

Psychological Effects of COVID-19 on Pregnant Women and New Mothers Living in a US Hotspot

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Received: 05 November 2021; Accepted: 24 February 2022; Published: 28 February 2022

Abstract

Purpose: This study investigated COVID-19 related psychological distress among expectant and new mothers, with and without infection, in metropolitan New York. It also examined the trajectories of participants' distress during pregnancy and postpartum, and the moderating effect of socioeconomic status (SES).

Methods: An online survey was conducted April through June 2020 among expectant and new mothers with infants (<12 months) (N=642). Associations between infection status and psychological symptoms, suicidal ideation, and substance use were examined. Changes in distress related to COVID-19 infection and SES were then examined.

Results: We found elevated anxiety and depression symptoms among infected compared to uninfected women. Similarly, infected, compared to uninfected women, had elevated risk for suicidal thoughts (quite often, AOR=3.97, sometimes AOR=13.2), and for substance use [alcohol (AOR=3.30); tobacco (AOR=4.54); cannabis (AOR=7.01); heroin (AOR=7.09); cocaine (AOR=10.05)]. Differences in trajectories of distress across pregnancy between the two groups were significant. Among infected women, distress was consistently high throughout. Among uninfected women, it started low and intensified toward the end of pregnancy. SES further moderated the impact of infection on distress. During earlier trimesters, infected/low SES women had greatest, and uninfected/high SES women had lowest, levels of distress. Their trajectories converged nearing childbirth.

Conclusions: New and expectant mothers, especially those infected, have suffered substantial psychological distress due to the pandemic. Moreover, SES moderated the trajectory of distress. Infected women who also had low SES experienced the highest distress levels among all groups. Mitigating strategies are imperative to alleviate this distress.

Keywords: COVID-19 infection; SES; Psychological distress; Depression; Anxiety; Suicidal ideation; Substance use

Introduction

On March 11, 2020, the World Health Organization officially announced the Coronavirus Disease 2019 (COVID-19) to be a pandemic. Measures such as quarantine, social isolation, daycare/school closures, and “work-from-home” initiatives taken by local and national authorities in the USA profoundly disrupted daily life.

COVID-19 presents an unprecedented challenge for maintaining psychological health. Excessive alcohol consumption [1] and an increase in self-harm [2] have been reported. COVID-19 stress hits vulnerable populations (i.e., expecting and new mothers) hard. Although pregnancy is thought of as a happy time, it is also a stressful, vulnerable period [3,4]. Women have to adapt to biological and emotional changes, financial and social pressures, restrictions on time for pre/postnatal care, and to a new role as a mother. These factors combined, elevate the risk of depression during this period [5,6]. Recent research has reported COVID-19 elevated psychological distress, worry, and fear [7] and elevated anxiety and depression symptomatology [8,9] among new and expecting mothers. A pilot study (n=31) of pregnant women in the U.S. reported high depressive symptoms and moderate to severe anxiety related to COVID-19 [10]. Concerns regarding COVID-infection or exposure may exacerbate the distress and mental health problems in expectant and new mothers [11,12].

Given the unprecedented level of suffering in the New York metropolitan area, the first epicenter of COVID-19 in the USA, we utilized this opportunity to evaluate the psychological consequences in a population already known to have increased vulnerability to psychological distress and whose psychological health has direct consequences not only to themselves but also to the well-being of their infants [13]. To do this, we employed online surveys to assess perceived risk of exposure, negative emotions, and thoughts and behaviors concerning COVID-19 among pregnant and new mothers. We expected that infection status would influence all of these factors. We also examined socioeconomic status (SES), expecting it to have a differential impact and further hypothesized psychological distress may be magnified among women with low SES, who have fewer resources to buffer the impact of the pandemic [14] and to cope with the restrictions and unknowns of COVID-19.

Methods

Procedure and Participants

The study was set-up with the online platform Qualtrics in conjunction with the Completely Automated Public Turing Test (CAPTCHA), which ensured data integrity by eliminating robotic participation. Participants were recruited through fliers at OB-GYN clinics and social-media platforms between April and June 2020. Interested individuals answered online eligibility questions. Criteria included living in the NY metropolitan area and being pregnant or having a child 12 months-old or younger. After eligibility was confirmed, 3 CAPTCHA verification challenge responses were required to proceed to digitally signing consent. Of 744 respondents, 99 did not meet screening criteria and 3 had missing responses, leaving 642 participants. The study was approved by the IRB at Queens College, CUNY.

