

Behavioral coping phenotypes and psychosocial outcomes in a national U.S. sample of pregnant and postpartum women during the COVID-19 pandemic

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Abstract

Maternal stress exposure during the COVID-19 pandemic may have transgenerational effects, adversely affecting both the pregnant woman and her offspring. Therefore, there is an urgent need to characterize the coping styles and psychosocial distress of pregnant and postpartum women during the COVID-19 pandemic to help mitigate lasting sequelae on both mothers and infants. Here we use latent profile analysis to examine patterns of behavioral coping strategies associated with risk and resiliency to adverse mental and physical health outcomes. Leveraging a large U.S. sample of perinatal women (N = 2,876 pregnant women, N = 1,536 postpartum women), we identified four behavioral phenotypes of coping strategies: (1) passive-coping, characterized by primarily engaging in high levels of screen time, social media use, and eating comfort foods; (2) active-coping, characterized by primarily engaging in high levels of self-care, social support, and limiting media exposure; (3) low-coping, characterized by low levels of all coping strategies; (4) high-coping, characterized by high levels of both active and passive coping strategies. Critically, we found that passive-coping phenotypes were associated with higher levels of depression and anxiety and worsening stress and energy levels in both pregnant and postpartum women. Supplementing passive coping strategies with high levels of active coping strategies (the high-coping profile) lessened adverse outcomes in postpartum women. These behavioral coping phenotypes highlight potential risk and protective factors for perinatal women, which is critical in helping to identify and treat perinatal women most at risk for experiencing mood and affective disorders resulting from the COVID-19 pandemic.

Introduction

The current COVID-19 pandemic reflects a unique, chronic stressor that likely has wide-ranging consequences for psychosocial functioning in pregnant and postpartum women across the globe. Indeed, emerging reports indicate that the COVID-19 pandemic is associated with heightened psychological distress in the general adult population (O'Connor et al., 2020; Xiong et al., 2020), with women and unpaid caregivers reporting disproportionate increases in symptoms of anxiety and depression (Daly, Sutin, & Robinson, 2020). The impact on pregnant and postpartum women is of particular concern given the established adverse effects of perinatal mood and anxiety disorders on the intrauterine and postnatal development of their offspring (Hoffman, Dunn, & Njoroge, 2017; Monk, Lugo-Candelas, & Trumpff, 2019; Van den Bergh et al., 2020). There is an urgent need to characterize the mental health outcomes of perinatal women during the COVID-19 pandemic and to identify behavioral risk and protective factors to minimize potentially harmful consequences during this global public health emergency. Leveraging a large, national sample of pregnant and postpartum women in the United States (N = 4,412), we use a data-driven, person-oriented approach to (1) classify behavioral phenotypes of coping strategies that perinatal women are engaging in to manage pandemic-related stress, (2) isolate associations between coping phenotypes and demographic characteristics, and (3) identify coping phenotypes that are associated with risk and resiliency for adverse mental and physical health outcomes. The findings from this study are essential for identifying behavioral markers of women at increased risk for adverse outcomes, pinpointing potential protective factors, and targeting interventions to reduce long-term consequences on women and infants.

Pregnant and postpartum women are at heightened risk for mood and anxiety disorders, particularly following stressful life events (Biaggi, Conroy, Pawlby, & Pariante, 2016; Salm Ward, Kanu, & Robb, 2017). The COVID-19 pandemic presents a number of unique stressors that may make perinatal women especially vulnerable to experiencing mood and anxiety disorders. For example, uncertainty regarding the impact of COVID-19 infection or vaccination on fetuses and infants, changes or disruptions in birth plans or postpartum care, and reduced access to childcare or social support systems may create additional risk for maladaptive outcomes in perinatal women relative to the general population. Women are also more likely to work in professions that have increased virus exposure risk, such as healthcare and teaching, and in professions that have experienced greater economic consequences and job losses, such as hospitality or service industries (Zamarro, Perez-Arce, & Prados, 2020). School and childcare closures have also led to a disproportionate increase in unpaid labor taken on by women (Kalenkoski, Pablonia, & Kalenkoski, 2020; Zamarro et al., 2020).

Collectively, these factors suggest that pregnant and postpartum women might be especially vulnerable to adverse mental and physical health outcomes during the COVID-19 pandemic.

The impact of pandemic-related stressors on pregnant and postpartum women is of heightened concern given that maternal mental health can have intergenerational influences on their child's development and long-term psychological health (Glover, 2014; Monk et al., 2019). It is well established that anxiety and depression during pregnancy is associated with a number of detrimental outcomes, including increased risk of preterm birth, low birth weight, postpartum depression, and long-term adverse neurobehavioral outcomes in infants (Dunkel Schetter & Tanner, 2012; Glover, 2014; Grote et al., 2010; Monk et al., 2019). Preventing or attenuating the incidence of perinatal mood and anxiety disorders is essential for preventing a sequelae of intergenerational transmission and negative developmental consequences. Yet, the degree to which the COVID-19 pandemic has uniquely impacted perinatal mental and physical health in the United States, as well as the potential behavioral strategies that might promote risk or resilience, has not been well characterized.

Insight into strategies to prevent potentially harmful short- and long-term consequences of pandemic-related stress on perinatal women and their offspring may be gleaned by exploring factors that are associated with risk and resiliency to pandemic-related stressors. For instance, emerging reports indicate that psychological flexibility and increased tolerance of uncertainty are associated with resiliency to pandemic-related stress (Daks, Peltz, & Rogge, 2020; McCracken, Badinlou, Buhrman, & Brocki, 2021). Another, large-scale online survey of adults ($N = 3,042$) found that psychological resiliency, defined by increased self-reliance, emotion-regulation, and interpersonal relations, was associated with lower COVID-19 related distress (Barzilay et al., 2020). However, behavioral coping strategies associated with risk and resiliency, which are more immediately modifiable than psychological characteristics and thus represent potential targets for intervention, have not been well characterized in perinatal women during the COVID-19 pandemic. Filling this empirical gap is critical for helping identify women most at risk for experiencing untreated mood and affective disorders during the pandemic and for informing scalable interventions to help mitigate lasting sequelae on women and their infants.

Here we use a data-driven, person-oriented approach to identify behavioral phenotypes of coping mechanisms in a large, national sample ($N = 4,412$) of pregnant and postpartum women (within the first 12 months of infant life) drawn from nine states across the United States. While traditional variable-oriented approaches assume that the associations among variables within a population are homogenous, person-oriented approaches, such as latent profile analysis, identify heterogenous subgroups that have similarities across several variables of interest. This approach is advantageous as it considers how *patterns* of behaviors jointly predict outcome measures, which allows for more precise identification of behavioral phenotypes associated with risk and resiliency.

