Received: 27 November 2021 | Revised: 14 March 2022 | Accepted: 15 June 2022

DOI: 10.1111/birt.12664

ORIGINAL ARTICLE

BIRTH ISSUES IN PERINATAL CARE WILEY

Latent class analysis of health, social, and behavioral profiles associated with psychological distress among pregnant and postpartum women during the COVID-19 pandemic in the United States

Ellen Goldstein PhD[1] | **Roger L. Brown PhD**[2] | **Robert P. Lennon MD, JD, FAAFP**[3] | **Aleksandra E. Zgierska MD, PhD, DFASAM**[3,4,5]

[1]Department Population Health Nursing Science, University of Illinois at Chicago College of Nursing, Chicago, Illinois, USA

[2]University of Wisconsin-Madison Schools of Nursing, Medicine and Public Health – Design and Statistics Unit, Madison, Wisconsin, USA

[3]Department of Family and Community Medicine, Pennsylvania State University College of Medicine, Hershey, Pennsylvania, USA

[4]Department of Anesthesiology and Perioperative Medicine, Pennsylvania State University College of Medicine, Hershey, Pennsylvania, USA

[5]Department of Public Health Sciences, Pennsylvania State University College of Medicine, Hershey, Pennsylvania, USA

Correspondence
Ellen Goldstein, PhD, UIC College of Nursing, 845 S Damen Ave, Chicago, IL 60612, USA.
Email: elleng@uic.edu

Funding information
This study was supported by funds from the University of Wisconsin School of Medicine and Public Health and from Pennsylvania State University Social Science Research Institute and Huck Institutes of the Life Sciences

Abstract

Background: There is a growing body of literature documenting negative mental health impacts from the COVID-19 pandemic. The purpose of this study was to identify risk and protective factors associated with mental health and well-being among pregnant and postpartum women during the pandemic.

Methods: This was a cross-sectional, anonymous online survey study distributed to pregnant and postpartum (within 6 months) women identified through electronic health records from two large healthcare systems in the Northeastern and Midwestern United States. Survey questions explored perinatal and postpartum experiences related to the pandemic, including social support, coping, and health care needs and access. Latent class analysis was performed to identify classes among 13 distinct health, social, and behavioral variables. Outcomes of depression, anxiety, and stress were examined using propensity-weighted regression modeling.

Results: Fit indices demonstrated a three-class solution as the best fitting model. Respondents (N = 616) from both regions comprised three classes, which significantly differed on sleep- and exercise-related health, social behaviors, and mental health: *Higher Psychological Distress* (31.8%), *Moderate Psychological Distress* (49.8%), and *Lower Psychological Distress* (18.4%). The largest discriminatory issue was support from one's social network. Significant differences in depression, anxiety, and stress severity scores were observed across these three classes. Reported need for mental health services was greater than reported access.

Conclusions: Mental health outcomes were largely predicted by the lack or presence of social support, which can inform public health decisions and measures to buffer the psychological impact of ongoing waves of the COVID-19 pandemic on pregnant and postpartum women. Targeted early intervention among those in higher distress categories may help improve maternal and child health.

KEYWORDS
COVID-19, maternal mental health, postpartum, pregnancy, psychological distress

1 | INTRODUCTION

In March 2020, the World Health Organization declared a global pandemic due to coronavirus disease-2019 (COVID-19).[1] The pandemic has exerted psychological harm on both infected and uninfected individuals,[2,3] with disproportionately negative effects among vulnerable groups,[4,5] and including pregnant and postpartum women.[6–8] This latter impact can have negative long-term implications for the neuro-cognitive and socio-emotional development of the fetus, and maternal and child health.[9–11] Consequently, there is an urgent need to identify risk and protective factors which can influence mental health and well-being among pregnant women and new mothers during the pandemic.

The perinatal period is a time of psychological and socioeconomic stress commonly associated with increased mental health needs of women.[12] Depression and anxiety symptoms in the perinatal period affect 10%-25% of individuals,[13] and can increase risk for impaired mother–infant bonding and cognitive and emotional development in the child, in addition to other deleterious outcomes.[14] These challenges are further aggravated by pandemic-worsened disparities, such as poor access to health care and racial-ethnic inequities.[15] Public health restrictions to prevent the spread of COVID-19, including physical distancing and "stay at home" orders, have contributed to isolation and disruptions in the natural rhythms of social interaction, which in turn can impact mental health in the perinatal period.[16] A survey of 1987 pregnant participants early in the pandemic documented increased rates of anxiety and depression compared to prepandemic cohorts, with 37% of women reporting clinically relevant depression symptoms and 57% reporting anxiety symptoms.[13] Those with higher depression and anxiety severity scores expressed greater concern about their own and their child's safety due to the pandemic and related subpar prenatal care, strained relationships, and social isolation.

The pandemic is a chronic daily stressor due to the prolonged and potentially life-threatening nature of this crisis,[17] which is forcing millions of people to adapt to a "new normal." Because COVID-19 is a recent phenomenon, we have incomplete knowledge about its short- and long-term impacts on mental health among pregnant and postpartum women. The purpose of this study was to identify patterns in health, social behaviors and mental health needs, and their associations with psychological distress in this population during the pandemic.

Almeida's framework for understanding how individual characteristics and their environment can influence exposure and reactivity to daily stressors defines risk factors that increase vulnerability to stress, and protective factors that increase resilience against negative effects of stress.[18,19] Drawing upon that framework and Green's risk and resilience theory,[20] we hypothesized that women reporting lower resilience (eg, lower protective, higher risk factors) would be more vulnerable to negative mental health outcomes than women reporting higher resilience (eg, higher protective, lower risk factors). We used latent class analysis to identify classes composed of protective (eg, health and prosocial behaviors) and risk (eg, negative social perceptions and unmet mental health needs) factors. An auxiliary analysis was conducted to compare class differences with outcomes of psychological distress (eg, depression, anxiety, stress). This manuscript describes these analyses and their findings.