Online questionnaires were used to assess stress, psychological symptoms, substance use, distress related to COVID-19, and COVID-19 infection status. Questions regarding distress related to COVID-19 were asked at different stages of pregnancy (1st, 2nd, 3rd trimester, and postpartum): postpartum mothers who had been pregnant during the pandemic responded to questions from earlier trimesters

retrospectively. Participants chose “not applicable (N/A)” for the trimesters when the pandemic had not yet evolved or that did not apply to them. For example, if the participant was in the 3rd trimester, she responded to questions in the 1st and 2nd trimesters retrospectively and chose “N/A” for the postpartum period.

Measures

Stress and Psychological Symptoms: The following were used: [15] Perceived Stress Scale (PSS); State-Trait Anxiety Inventory [16] (STAI); and Edinburgh Postnatal Depression Scale [17]. Cronbach Alpha for those instruments are .75, .80, and .80, respectively.

Suicidal Thoughts and Substance Use: The EPDS question, “The thought of harming myself has occurred to me,” was used as an index of suicidal ideation. Answering that they experienced suicidal ideation “quite often” or “sometimes” was coded as 1; any other choice was 0. Substance use (tobacco, cannabis, alcohol, cocaine, opiates) was coded as 1; absence was 0.

Distress due to COVID-19: We adapted the PSS to ascertain levels of COVID-specific distress. It employs a 5-point Likert scale with 7 items: “feeling upset about unexpected outbreak,” “feeling unable to control things that are important,” “feeling nervous and stressed,” “feeling vulnerable,” “feeling that you and your baby’s health are at risk,” “feeling upset about the uncontrollable situation,” and “feeling that it is difficult to keep the family virus-free.” As the Cronbach Alpha for those items was excellent (Alpha=.95), we used the mean total score to assess trajectories of distress.

Demographics: The Demographics Questionnaire included education, parity, residence area, current pregnancy status, age, race, and marital status. During pregnancy and early postpartum, education is considered the best SES indicator [18], because other indicators (i.e., employment or income) may introduce systematic bias if mothers choose not to work. Education was dichotomized into high (college graduate or higher) and low (an associate degree or less) for SES index.

Infection Status: Self-report confirmed infection status (yes or no).

Missing Values: There are no missing data on the predictors or demographics. The frequency of missing data on the responses was negligible (less than 1%).

Statistical Strategies

Data Preparation

We examined normality using the univariate indices of skewness and found no violation.

Cross Sectional Analysis

First, univariate analyses (Chi-Square for dichotomous and analysis of variance for continuous outcomes) were conducted, followed by multivariate analyses (logistic regression for dichotomous and analysis of co-variance for continuous outcomes). Covariates included age, marital status, race, and parity.

Longitudinal Analysis

We used a generalizing estimating equation (GEE) to evaluate the influence of COVID-19 infection, time (1st, 2nd, 3rd trimesters, and postpartum), and the interaction between infection status and time on the distress score at each time point and an overall difference in trajectory. This was followed by HLM, which estimates both within-person longitudinal and between-person effects [19]. The within-person model mapped the trajectory of distress at four time points. All models in the analysis were corrected for non-normal distributions of level 2 residuals by applying the full maximum likelihood estimation (MLE) with robust standard errors to incorporate the missing data imputation [20]. The interaction evaluated the magnitude of the moderating effect of SES on the influence of COVID-19 infection.

Given that little information was available on changes in distress among expecting and new mothers in the early pandemic, we chose to let the data determine the best-fit model. We began by testing the trajectory of changes without predictors and covariates. As both linear and curvilinear models could be significant, tests of relative model fit were computed by comparing deviance statistics to choose the best-fit model. Random effects were included in the intercept and change coefficients. Time was centered on the intercept that represented distress in the 3rd trimester. After determining the best-fit model, we examined whether infection status was a significant predictor for the distress score, and then examined the joint effects of infection and SES with an additional interaction between the two.