As such, we first use latent profile analysis to identify different adaptive and maladaptive behavioral coping phenotypes in pregnant and postpartum women. We examined behavioral phenotypes in pregnant and postpartum women separately to account for potentially different patterns of coping strategies, and relations with outcome measures, that might be obscured in the full sample (e.g., increased substance use may be more common among postpartum women relative to pregnant women). We then examine relations between coping phenotypes and demographic/socioeconomic characteristics of our sample. Finally, we identify coping phenotypes that are associated with risk and resiliency to maternal anxiety and depression symptoms, as well as measures of sleep quality, stress and energy levels, and overall perceived distress related to the pandemic. Leveraging this large, geographically diverse sample, the current study characterizes the impact of the COVID-19 pandemic on perinatal psychosocial functioning and offers insights into potential risk and protective factors for adverse outcomes.

Method

Participants & procedures

Participants were recruited into studies examining the impact of COVID-19 on perinatal women taking place at 14 academic research institutions (Figure 1A). All studies were approved by the local Institutional Review Board at each site. The studies were independent, but the investigators opted to use common research methods to facilitate future harmonization and cross-site data sharing. All sites administered the COPE: COVID-19 & Perinatal Experiences - Impact Survey (Thomason, Graham, & VanTieghem, 2020) online between March and October 2020, with the majority of data collection occurring in April 2020 (Figure 1B). Informed electronic consent was obtained prior to data collection. Criteria for participation included being pregnant or postpartum within the first 12 months of infant life. The combined sample consisted of 4,412 women (2,876 pregnant women, 1,536 postpartum women) collected from 9 states (California, Michigan, New York, Oregon, Pennsylvania, Tennessee, Utah, Vermont, Virginia; Figure 1). Demographic characteristics of the final sample are reported in Table 1. The survey was administered to an additional 1,294 women, but their data were excluded due to failure to complete the "Adjustment and Coping" subsection of the COPE-IS survey ($n = 814$), or due to inconsistent or unreliable survey response patterns ($n = 37$ were excluded due to selecting categories for both "increased" and "decreased" behaviors; $n = 389$ were excluded due to selecting "None" in addition to other behaviors). We additionally excluded $n = 54$ women who reported no coping behaviors.

Measures

Coping behaviors. Women selected behaviors they were engaging in to cope with stress related to the COVID-19 pandemic on the "Coping and Adjustment" subsection of the COPE: COVID-19 & Perinatal Experiences - Impact Survey (Thomason et al., 2020). The specific survey items and proportion of subjects endorsing each item are listed in Figure 2. The survey items probed a broad spectrum of adaptive and maladaptive behaviors, including social support mechanisms, physical activity, nutrition, substance use, healthcare utilization, news consumption, screen time, and self-care related activities (Figure 2). One additional item ("using other recreational drugs") in the original survey was removed for analyses due to fewer than 5 responses to this question across participants. The survey items were selected to encompass a range of physical, emotional, and social support mechanisms that are both accessible to women during the pandemic and that are hypothesized to have predictive value for risk and resiliency for poor mental and physical health outcomes.

Mental and physical health outcomes. Data were collected on how the COVID-19 pandemic changed women's self-reported sleep, energy levels, and overall stress/mental health using 5-point Likert scales (1 = worsened significantly, 2 = worsened moderately, 3 = no change, 4 = improved moderately, 5 = improved significantly). We also collected data on women's self-reported overall level of stress specifically related to the COVID-19 pandemic using a 7-point Likert scale (1 = nothing, 7 = extreme). Finally, women's overall levels of anxiety and depression symptoms were measured using the Anxiety and Depression subscales of the Brief Symptom Inventory (BSI-18; Derogatis, 2001), as well as clinically-elevated symptoms of depression and anxiety, defined by BSI transformed t scores of 63 or greater (Derogatis, 2001).

Analytic plan

We first used factor analysis to reduce the survey items into composite variables representing different dimensions of coping strategies. We conducted an exploratory principal components analysis to determine the latent structure of coping strategies using SPSS version 21.0, which was verified using confirmatory factor analysis in Mplus Version 8.1.

We then used latent profile analysis (LPA) to identify groups of pregnant and postpartum women categorized based on similar patterns of coping strategies. All LPA analyses were conducted in Mplus Version 8.1, and separate models were fit for pregnant women and postpartum women to account for potential differences in patterns of coping strategies between pregnant and postpartum women. Each LCA was initialized 200 times, with 50 iterations for the final stage of

optimization. Using the Nylund, Asparouhov, & Muthén (2007) guidelines for latent profile analysis, the following steps were used to determine the best fitting model. As a first step, the model with the lowest Bayesian information criterion (BIC) combined with a statistically significant Lo–Mendell–Rubin likelihood ratio test (LMR) was considered as the potentially best fitting model. As a second step, we ensured that the best fitting model also had a high entropy value (greater than .75, or closest to 1.0, indicating low classification error), at least 5% of the total participant count in a given profile, and high posterior probabilities (close to 1.0, indicating high confidence that an individual assigned to a given profile actually belongs to that profile). We sequentially tested the fit of multiple models, stopping once the LMR indicated no difference.

Finally, we examined demographic and socioeconomic predictors of latent profile membership using the 3-step procedure for predictor variables (“R3STEP” command for multinomial logistic regression in Mplus). To safeguard against biased estimates when examining associations between profile membership and distal outcomes (stress levels, sleep quality, energy levels, symptoms of depression and anxiety, and overall COVID-related distress), we used the 3-step auxiliary approach for outcome measures with unequal means and equal variances (“DE3STEP” command in Mplus). This approach accounts for measurement error associated with most likely profile membership and is shown to be superior to other methods (Asparouhov & Muthén, 2014).

Results

Descriptive statistics

Demographic characteristics and means for all mental and physical health outcome variables for the full sample are presented in Table 1. The proportion of participants endorsing each of the coping behavior survey items are presented in Figure 2. Twenty-one percent (21.2%) of pregnant women and 20.8% of postpartum women met cut-off estimates for clinically elevated anxiety symptoms, and 16.6% of pregnant women and 16.3% of postpartum women met cut-off estimates for clinically elevated depression symptoms (both defined by BSI transformed *t* scores of 63 or greater; Derogatis, 2001).

Table 1. Descriptive Statistics

Variable	Pregnant women			Postpartum women		
	<i>N</i>	<i>Mean (or %)</i>	<i>SD</i>	<i>N</i>	<i>Mean (or %)</i>	<i>SD</i>
Demographic variables						
Maternal race/ethnicity (% BIPOC)	2876	29%	-	1536	29%	-
Black (%)	2876	4.7%	-	1536	4.5%	-
Native American/ Alaska Native (%)	2876	<1%	-	1536	<1%	-
Native Hawaiian/ Pacific Islander (%)	2876	<1%	-	1536	<1%	-
Asian (%)	2876	7.1%	-	1536	7.7%	-
Hispanic/Latin (%)	2876	6.7%	-	1536	5.5%	-
Two or More Races/Other (%)	2876	9.7%	-	1536	11.4%	-
Maternal age	2667	32.40	4.47	1419	33.15	4.57
Maternal education ^a	2824	6.91	1.41	1497	6.94	1.48
Maternal education (% 4-year college graduate)	2824	78%	-	1497	79%	-
Family income ^b	2813	8.67	4.01	1488	8.69	4.14
Number of children in the home	2796	0.79	1.10	1497	1.78	1.08
Mental and physical health variables						
Mean raw BSI anxiety score (0 – 4 range)	2859	0.65	0.73	1522	.67	0.72
Clinically-elevated anxiety symptoms (%)	2859	21.2%	-	1522	20.8%	-
Mean raw BSI depression score (0 – 4 range)	2859	0.80	.80	1523	.79	0.80
Clinically-elevated depression symptoms (%)	2859	16.6%	-	1523	16.3%	-
Change in energy levels (1 = worsened, 5 = improved)	2543	2.33	.72	1300	2.42	0.70
Change in sleep quality (1 = worsened, 5 = improved)	2843	2.56	.77	1515	2.62	0.66
Change in stress levels (1 = worsened, 5 = improved)	2728	2.11	.69	1501	2.08	.68
COVID-related distress (1 = nothing, 7 = extreme)	2734	4.30	1.50	1516	4.44	1.45