2 | METHODS

This study was a two-site, cross-sectional survey of pregnant and postpartum women completed between August 4 and November 24, 2020 (Northeast) and January 15 and April 15, 2021 (Midwest). Data were collected separately by each site, then deidentified data were pooled. This study was approved by Institutional Review Boards of the participating institutions.

2.1 | Participants and settings

Adult patients (age ≥ 18 years) of two large healthcare systems in the Northeastern and Midwestern U.S., who were fluent in English, and pregnant or had given birth within the prior 6 months, were eligible for study participation. Potential participants (n = 4409) identified through electronic health records (EHRs) were mailed a letter explaining the study and provided an URL and unique identification number to access a web-based survey hosted in secure REDCap; those with diagnoses of a stillbirth or miscarriage were excluded from the mailing list to minimize harm to patients suffering a traumatic loss. Those who did not complete the survey after the initial mailing received a reminder phone call (n = 124) and/or reminder letter (n = 2811). The Northeastern participants did not receive recruitment incentives or reimbursement for

survey completion; however, they were given the option to enter a raffle to win a $75 gift card from Amazon. The Midwestern participants received a letter that randomly assigned them to one of three recruitment strategy groups: (a) no incentive for participating; (b) a prepaid incentive of $1 sent with the invitation letter; (c) a prepaid incentive of $1, followed by a prepaid incentive of $2 sent in the postal reminder letter. There was no reimbursement for survey completion for Midwestern participants.

2.2 | Survey design

The COVID-19 pregnancy and postpartum survey, estimated to take 25-30 minutes, was adapted from the existing survey.[21,22] A screening tool with built-in algorithms was added to identify women at risk for adverse outcomes related to known risk factors of financial insecurity, domestic violence, mental health and substance use-related problems, and inadequate healthcare access. Based upon responses, participants were directed via Internet links to local and national resources for smoking cessation, addiction treatment, domestic violence, mental health, and financial assistance. Participants could opt-in to receive information tailored to their specific need (ie women who screened positive for food insecurity received a list of food support resources) or a handout with the list of all resources. Women who reported a need for healthcare services were provided a link to the health systems' telehealth information to schedule a visit with a clinician.

Survey questions explored perinatal experiences related to the pandemic (eg, pregnancy or postpartum-related health problems and experiences, resource availability); COVID-19 exposures and symptoms; social support activities; coping and adjustment; emotions; health background; need for healthcare services; and demographics. For this analysis, we focused on questions related to health and social behaviors: mental health treatment and its access; and depression, anxiety, and perceived stress.

2.3 | Measures

2.3.1 | Health, social, and behavioral variables

A combination of ordered categorical variables (eg health and social behaviors) and binary (0/1) (eg, mental health status, access, and receipt of treatment) were selected from the survey. The stem question asked, "Due to the COVID-19 pandemic, how are you engaging in the following activities?" Changes to engagement in health coping behaviors (eg, sleep, exercise) and social behaviors (eg, social interaction with friends) due to the pandemic were measured using a 4-point Likert scale (0 = "I do not engage in this activity"; 4 = "more frequently"). Social support was measured by asking the question, "Currently during the COVID-19 pandemic, how supported do you feel by your social network?" on a 1-7 scale (1 = "not at all supported"; 7 = "very well supported"). Three questions were selected to reflect the possible negative impacts of physical distancing (eg, "How often do you feel (a) lack of companionship, (b) left out, (c) isolated from others?" using 3-response items (1 = "hardly ever", 3 = "often")).

2.3.2 | Outcome variables

Depression and anxiety symptom severity (past 7 days) were measured with the 10-item Edinburgh Postnatal Depression Scale (EPDS).[23] EPDS was validated both in prenatal[24] and postnatal periods.[23] A score of ≥13 (range: 0-30) indicates a positive screen for depression[25]; this cut-off score's sensitivity ranges from 38% to 43% and specificity from 98% to 99% for detecting depression, depending on the perinatal period.[24] A score of ≥6 (range: 0-9) from a 3-item subscale indicates a positive screen for anxiety.[26]

Perceived stress severity was measured with a single question: "What is your overall level of stress related to the COVID-19 pandemic?". Responses were recorded on a 7-point Likert scale (1 = "no stress", 7 = "extreme stress"). Single-item stress measures have been shown to have satisfactory content, criterion, and construct validity associated with health indicators and mental well-being.[27]

2.4 | Statistical analysis

Latent Class Analysis (LCA) was used to identify distinct classes based on 13 indicators: (a) health behaviors (adequate sleep, healthy eating, exercise, low-impact activities, eg, reading books); (b) social behaviors (social interaction with friends or family, perceived social support, helping others, feeling isolated); and (c) behavioral health (mental health status, access to and receiving mental health services). Prior history of a mental health disorder is a risk factor for COVID-19 complications and/or depression/anxiety disorder during the perinatal period; as such, prior mental health disorder history was included as a predictor in the LCA modeling.