Missing Data

Distress scores include a choice of NA, which was treated as system missing (missing as they should). Longitudinal analyses apply MLE, using available data to yield parameter estimates for the missing time points for a total distress score (within-subject variability), but not for predictor variables that explain between-subject variability [19].

Results

Demographics and Psychosocial Characteristics

440 (68.5%) participants were postpartum, and 202 (31.5%) were pregnant (1st trimester: 37; 2nd: 114; 3rd: 51). The mean (SD) age of postpartum mothers’ infants was 7.07 (3.17) months. The largest number of participants lived in Staten Island (43.3%). 76% of all participants were White, 81.2% were 22-30 years old, and 64.5% had college/graduate degrees. Perceived stress (mean=45.19, SD=7.71), anxiety symptoms (mean=93.67, SD=12.35), and depression symptoms (mean=13.49, SD=4.36) all reached levels of clinical significance (40, 80, and 12, respectively). 35.3% had suicidal ideation “at least sometimes”, and 7.2% had it “quite often”. Prevalence rates of substance use, including tobacco (20.7%), cannabis (15.0%), and alcohol (38.0%), were high (Table 1).

Infected Compared to Uninfected Women

Stress and Psychological Functioning: Infected, compared to uninfected, women reported greater levels of anxiety (100.10 vs. 93.40, $p=.00003$) and depression (17.05 vs. 13.25, $p<.00001$) symptoms, but did not differ on perceived stress.

Suicidal Thoughts: The prevalence of suicidal thoughts among infected women, compared to uninfected, showed a 4-fold increase for “quite often” (17.9% vs. 6.5%, AOR=3.97, 95%CI 1.39-11.38, $p=.01$) and an overall 13-fold increase for “sometimes” (89.7% vs. 31.8%, AOR=13.20, 95%CI 4.46-39.13, $p<.0001$).

Substance Use: Infected women, compared to uninfected, had a 3-fold increase in alcohol use (72.5% vs. 35.7%, AOR=3.30, 95%CI 1.50-7.25, $p=.003$), an over 4-fold increase in tobacco use (70.0% vs. 17.4%, AOR=4.54, 95%CI 2.06-10.00, $p=.0002$), a 7-fold increase in cannabis (65.0% vs. 11.6%, AOR=7.01, 95%CI 3.02-16.29, $p<.0001$) and heroin use (30.0% vs. 3.0%, AOR=7.09, 95%CI 2.87-17.54, $p=.001$), and a 10-fold increase in cocaine use (30.0% vs. 2.8%, AOR=10.05, 95%CI 4.05-24.94, $p<.0001$) (Table 2).

Influence of COVID-19 infection, time (1st, 2nd, 3rd trimesters pregnancy, and postpartum), and the interaction between the two on the level of distress

GEE was used to evaluate the influence of COVID-19 infection, time (1st, 2nd, 3rd trimesters, and postpartum), and interaction between infection status and time on the level of distress at each time point, and an overall difference in trajectory. Results showed a significant time-effect ($p<.001$), infection-effect ($p=.008$), and trajectory difference (i.e., interaction) between infected and uninfected women ($p<.001$).

Table 1: Characteristics of participants (N=642).

Demographic and Psychosocial Characteristics of the participants			
Area of residence, N (%)	Out of NYS		30 (4.7)
	Manhattan		61 (9.5)
	Bronx		73 (11.3)
	Brooklyn		60 (9.3)
	Queens		64 (10.0)
	Long Island		14 (2.2)
	Staten Island		278 (43.3)
	Westchester		62 (9.7)
Pregnancy status, N (%)	Currently Pregnant		202 (31.5)
Age, N (%)	< 18		1 (0.2)
	18-21		3 (0.4)
	22-30		521 (81.2)
	31-40		116 (18.0)
	> 40		1 (0.2)
Education, N (%)	Primary School		8 (1.2)
	High School		27 (4.2)
	Some College		113 (17.6)
	Associate Degree		80 (12.5)
	College or Graduate Degree		414 (64.5)
Marital Status, N (%)	Married		638 (99.4)
	Common Law		2 (0.3)
	Single		2 (0.3)
Race, N (%)	White		488 (76.0)
	Black		21 (3.25)
	Hispanic		114 (17.75)
	Asian		19 (3.0)
Parity, Mean (SD) Range		1.50 (1.19)	0-5
Perceived stress, Mean (SD) Range		45.19 (7.71)	0-56
State-Trait Anxiety, Mean (SD) Range		93.67 (12.35)	0-137
Depression, Mean (SD) Range		13.49 (4.36)	3-26
Suicidal thoughts, N (%) ^a	Quite often		46 (7.2)
	At least sometimes		225 (35.3)
Substance Use, N (%)	Alcohol		244 (38.0)
	Tobacco		133 (20.7)
	Cannabis		96 (15.0)
	Heroin Cocaine		30 (4.7) 29 (4.5)

