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Mediating Mechanisms for Maternal Mental Health from Pre- to during the COVID-19 Pandemic

Mediators of maternal mental illness during COVID-19

Nicole Racine a, Sheila McDonald b,c, Suzanne Tough b,1, Sheri Madigan a,1,*

a Department of Psychology, University of Calgary, Calgary, Alberta, Canada
b Department of Community Health Sciences, University of Calgary, Calgary, Alberta, Canada
1 Alberta Health Services, Canada

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ABSTRACT

Background: Mothers have experienced a near doubling of depression and anxiety symptoms pre- to during the COVID-19 pandemic. The identification of mechanisms that account for this increase can help inform specific targets for mental health recovery efforts. The current study examined whether women with higher levels of depression and anxiety symptoms pre-pandemic, reported higher levels of depression and anxiety symptoms during the pandemic, and whether these increases were mediated by perceived stress, strained relationships, coping attitudes, participation in activities, alcohol use, and financial impact.

Methods: Mothers (n = 1,333) from an ongoing longitudinal cohort (All Our Families; AOF) from Calgary, Alberta, Canada, completed online questionnaires prior to (2017–2019) and during the COVID-19 pandemic (May–July 2020). Mothers reported on depressive and anxiety symptoms pre- and during the pandemic, as well as perceived stress, engagement in physical and leisure activities, coping, alcohol use, and financial impact of the pandemic.

Results: In unadjusted analyses, maternal depression and anxiety symptoms pre-pandemic were strongly associated with COVID-19 depressive (r = 0.57, p < .01) and anxiety symptoms (r = 0.49, p < .01). Significant indirect effects between maternal depressive symptoms pre- and during COVID-19 were found for coping behavior (ab = 0.014, 95%CI = 0.005, 0.022, p = .001), perceived stress (ab = 0.22, 95%CI = 0.179, 0.258, p < .001), and strained relationships (ab = 0.013, 95%CI = 0.005, 0.022, p = .003). For maternal anxiety symptoms pre- and during COVID-19, significant indirect effects were observed for perceived stress (ab = 0.012, 95%CI = 0.077, 0.154, p = .003) and strained relationships (ab = 0.010, 95%CI = 0.001, 0.018, p = .03).

Conclusions: Perceived stress, coping attitudes, and interpersonal relationships are three potential intervention targets for mitigating COVID-19 related mental distress in mothers.

1. Introduction

A pernicious consequence of the COVID-19 pandemic has been its impact on mental health across the globe (Holmes et al., 2020). Social isolation and increased financial stress associated with the COVID-19 pandemic have created a ripe context for increases in mental illness (Brooks et al., 2020), particularly for parents who have also endured stress related to homeschooling responsibilities, loss of childcare, and significant disruptions in daily routines (Cameron et al., 2020; Racine et al., 2020; Wade et al., 2021). Indeed, longitudinal research has highlighted that during COVID-19, parents are demonstrating sharper increases in mental distress compared to individuals without children (Pierce et al., 2020). Specifically, from pre- to during the COVID-19 pandemic, mothers have experienced a near doubling of clinically-significant depression (19% to 35%) and anxiety (18% to 31%) symptoms (Racine et al., 2021). The rapid rise in maternal mental distress during the COVID-19 pandemic is concerning, as it is well established that maternal mental illness is adversely associated with developmental outcomes in offspring (Rogers et al., 2020; Wall-Wieler et al., 2020). Thus, there is urgency in identifying mechanisms, both...
unique to COVID as well as though that have been shown previously, that account for why these increases in maternal mental illness have occurred. Understanding the mechanisms that may account for the association between mental health difficulties before and during the COVID-19 pandemic can inform the mobilization of intervention and recovery efforts.