The goal of LCA was to identify and classify homogeneous subcategories from an array of heterogeneous variables, enabling the identification of previously unknown subgroups of individuals.[28] Model selection was based on fit testing across four classes and was determined by comparing predicted frequencies to

cross-classification frequencies. Common parsimony indices included Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and adjusted BIC (aBIC).[29] The number of classes selected for the model structure were based on: (a) interpretability; (b) parsimony; (c) lowest BIC and aBIC scores; (d) lowest AIC; (e) entropy >0.7; (f) average posterior probability in each class >0.75, and ≤10% overlap/cross-membership between noncontiguous clusters; (g) ≥2.5% of total count in each class; and (h) no significant improvement assessed by likelihood ratio tests.[30] Mplus Version 8.6 was used to model the LCA.[31]

Descriptive statistics were used to calculate the demographics of the sample and for each class using mean ± standard deviation or number/percentage values. An omnibus test was performed to examine significant differences between classes. Analysis of items to characterize the LCA classes was conducted using propensity-weighted regression and pairwise comparisons of adjusted means and standard errors for categorical and binary variables with 95% confidence intervals. The outcome measures were assessed across the classes using propensity-weighted regression modeling with comparison tests. Statistical significance was assessed using two-tailed tests at significance level $p < .05$. Multiple imputation by chained equations was used to impute missing data. These analyses were conducted using Stata Version 16.1.[32]

Propensity score weighting was used to minimize the confounding of effects relative to class differences. Generalized Boosted Modeling (GBM), an automated algorithm that uses covariates to predict treatment assignment, was used to obtain propensity weights. Standardized effect sizes were calculated on all unweighted covariates and decisions about the most influential covariates were based on effect sizes ≥0.20. The GBM algorithm searches to reduce effect sizes by balancing the covariates, with general success achieved if effect sizes ≤0.20. Leaving all covariates in the model can improve the sensitivity of the analysis, including covariates with smaller effect sizes. Propensity weights were incorporated into multiple regression models of group and unbalanced covariates to examine class contrasts and clinical cut-off points.

3 | RESULTS

3.1 | Study flow

Figure 1 illustrates the flow of recruitment and participation for survey respondents. The overall response rate was 616 (14%); 463 (10.5%) from the first mailing and 153 (5.4%) from subsequent outreach. The recruitment letters were sent to 3971 pregnant (55%) and 3249 postpartum

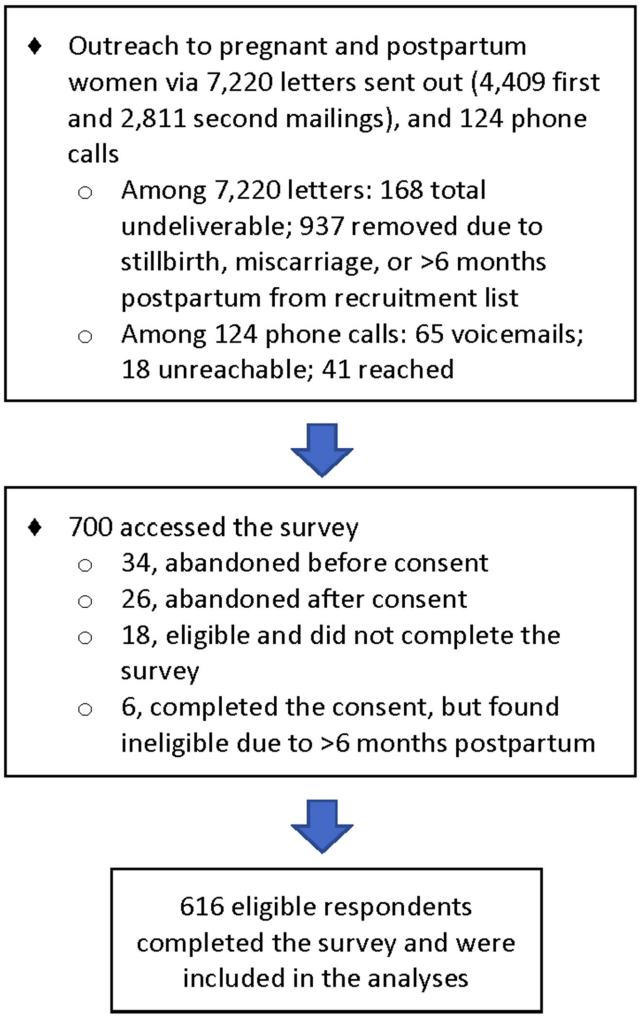

FIGURE 1 Study flow of recruitment and participation

(45%) women, resulting in a study sample composed of 303 (49.2%) pregnant and 313 (50.8%) postpartum women.

3.2 | Respondents

The sample (n = 616) was composed of pregnant (49.2%) and postpartum (50.8%) women from Northeastern (32%) and Midwestern (67.4%) regions of the U.S. Respondents had a mean age 31.6 ± 4.5 years, were mostly White (89.6%), partnered or married (94%), college graduates (51.4%), working (66.9%), and not having difficulty living on their household income (68.1%) (Table 1).

3.3 | Latent class analysis

Table 2 presents the fit indices for LCA models 1-4. The best fitting class was the three-class solution demonstrated by a lower BIC value (BIC = 14 283.53) and a

TABLE 1 Sample demographics

	N = 616
Age (y), mean ± SD	31.6 ± 4.5
Status, n (%)	
Pregnant	303 (49.2)
Postpartum	313 (50.8)
Geographic region, n (%)	
Northeast	201 (32.6)
Midwest	415 (67.4)
Race, n (%)	
American Indian or Alaskan Native	8 (1.3)
Black or African American	19 (3.1)
White	552 (89.6)
Asian	32 (5.2)
Native Hawaiian or Other Pacific Islander	1 (0.2)
Other	14 (2.3)
Ethnicity, n (%)	
Hispanic or Latino	28 (4.6)
Education, n (%)	
≤High school diploma/GED	40 (0.7)
Partial college	58 (9.4)
Completed college	316 (51.4)
Graduate degree	199 (32.4)
Marital status, n (%)	
Single	27 (4.4)
Married, or in a domestic partnership	579 (94.0)
Divorced or separated	4 (0.7)
Other	6 (1.0)
Employment status, n (%)	
Working	412 (66.9)
Maternity leave/sick leave/temporarily laid off	93 (15.1)
Homemaker	99 (16.1)
Disabled, permanently or temporarily	2 (0.3)
Student	24 (3.9)
How difficult is it for you to live on your total household income right now, n (%)	
Extremely difficult, impossible	3 (0.5)
Very difficult, not getting by	9 (1.5)
Difficult, can barely get by	38 (6.2)
Somewhat difficult	146 (23.8)
Not at all difficult	418 (68.1)