^a There are missing data among n=5 participants on suicidal thoughts

Table 2. Differences in stress and emotions, and substance use among women infected and not infected with COVID-19

STRESS, ANXIETY, and DEPRESSION	Not infected (N=602)	Infected (N=40)	Unadjusted Model Statistics, p-value			Adjusted Model ^a Statistics, p-value		
			OR (95% CI)	Wald X ²	p-value	AOR (95% CI)	Wald X ²	p-value
Perceived stress, Mean (SD)	45.77 (6.53)	42.18 (7.04)		F=10.96,	p=.001	F=1.25,	p=.27	
State-Trait Anxiety, Mean (SD)	93.40 (11.84)	100.10 (9.09)		F=12.02,	p=.001	F=17.63,	p=.00003	
Depression, Mean (SD)	13.25 (4.37)	17.05 (2.13)		F=29.03,	p<.0001	F=24.49,	p<.00001	
SUICIDAL THOUGHTS	Not infected (N=602)	Infected (N=40)	Unadjusted Model			Adjusted Model ^a		
			OR (95% CI)	Wald X ²	p-value	AOR (95% CI)	Wald X ²	p-value
Suicidal thought (quite often), N (%)	39 (6.5)	7 (17.9)	3.14 (1.30-7.59)	7.14	p=.008	3.97 (1.39-11.38)	6.59	p=.01
Suicidal thought (at least sometimes), N (%)	190 (31.8)	35 (89.7)	18.79 (6.58-53.62)	58.86	p<.0001	13.20 (4.46-39.13)	21.68	p<.0001
SUBSTANCE USE during PREGNANCY	Not infected (N=602)	Infected (N=40)	Unadjusted Model			Adjusted Model ^a		
			OR (95% CI)	Wald X ²	p-value	AOR (95% CI)	Wald X ²	p-value
Alcohol use, N (%)	215 (35.7)	29 (72.5)	4.75 (2.32-9.69)	21.54	p<.0001	3.30 (1.50-7.25)	8.86	p=.003
Tobacco use, N (%)	105 (17.4)	28 (70.0)	11.04 (5.44-22.45)	63.08	p<.0001	4.54 (2.06-10.00)	14.12	p=.0002
Cannabis use, N (%)	70 (11.6)	26 (65.0)	14.11 (7.04-28.31)	84.02	p<.0001	7.01 (3.02-16.29)	20.47	p<.0001
Heroin use, N (%)	18 (3.0)	12 (30.0)	13.91 (6.11-31.67)	61.43	p<.0001	7.09 (2.87-17.54)	18.03	p=.001
Cocaine use, N (%)	17 (2.8)	12 (30.0)	14.75 (6.43-33.84)	64.23	p<.0001	10.05 (4.05-24.94)	24.79	p<.0001
Methadone use, N (%)	19 (3.2)	2 (5.0)	1.62 (0.36-7.19)	0.40	p=.53	1.15 (0.24-5.51)	0.31	p=.73
Opiate, N (%)	13 (2.2)	3 (7.5)	3.67 (1.0-13.46)	4.40	p=.04	2.38 (0.58-9.82)	1.44	p=.23

OR=odds ratio; AOR=adjusted odds ratio; CI=confidence interval

a. Adjusted model includes race, parity, age, and education of participants.

Table 3. The effects of COVID infection on feeling and distress toward COVID-19 pandemic at different gestational periods (1st trimester, 2nd trimester, 3rd trimester, and within 1 year postpartum).