There are several candidate mechanisms that may account for the association between maternal mental illness prior to, and during, the COVID-19 pandemic. First, perceived stress is a well-established catalyst for mental health difficulties (Harkness, 2020), and may be playing a critical role in the observed increase in mental health difficulties in mothers. Indeed, parents, but especially mothers, have reported higher levels of stress exposure, including financial disruption and increased household and childcare responsibilities during the pandemic (Wade et al., 2021). Second, according to transactional interpersonal theories of mental illness, individuals with pre-existing symptoms of depression or anxiety may act in ways that promote conflict or strain relationships, which subsequently perpetuate mental health difficulties (Rudolph et al., 2009). As a result of public health measures imposed during the pandemic, including home confinement, loss of social support, and increased demands, mothers may have experienced increased relational strain with partners and children (Pietromonaco and Overall, 2020; Russell et al., 2020), and these relational challenges may be contributing to worsening mental health symptoms. Other potential COVID-19 specific mechanisms accounting for the association between symptoms of mental illness from pre- to during the pandemic include poor coping strategies, increased alcohol consumption, and due to various restrictions (e.g., closing of fitness centres), decreased physical and recreational activities (Rettie and Daniels, 2020). Finally, there is also evidence to suggest that financial strain during the pandemic is associated with increased depressive symptoms and may propel feelings of hopelessness and worry that could exacerbate pre-existing mental distress (Hertz-Palmor et al., 2020).

In the current study, we report on findings from a cohort of mothers with children aged 9–11 years who have been followed longitudinally. We examined whether women who had higher levels of depression and anxiety symptoms pre-pandemic (2017 to 2019), reported higher levels of depression and anxiety symptoms during the pandemic (May–June 2020), and whether these increases were mediated by a priori defined candidate mechanisms. We expected that pre-pandemic depression and anxiety symptoms would be associated with COVID-19 depression and anxiety symptoms through perceived stress, strained relationships, coping attitudes, participation in activities, alcohol use, and financial impact.

2. Methods

2.1. Participants and study design

Participants in the current study are part of an ongoing longitudinal cohort from Calgary, Alberta, Canada, the All Our Families study (AOF; McDonald et al., 2015; Tough et al., 2017) examining longitudinal associations of maternal-child health and wellbeing. The AOF study started in 2008 and recruited women in pregnancy from medical laboratory offices, primary care clinics, and public locations that pregnant women frequent. To date, 2445 women have participated in data collection consistently over time, through eight data waves including prior to 25 weeks gestation, between 34- and 36-weeks gestation, and when their child was 4-months, 1-year, 2-years, 3-years, 5-years, and 8-years of age. In the current study we include data collected immediately prior to the COVID-19 pandemic (child age 8-years; collected 2017–2019), to directly examine associations with COVID-19 mental illness.

In March 2020, a state of emergency was declared in the province of Alberta as a result of the COVID-19 pandemic. A COVID-19 impact survey was emailed to AOF mothers and completed between May 20th and July 15th, 2020. Eligible mothers were those who have remained in the study over time (i.e., had not discontinued, were not lost to follow-up, and had an email address available on file; \( n = 2445 \), 72% retention). A total of 1333 women (54.5% of eligible women) consented to participate in the COVID-19 impact survey. Mothers who have been retained in the study across time are generally of higher education, higher income, older, more likely to be in a stable relationship, and more likely to be born in Canada (Tough et al., 2017). Patterns were similar when comparing women who were initially enrolled in the study (\( n = 3387 \)) with those who participated in the COVID-19 impact survey (\( n = 1333 \)). Specifically, women who participated in the COVID-19 impact survey had higher income (\( t = -6.53, p < .0001 \)), were older (\( t = -4.04, p < .0001 \)), and had higher education levels (\( t = -5.62, p < .0001 \)) than women initially enrolled at baseline into the AOF study. Analyses that weighted for non-response (Racine et al., 2021) found similar rates of depression and anxiety symptoms during the pandemic for mothers who participated at the COVID-19 time point, indicating that mental health rates of mothers who did and didn’t respond were likely similar.

2.2. Procedures and variables

Data at the COVID-19 timepoint was collected using the Research Electronic Data Capture (REDCap) platform and was linked with the most recent pre-COVID-19 timepoint when the child was 8 years of age, which was collected from February 2017 to October 2019. Both the 8-year and COVID-19 impact surveys included questions about demographic information (i.e., race/ethnicity, household income, maternal age, maternal education), maternal mental health and well-being, and family functioning. All demographic information for the sample is reported in Table 1. The University of Calgary Institutional Review Board approved all data collection for this study (REB13–0868).