Note: Respondents could select multiple races and employment status.

higher entropy (0.84) compared to the two-class model (BIC = 14 344.40, entropy = 0.86). There was no statistically significant improvement for models with more than three classes as assessed by the Vuong-Lo-Mendell-Rubin likelihood ratio test indicating that a four-class structure overfit the data (p value = .13). The overlap/cross-membership was 4.2% between noncontiguous clusters, with average posterior probabilities >.75 for each class (eg, Class 1 = .917, Class 2 = .902, and Class 3 = .939).

3.4 | Class descriptions

Figure 2 illustrates the three LCA classes grouped by health and social behaviors and mental health categories. Protective factors included health (eg, adequate sleep, healthy eating, exercise, low-impact activities) and prosocial (eg, social interaction, social support, helping others) behaviors. Risk factors included negative social perceptions (eg, lack of companionship, feeling left out, isolated) and mental health-related variables (eg, status, treatment/services access). Table 3 presents the demographics for each class and significant differences between classes. Class 1 (n = 307, 49.8%), composed of nearly half of the total sample, was distinguished by moderate levels of protective and risk factors. Class 2 (n = 196, 31.8%) closely mirrored trends in Class 1 and demonstrated the lowest protective and highest risk factors. Class 3 (n = 113, 18.3%), with the smallest sample of the three classes, was characterized by the highest protective and lowest risk factors. Pregnancy status, geographical region, marital status, and financial difficulty were significantly different between the classes. A larger proportion of postpartum women were clustered in the highest risk Class 2, which also had a higher concentration of women who were not married/partnered and reported financial difficulty compared to the other two classes. Classes 1 and 2 had comparable percentages of participants from both regions; yet they had larger proportions of participants from the Midwest than Class 3.

3.5 | Propensity weighting

Generalized Boosted Modeling provided the weighted adjustments for covariates of age, region, pregnancy status, race, marital status, education, employment, and income difficulty. The algorithm improved the balance of covariates by reducing differences ≤0.2 between weighted and unweighted covariates (see Tables S1 and S2).

3.6 | Propensity-weighted class comparisons

Table 4 shows the propensity-weighted adjusted means and standard errors for latent class variables

Model	AIC	BIC	aBIC	Entropy	LMR *p*-value	VLMR *p*-value
1	14812.86	14958.83	14854.06			
2	14013.88	14310.24	14097.53	0.77	<.001	<.001
3	**13836.78**	**14283.53**	**13962.87**	**0.84**	**.002**	**.002**
4	13747.26	14344.40	13915.80	0.86	.13	.13

TABLE 2 Fit indices for latent class models 1-4

Note: Bold indicates optimal model fit and parsimony.

Abbreviations: aBIC, adjusted Bayesian information criteria; AIC, Akaike information criterion; BIC, Bayesian information criteria; LMR, Lo-Mendell-Rubin; VLMR, Vuong-Lo-Mendell-Rubin.

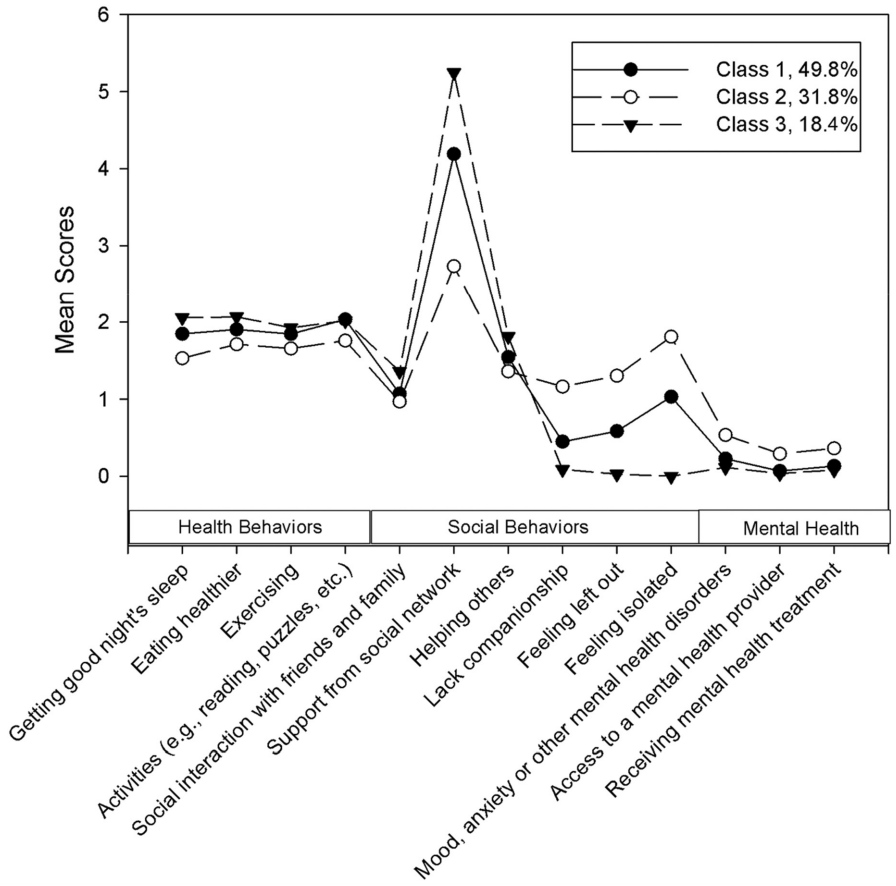

FIGURE 2 Raw mean values of class variables identified by the latent class analysis and grouped by health and social behaviors and mental health categories for each of the three classes