Question items	INFECTION STATUS	1 st TM		2 nd TM		3 rd TM		postpartum		Statistics			
		M	SE	M	SE	M	SE	M	SE	INFECTION X ² (df) p-value	TIME X ² (df) p-value	INTERACTION X ² (df) p-value	
Individual distress measures													
Upset about the unexpected outbreak	No	1.75	.06	1.90	.06	1.93	.06	2.95	.05				
	Yes	2.30	.16	2.22	.15	2.32	.19	2.63	.16	4.15 (1)	.042	17.07(3)	<.001
Unable to control life matters	No	1.76	.05	1.90	.06	1.91	.06	2.95	.05				
	Yes	2.32	.17	2.32	.14	2.29	.18	2.78	.16	6.61 (1)	.010	39.34 (3)	<.001
Nervous and stressed	No	1.70	.05	1.92	.06	1.97	.06	2.97	.05				
	Yes	2.20	.16	2.35	.18	2.40	.20	2.68	.14	4.51 (1)	.031	22.54 (3)	<.001
Feeling vulnerable	No	1.64	.05	1.78	.06	1.87	.06	2.81	.05				
	Yes	2.43	.15	2.04	.15	2.25	.21	2.68	.14	7.85 (1)	<.001	22.88(3)	<.001
Worries about the baby's health	No	1.68	.05	1.89	.06	1.95	.06	2.94	.05				
	Yes	2.72	.14	2.30	.16	2.07	.20	2.42	.15	4.47 (1)	.038	43.57(3)	<.001
Upset for things that are out of control	No	1.67	.05	1.22	.06	1.87	.06	2.97	.05				
	Yes	2.42	.15	2.24	.14	2.15	.17	2.72	.13	8.07 (1)	.005	59.3 (3)	<.001
Difficult to keep infection away	No	1.72	.05	1.89	.05	1.97	.06	2.97	.05				
	Yes	2.11	.15	2.37	.15	2.22	.19	2.70	.16	3.42 (1)	.065	30.62 (3)	<.001
Summary distress measure													
Distress Total (mean)	No	1.70	.05	1.88	.05	1.93	.05	2.98	.03				
	Yes	2.36	.20	2.27	.12	2.26	.15	2.69	.10	7.13 (1)	.008	61.94 (3)	<.001

GEE was used to assess the effects of COVID-19 infection on a linear change. Marital status, race, parity, and age of the participants were controlled. The interaction term (INFECTION x TIME) shows the difference in the linear change of the distress scores over time between infected and uninfected participants.

1st TM = first trimester, 2nd TM = second trimester, and 3rd TM = third trimester.

M= mean; SE= standard error

Table 4. Linear and quadratic change in feelings and distress toward COVID-19 pandemic during different gestational periods (1st trimester, 2nd trimester, 3rd trimester, and within 1 year postpartum).

Question items	Intercepts			Linear			Quadratic			Model Comparison	
	γ ₀₀ : M	SE	t-ratio	γ ₁₀ : M	SE	t-ratio	γ ₂₀ : M	SE	t-ratio	ΔX ² (4)	P-value
Individual distress measures											
Upset about the unexpected outbreak	2.109	.046	45.45*****	.555	.041	13.69*****	.205	.023	8.94*****	366.41	<.00001
Unable to control life matters	2.100	.047	44.71*****	.567	.039	14.46*****	.211	.022	9.48*****	379.05	<.00001
Nervous and stressed	2.192	.046	46.87*****	.528	.039	13.66*****	.177	.023	7.71*****	353.40	<.00001
Feeling vulnerable	2.031	.048	42.72*****	.513	.041	12.53*****	.187	.023	8.02*****	400.34	<.00001
Worries about the baby's health	2.131	.047	45.46*****	.533	.040	13.36*****	.193	.022	8.63*****	381.77	<.00001
Upset for things that are out of control	2.099	.046	45.33*****	.571	.038	15.19*****	.215	.022	9.57*****	381.01	<.00001
Difficult to keep infection away	2.157	.045	47.21*****	.542	.037	14.71*****	.183	.021	8.68*****	347.50	<.00001
Summary distress measure											
Distress Total (mean)	2.142	.042	51.62*****	.562	.034	16.26*****	.198	.019	10.72*****	612.68	<.00001

Note: γ_s(M) represents the average, or fixed effects. SE = standard error. Chi-square difference test (ΔX²) yields model comparison between the linear and quadratic models.

