile 3**
	Mean	**Mean**	**Mean**
	14.27 $_{a}$	**3.95 $_{c}$**	**8.09 $_{b}$**
Perinatal anxiety	29.35 $_{a}$	12.95 $_{c}$	20.40 $_{b}$
Perinatal perceived stress	26.59 $_{a}$	14.63 $_{c}$	20.54 $_{b}$
Pregnancy-Specific Distress	17.09 $_{a}$	5.77 $_{c}$	11.66 $_{b}$
Note: Means sharing subscripts do not differ significantly at *p* < .05			

3.5. Differences across profiles in sociodemographic variables

No significant differences were observed across latent profiles in maternal age [F(2, 112) = 0.358, p > .05] or number of children [F(2, 108) = 0.234, p > .05]. Similarly, chi-square analyses showed no significant differences across profiles in institution of care, educational level, marital status, cohabitation with a partner, occupational status, social class, or parity (all p > .05).

4. DISCUSSION

The present study examined maternal perinatal psychosocial stress using an integrative framework that combined variable-centered and person-centered approaches within a longitudinal design spanning pregnancy and early postpartum. The findings provide consistent evidence that diverse indicators of psychological distress—including depressive symptoms, anxiety, perceived stress, and pregnancy-related distress—converge into a common latent dimension, while simultaneously revealing meaningful heterogeneity across individuals.

From a clinical perspective, these results are particularly relevant for improving the identification of women at risk during the perinatal period. Current screening practices in perinatal mental health frequently rely on single instruments, most commonly targeting depressive symptomatology. However, the strong convergence observed across multiple indicators suggests that maternal perinatal stress may be more accurately conceptualized as a multidimensional construct encompassing overlapping affective and cognitive domains (Nast et al., 2013; Van den Bergh et al., 2020). This supports the need for more

comprehensive screening strategies capable of capturing the cumulative and co-occurring nature of maternal distress, rather than focusing on isolated symptom domains.

At the same time, the person-centered analyses demonstrated that maternal perinatal stress is not uniformly distributed across individuals. The identification of three distinct profiles—low, moderate, and high stress—indicates that variability in maternal distress is primarily expressed along a gradient of severity. This pattern is consistent with previous studies employing person-centered approaches, which have similarly identified subgroups characterized by differing levels of psychological burden (Racine et al., 2018; Walsh et al., 2019; Luo et al., 2021; Li et al., 2022). Importantly, these profiles were differentiated by the co-occurrence and intensity of symptoms across all indicators, suggesting that risk stratification in clinical settings may benefit from considering both the level and the accumulation of distress-related experiences.

A notable finding was the consistently strong contribution of depressive symptoms to the latent stress dimension across time points. This result reinforces the central role of depression within the broader spectrum of perinatal mental health problems and aligns with evidence highlighting its prevalence and clinical significance during pregnancy and postpartum (Howard et al., 2014). At the same time, the findings suggest that depressive symptoms may function as a core component within a multidimensional stress framework, rather than as an isolated construct. From a clinical standpoint, this supports maintaining depression screening as a central element of perinatal care while complementing it with additional indicators to capture the broader stress experience.

The observed pattern of strong within-time associations and comparatively weaker associations across time points further underscores the temporal specificity of maternal perinatal stress. These findings suggest that stress during the perinatal period may be better understood as a dynamic process that fluctuates across pregnancy and early motherhood, rather than as a stable trait. This has important implications for clinical practice, as it highlights the need for repeated assessments across different perinatal stages to improve detection and monitoring of psychological distress.

Interestingly, no significant differences were observed across latent profiles in sociodemographic and contextual variables. While this finding may partly reflect the relative homogeneity of the sample, it also suggests that maternal psychological distress during the perinatal period cannot be fully explained by traditional sociodemographic risk factors alone. This reinforces the importance of direct psychological assessment in perinatal care settings, rather than relying solely on demographic indicators to identify women at risk.