Mental health variables. Maternal depressive and anxiety symptoms were obtained via maternal self-report at the pre-COVID-19 and COVID-19 timepoints. Depressive symptoms in the past week were assessed using the 10-item Center for Epidemiological Studies of Depression Short Form (CES-D-10), with scores ranging from 0 to 30. Anxiety symptoms were assessed using the 6-item Spielberger State-Trait Anxiety Inventory (Bjorgvinsson et al., 2013). Internal consistency for the CES-D-10 in the current study was good (\( \alpha = .81 \)).

| Variable | Mean (SD) |
|----------|-----------|
| Maternal age | 41.56 (4.35) |
| Child age | 9.66 (0.81) |
| Family income $≤ 50,000 | 11.1 (156) |
| Single parent family | 6.8 (91) |
| Family had COVID-19 exposure | 8.7 (116) |
| Family income $>80,000 per year | 81.2 (1083) |
| Highest level of maternal education Less than high school | 1.4 (18) |
| Graduated high school | 5.0 (66) |
| Some college, trade school, university | 13.1 (174) |
| Graduated college, trade school, university | 64.3 (857) |
| Some graduate school | 2.6 (35) |
| Completed graduate school | 13.5 (180) |
| Race/Ethnicity | |
| Asian | 11.1 (148) |
| Black | 0.80 (10) |
| First Nations, Inuit, Metis | 0.50 (7) |
| Latin | 1.5 (20) |
| Mixed/Other | 2.9 (39) |
| White | 82.7 (1102) |
State-Trait Anxiety Inventory Short Form (STAI-SF) (Marteau and Bekker, 1992), with scores ranging from 6 to 24. The SSAI-SF, which has previously been validated for use with mothers (Bayrampour et al., 2014), has demonstrated good psychometric properties (Tluczek et al., 2009). Good internal consistency for the SSAI-SF has been demonstrated (MacKinnon et al., 2007). We used a bootstrapping method (5000 bootstrap draws) to obtain 95% confidence intervals around the indirect effect estimates. All analyses were conducted using Full Information Maximum Likelihood (Graham, 2009) and thus all data for participants that did not have complete missing data were included in the path analysis (n = 1332).

3. Results

3.1. Descriptive characteristics and associations among variables

Descriptive statistics and correlations are presented in Table 2. There were strong positive associations among depression and anxiety symptoms from pre- to during COVID-19 with correlations ranging from 0.42 to 0.72. Increased uptake of activities and coping were negatively associated with depressive and anxiety symptoms at both timepoints, while perceived stress, strained relationships, financial impact, and alcohol use were positively associated with mental health symptoms pre- and during COVID-19.

3.2. Increases in maternal depression and anxiety symptoms from pre to during COVID-19

Using a paired sample t-test, we found a significant difference in maternal depression symptoms from pre (M = 5.45, SD = 4.66) to during the COVID-19 pandemic (M = 7.97, SD = 5.72) (Mean difference = −2.52, SD = 4.90, 95% CI = −2.80 to −2.24, t = −17.84, df = 1203, p < .001), with higher depressive symptoms during the COVID-19 pandemic. Using a paired sample t-test, we found a significant difference in maternal anxiety symptoms from pre (M = 10.12, SD = 3.54) to during the COVID-19 pandemic (M = 11.73, SD = 4.03) (Mean difference = −1.62, SD = 3.85, 95% CI = −1.83 to −1.40, t = −14.68, df = 1231, p < .001).

3.3. Mediation model

The full mediation model with statistically significant associations is presented in Fig. 1. The fit statistics for the model were adequate with RMSEA = 0.07, CFI = 0.97, TLI = 0.89, SRMR = 0.03, which are deemed acceptable. Despite the small effect sizes, the mediation model is presented as the indirect effects were small but statistically significant. This
### Table 2
Descriptive statistics and correlation matrix ($N = 1333$).