and pairwise comparisons. The largest discriminatory issue was support from one's social network. On average, Class 3 reported significantly higher prevalence of positive health behaviors in two domains (getting a good night's sleep; healthy eating) and prosocial behaviors (social interaction with friends/family; support from social network; helping others) relative to other Classes. Conversely, Class 2 reported higher negative social perceptions (eg, lack of companionship, feeling left out and isolated) and the greatest need for, and greater access to and utilization of, mental health services compared to Classes 1 and 3. Participants in all classes revealed that not everyone was able to receive mental health services despite needing them.

3.7 | Propensity-weighted outcomes and class contrasts

Overall, 157 (25.5%) respondents reported mild/moderate depressive symptoms (EPDS total score 9-12); 80 (13%) had a positive depression screen (EPDS total score ≥13); 124 (20.12%) had a positive anxiety screen (EPDS anxiety subscale score ≥6); and 320 (52%) reported moderate/extreme stress severity (single item score ≥5). Table 5 presents the propensity-weighed outcome adjusted means and standard errors for outcome totals, clinical cut-off points, and class-contrasted mean differences. Depression, anxiety, and stress symptom severity scores significantly differed across the three classes,

TABLE 3 Sample demographics for each class and significant differences between classes

Variable	Class 1 (n = 307)	Class 2 (n = 196)	Class 3 (n = 113)	Test *p*-value
Age (y), mean ± SD	31.96 ± 4.37	31.32 ± 4.59	31.26 ± 4.39	$F = 1.73$ (2613) .17
Status, n (%)				
Pregnant	154 (50.16)	78 (39.80)	71 (62.83)	**$\chi^2 = 15.58$ (2) <.001**
Postpartum	153 (49.84)	118 (60.20)	42 (37.17)	
Geographic region, n (%)				
Northeast	89 (28.99)	57 (29.08)	55 (48.67)	**$\chi^2 = 15.47$ (2) <.001**
Midwest	218 (71.01)	139 (70.92)	58 (51.33)	
Race/ethnicity, n (%)				
Minority	29 (9.45)	17 (8.67)	18 (15.93)	$\chi^2 = 4.21$ (2) .12
White	278 (90.55)	179 (91.33)	95 (84.07)	
Education, n (%)				
≤High school diploma/GED	9 (2.94)	19 (9.75)	12 (10.71)	$\chi^2 = 1.42$ (3) .70
Partial college	33 (10.78)	15 (7.69)	10 (8.93)	
Completed college	155 (50.65)	107 (54.87)	54 (48.21)	
Graduate degree	109 (35.62)	54 (27.69)	36 (32.14)	
Marital status, n (%)				
Not married	8 (2.62)	16 (8.33)	6 (5.4)	**$\chi^2 = 8.2$ (2) .016**
Married, or in a domestic partnership	298 (97.39)	176 (91.67)	105 (94.59)	
Employment status, n (%)				
Not working	93 (30.8)	59 (31.06)	35 (33.66)	$\chi^2 = 0.30$ (2) .85
Working	209 (69.21)	131 (68.95)	69 (66.35)	
Income difficulty, n (%)				
Not at all difficult	217 (71.15)	115 (58.67)	86 (76.11)	**$\chi^2 = 24.33$ (4) <.001**
Somewhat difficult	74 (24.26)	50 (25.51)	22 (19.47)	
Difficult, very difficult, or Extremely difficult	14 (4.59)	31 (15.81)	5 (4.42)	

Note: Bold values are statistically significant.

with the highest mean values for all three outcomes in descending order: Class 2 (*Higher Psychological Distress; Low Protective/High Risk Factors*), Class 1 (*Moderate Psychological Distress; Moderate Protective/Risk Factors*), and Class 3 (*Lower Psychological Distress; High Protective/Low Risk Factors*). Class 2 mean values were elevated compared to other classes and had a higher number of individuals who screened positive for depression, anxiety, and moderate/extreme stress.

4 | DISCUSSION

The goal of this study was to discern the health, social, and behavioral profiles associated with psychological distress in pregnant and postpartum women during the COVID-19 pandemic. We identified three unique classes with significant differences across health and social behaviors as well as mental health domains. The reported need for mental health services was greater than the reported access to treatment across all three classes. Women in the *Higher Psychological Distress* category consistently reported the lowest health and prosocial behaviors, and the highest negative social perceptions and mental health needs of the three classes. This class exhibited more potential demographically based risk factors for worsened mental health than the other two classes. The most common class, *Moderate Psychological Distress*, comprised half of the sample and represented women with moderate protective and risk factors. The class with the least number of individuals, the *Lower Psychological Distress* category, reported the highest social support from their networks. Despite physical and social distancing constraints due to the pandemic, support from one's social network was the highest reported latent class variable in the model underscoring the importance of and need for connection and belonging during times of crisis and transition critical for mental health and stress coping.