In this context, an intersectional perspective provides an important framework for understanding the broader determinants of maternal perinatal stress. Intersectionality, as introduced by Kimberlé Crenshaw (1991), emphasizes the interconnected nature of social categories such as gender, socioeconomic status, and other axes of identity, which may shape exposure to stress and access to resources. Applied to perinatal mental health, this perspective highlights that individuals navigating multiple and overlapping forms of social disadvantage may experience cumulative stressors—such as discrimination

or limited access to healthcare and social support—that are not fully captured by conventional sociodemographic indicators (Bush, 2024). This may partly explain the absence of differences observed in the present study, suggesting that standard demographic variables may not adequately reflect the complexity of lived experiences underlying maternal stress.

Future research would benefit from incorporating multidimensional and intersectional approaches that explicitly examine how social determinants interact to influence maternal stress trajectories. In particular, it will be important to investigate how cumulative exposures to social and structural stressors, as well as access to protective resources, shape both maternal mental health and downstream child outcomes. Such approaches may help identify vulnerable subgroups that remain undetected when using traditional risk indicators alone and inform the development of more tailored and equitable screening strategies.

From a public health perspective, these findings also point to the importance of structural interventions. Evidence suggests that policies aimed at increasing support for pregnant individuals and caregivers—such as expanded parental leave, improved health coverage, and financial assistance programs—can reduce stress and improve family well-being (Roman et al., 2014; Troller-Renfree et al., 2022; Van Niel et al., 2020). Universal access to these resources may help reduce stigma and mitigate disparities in perinatal mental health outcomes. Importantly, policies addressing maternal stress should consider the diverse needs of individuals with intersecting social identities to promote more equitable health outcomes (Bush, 2024).

From a methodological standpoint, the integration of variable-centered and person-centered approaches represents a key contribution of the present study. Variable-centered analyses allowed for the identification of a coherent latent structure underlying multiple stress indicators, whereas person-centered analyses translated this structure into clinically interpretable subgroups. By combining these approaches, the study provides a more comprehensive framework for understanding maternal perinatal stress, addressing both its underlying structure and its expression across individuals.

Several limitations should be considered. The use of a non-probabilistic sample limits generalizability, and the absence of maternal or infant outcomes precludes conclusions regarding predictive validity. Future studies should examine how these multidimensional stress indicators and profiles relate to maternal mental health trajectories and child developmental outcomes, particularly in low- and middle-income contexts where disparities remain pronounced (Fisher et al., 2012; Herba et al., 2016).

Despite these limitations, the present study advances current understanding of maternal perinatal psychosocial stress by providing an empirically grounded and clinically relevant framework that integrates multiple indicators and analytical perspectives. By demonstrating both the coherence and heterogeneity of maternal stress, these findings support the development of more nuanced and effective approaches to screening and early identification in perinatal mental health care.

CONCLUSION

Maternal perinatal psychosocial stress can be understood as a multidimensional yet coherent construct that varies meaningfully across individuals. The integration of variable-centered and person-centered approaches provides a robust framework for capturing both its underlying structure and its heterogeneity, with direct implications for improving early identification in perinatal mental health care.

Importantly, these findings should be interpreted within a broader intersectional framework that recognizes the role of cumulative social and structural determinants in shaping maternal stress experiences. Future research should incorporate multidimensional models that account for interacting social identities and contextual factors, as well as examine how access to resources and support systems may buffer or exacerbate stress-related risks.

At the policy level, expanding access to structural supports—such as parental leave, healthcare coverage, and financial assistance—may play a critical role in reducing maternal stress and promoting equitable health outcomes (Roman et al., 2014; Troller-Renfree et al., 2022; Van Niel et al., 2020). Advancing this line of research will be essential for informing inclusive and evidence-based perinatal mental health strategies that address both individual and structural determinants of risk.