|          | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 12    | M     | SD    | Min-Max |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------|
| 1. COVID-Dep | .72** | .57** | .45** | -.16** | -.40** | .80** | .40** | .22** | .15** | -.01  | -.09** | 8.06  | 5.75  | 0-29    |
| 2. COVID-Anx | 1     | .42** | .49** | -.18** | -.35** | .74** | .35** | .22** | .14** | -.01  | -.05  | 11.76 | 4.04  | 6-24    |
| 3. Pre-Dep  | 1     | .61** | .61** | -.13** | -.27** | .48** | .26** | .14** | .09** | -.05  | -.14** | 5.43  | 4.66  | 0-29    |
| 4. Pre-Anx  | 1     | -.10** | -.27** | .41** | -.13** | .13** | -.01  | -.08** | 10.14 | 3.55  | 6-23   |       |       |         |
| 5. Increased activities | 1     | -.24** | -.17** | -.13** | .02  | -.10** | -.03  | .01  | 3.27  | 1.12  | 0-5    |       |       |         |
| 6. Coping   | 1     | -.09** | -.20** | .001  | -.10** | .04  | .03  | 14.90 | 2.62  | 4-20  |       |       |       |         |
| 7. Perceived Stress | 1     | .38** | .24** | .10** | -.04  | -.05  | 16.16 | 6.76  | 0-39  |       |       |       |       |         |
| 8. Strained relationships | 1     | .17** | .11** | .03  | -.01  | .04  | .66  | 0-3  |       |       |       |       |       |         |
| 9. Financial Impact | 1     | .06  | .01  | .27** | 1.69  | 0.91  | 1-4  |       |       |       |       |       |       |         |
| 10. Alcohol Use | 1     | -.05  | .02  | 1.37  | 3.27  | 0-30  |       |       |       |       |       |       |       |         |
| 11. Maternal age | 1     | .12** | 41.56 | 4.35  | 29    |       |       |       |       |       |       |       |       | 54     |
| 12. Income before COVID-19 | 1     |       |       |       |       |       |       |       |       |       |       |       |       | 1-8     |

Note. Pre-Dep: Depressive symptoms prior to the COVID-19 pandemic, Pre-Anx: Anxiety symptoms prior to the COVID-19 pandemic, COVID-Dep: Depressive symptoms during the COVID-19 pandemic, COVID-Anx: Anxiety symptoms during the COVID-19 pandemic. ** $p < .01$.

### Table 3
Completely Standardized Effects for all a and b paths from mediation analyses.

| a paths         | Estimate | 95%CI | $p$ | b paths         | Estimate | 95%CI | $p$ |
|-----------------|----------|-------|-----|-----------------|----------|-------|-----|
| Pre-Dep $\rightarrow$ Activities | -.094 | -.166, -.022 | 0.011 | Activities $\rightarrow$ COVID-Dep | .007 | -.028, 0.040 | 0.684 |
| Pre-Dep $\rightarrow$ Coping | .173 | -.241, -.107 | <.001 | Coping $\rightarrow$ COVID-Dep | -.078 | -.116, -.04 | <.001 |
| Pre-Dep $\rightarrow$ Perceived stress | .358 | .295, .420 | <.001 | Perceived stress $\rightarrow$ COVID-Dep | .611 | .572, .649 | <.001 |
| Pre-Dep $\rightarrow$ Strained relationships | .149 | .074, .23 | <.001 | Strained relationships $\rightarrow$ COVID-Dep | .089 | .048, .132 | <.001 |
| Pre-Dep $\rightarrow$ Financial impact | .104 | .027, .178 | .007 | Financial impact $\rightarrow$ COVID-Dep | .020 | -.015, .054 | .272 |
| Pre-Dep $\rightarrow$ Alcohol use | .031 | -.047, .115 | .448 | Alcohol use $\rightarrow$ COVID-Dep | .057 | .02, .095 | .003 |
| Pre-Anx $\rightarrow$ Activities | -.048 | -.121, .022 | .193 | Activities $\rightarrow$ COVID-Anx | -.032 | -.07, .006 | .093 |
| Pre-Anx $\rightarrow$ Coping | .166 | -.235, -.098 | <.001 | Coping $\rightarrow$ COVID-Anx | -.043 | -.09, .001 | .053 |
| Pre-Anx $\rightarrow$ Perceived stress | .196 | .129, .261 | <.001 | Perceived stress $\rightarrow$ COVID-Anx | .589 | .54, .63 | <.001 |
| Pre-Anx $\rightarrow$ Strained relationships | .170 | .097, .241 | <.001 | Strained relationships $\rightarrow$ COVID-Anx | .056 | .013, .099 | .009 |
| Pre-Anx $\rightarrow$ Financial impact | .065 | -.005, .135 | .069 | Financial impact $\rightarrow$ COVID-Anx | .051 | .012, .090 | .011 |
| Pre-Anx $\rightarrow$ Alcohol use | .124 | .04, .21 | .004 | Alcohol use $\rightarrow$ COVID-Anx | .034 | -.016, .083 | .174 |