***** p <.00001

Specifically, among infected women, the scores at 1st, 2nd, 3rd trimesters, and postpartum were 2.36, 2.27, 2.26, and 2.69, respectively, whereas among uninfected women they were 1.70, 1.88, 1.93, and 2.98. The patterns were very similar in trajectory of each subscale (Table 3).

Longitudinal changes across pregnancy and postnatal period in distress by COVID-19 infection

We first examined each distress measure as a function of the intercept plus the linear/quadratic effect of time without predictors and covariates (**Panel A**). We found that a curvilinear model was the best-fit to explain the trajectory of distress (Table 4). After choosing the best-fit model, Model 1 examined the trajectory of distress with infection status. Then, we evaluated the model with infection, SES, and the interaction between the two (**Model 2**) to determine whether the effect of infection was moderated by SES (Figure 1).

Model 1. With only infection status

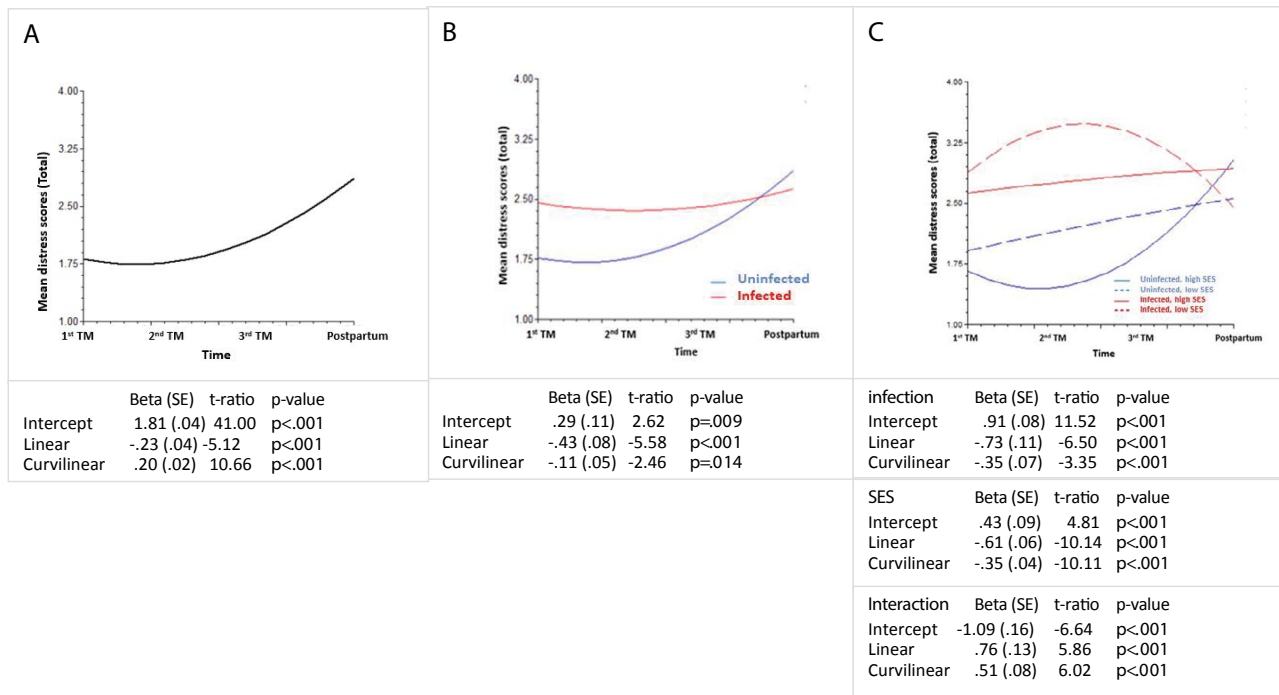
There was a significant difference in distress (t=2.62, p=.009) between infected and uninfected women at the intercept (3rd trimester).

Panel B shows the patterns of change in distress over time by infection status. Among infected women, the level of distress increased slightly throughout the study period. Among uninfected women, the level started low but increased throughout pregnancy and exceeded the level of infected women after childbirth (t=-5.58, p<.001).

Model 2. With infection, SES and interaction of the two

Infection status (t-ratio=11.52, p<.001) and SES (t-ratio=4.81, p<.001) predicted a significantly different distress level at the intercept (3rd trimester). The interaction was also significant (t-ratio=-6.64, p<.001), indicating that SES moderated the effect of infection.