DECLARATIONS

Author Contribution

HLM: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. JMS: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. ETC: Conceptualization, Investigation, Methodology, Writing – original draft. GDS: Conceptualization, Investigation, Methodology, Writing – original draft. AEF: Data curation, Formal analysis, Methodology, Resources, Supervision, Writing – original draft. MCL: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Validation, Writing – review & editing. SU: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing – review & editing.

Acknowledgement

The authors formally acknowledge the mothers and infants who participated in this study. Their contribution made this research possible.We also recognize the collaboration of the healthcare personnel from the Primary Health Care Centers of the Municipality of General Pueyrredón (Buenos Aires, Argentina), whose support facilitated participant recruitment and access to the study setting.We acknowledge the work of the research assistants and undergraduate collaborators — Joaquín Bunge, Juan Martín Auberge, Rocío González, Daniela Colacino, Daniela Rimer, and Micaela Colman — for their

involvement in data collection procedures and database management.Institutional support was provided by the National University of Mar del Plata, the School of Psychology, and the National Scientific and Technical Research Council (CONICET). This research was conducted within publicly funded health and higher education systems that sustain scientific development.

REFERENCES

1. Acosta H, Kantojärvi K, Tuulari JJ, Lewis JD, Hashempour N, Scheinin NM et al (2023) Association of cumulative prenatal adversity with infant subcortical structure volumes and child problem behavior and its moderation by a coexpression polygenic risk score of the serotonin system. Dev Psychopathol 1–16. https://doi.org/10.1017/S0954579423000275
2. Akaike H (1987) Factor analysis and AIC. Psychometrika 52:317–332. https://doi.org/10.1007/BF02294359
3. Alderdice F, Lynn F, Lobel M (2012) A review and psychometric evaluation of Pregnancy-Specific Distress measures. J Psychosom Obstet Gynaecol 33(2):62–77. https://doi.org/10.3109/0167482X.2012.673040
4. Andhavarapu M, Orwa J, Temmerman M, Musana JW (2021) Maternal sociodemographic factors and antenatal stress. Int J Environ Res Public Health 18(13):6812. https://doi.org/10.3390/ijerph18136812
5. Barba-Müller E, Craddock S, Carmona S, Hoekzema E (2019) Brain plasticity in pregnancy and the postpartum period: Links to maternal caregiving and mental health. Arch Womens Ment Health 22:289–299. https://doi.org/10.1007/s00737-018-0889-z
6. Bleker LS, de Rooij SR, Roseboom TJ (2019) Programming effects of prenatal stress on neurodevelopment—the pitfall of introducing a self-fulfilling prophecy. Int J Environ Res Public Health 16(13):2301. https://doi.org/10.3390/ijerph16132301
7. Bush NR Programming the next generation of prenatal programming of stress research: A review and suggestions for the future of the field. Dev Psychopathol. 2024:1–14. https://doi.org/10.1017/S0954579424000488
8. Caparrós-González RA, Perra O, Alderdice F, Lynn F, Lobel M, García-García I et al (2019) Psychometric validation of the Prenatal Distress Questionnaire (PDQ) in pregnant women in Spain. Women Health 59(8):937–952. https://doi.org/10.1080/03630242.2019.1584143
9. Cecil CA, Lysenko LJ, Jaffee SR, Pingault JB, Smith RG, Relton CL et al (2014) Environmental risk, Oxytocin Receptor Gene (OXTR) methylation and youth callous-unemotional traits: a 13-year longitudinal study. Mol Psychiatry 19(10):1071–1077. https://doi.org/10.1038/mp.2014.95
10. Cohen S, Kamarck T, Mermelstein R (1983) A global measure of perceived stress. J Health Soc Behav 24:385–396. https://doi.org/10.2307/2136404
11. Cortes Hidalgo AP, Neumann A, Bakermans-Kranenburg MJ, Jaddoe VWV, Rijlaarsdam J, Verhulst FC et al (2020) Prenatal maternal stress and child IQ. Child Dev 91(2):347–365. https://doi.org/10.1111/cdev.13177