^a Education was coded as 1 = < 10th grade, 2 = 10-12th grade, 3 = high school/GED, 4 = apprenticeship/trade school, 5 = partial college, 6 = 2-year college, 7 = 4-year college, 8 = graduate degree

^b Income was coded as 1 = < 10k, 2 = 10-20k, 3 = 20-30k, 4 = 30-40k, 5 = 40-50k, 6 = 50-60k, 7 = 60-80k, 8 = 80-100k, 9 = 100-120k, 10 = 120-140k, 11 = 140-160k, 12 = 160-180k, 13 = 180-200k, 14 = 200-220k, 15 = 220-250k, 16 = 250k+

Dimensionality reduction

Exploratory factor analysis. We used a principal components analysis with promax rotation, which permits correlation between the factors, to guide the creation of composite variables from the original survey items (Figure 2). Examination

of the scree plot suggested a 6-factor solution, which was conceptually appropriate and accounted for 38.7% of the overall variance. One item (“Other”) did not load on any factors above .2 and was thus removed. All remaining variables had loadings above .45, with the exception of “Using CBD only”, which showed a marginally lower loading of .37. There were no substantial cross-loadings of variables onto multiple factors. The structure matrix for the final 6-factor solution is shown in Table 2.

Table 2. Principal components analysis structure matrix.

Survey item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Increased self-care (e.g., baths, facials)	0.63					
Eating healthier	0.57					
Increased calm activities (e.g., reading, puzzles)	0.55					
Exercising	0.54					
Getting a good night’s sleep	0.49					
Meditation and/or mindfulness practices	0.46					
Increased screen time (e.g., gaming, TV)		0.76				
Increased time on social media		0.73				
Eating comfort foods (e.g., candy and chips)		0.63				
Decreased time following news coverage			0.80			
Increased time following news coverage			-0.68			
Decreased time on social media			0.60			
Talking with friends and family				0.62		
Talking to people who are pregnant or parenting				0.55		
Engaging in more family activities				0.52		
Helping others				0.47		
Talking with a mental health care provider					0.61	
Talking to my health providers more frequently					0.57	
Using new prescription drugs					0.55	
Using over the counter sleep aids					0.46	
Using CBD only						0.37
Using tobacco (i.e. smoking, vaping)						0.65
Using marijuana (i.e. smoking, vaping, eating)						0.57
Drinking alcohol						0.49

Note. N = 4,412. Component loadings below |.30| are suppressed for ease of presentation.

Factor 1 reflects “self-care” and consists of exercising, getting a good night’s sleep, meditation, eating healthy, self-care activities (e.g., baths, facials), and calm activities such as puzzles and reading. Factor 2 reflects “vegging out” and consists of increased screen time, increased social media use, and increased comfort foods. Factor 3 reflects “decreased media/news” and consists of decreased social media use, decreased time following news, and increased time following news (reverse scored). Factor 4 embodies “social support” and consists of talking with friends and family, helping others, engaging in family activities, and talking to other parents/pregnant women. Factor 5 reflects “healthcare utilization” and consists of talking to health providers, talking to mental health providers, using new prescription drugs, and using over-the-counter sleep aids. Finally, Factor 6 reflects “substance use” and consists of tobacco use, marijuana, CBD, and alcohol consumption. Correlations among factors ranged from $-.127$ to $.195$. Broadly, these factors reflect dimensions of active coping strategies (self-care, social support, healthcare) and passive coping strategies (vegging out, substance use, and media use).

Confirmatory factor analysis. We verified the fit of these active and passive coping strategy dimensions using confirmatory factor analyses in Mplus with Robust Weighted Least Squares (WLSVM) extraction. Fit indices indicated adequate fit of the proposed dimensions of the active coping strategy latent variables, RMSEA = 0.03, 90% C.I. (0.027, 0.033), CFI = .90, $\chi^2 = 369.62$, $p < 0.001$, as well as the passive coping strategy latent variables, RMSEA = 0.038, 95% C.I. (0.03, 0.04), CFI = .93, $\chi^2 = 235.83$, $p < 0.001$, based on recommended fit indices of RMSEA $< .08$ and CFI $> .90$ [1] (Kline, 2015). Inspection of parameter estimates indicated that all of the factor loadings were significant and in the expected direction for both models. Composite reliability (CR), using McDonald’s omega, indicated that internal consistency was adequate for self-care (CR = .70), vegging out (CR = .74), decreased media/news (CR = .89), substance use (CR = .75), and healthcare utilization (CR = .72), based on recommended guidelines of composite reliability equal to or greater than .60 for exploratory scales (Hair, Black, Babin, & Anderson, 2010). Social support had relatively lower internal consistency (CR = .55), but we retained this composite given the conceptual fit and given that all indicators loaded significantly and in the expected direction on this factor.

Coping strategy composite variables. Composite variables for “self-care”, “social support”, “decreased media/news”, and “vegging out” were created by averaging over the individual items that loaded strongly onto each of these constructs (Table 2). Note that “increased news coverage” was reverse coded prior to averaging in the “decreased media” composite variable. Composite variables for “substance use” and “healthcare utilization” were created by discretizing the individual items into a binary categorical variable (none, or 1+ items). We did this to prevent floor effects resulting from the low proportion of responses across these items (see Figure 2), which would have prevented model convergence in subsequent latent profile analyses. We created composite variables in this way, rather than using the latent factor scores, as this method retains the variance in the original data and is superior when using exploratory scales (DiStefano, Zhu, & Mîndrilă, 2009). Preserving the variation in the original data is particularly desirable here as the factor structure explained only 39% of the total variance.

Latent profile analysis

Four models, testing the fit of 2-5 possible profiles (stopping once the LMR test was no longer significant), were generated and compared for both pregnant and postpartum women separately using the composite coping strategy variables as indicators. The 4-profile model was the best fitting model for both pregnant and postpartum women, as reflected by a low BIC, a significant LMR test, a high entropy value, and each profile representing at least 5% of the entire sample (see Table 3 for full results). The latent structures of the profiles are presented in Figure 3, which illustrate mean values for the continuous and categorical variables for each profile. The means of the coping strategies were directly compared between profiles using an analysis of variance (ANOVA), which revealed significant differences among the profiles on the behavioral coping strategies (see Table 4 and Table 5). Tukey’s Honest Significant Difference test was

used to compare the means of the individual coping strategies between the profiles (Table 4 and Table 5). Similar profiles were found for pregnant and postpartum women and are described below.