Figure 1: Trajectory of change in distress across pregnancy and 1-year postpartum (N=642).



Panel A shows the trajectory of distress without any predictors and covariates; Panel B shows the trajectory of distress by infection status; Panel C shows the trajectory of distress by infection status and SES. Marital status, race, parity, and age of participants were controlled in the analyses depicted in Panels B and C. 1st TM = first trimester, 2nd TM = second trimester, and 3rd TM = third trimester.

Panel C shows the trajectory of distress by infection status and SES. Both infection status and SES had significant effects in predicting the linear change (t-ratio=-6.50, p<.001; t-ratio=-10.14, p<.001, respectively) and curvilinear changes in distress (t-ratio=-3.35, p<.001; t-ratio=-10.11, p<.001, respectively). The interaction was significantly different for both linear (t-ratio=5.86, p<.001) and curvilinear changes (t-ratio=6.02, p<.001). Specifically, SES has a differential impact on the effect of infection on the trajectory of distress. Among uninfected women, those with low SES had a substantially greater level of distress approaching their 3rd trimester, relative to women with high SES, whereas women with high SES had a lower level of distress toward the end of the 3rd trimester, but it continued to increase postpartum.

Discussion

This study examined how the COVID-19 pandemic impacted the mental health of new and expectant mothers living in metropolitan New York. Consistent with early reports [7-10], we found alarmingly high levels of mental health problems, especially among infected mothers. Further, we observed different trajectories of distress levels across pregnancy based upon infection status and SES. Infected compared to uninfected women had higher levels of distress in early pregnancy, but for both groups, distress levels reached their height toward the end of pregnancy. Notably, during the 1st and 2nd trimesters, infected expecting mothers who also had low SES were the most vulnerable group and had the highest levels of distress.

On questionnaires assessing stress and psychological symptoms (PSS; STAI; EPDS), participants’ responses yielded mean scores above clinical significance. Alarmingly, over 7% of women reported having suicidal thoughts “quite often” and 35% reported having them “sometimes.” Additionally, prevalence rates of substance use in participants (tobacco: 20.7%, cannabis: 15.0%; alcohol: 38.0%) were higher than the prevalence of reproductive-age women in the general population during pre-COVID (7.1-10.3%, 4.98%, and 8.4-11.3%, respectively) [21-24].

Mental health consequences of the pandemic were worse for

infected than for uninfected women. Forty participants had confirmed COVID-19 and 4 had suspected infection. Infected participants had higher levels of anxiety and depression symptoms, and suicidal ideation. There was a 4-fold increase in having suicidal thoughts “quite often” and an over 13-fold increase in having them “sometimes” among infected women. Importantly, the prevalence of substance use among infected women was also markedly higher (infected/uninfected - tobacco: 70.0%/17.4%; cannabis: 65.0%/11.6%; alcohol: 72.5%/35.7%). Given that we lack pre-pandemic substance use data, we are unable to conclude that this disturbing pattern of substance use results from the stress of infection, as opposed to riskier COVID-19 behavior among substance users leading to higher infection rates, or possibly to under-resourced and marginalized communities having higher rates of both. Future research is required to clarify the relationship between substance use and infection in expecting and new mothers.

We hypothesized that infection status had different effects on the trajectory of distress across pregnancy and the postpartum period. We observed that infected, relative to uninfected mothers, had substantially higher levels of distress in early pregnancy, and the level of distress remained relatively unchanged throughout, reaching its height in the postpartum period. This has been similarly observed in non-COVID studies on the progression of anxiety and depression symptoms during pregnancy [5,25]. Notably, while the distress level in uninfected women started low in early pregnancy, it rose at a greater rate toward the end of the pregnancy, exceeding the level among infected women in the early postpartum period. Although speculative, these findings may suggest that mothers, regardless of infection status, become more concerned as they approach their delivery date and the consideration of the health of their newborns becomes more immediate.