12. Cox J (2019) Thirty years with the Edinburgh Postnatal Depression Scale: voices from the past and recommendations for the future. Br J Psychiatry 214(3):127–129. https://doi.org/10.1192/bjp.2018.245
13. Cox JL, Holden JM, Sagovsky R (1987) Detection of postnatal depression: development of the 10-item Edinburgh Postnatal Depression Scale. Br J Psychiatry 150(6):782–786. https://doi.org/10.1192/bjp.150.6.782
14. Delgado AM, Freire ADB, Wanderley ELS, Lemos A (2016) Analysis of the construct validity and internal consistency of the state-trait anxiety inventory (STAI) state-anxiety (S-anxiety) scale for pregnant women during labor. Rev Bras Ginecol Obstet 38:531–537. https://doi.org/10.1055/s-0036-1593894
15. Dennis CL, Falah-Hassani K, Shiri R (2017) Prevalence of antenatal and postnatal anxiety: systematic review and meta-analysis. Br J Psychiatry 210(5):315–323. https://doi.org/10.1192/bjp.bp.116.187179
16. Evans J, Tiemeier H (2021) Epidemiology of prenatal stress: depression and anxiety. In: Wazana A, Székely E, Oberlander TF (eds) Prenatal stress and child development. Routledge, pp 13–22. https://doi.org/10.1007/978-3-030-60159-1.
17. Fisher J, Cabral de Mello M, Patel V, Rahman A, Tran T, Holton S et al (2012) Prevalence and determinants of common perinatal mental disorders in women in low- and lower-middle-income countries: a systematic review. Bull World Health Organ 90(2):139G–149. https://doi.org/10.2471/BLT.11.091850. G
18. García-Esteve L, Ascaso C, Ojuel J, Navarro P (2003) Validation of the Edinburgh postnatal depression scale (EPDS) in Spanish mothers. J Affect Disord 75(1):71–76. https://doi.org/10.1016/S0165-0327(02)00020-4
19. Herba CM, Glover V, Ramchandani PG, Rondon MB (2016) Maternal depression and mental health in early childhood: an examination of underlying mechanisms in low-income and middle-income countries. Lancet Psychiatry 3(10):983–992. https://doi.org/10.1016/S2215-0366(16)30148-1
20. Howard LM, Molyneaux E, Dennis CL, Rochat T, Stein A, Milgrom J (2014) Non-psychotic mental disorders in the perinatal period. Lancet 384(9956):1775–1788. https://doi.org/10.1016/S0140-6736(14)61276-9
21. Howland MA, Cicchetti D (2021) Gestational stress and resilience: Perspectives to guide interdisciplinary research. In: Wazana A, Székely E, Oberlander TF (eds) Prenatal stress and child development. Routledge, pp 387–432. https://doi.org/10.1007/978-3-030-60159-1.
22. Kashanian M, Faghankhani M, YousefzadehRoshan M, EhsaniPour M, Sheikhansari N (2021) Woman's perceived stress during pregnancy; stressors and pregnancy adverse outcomes. J Matern Fetal Neonatal Med 34(2):207–215. https://doi.org/10.1080/14767058.2019.1602600
23. Khashan AS, McNamee R, Abel KM, Mortensen PB, Kenny LC, Pedersen MG et al (2009) Rates of preterm birth following antenatal maternal exposure to severe life events: a population-based cohort study. Hum Reprod 24(2):429–437. https://doi.org/10.1093/humrep/den418