Table 3. LPA model fits for pregnant and postpartum women.

	BIC		Entropy		Smallest profile (%)		LMR <i>p</i> value	
	<i>Pregnant</i>	<i>Postpartum</i>	<i>Pregnant</i>	<i>Postpartum</i>	<i>Pregnant</i>	<i>Postpartum</i>	<i>Pregnant</i>	<i>Postpartum</i>
2-profile	5521	4142	.90	.90	47%	50%	< .001	< .001
3-profile	5352	3979	.82	.85	7%	7%	< .001	.04
4-profile	5155	3810	.78	.86	12%	8%	< .001	< .001
5-profile	5166	3793	.76	.84	6%	2%	.41	.75

Note. BIC=Bayesian Information Criteria; LMR=Lo-Mendell-Rubin.

Table 4. Mean comparisons of coping strategies between profiles for pregnant women.

	Low-coping (n = 1188)	Passive-coping (n = 960)	Active-coping (n = 349)	High-coping (n = 379)	<i>F</i>	η_p^2
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>		
Self-Care	.24 (.17) ^b	.20 (.15) ^b	.67 (.15) ^a	.63 (.16) ^a	1298.72	.58
Social Support	.31 (.21) ^b	.33 (.21) ^b	.50 (.23) ^a	.53 (.23) ^a	156.65	.14
Decreased media/news	.40 (.26) ^b	.30 (.26) ^c	.61 (.30) ^a	.37 (.30) ^b	109.71	.10
Vegging out	.16 (.17) ^b	.80 (.16) ^a	.15 (.17) ^b	.81 (.17) ^a	3706.66	.80
Substance Use	.01 (.09) ^b	.02 (.15) ^a	.01 (.09) ^a	.02 (.14) ^a	3.50	<.01
Healthcare	.11 (.31) ^c	.17 (.11) ^b	.23 (.42) ^b	.31 (.46) ^a	32.07	.03

Differing subscripts within rows indicate significantly different means at $p < .05$, with Tukey's HSD correction.

Table 5. Mean comparisons of coping strategies between profiles for postpartum women.

	Low-coping (n = 595)	Passive-coping (n = 635)	Active-coping (n = 178)	High-coping (n = 128)		
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>F</i>	η_p^2
Self-Care	.14 (.12) ^b	.13 (.13) ^b	.59 (.14) ^a	.60 (.14) ^a	1017.26	.67
Social Support	.34 (.21) ^b	.36 (.22) ^b	.47 (.26) ^a	.52 (.25) ^a	30.27	.06
Decreased media/news	.43 (.29) ^b	.34 (.27) ^c	.52 (.33) ^a	.41 (.34) ^b	22.70	.04
Vegging out	.16 (.17) ^b	.82 (.17) ^a	.16 (.17) ^b	.81 (.17) ^a	2019.52	.80
Substance Use	.14 (.34) ^c	.24 (.43) ^b	.24 (.43) ^b	.41 (.50) ^a	18.81	.04
Healthcare	.14 (.35) ^b	.14 (.35) ^b	.19 (.39) ^b	.26 (.44) ^a	4.53	.01

Differing subscripts within rows indicate significantly different means at $p < .05$, with Tukey's HSD correction.

Profile 1 – Low-coping. The first profile extracted accounted for 41% of the sample in pregnant women ($n = 1188$), and 39% of the sample in postpartum women ($n = 595$). This profile was characterized by significantly lower endorsements of all coping strategies in both postpartum and pregnant women.

Profile 2 – Passive-coping. The second profile extracted accounted for 33% of the sample in pregnant women ($n = 960$), and 41% of the sample in postpartum women ($n = 635$). This profile was characterized by high levels of vegging out, and lower levels of self-care, social support, and healthcare utilization.

Profile 3 – Active-coping. The third profile extracted accounted for 12% of the sample in both pregnant women ($n = 349$) and in postpartum women ($n = 178$). This profile was characterized by high levels of self-care and social support, as well as decreased media/news consumption.

Profile 4 – High-coping. The final profile extracted accounted for 13% of the sample in pregnant women ($n = 379$), and 8% of the sample in postpartum women ($n = 128$). This profile was characterized by high levels of self-care, social support, and healthcare utilization, as well as very high levels of vegging out. This profile was also characterized by higher levels of substance use in the postpartum women only.

Relation to demographic and socioeconomic variables

Multinomial logistic regression analysis was used to examine predictors of latent profile membership based on demographic and socioeconomic variables. The multinomial logistic model parameters using the low-coping profile as the reference category are presented for pregnant and postpartum women in Table 6 and Table 7, respectively. Pregnant women in the active-coping profile were more likely to have fewer children (odds ratio [OR] = .64, 95% CI = .52-.78). Women in this profile were also less likely to identify as Black (OR = 0.30, 95% CI = 0.12-0.73) or Asian (OR = 0.42, 95% CI = 0.21-0.84). Similarly, women in the high-coping profile were also more likely to have fewer children (OR = .61, 95% CI = .43-.87) and greater educational attainment (OR = 1.15, 95% CI = 1.03-1.28). Women in the passive-coping profile were marginally more likely to have greater educational attainment (OR = 1.004, 95% CI = 1.002-1.006), and were also less likely to identify as Black (OR = 0.65, 95% CI = 0.46-0.92).

Table 6. Multinomial logistic regression of predictors of latent profile membership for pregnant women.

	High-coping (vs. low)			Passive-coping (vs. low)			Active-coping (vs. low)		
	<i>B</i>	<i>SE</i>	<i>Odds ratio</i>	<i>B</i>	<i>SE</i>	<i>Odds ratio</i>	<i>B</i>	<i>SE</i>	<i>Odds ratio</i>
Black^a	-0.62	.41	0.54	-0.43*	0.21	0.65	-1.21*	0.55	0.30
Hispanic/Latin^a	-0.46	.32	0.63	-0.32	0.17	0.73	-0.44	0.31	0.65
Asian^a	-0.10	0.26	0.90	-0.10	0.18	0.91	-0.88*	0.42	0.42
Two or more races/other^a	-0.16	0.38	0.85	0.13	0.22	1.14	0.48	0.14	1.61
Maternal age	-0.02	0.02	0.98	-0.02	0.01	0.98	0.03	0.02	1.03
Children	-0.49*	0.22	0.61	-0.07	0.05	0.92	-0.46**	0.13	0.64
Education	0.14*	0.07	1.15	0.004*	0.001	1.004	0.00	0.00	1.00
Income	0.00	0.02	1.01	0.01	0.02	1.01	-0.04	0.03	0.96

^a Race/ethnicity was dummy-coded, with white as the reference category

* $p < .05$

** $p < .01$

Postpartum women in the passive-coping profile were more likely to have greater educational attainment relative to the low-coping profile (OR = 1.13, 95% CI = 1.04-1.23), in addition to being younger in age (OR = .96, 95% CI = .94-.99). Women in the passive-coping profile were also more likely to identify as Black (OR = 2.33, 95% CI = 1.42-3.84). Women in the active-coping and high-coping coping profiles were more likely to have greater educational attainment (active-coping: OR = 1.26, 95% CI = 1.07-1.48; high-coping: OR = 1.25, 95% CI = 1.07-1.47). No other variables were significant predictors of profile membership.