TABLE 4 Propensity-weighted adjusted means (SE) for latent class variables and paired comparisons

Categorical variable	Class 1 (n = 307)	Class 2 (n = 196)	Class 3 (n = 113)	*F* statistic (*df* = 2)	Group differences
Health behaviors, mean (SE)					
Getting a good night's sleep	1.85 (0.04)	1.53 (0.05)	2.10 (0.05)	**35.03**	**3 > 1 > 2**
Eating healthier	1.90 (0.04)	1.75 (0.06)	2.11 (0.07)	**7.69**	**3 > 1, 3 > 2**
Exercising	1.86 (0.04)	1.70 (0.06)	1.94 (0.09)	**3.13**	—
Activities (eg, reading books, puzzles, or crosswords)	2.04 (0.05)	1.83 (0.06)	2.08 (0.09)	**4.22**	**1 > 2**
Social behaviors, mean (SE)					
Social interaction with friends and family	1.07 (0.02)	0.96 (0.19)	1.29 (0.05)	**18.83**	**3 > 1 > 2**
Support from social network	4.20 (0.07)	2.69 (0.11)	5.31 (0.10)	**156.08**	**3 > 1 > 2**
Helping others	1.53 (0.04)	1.35 (0.05)	1.81 (0.07)	**14.32**	**3 > 1 > 2**
Lack of companionship	0.45 (0.03)	1.17 (0.04)	0.11 (0.04)	**171.09**	**2 > 1 > 3**
Feeling left out	0.59 (0.03)	1.30 (0.05)	0.02 (0.01)	**460.85**	**2 > 1 >, 2 > 3**
Feeling isolated	1.03 (0.02)	1.82 (0.03)	0 (0.00)	**477.39**	**2 > 1 >, 2 > 3**
Binary variable	**Class 1 (n = 307)**	**Class 2 (n = 196)**	**Class 3 (n = 113)**	**Wald chi-squared (*df* = 2)**	**Group differences**
Mental health, mean (SE)					
Mood, anxiety, or mental health disorders	0.23 (0.02)	0.52 (0.04)	0.10 (0.03)	**57.45**	**2 > 1 > 3**
Access to a mental health care provider	0.07 (0.02)	0.26 (0.03)	0.03 (0.02)	**40.53**	**2 > 1,3**
Receiving mental health treatment	0.13 (0.02)	0.36 (0.04)	0.07 (0.03)	**40.48**	**2 > 1,3**

Note: Bold values are statistically significant.

Abbreviations: *df*, degrees of freedom; SE, standard error.

TABLE 5 Propensity-weighted adjusted means (SE) for outcome totals and clinical cut-off points, and class contrasted mean differences

	Class 1 (n = 307)	Class 2 (n = 196)	Class 3 (n = 113)	Contrast 2 vs 1 MD [95% CI]	Contrast 3 vs 1 MD [95% CI]	Contrast 3 vs 2 MD [95% CI]
Outcome						
Depression	6.27 (0.23)	10.19 (0.29)	3.74 (0.38)	**3.92 [−4.65, −3.19]**	**2.53 [1.66, 3.41]**	**6.45 [5.51, 7.39]**
Anxiety	3.36 (0.11)	4.76 (0.14)	2.09 (0.19)	**1.40 [−1.75, −1.05]**	**1.27 [0.85, 1.69]**	**2.67 [2.22, 3.13]**
Stress	4.18 (0.07)	5.16 (0.08)	3.19 (0.11)	**0.98 [−1.20, −0.78]**	**0.99 [0.74, 1.24]**	**1.97 [1.71, 2.25]**
Positive screen						
Depression (≥13)	0.07 (0.02)	0.29 (0.03)	0.02 (0.01)	**0.22 [0.14, 0.32]**	**−0.05 [−0.10, −0.01]**	**−0.27 [−0.36, −0.19]**
Anxiety (≥6)	0.12 (0.02)	0.40 (0.04)	0.07 (0.03)	**0.28 [0.18, 0.38]**	−0.05 [−0.13, 0.03]	**−0.33 [−0.44, −0.22]**
Stress (≥5)	0.45 (0.03)	0.80 (0.03)	0.17 (0.04)	**0.35 [0.25, 0.45]**	**−0.28 [−0.40, −0.16]**	**−0.63 [−0.75, −0.51]**

Note: Bold values are statistically significant.

Abbreviations: CI, confidence interval; RMD, raw mean difference; SE, standard error; vs, versus.

4.1 | Health and social behaviors

Concordant with prior research, our findings suggest that healthy habits and prosocial behaviors likely contributed to a reduced sense of isolation and psychological distress for some individuals during the pandemic.[33] Those who were especially affected by the pandemic and its restrictions may have had difficulty engaging in self-care practices, such as healthy eating and exercise, and staying connected to their social support networks.[34] Furthermore, pandemic-related challenges have involved changes in daily routines, working from home, childcare and homeschooling obligations, and other adaptations to accommodate a new reality of virtual and physical/social distancing necessities. Consequently, a pervasive sense of isolation, along with elevated levels of anxiety, depression, and stress, could have interfered with women's engagement in some of the most basic health behaviors, such as physical activity, nutrition, and sleep, and that, in turn, could lead to the exacerbation of maternal mental health with lasting effects on fetal and infant health development.[35] Engaging in prosocial behaviors and maintaining physical activity, which can promote a sense of psychological well-being and reduce distress, are targets conducive for intervention and prevention.[13,36]

4.2 | Maternal mental health

Our study adds to the global[37,38] studies and only U.S.[22] study demonstrating the negative mental health impact among pregnant women and new mothers during COVID-19. Our depression rates are consistent with those reported by others during the pandemic.[22] Another study reported an average EPDS score of 10.7 ± 5.7 (n = 1764 pregnant women),[13] comparable to women in our *Higher Psychological Distress* (Class 2) category (10.2 ± 4.9, n = 196.) Although most women in this study did not meet the criteria for depression, at least one-quarter of this sample was experiencing clinically significant levels of depression.