24. Klein EM, Brähler E, Dreier M, Reinecke L, Müller KW, Schmutzer G et al (2016) The German version of the Perceived Stress Scale–psychometric characteristics in a representative German community sample. BMC Psychiatry 16:1–10. https://doi.org/10.1186/s12888-016-0875-9
25. Kornfield SL, Riis VM, McCarthy C, Elovitz MA, Burris HH (2022) Maternal perceived stress and the increased risk of preterm birth in a majority non-Hispanic Black pregnancy cohort. J Perinatol 42(6):708–713. https://doi.org/10.1038/s41372-021-01186-4
26. Leibovich de Figueroa NB (1991) Ansiedad: algunas concepciones teóricas y su evaluación. In: Casullo MM, de Leibovich NB, Aszkenazi M (eds) Teoría y técnicas de evaluación psicológica. Psicoteca, Buenos Aires, pp 123–155
27. Li X, Liu X, Wei M, Liu X, Shi X, Zhu Y et al (2022) Trajectories of maternal depressive symptoms from pregnancy to first six months postpartum and child neurodevelopment at eight months [preprint]. https://doi.org/10.21203/rs.3.rs-1281796/v1. Research Square
28. Loomans EM, van Dijk AE, Vrijkotte TG, van Eijsden M, Stronks K, Gemke RJ et al (2013) Psychosocial stress during pregnancy is related to adverse birth outcomes: results from a large multi-ethnic community-based birth cohort. Eur J Public Health 23(3):485–491. https://doi.org/10.1093/eurpub/cks097
29. Luo Z, Shen Y, Yuan J, Zhao Y, Liu Z, Shangguan F (2021) Perceived stress, resilience, and anxiety among pregnant Chinese women during the COVID-19 pandemic: latent profile analysis and mediation analysis. Front Psychol 12:696132. https://doi.org/10.3389/fpsyg.2021.696132
30. Matsumura K, Hamazaki K, Tsuchida A, Kasamatsu H, Inadera H (2019) Japan Environment and Children's Study (JECS) Group. Education level and risk of postpartum depression: results from the Japan Environment and Children's Study (JECS). BMC Psychiatry 19(1):419. https://doi.org/10.1186/s12888-019-2401-3
31. Nast I, Bolten M, Meinlschmidt G, Hellhammer DH (2013) How to measure prenatal stress? A systematic review of psychometric instruments to assess psychosocial stress during pregnancy. Paediatr Perinat Epidemiol 27(4):313–322. https://doi.org/10.1111/ppe.12051
32. Nóblega M, Retiz O, del Nuñez J, Bartra R (2024) Maternal stress mediates association of infant socioemotional development with perinatal mental health in socioeconomically vulnerable Peruvian settings. Int J Environ Res Public Health 21(7):844. https://doi.org/10.3390/ijerph21070844
33. O'Brien J, Gregg L, Wittkowski A (2023) A systematic review of clinical psychological guidance for perinatal mental health. BMC Psychiatry 23(1):790. https://doi.org/10.1186/s12888-023-05173-1
34. O'Donnell K, O'Connor TG, Glover V (2009) Prenatal stress and neurodevelopment of the child: focus on the HPA axis and role of the placenta. Dev Neurosci 31(4):285–292. https://doi.org/10.1159/000216539
35. Padmanabhan V, Cardoso RC, Puttabyatappa M (2016) Developmental programming, a pathway to disease. Endocrinology 157(4):1328–1340. https://doi.org/10.1210/en.2016-1003
36. Qiu X, Wu Y, Sun Y, Levis B, Tian J, Boruff JT et al (2023) Individual participant data meta-analysis to compare EPDS accuracy to detect major depression with and without the self-harm item. Sci Rep