Table 7. Multinomial logistic regression of predictors of latent profile membership for postpartum women.

	High-coping (vs. low)			Passive-coping (vs. low)			Active-coping (vs. low)		
	<i>B</i>	<i>SE</i>	<i>Odds ratio</i>	<i>B</i>	<i>SE</i>	<i>Odds ratio</i>	<i>B</i>	<i>SE</i>	<i>Odds ratio</i>
Black ^a	0.18	0.62	1.20	0.85**	0.30	2.33	0.70	0.46	2.01
Hispanic/Latin ^a	-0.63	0.47	0.54	0.11	0.22	1.11	-0.20	0.38	0.82
Asian ^a	-0.40	0.47	0.67	-0.10	0.24	0.90	-0.35	0.45	0.70
Two or more races/other ^a	0.55	0.48	1.73	0.18	0.33	1.20	0.45	0.46	1.56
Maternal age	-0.04	0.03	0.96	-0.04*	0.02	0.96	-0.05	0.03	0.95
Children	-0.22	0.27	0.80	0.02	0.07	1.02	-0.12	0.10	0.89
Education	0.23*	0.10	1.25	0.12*	0.05	1.13	0.23*	0.10	1.26
Income	-0.04	0.03	1.20	0.02	0.02	1.02	0.00	0.03	1.00

^a Race/ethnicity was dummy-coded, with white as the reference category

* $p < .05$

** $p < .01$

Relation to mental and physical health outcomes

Finally, we examined whether latent profile membership was a significant predictor of mental and physical health outcome variables. In pregnant women, membership in a particular profile was a significant predictor of all outcome measures, as indicated in Table 8. Of note, women with coping profiles characterized by high levels of vegging out (high-coping and passive-coping) were more likely to have increased anxiety and depression (Figure 4). Women in these profiles also exhibited worsening stress levels, and overall greater COVID-related distress relative to women in the active-coping and low-coping profiles. Additionally, women in the active-coping profile reported fewer changes in energy levels relative to the other profiles. Women with profiles characterized by high self-care and social support (active-coping and high-coping) also had fewer negative changes in sleep quality.

Table 8. Comparisons of mental and physical outcome measures between profiles for pregnant women.

	<i>Active-coping</i>	<i>High-coping</i>	<i>Passive-coping</i>	<i>Low-coping</i>	<i>Omnibus χ^2 test</i>
	<i>M (SE)</i>	<i>M (SE)</i>	<i>M (SE)</i>	<i>M (SE)</i>	
BSI anxiety	.56 (.04) ^a	.70 (.05) ^b	.85 (.03) ^b	.50 (.02) ^a	$\chi^2(3) = 101.6, p < .001$
BSI depression	.60 (.04) ^a	.81 (.05) ^b	1.05 (.04) ^b	.64 (.04) ^a	$\chi^2(3) = 133.8, p < .001$
Change in energy	2.56 (.05) ^a	2.33 (.05) ^b	2.16 (.03) ^c	2.39 (.02) ^b	$\chi^2(3) = 70.97, p < .001$
Change in sleep	2.79 (.05) ^a	2.68 (.06) ^{a,b}	2.34 (.03) ^c	2.59 (.02) ^b	$\chi^2(3) = 61.53, p < .001$
Change in stress	2.29 (.05) ^a	2.06 (.05) ^b	1.96 (.05) ^b	2.20 (.02) ^a	$\chi^2(3) = 82.32, p < .001$
COVID-related distress	4.21 (.11) ^a	4.49 (.08) ^b	4.63 (.05) ^b	4.00 (.05) ^a	$\chi^2(3) = 90.03, p < .001$

Superscripts indicate which groups differ based on significant ($a < .05$) Wald tests, with Holm-Bonferroni corrections for multiple comparisons.

As indicated in Table 9, latent profile membership was a significant predictor of all outcome variables for postpartum women with the exception of changes in sleep quality, which showed no differences. Of note, women in the passive-coping profile reported elevated depression symptoms relative to all other profiles (Figure 4). Additionally, women in the passive-coping profile also exhibited worsening stress levels relative to other women. We also found that women with profiles characterized by high levels of vegging out (high-coping and passive-coping) reported increased anxiety symptoms (Figure 4), as well as moderately worsening energy levels.

Table 9. Comparisons of mental and physical outcome measures between profiles for postpartum women.

	<i>Active-coping</i>	<i>High-coping</i>	<i>Passive-coping</i>	<i>Low-coping</i>	<i>Omnibus χ^2 test</i>
	<i>M (SE)</i>	<i>M (SE)</i>	<i>M (SE)</i>	<i>M (SE)</i>	
BSI anxiety	.60 (.06) ^{a,b}	.79 (.08) ^b	.76 (.03) ^b	.56 (.03) ^a	$\chi^2(3) = 28.38, p < .001$
BSI depression	.59 (.06) ^a	.74 (.06) ^a	.98 (.04) ^b	.67 (.03) ^a	$\chi^2(3) = 53.54, p < .001$
Change in energy	2.62 (.06) ^a	2.44 (.07) ^{a,b}	2.32 (.03) ^b	2.45 (.03) ^a	$\chi^2(3) = 21.73, p < .001$
Change in sleep	2.69 (.05) ^a	2.66 (.07) ^a	2.57 (.03) ^a	2.63 (.03) ^a	$\chi^2(3) = 5.35, p = .15$
Change in stress	2.27 (.06) ^a	2.17 (.07) ^a	1.98 (.03) ^b	2.12 (.03) ^a	$\chi^2(3) = 26.50, p < .001$
COVID-related distress	4.24 (.13) ^a	4.47 (.14) ^{a,b}	4.68 (.06) ^b	4.25 (.07) ^a	$\chi^2(3) = 26.27, p < .001$

Superscripts indicate which groups differ based on significant ($a < .05$) Wald tests, with Holm-Bonferroni corrections for multiple comparisons.

[1] We verified that model fit did not change if conducting the confirmatory factor analyses on pregnant and postpartum women separately.

Discussion

There is urgent need to characterize the impact of COVID-19 related stress on perinatal women, particularly given the potential for significant stressors to have negative intergenerational effects on their offspring (Monk et al., 2019; Van den Bergh et al., 2020). In addition to presenting a number of unique health, economic, and social-related stressors, COVID-19 has also disrupted routines, support systems, and behavioral strategies that previously may have been beneficial for mitigating psychological distress in response to stressful life events. Identifying behavioral phenotypes that are related to risk and resiliency for negative outcomes is essential for targeting resources and interventions for those most vulnerable. Here we used person-oriented latent profile analyses to identify behavioral phenotypes of coping strategies in a large, national sample of perinatal women. Using a person-oriented approach, over a variable-oriented approach, provides a better understanding of how distinct patterns of behavioral coping strategies jointly predict outcome measures. This approach thus affords more precise identification of potential risk and protective factors for mental and physical health outcomes.