Note: Confidence intervals were derived from bootstrapping across 5000 draws. Covariates included in the model were maternal age and income prior to COVID-19. Pre-Dep: Depressive symptoms prior to the COVID-19 pandemic, Pre-Anx: Anxiety symptoms prior to the COVID-19 pandemic, COVID-Dep: Depressive symptoms during the COVID-19 pandemic, COVID-Anx: Anxiety symptoms during the COVID-19 pandemic.
model accounted for 70.1% of the variance in maternal depression at the COVID-19.

For maternal anxiety symptoms pre- and during COVID-19, significant indirect effects were observed for perceived stress ($ab_{cs}=0.012$, 95%CI=0.077, 0.154, $p<0.001$) and strained relationships ($ab_{cs}=0.010$, 95%CI=0.002, 0.019, $p<0.03$), suggesting that the effects of anxiety pre-to during the COVID-19 pandemic operated through perceived stress and strained relationships. The indirect effects were small, albeit statistically significant. This model accounted for 59.2% of the variance in maternal anxiety at the COVID-19.

Lastly, the direct effect of maternal depressive symptoms pre-COVID-19 on depressive symptoms during COVID-19 remained statistically significant, irrespective of the mediators tested ($c'=0.23$, 95% CI=0.19, 0.28). Similarly, the direct effect of maternal anxiety symptoms pre-COVID-19 on anxiety symptoms during COVID-19 remained statistically significant, irrespective of the mediators tested ($c'=0.21$, 95% CI=0.17, 0.25). These findings suggest that the effects of maternal mental health from pre- to during COVID-19 are not fully captured by the mediators included in the current model.

### 4. Discussion

This study found increases in maternal depression and anxiety symptoms from pre- to post-COVID19 and strong positive association between maternal-reported symptoms of depression and anxiety prior to and those experienced during the COVID-19 pandemic. The strength of these associations is consistent with those reported in prior longitudinal research before the COVID-19 pandemic (Paulson et al., 2016). This is not entirely surprising as one of the best predictors of current mental health symptoms is past mental health symptoms (Rudolph et al., 2009). These findings are also consistent with studies from previous natural disasters (e.g., Hurricane Katrina) that show that those who had clinically significant depression and/or anxiety symptoms were most at risk for screening positive for mental illness (Sullivan et al., 2013). Ultimately, our results suggest that consideration of previous mental health history should be considered when assessing or triaging mothers for mental health support.

Consistent with other general population studies (Asmundson et al., 2020a), we also found that mothers who self-reported pre-existing struggles with mental health up to 2-years prior to the COVID-19 pandemic, were more susceptible to the social, financial, and relational stressors and disruptions caused by COVID-19. These stressors were in turn precipitants of increases in mental health symptoms during COVID-19 (Kessler, 1997; Monroe et al., 2019). Individuals with pre-existing anxiety-related and mood disorders have been shown to exhibit higher stress during the COVID-19 pandemic and to generally perceive the consequences of the pandemic, such as financial impacts, as worse compared to individuals without mental health conditions (Asmundson et al., 2020b). Thus, for mothers with pre-existing mental health concerns, elevations in perceived stress and increased financial impact may play an important role in the perpetuation of mental health difficulties during the pandemic.

In the current study we identify three important modifiable factors that partially mediated the association between mental illness symptoms from pre- to during the pandemic: perceived stress, strained relationships, and coping attitudes. That is, individuals who felt the most overwhelmed with the shifts in daily life activities and extra demands that were placed upon them during the COVID-19 pandemic appeared to struggle the most with anxious and depressive symptoms. Experiencing strain in relationships with their spouse, children, and/or friends also partially accounted for the association between depression and anxiety symptoms from pre- to during the pandemic. Mental health difficulties may trigger conflict or strain in interpersonal relationships further perpetuating feelings of frustration, sadness, and/or worry (Russell et al., 2020). Optional relational functioning across the entire family (Prime et al., 2020), especially during COVID-19 when external social supports are limited, are critical for well-being.