13(1):4026. https://doi.org/10.1038/s41598-023-29114-w

37. Racine N, Madigan S, Plamondon A, Hetherington E, McDonald S, Tough S (2018) Maternal psychosocial risk profiles in pregnancy: associations with postpartum maternal health and child outcomes. Clin Psychol Sci 6(6):783–796. https://doi.org/10.1177/2167702618788863
38. Remor EA (2006) Psychometric properties of a European Spanish version of the perceived stress scale (PSS). Span J Psychol 9(1):86–93. https://doi.org/10.1017/S1138741600006004
39. Riquelme AG, Casal GB (2011) Actualización psicométrica y funcionamiento diferencial de los ítems en el State Trait Anxiety Inventory (STAI). Psicothema 23(3):510–515
40. Roman L, Raffo JE, Zhu Q, Meghea CI (2014) A statewide medicaid enhanced prenatal care program: impact on birth outcomes. JAMA Pediatr 168(3):220–227. https://doi.org/10.1001/jamapediatrics.2013.4347
41. Rondon MB (2020) Perinatal mental health around the world: priorities for research and service development in South America. BJPsych Int 17(4):85–87. https://doi.org/10.1192/bji.2020.9
42. Roos A, Lochner C, Kidd M, van Honk J, Vythilingum B, Stein DJ (2012) Selective attention to fearful faces during pregnancy. Prog Neuropsychopharmacol Biol Psychiatry 37(1):76–80. https://doi.org/10.1016/j.pnpbp.2011.11.012
43. Servin-Barthet C, Martínez-García M, Pretus C, Paternina-Die M, Soler A, Khymenets O et al (2023) The transition to motherhood: linking hormones, brain and behaviour. Nat Rev Neurosci 24(10):605–619. https://doi.org/10.1038/s41583-023-00733-6
44. Silveira PP, Pokhvisneva I, Parent C, Cai S, Rema ASS, Broekman BFP et al (2017) Cumulative prenatal exposure to adversity reveals associations with a broad range of neurodevelopmental outcomes that are moderated by a novel, biologically informed polygenetic score based on the serotonin transporter solute carrier family C6, member 4 (SLC6A4) gene expression. Dev Psychopathol 29(5):1601–1617. https://doi.org/10.1017/S0954579417001262
45. Spielberger CD, Gorsuch RL, Lushene R (1982) Manual del Cuestionario de Ansiedad Estado/Rasgo (STAI). TEA Ediciones, Madrid
46. Troller-Renfree SV, Hart ER, Sperber JF, Fox NA, Noble KG (2022) Associations among stress and language and socioemotional development in a low-income sample. Dev Psychopathol 34(2):597–605. https://doi.org/10.1017/S0954579421001759
47. Van den Bergh BR, van den Heuvel MI, Lahti M, Braeken M, de Rooij SR, Entringer S et al (2020) Prenatal developmental origins of behavior and mental health: The influence of maternal stress in pregnancy. Neurosci Biobehav Rev 117:26–64. https://doi.org/10.1016/j.neubiorev.2017.07.003
48. Van Niel MS, Bhatia R, Riano NS, de Faria L, Catapano-Friedman L, Ravven S, Weissman B, Nzodom C, Alexander A, Budde K, Mangurian C (2020) The impact of paid maternity leave on the mental and physical health of mothers and children: a review of the literature and policy implications. Harv Rev Psychiatry 28(2):113–126. https://doi.org/10.1097/HRP.0000000000000246
49. Walsh K, McCormack CA, Webster R, Pinto A, Lee S, Feng T et al (2019) Maternal prenatal stress phenotypes associate with fetal neurodevelopment and birth outcomes. Proc Natl Acad Sci U S A

116(48):23996–24005. https://doi.org/10.1073/pnas.1905890116

50. Wazana A, Székely E, Oberlander TF (2021) Prenatal stress and child development: The future that lies ahead. In: Wazana A, Székely E, Oberlander TF (eds) Prenatal stress and child development. Routledge, pp 623–632. https://doi.org/10.1007/978-3-030-60159-1.
51. Yali AM, Lobel M (1999) Coping and distress in pregnancy: an investigation of medically high-risk women. J Psychosom Obstet Gynaecol 20:39–52. https://doi.org/10.3109/01674829909075575