Across both pregnant and postpartum women, we observed four distinct phenotypes of coping strategies. The most common phenotype (low-coping profile) consisted of women who reported low levels across all categories of coping strategies. The second most prevalent phenotype (passive-coping profile) consisted of pregnant and postpartum women who primarily engaged in passive coping strategies characterized by “vegging out” – that is, engaging in increased screen time, social media use, and comfort foods to cope with pandemic-related stress. We also identified phenotypes of women who reported high levels of all coping strategies (high-coping profile), and women who predominately reported engaging in increased self-care, social support, and limiting exposure to news coverage and social media (active-coping profile). Additionally, women in the high-coping phenotype reported increased substance use, however this was only true for postpartum women. Pregnant and postpartum women in both the high-coping and active-coping phenotypes tended to report higher levels of education, and pregnant women in these phenotypes also had fewer children than other women.

We also examined whether profile membership differed by race/ethnicity, particularly given that Black, Indigenous, and people of color (BIPOC) have been disproportionately impacted by the COVID-19 pandemic (Cyrus et al., 2020; Millett et al., 2020). In pregnant women, we observed that Black women were 35% less likely to be members of the passive-coping phenotype, and 70% less likely to be members of the active-coping phenotype. We also found that Asian women were 58% less likely to be members of the active-coping phenotype. In postpartum women, Black women were twice as likely to be members of the passive-coping phenotype, but we observed no other differences based on race/ethnicity. To ensure that profile identification was not skewed by race/ethnicity, we conducted *post hoc* latent profile analyses with only BIPOC women, which indicated the same patterns of behavioral profiles and associations with outcome measures (see Supplementary Information). These findings suggest that similar patterns of behavioral coping phenotypes are observed regardless of race/ethnicity, but the probability of belonging in a particular coping phenotype varies by race/ethnicity. This is particularly noteworthy given differential associations between profile membership and mental and physical health variables. However, these findings should be interpreted with caution given that our sample was somewhat skewed, with 71% of the sample identifying as non-Hispanic white (see Table 1).

A key aim of this study was to identify associations between coping phenotypes and measures of mental and physical health. Both pregnant and postpartum women reported worsening changes in sleep quality, energy levels, and stress levels relative to pre-pandemic levels, but the degree to which women reported worsening outcomes differed based on coping phenotype. In particular, women in phenotypes characterized by high levels of vegging out (the high-coping and passive-coping profiles) reported the largest negative change in energy and stress levels. In contrast, women in the active-coping phenotype reported fewer negative changes in sleep quality and energy levels relative to other women, particularly among pregnant women. Similarly, women in the low-coping phenotype also reported fewer negative changes in mental and physical health outcomes, as well as relatively lower levels of overall COVID-19 related distress.

This suggests that women in the low-coping phenotype may reflect a subgroup of women who are experiencing lower distress related to the pandemic and are accordingly engaging in fewer coping strategies.

When examining mental health outcomes, we observed high levels of clinically elevated symptoms of both anxiety (21.2% of pregnant women and 20.8% of postpartum women) and depression (16.6% of pregnant women and 16.3% of postpartum women) across the full sample. For reference, recent meta-analyses estimate that pre-pandemic rates of perinatal anxiety and depression in the United States were approximately 20.7% and 11.9%, respectively (Fawcett, Fairbrother, Cox, White, & Fawcett, 2019; Woody, Ferrari, Siskind, Whiteford, & Harris, 2017). This suggests that rates of perinatal depression in particular may be elevated relative to pre-pandemic levels. Notably, we found significant differences in reported levels of anxiety and depression symptoms as a function of behavioral coping phenotypes. Pregnant women in the passive-coping and high-coping phenotypes reported increased symptoms of both anxiety and depression (Figure 4). Similarly, postpartum women in passive-coping and high-coping phenotypes reported increased anxiety symptoms; however postpartum women in the high-coping phenotype exhibited fewer depression symptoms relative to women in the passive-coping phenotype (Figure 4). This result suggests that supplementing passive coping strategies with more active strategies may buffer the negative association between passive coping and increased depression symptoms, particularly among postpartum women. Yet, supplementing passive coping strategies with active coping strategies did not lessen the severity of anxiety symptoms in either pregnant or postpartum women.

While we cannot establish causality, our findings are consistent with clinical models of depression, which emphasize the role of inactivity as both a symptom of and contributor to a self-reinforcing cycle of depression (Martell, Dimidjian, & Herman-Dunn, 2013). Moreover, our findings align with recent reports indicating that increased physical activity is associated with increased resiliency to COVID-19-related stress in pregnant women across the globe (Davenport, Meyer, Meah, Strynadka, & Khurana, 2020; Lebel, MacKinnon, Bagshawe, Tomfohr-Madsen, & Giesbrecht, 2020; Preis, Mahaffey, Heiselman, & Lobel, 2020). However, even though we observed moderately elevated levels of depression relative to pre-pandemic estimates, we cannot ascertain that our findings are directly tied to the COVID-19 pandemic, particularly given the lack of a matched pre-pandemic comparison group. Indeed, these behavioral phenotypes may not be unique to the COVID-19 pandemic but may reflect more generalizable patterns of coping strategies in response to stressful life events. For instance, prior work has similarly observed that engaging in passive psychological coping styles, such as avoidance or denial, is associated with increased depression symptoms during the prenatal and postpartum periods (Gutiérrez-Zotes et al., 2016; Honey, Bennett, & Morgan, 2003; Razurel, Kaiser, Sellenet, & Epiney, 2013; Van Bussel, Spitz, & Demyttenaere, 2009). Yet, it is noteworthy that we observed a large percentage of both pregnant and postpartum women in the passive-coping behavioral phenotypes in our sample (33% and 41%, respectively). Future work is needed to ascertain whether these rates are substantially higher than might typically be expected.

In pregnant women, supplementing high levels of passive coping strategies with active strategies (i.e., the high-coping profile) did not substantially lessen the severity of depression symptoms. This result is in contrast to our findings in postpartum women, where we observed attenuated depression symptoms among women in the high-coping profile. This is an important consideration when evaluating both the etiology of symptoms and recommendations for informing perinatal depression interventions. One explanation for this result could relate to differences in pregnant versus postpartum women's motivation for engaging in active coping strategies. For instance, pregnant women may engage in active strategies such as increased physical activity and healthy eating for the wellbeing of their unborn baby, whereas postpartum women may be more likely to engage in these activities for their own health and wellbeing. Another possibility could be due to relatively increased vulnerability of pregnant women to mood and anxiety disorders (Kessler, 2003; Underwood, Waldie, D'Souza, Peterson, & Morton, 2016), which may negate the otherwise beneficial effects of behavioral activation for depression (Martell et al., 2013). Nonetheless, even though we cannot determine the source of these differences, these findings demonstrate that "vegging out" may be an important behavioral marker for adverse outcomes in pregnant women. This knowledge can be used to target interventions and support systems for women at

risk for perinatal mood and anxiety disorders, possibly even prior to the emergence of clinically elevated symptoms. For instance, clinicians and care providers could have women use wearable activity monitors or ask questions probing physical activity and nutrition to help identify and provide resources for women at risk for adverse outcomes. This information is especially relevant given that a number of women often do not report symptoms or seek treatment for perinatal mood and anxiety disorders, in part due to stigma surrounding maternal depression or fear of teratogenic effects with medication use (Bonari et al., 2004).