Furthermore, we simultaneously examined infection status and SES on the trajectory of COVID-19 distress during pregnancy and postpartum. Although both factors influenced change in COVID-19 distress, SES status moderated the trajectory specifically among infected women. In the earlier trimesters, distress level for low SES participants was greater than for high SES participants. It gradually

increased, peaking around the 2nd trimester, and then decreased again. On the other hand, women with high SES started with lower distress levels which increased gradually at the same steady rate throughout. High SES participants who were uninfected by COVID-19 had the lowest levels of distress in their 1st trimester. Distress levels decreased to their lowest point in the second trimester but rose again toward postpartum. The level of COVID-19 related distress appeared to be elevated in all mothers after their babies were born.

This pattern of change is inconsistent with a recent pre-COVID study of 186 women which demonstrated that anxiety was the highest during the first trimester, decreased as the pregnancy progressed into the second trimester, and remained low during the third [26]. Although the reason for these different patterns of distress between a pre-pandemic and a pandemic group remain in the realm of speculation, they strengthen the evidence for significant effects of COVID, and its accompanying uncertainties, on elevating women's levels of distress just before childbirth and during the early postpartum period when their children are very vulnerable. Our findings suggest that healthcare providers and policy makers need to offer additional resources that address new mothers' concerns and anxiety about safeguarding their newborns from the possibility of infection.

There are several limitations in the current study. First, it was conducted when New York was at a COVID-19 peak and under lockdown. Although face-to-face interviews were preferable, circumstances necessitated online self-report. Second, women participated at different pregnancy stages, resulting in retrospective responses for periods earlier in pregnancy. This opens the possibility of some recall bias due to retrospective data ascertainment. Third, some asymptotically infected participants may have unknowingly been classified as uninfected; however, this study was intended to evaluate the psychological, not biomedical, consequences of COVID-19. Fourth, there is a relatively low prevalence of infected women in our study population. Fifth, we did not collect data on all social and financial factors potentially affecting COVID-19 distress (e.g., unemployment, non-COVID stressful life-events, access to healthcare, social support). Consequently, statistical analyses do not include these potentially important factors. Sixth, although our participants' racial distribution is closest to that of Staten Island, where the largest proportion of participants live, it is disproportionately Caucasian, married, and well-educated. Given that Caucasian women with higher SES were overrepresented in this study and that financial and racial minorities are considerably disadvantaged with higher COVID-19 infection rates [27,28], our findings suggest an alarming picture for those experiencing increased vulnerability due to socioeconomic privation and racial discrimination. Future in-depth studies, that include a broader range of demographic factors and target financial and racial inequality, will help bridge the gap in our understanding of the sociopsychological vulnerabilities in new and expectant mothers.

Despite these limitations, our study contributes a deeper understanding of the serious impact of the COVID-19 pandemic on the mental health of expecting and new mothers. Highlighting the effect of COVID-19 on these women has implications beyond the current pandemic. Our study addresses what may be a COVID-19 mental health crisis among expectant and new mothers and suggests that these women—especially if they are infected and are classified as low SES—are suffering considerable mental health consequences. It is essential that services such as psychological support and stress reduction, be made available for women of reproductive age and their families in order to prevent potential long-term consequences in their ability to care for their newborns. It is equally important for policy makers, obstetricians, and pediatricians to create an infrastructure to assist pregnant women and their families when confronting COVID infection, in order to mitigate risks to themselves and their children *in-utero*. Finally, it is important to adapt longitudinal studies such as this one to evaluate the multi-faceted long-term effects of the COVID

pandemic on maternal mental health outcome, as well as those of their infants and partners. Policy changes, with state and federal support, are urgently needed to alleviate the high level of distress among this population.

Acknowledgments

The authors are very grateful to research assistants Christine Ginalis, Mardia Nasrin, Johnny Lopez, Patricia Pehme, and Fareeha Mannan at Queens College, CUNY for their time in setting up the online study. We are especially indebted to Nazia Hasan for overseeing the online study progress and validation checking.

Funding

The study was funded by the Department of Psychology, the School of Math and Sciences Division, and the Office of the Provost, Queens College, CUNY (to YN), and supported in part by funds from the New York State Office for People with Developmental Disabilities (to PK, AG and HP).

Availability of Data and Material

Available upon request

Ethics Approval

Approved by Queens College, CUNY IRB

Consent to Participate

Informed consent was obtained from all individual participants included in the study.

Consent to Publish

Patients signed informed consent regarding publishing their data.

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