Figures



Figure 1

Study design and measures across the perinatal period

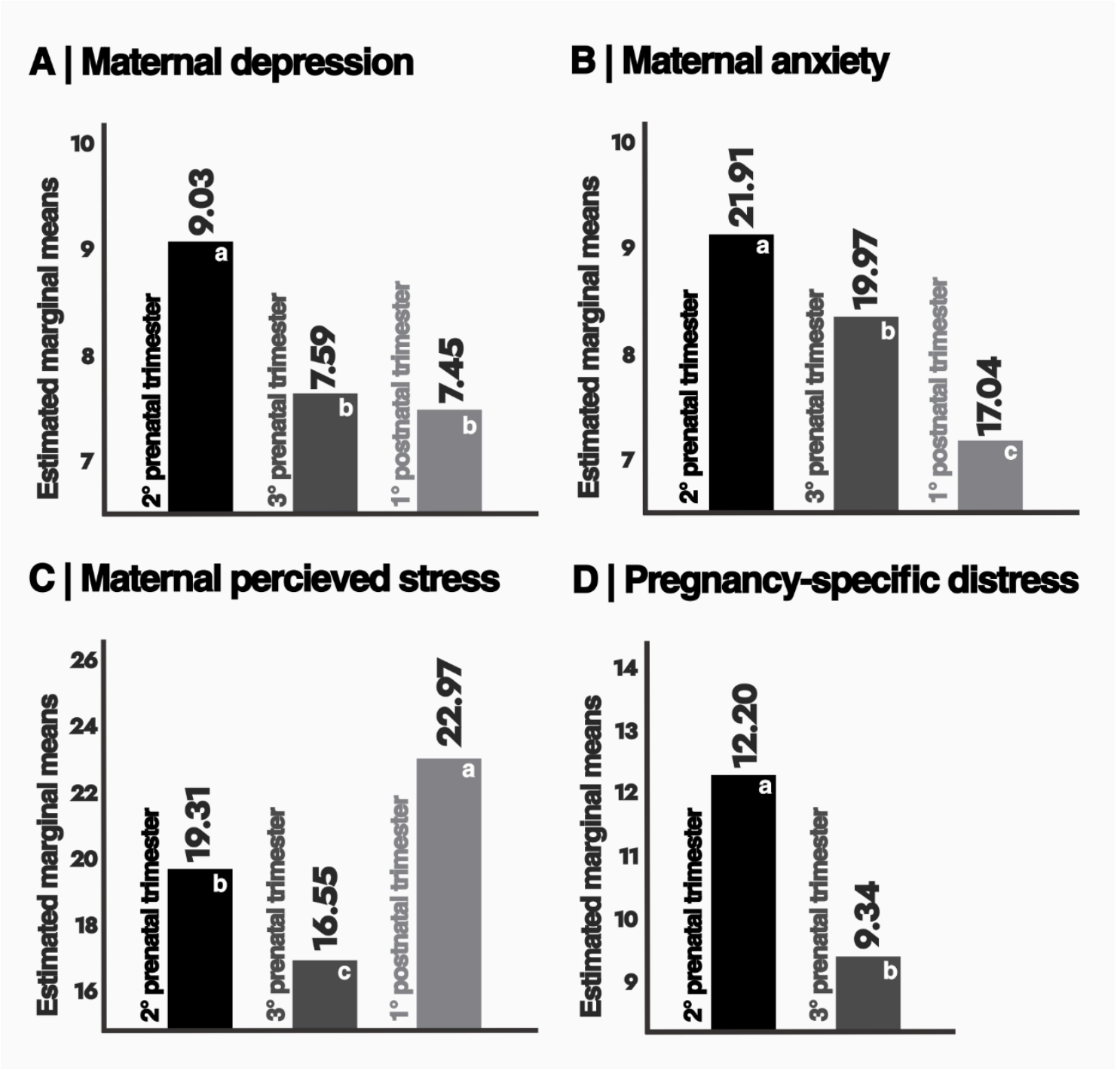


Figure 2

Perinatal variation in maternal psychosocial stress.

Note: Estimated marginal means of maternal depressive symptoms (A), anxiety (B), perceived stress (C), and pregnancy-specific distress (D) across the second and third prenatal trimesters and at three months postpartum. Different letters denote significant pairwise differences ($p < .05$).