The COVID-19 pandemic is unique relative to other stressful life events that have impacted widespread communities, such as natural disasters, partly due to the chronic and uncertain nature of the pandemic. Stress related to high levels of uncertainty is proposed to be energetically costly (Peters, McEwen, & Friston, 2017). Thus, individuals may be more likely to “veg out” and eat high-calorie comfort foods as a way to cope with the increased energetic demand associated with uncertainty stress during the COVID-19 pandemic. Indeed, we observed that a large proportion of women were members of passive-coping profiles (33% of pregnant women and 41% of postpartum women). The prevalence of these coping phenotypes might relate to the high energetic cost of uncertainty stress resulting from the COVID-19 pandemic, which could lead more women to “veg out”. This idea is additionally supported by recent findings showing that individual differences in tolerance of uncertainty was related to greater psychological distress at the start of COVID-19 lockdowns in adults (Rettie & Daniels, 2020). Future work is needed to assess this possibility and the long-term physical and psychological costs associated with passive coping strategies to manage pandemic-related stress.

In sum, this large-scale, national study highlights the impact of the COVID-19 pandemic on mental and physical health outcomes of perinatal women in the United States. Importantly, it identifies widespread heterogeneous patterns of coping strategies that perinatal women are engaging in to manage pandemic-related stress. This study also illustrates the advantages of using person-oriented approaches to ascertain the complex and multifaceted patterns of behaviors that are associated with differing mental and physical health outcomes. The behavioral coping phenotypes we identified highlight potential risk and protective factors for perinatal women, which is critical in helping to identify and treat women most at risk for experiencing mood and anxiety disorders during this global health crisis.

Declarations

Conflict of Interest Statement:

The authors report no conflicts of interest.

Data Availability Statement:

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Figures

A. Geographic distribution of data collection



B. Temporal distribution of data collection

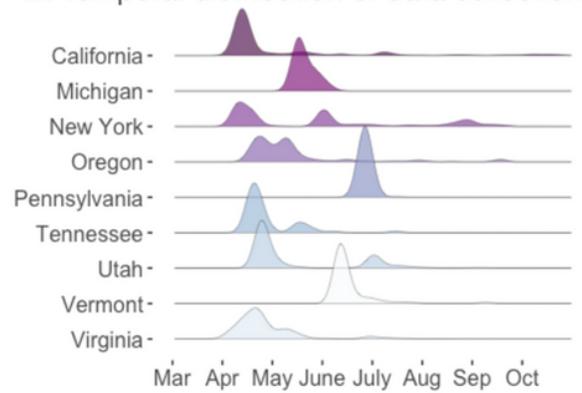


Figure 1

Geographic distribution and study site locations (A), and density plots illustrating the temporal distributions of data collection by state (B).

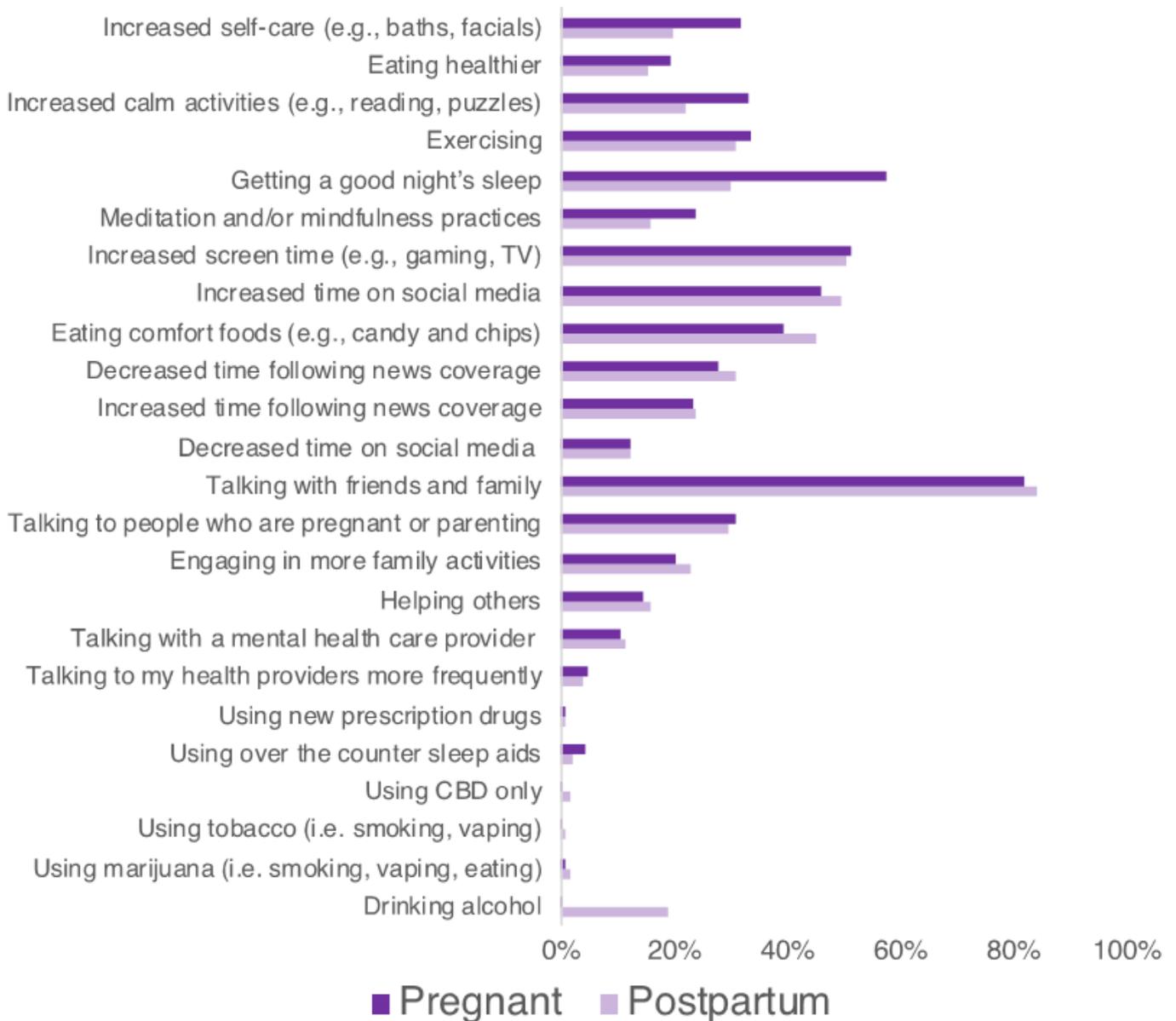


Figure 2

Percentage of pregnant and postpartum women endorsing each survey item.