The proportion of women reporting increased mood, anxiety, or stress severity was higher than those receiving treatment and even higher compared to those reporting having access to mental health services, consistent with prior studies.[39] This finding points to the need for implementing routine screening and improving access to mental health services as part of routine obstetric care. The American College of Obstetricians and Gynecologists recommends routine screening for depression and anxiety using standardized, validated instruments at least once during the perinatal period and additionally at the postpartum visit,[40] with referral to a behavioral health provider and subsequent initiation of treatment as indicated.[41] Telemental health may facilitate greater access to mental health care during the pandemic.[42]

4.3 | Implications for policy and/or practice

Understanding risk and resilience-promoting factors and the ways in which people can more effectively cope with stress are keys to intervention aimed at facilitating long-term well-being and reducing vulnerability to developing psychological problems.[18] This information is critically important for optimizing services during prenatal and perinatal periods, designing a preventive and interventive public health strategy, and informing responses to new infection waves or public health threats.[4] Future research should help identify the inequities contributing to risk and protective factors, which inform public health action and measures that can buffer the psychological impact of

the pandemic for vulnerable groups, including pregnant women and new mothers.

4.4 | Limitations

This study had several limitations. The survey was cross-sectional, which precludes causal analysis and may not be generalizable over time. It used a convenience sample, which had an overrepresentation of white, urban, well-educated, and economically secure women. To mitigate this, propensity-weighted covariate adjustments were applied to control for potential biases in the mean differences relative to the classes. Although some Midwestern respondents were provided an incentive to participate, there were no notable demographic differences between the two regions. By including mental health status in the LCA model, we may be more likely to predict that people with mental health diagnoses are going to report higher mental health scores, and possibly more use of services. However, the mental health variable included in the LCA model is a binary (yes/no) singe-item question and is not a reliable diagnosis, whereas the outcome variables of depression and anxiety were assessed using the 10-item Edinburgh Postnatal Depression Scale (EPDS), a reliable and validated measure of depression and anxiety symptom severity over the past 7 days, as indicators of mental health. Including both measures is reinforcing (not overlapping), particularly in relation to assessing the patterns of access to services and treatment for those who may be concerned about a mental health condition as a risk factor for COVID-19 complications. Moreover, there is clinical value in confirming predicted worse mental health outcomes among women with prior mental health issues.

4.5 | Conclusions

Findings from this study show that women in the *Higher Psychological Distress* category- despite reporting higher access/utilization and history of mental health issues, still had higher depression/anxiety/stress scores. This study identifies intervention targets for clinicians to help pregnant women and new mothers during this pandemic. Respondents' mental health outcomes were largely predicted by the lack or presence of social support, and pregnant and postpartum women with low protective factors (eg, adequate sleep, exercise, constructive activities, and social engagement and support) and increased risk factors (eg, lack of companionship, feeling left out, isolated, and unmet mental health needs) were at the highest risk for psychological distress during the COVID-19 pandemic. Implementing routine screening for psychosocial factors as well as mental health and coping behaviors in healthcare settings are recommended. Targeted early interventions among those in higher distress may help improve maternal health, which is critical for pregnancy, child, and family well-being.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare that are relevant to the content of this article.

DATA AVAILABILITY STATEMENT

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

ORCID

Ellen Goldstein https://orcid.org/0000-0003-4012-5337

REFERENCES

1. Cucinotta D, Vanelli M. WHO declares COVID-19 a pandemic. *Acta Biomed*. 2020;91(1):157-160.
2. Canet-Juric L, Andrés ML, Del Valle M, et al. A longitudinal study on the emotional impact cause by the COVID-19 pandemic quarantine on general population. *Front Psychol*. 2020;11:565688.
3. Lima CKT, Carvalho PMM, Lima I, et al. The emotional impact of coronavirus 2019-nCoV (new coronavirus disease). *Psychiatry Res*. 2020;287:112915.
4. Holmes EA, O'Connor RC, Perry VH, et al. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. *Lancet Psychiatry*. 2020;7(6):547-560.
5. Abdoli A, Falahi S, Kenarkoohi A, Shams M, Mir H, Jahromi MAM. The COVID-19 pandemic, psychological stress during pregnancy, and risk of neurodevelopmental disorders in offspring: a neglected consequence. *J Psychosom Obstet Gynaecol*. 2020;41(3):247-248.
6. López-Morales H, Del Valle MV, Canet-Juric L, et al. Mental health of pregnant women during the COVID-19 pandemic: a longitudinal study. *Psychiatry Res*. 2021;295:113567.
7. Berthelot N, Lemieux R, Garon-Bissonnette J, Drouin-Maziade C, Martel É, Maziade M. Uptrend in distress and psychiatric symptomatology in pregnant women during the coronavirus disease 2019 pandemic. *Acta Obstet Gynecol Scand*. 2020;99(7):848-855.
8. Durankuş F, Aksu E. Effects of the COVID-19 pandemic on anxiety and depressive symptoms in pregnant women: a preliminary study. *J Matern Fetal Neonatal Med*. 2022;35(2):205-211.
9. Madigan S, Oatley H, Racine N, et al. A meta-analysis of maternal prenatal depression and anxiety on child socioemotional development. *J Am Acad Child Adolesc Psychiatry*. 2018;57(9):645-657.e648.
10. Racine N, Devereaux C, Cooke JE, Eirich R, Zhu J, Madigan S. Adverse childhood experiences and maternal anxiety and depression: a meta-analysis. *BMC Psychiatry*. 2021;21(1):28.
11. Slomian J, Honvo G, Emonts P, Reginster J-Y, Bruyère O. Consequences of maternal postpartum depression: a systematic