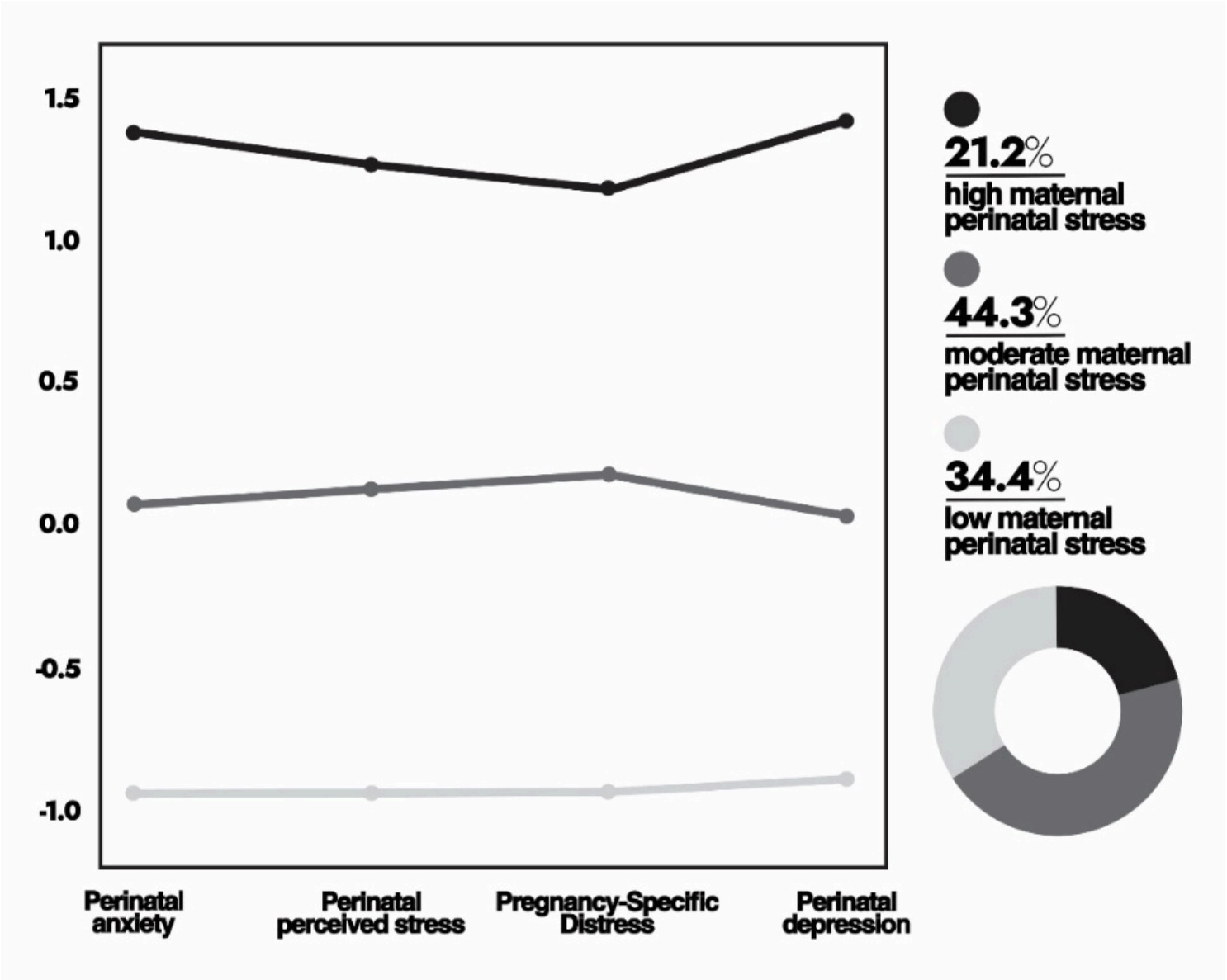


Figure 3

Means for each variable included in the model, separated by profiles.