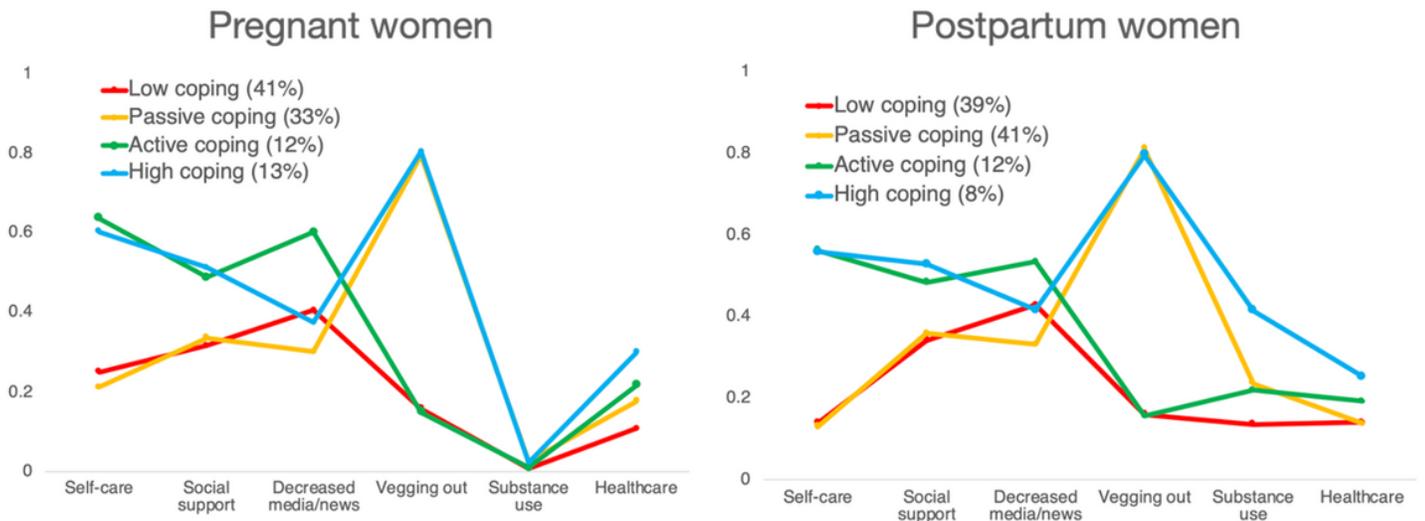


Figure 3

Estimated means for the 6 coping strategies across all profiles for both pregnant women and postpartum women.

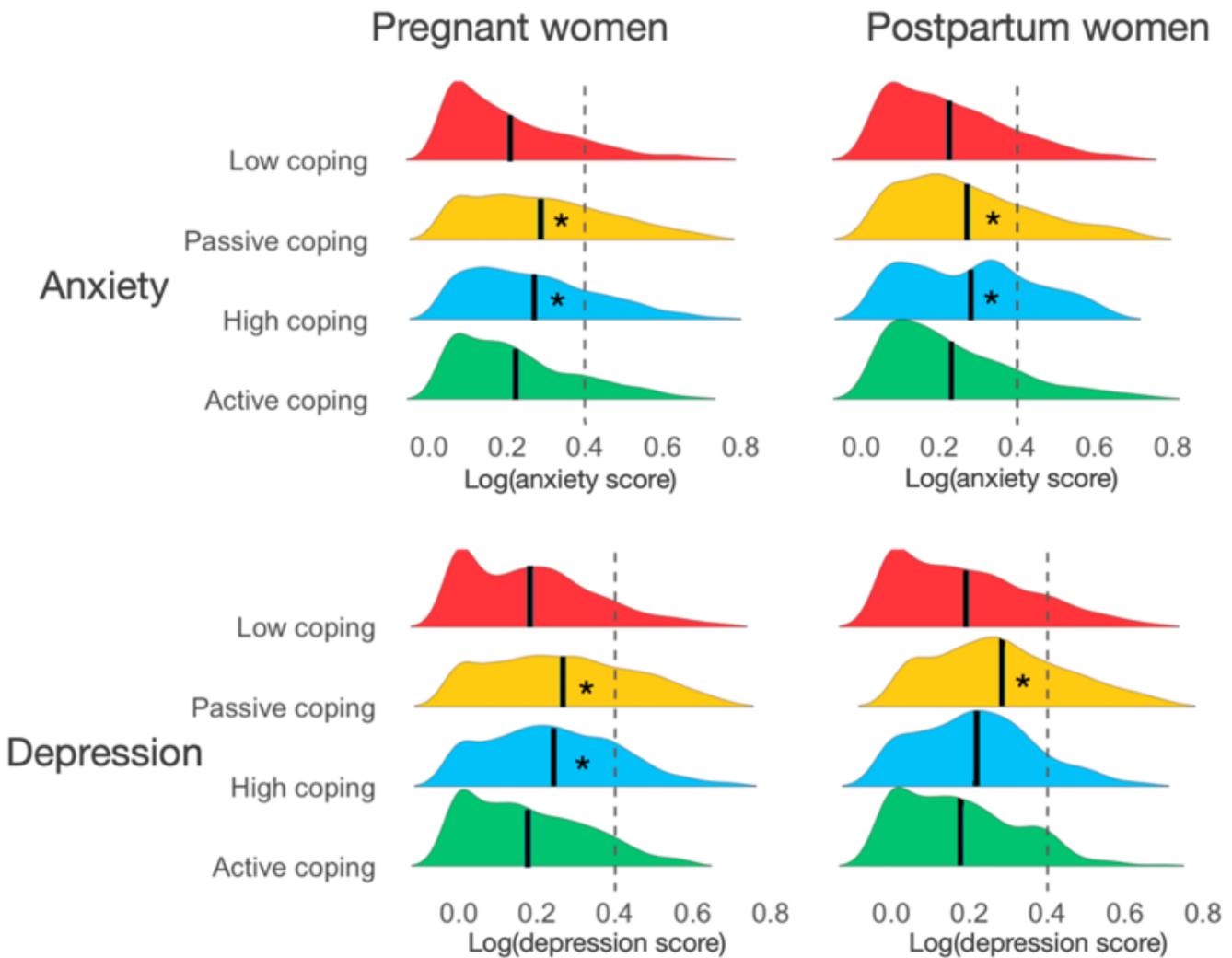


Figure 4

Distributions of anxiety and depression scores by profile for pregnant and postpartum women, based on most likely profile membership. Solid lines indicate estimated means, and dashed lines indicate cut-offs for clinically elevated symptoms. Asterisks indicate which profiles had significantly higher means.

Supplementary Files

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