review of maternal and infant outcomes. *Womens Health (Lond)*. 2019;15:1745506519844044.
12. Wachs TD, Black MM, Engle PL. Maternal depression: a global threat to children's health, development, and behavior and to human rights. *Child Dev Perspect*. 2009;3(1):51-59.
13. Lebel C, MacKinnon A, Bagshawe M, Tomfohr-Madsen L, Giesbrecht G. Elevated depression and anxiety symptoms among pregnant individuals during the COVID-19 pandemic. *J Affect Disord*. 2020;277:5-13.
14. Glover V. Prenatal stress and its effects on the fetus and the child: possible underlying biological mechanisms. *Adv Neurobiol*. 2015;10:269-283.
15. Kim SJ, Bostwick W. Social vulnerability and racial inequality in COVID-19 deaths in Chicago. *Health Educ Behav*. 2020;47(4):509-513.
16. Saccone G, Florio A, Aiello F, et al. Psychological impact of coronavirus disease 2019 in pregnant women. *Am J Obstet Gynecol*. 2020;223(2):293-295.
17. Bridgland VME, Moeck EK, Green DM, et al. Why the COVID-19 pandemic is a traumatic stressor. *PLoS One*. 2021;16(1):e0240146.
18. Diehl M, Hay EL, Chui H. Personal risk and resilience factors in the context of daily stress. *Annu Rev Gerontol Geriatr*. 2012;32(1):251-274.
19. Almeida DM. Resilience and vulnerability to daily stressors assessed via diary methods. *Curr Dir Psychol Sci*. 2005;14(2):64-68.
20. Green R. *Risk and Resilience Theory: A Social Work Perspective*. 3rd ed. Thomas Brooks/Cole; 2008.
21. Thomason ME, Graham A, VanTieghem MR. COPE-IS: Coronavirus Perinatal Experiences – Impact Survey. 2020. Accessed October 19, 2021. https://www.nlm.nih.gov/dr2/COPE-Impact_Survey_Perinatal_Pandemic_Survey.pdf
22. Gustafsson HC, Young AS, Doyle O, et al. Trajectories of perinatal depressive symptoms in the context of the COVID-19 pandemic. *Child Dev*. 2021;92(5):e749-e763.
23. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *Br J Psychiatry*. 1987;150:782-786.
24. Bergink V, Kooistra L, Lambregtse-van den Berg MP, et al. Validation of the Edinburgh Depression Scale during pregnancy. *J Psychosom Res*. 2011;70(4):385-389.
25. Smith-Nielsen J, Matthey S, Lange T, Væver MS. Validation of the Edinburgh Postnatal Depression Scale against both DSM-5 and ICD-10 diagnostic criteria for depression. *BMC Psychiatry*. 2018;18(1):393.
26. Matthey S, Fisher J, Rowe H. Using the Edinburgh postnatal depression scale to screen for anxiety disorders: conceptual and methodological considerations. *J Affect Disord*. 2013;146(2):224-230.
27. Elo AL, Leppänen A, Jahkola A. Validity of a single-item measure of stress symptoms. *Scand J Work Environ Health*. 2003;29(6):444-451.
28. Lazarsfeld PF, Henry NW. *Latent Structure Analysis*. Houghton Mifflin; 1968.
29. Sclove S. Application of model-selection criteria to some problems in multivariate analysis. *Psychometrika*. 1987;52(3):333-343.
30. Nylund KL, Asparouhov T, Muthén BO. Deciding on the number of classes in latent class analysis and growth mixture modeling: a Monte Carlo simulation study. *Struct Equ Model Multidiscip J*. 2007;14(4):535-569.
31. Muthén LK, Muthén BO. *Mplus User's Guide [Compiter Software and Manual]*. 8th ed. Muthén & Muthén; 2021.
32. StataCorp. *Stata Statistical Software: Release 16*. StataCorp LLC; 2019.
33. Ramkissoon H. COVID-19 place confinement, pro-social, pro-environmental behaviors, and residents' wellbeing: a new conceptual framework. *Front Psychol*. 2020;11:2248.
34. Sanderson WC, Arunagiri V, Funk AP, et al. The nature and treatment of pandemic-related psychological distress. *J Contemp Psychother*. 2020;50(4):251-263.
35. Coussons-Read ME. Effects of prenatal stress on pregnancy and human development: mechanisms and pathways. *Obstet Med*. 2013;6(2):52-57.
36. Davenport MH, Meyer S, Meah VL, Strynadka MC, Khurana R. Moms are not OK: COVID-19 and maternal mental health. *Front Glob Womens Health*. 2020;1:1.
37. Yan H, Ding Y, Guo W. Mental health of pregnant and postpartum women during the coronavirus disease 2019 pandemic: a systematic review and meta-analysis. *Front Psychol*. 2020;11:617001.
38. Ahmad M, Vismara L. The psychological impact of COVID-19 pandemic on women's mental health during pregnancy: a rapid evidence review. *Int J Environ Res Public Health*. 2021;18(13):7112.
39. Pfefferbaum B, North CS. Mental health and the Covid-19 pandemic. *N Engl J Med*. 2020;383(6):510-512.
40. American College of Obstetricians and Gynecologists. ACOG Committee opinion no. 757: screening for perinatal depression. *Obstet Gynecol*. 2018;132(5):e208-e212.
41. O'Connor E, Rossom RC, Henninger M, Groom HC, Burda BU. Primary care screening for and treatment of depression in pregnant and postpartum women: evidence report and systematic review for the US Preventive Services Task Force. *JAMA*. 2016;315(4):388-406.
42. Mishkind MC, Shore JH, Bishop K, et al. Rapid conversion to Telemental Health Services in response to COVID-19: experiences of two outpatient mental health clinics. *Telemed J E Health*. 2020;27(7):778-784.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Goldstein E, Brown RL, Lennon RP, Zgierska AE. Latent class analysis of health, social, and behavioral profiles associated with psychological distress among pregnant and postpartum women during the COVID-19 pandemic in the United States. *Birth*. 2022;00:1-11. doi: 10.1111/birt.12664