Finally, a mediator unique to depressive symptoms, was poor coping behaviors. Those who lacked coping skills (i.e., flexibility and problem solving in the face of stress) had higher depressive symptoms, but not anxiety symptoms. Indeed, evidence-based psychological interventions, such as Cognitive-Behaviour Therapy (CBT) (Sheeber et al., 2012), specifically increase coping strategies and decrease negative thought patterns, which have been shown to decrease maternal depressive symptomatology (Cuijpers et al., 2015).

Maternal mental illness was a glaring public health concern pre-COVID-19, with nearly 50% of children being exposed to maternal mental illness before 16 years of age (Abel et al., 2019). Emerging research suggesting a doubling of maternal mental illness estimates during COVID-19 (Racine et al., 2021), and therefore, a greater likelihood that many more children will be exposed to maternal mental illness. In addition to health consequences for mothers (Witt et al., 2011), maternal mental illness has been associated with decreased cognitive, socio-emotional, and motor outcomes in children (Rogers et al., 2020). Mediation findings from the current study, albeit small in effect, indicate that reducing stress, increasing coping strategies, and increasing relational functioning for mothers are key targets to reduce mental health difficulties. Services and opportunities that decrease stress for mothers are critical components of recovery efforts. For mothers where symptoms of depression and anxiety persist, targeted
interventions, such as Cognitive-Behaviour Therapy (CBT), should be made available. CBT specifically targets stress reducing, improved coping, and problem solving that can improve relational functioning (Amerman et al., 2011). Given that mothers have primarily accessed mental health resources online during the pandemic (Cameron et al., 2020), web-based or app-based psychoeducational materials and treatment (Hermann et al., 2021) should be prioritized.

4.1. Limitations

The women recruited into the All Our Families cohort are generally representative of those living in the city and province from which they were recruited (Tough et al., 2017). Consequently, risk estimates for marginalized populations may be underestimated. A recent study using longitudinal non-response weights in the All Our Families Cohort showed that complete case analysis and a weighted analyses (full sample) produced similar maternal mental health estimates (Racine et al., 2021). Thus, the impact of attrition is hypothesized to be small. Second, given the time sensitivity for gathering data during the COVID-19 pandemic, measurement was single informant and self-report in nature. This means that we cannot preclude single-informant bias in our findings. Third, although the inclusion of pre-pandemic data is a strength of the current study, both mediators and COVID-19 mental health outcomes were collected at the same time point. Thus, we are limited in our ability to make causal inferences related to the timing of variables.

5. Conclusions

Our findings indicate that perceived stress, coping attitudes, and strained interpersonal relationships are three potential intervention targets for mitigating the association between mental health symptoms from pre- to during the COVID-19 pandemic. As mental health services and interventions adapt both during and in the aftermath of the pandemic (Moreno et al., 2020), consideration to evidence-based approaches that address stress reduction, increased perceived coping, and provide strategies for managing in interpersonal relationships both in and outside the home are needed. Ongoing research to examine the trajectory of maternal mental health during the recovery phase of the pandemic will inform long-term implications for maternal and parent mental health.

Contributors

Racine and Madigan contributed to conceptualization, formal analysis, writing-original draft, and writing-review and editing. McDonald and Tough contributed to methodology, investigation, data curation, writing-review and editing, project administration, and funding acquisition.

Data sharing

The All Our Families meta-data are available online https://sagemetadatapolicywise.com/nada/index.php/catalog/1. Investigators can submit a proposal that has been approved by an independent ethics and scientific review committee to obtain de-identified individual participant data. Data requestors will need to sign confidentiality and access agreements. The study protocol for the current study is available upon request to stough@ucalgary.ca. Data are also available from the principal investigator of the All Our Families study, Suzanne Tough, through University of Calgary processes.

Role of the funding source

The funding source had no role in data collection, analysis, interpretation, or the decision to submit for publication.

Declaration of Competing Interest

None to declare.

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