Protocol for the COVID-19 Wellbeing and Stress Study: a longitudinal study of parent distress, biological stress and child biopsychosocial development during the pandemic and beyond

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ABSTRACT

Introduction The COVID-19 pandemic has had a unique impact on the mental health and well-being of pregnant individuals and parents of young children. However, the impact of COVID-19-related stress during pregnancy on early child biopsychosocial development remains unclear. The COVID-19 Wellbeing and Stress Study will: (1) investigate the impact of different forms of prenatal stress experienced during the pandemic (including objective hardship, perceived psychological distress and biological stress) on child stress biology, (2) examine the association between child stress biology and child developmental outcomes, (3) determine whether child stress biology acts as a mechanism linking prenatal stress to adverse child developmental outcomes and (4) assess whether gestational age at the onset of the COVID-19 pandemic or child sex, moderate these associations.

Methods and analyses The COVID-19 Wellbeing and Stress Study is a prospective longitudinal study, consisting of six time points, spanning from pregnancy to 3 years postpartum. The study began in June 2020, consisting of 304 pregnant people from Ontario, Canada. This multimethod study is composed of questionnaires, biological samples, behavioural observations and developmental assessments.

Ethics and dissemination This study was approved by the Hamilton Integrated Research Ethics Board (#11034) and the Mount Saint Vincent University Research Ethics Board (#2020-187, #2021-075, #2022-008). Findings will be disseminated through peer-reviewed presentations and publications, community presentations, and electronic forums (social media, newsletters and website postings).

INTRODUCTION

Since the beginning of the global COVID-19 pandemic, declared on 11 March 2020,1 the lives of millions of individuals have been impacted. Given the imminent risk to public health, governments globally implemented public health measures to mitigate the transmission of SARS-CoV-2, including travel restrictions, physical and social distancing, school and daycare closures, and restricted access to in-person healthcare. In addition to the high rates of morbidity and mortality, the economic and social ramifications of the pandemic led to dramatic changes to daily life. Since 2020, it has become clear that the pandemic has had a heavy burden on the mental health of the global population. Pregnant individuals and parents of young children have uniquely experienced this mental health burden.2,3 The potential adverse effects that prenatal stress can have on fetal development are well documented,4–10 however, the long-standing COVID-19 pandemic represents an unfortunate but rare opportunity to investigate the enduring effects of a chronic stressor on pregnant people and their developing children.

PRENATAL STRESS AND CHILD DEVELOPMENT

The perinatal period is a time of vulnerability for both the mother and fetus. The Developmental Origins of Health and Disease (DOHaD) hypothesis suggests that the prenatal and early postnatal period signifies a time of rapid growth and development,4–10 where stress can impact fetal biomarkers,
including the developing brain, which form the building blocks critical to lifelong health and development.\textsuperscript{7,8,11-13} Prior research indicates that maternal self-reported distress during pregnancy is linked to diverse developmental outcomes (for reviews see, references 14–17) including adverse birth outcomes,\textsuperscript{18-19} infant temperament,\textsuperscript{20} as well as later child developmental outcomes, including delays in language and motor development,\textsuperscript{21,22} academic challenges,\textsuperscript{23} and mental health problems.\textsuperscript{24}

The prenatal stress literature is often limited by the exclusive reliance on (mainly retrospective) self-reports of prenatal stress. Stressful events that impact many individuals, such as natural disasters, epidemics and pandemics, are important for disentangling the components of prenatal stress, that is, determining whether the effect of prenatal stress on child development can be attributed to the mother’s (A) objective exposure to a stressor, (B) subjective experience of distress or (C) biological stress response. Indeed, the natural disaster literature demonstrates that these three components of prenatal stress differentially impact child development.\textsuperscript{25-27} Given the heavy burden that the pandemic has had on the mental health and well-being of pregnant individuals and parents, it is essential to understand the role that COVID-19-related prenatal stress may have in impacting child development, in both the short term and long term, and elucidating the mechanisms responsible for these effects.

The impact of COVID-19 on pregnant people and parents

Pregnant individuals and parents of young children have been strongly affected by the pandemic.\textsuperscript{2,3,5} Pregnant people have endured the additional burden related to perinatal COVID-19 infection, with possible health implications for themselves and their fetus,\textsuperscript{28} as well as uncertainty regarding birthing processes due to hospital restrictions, and limited access to social support, during a time when such support is critical.\textsuperscript{29,30} In addition, reductions in access and increased restrictions to healthcare heavily impacted pregnancy. Results from the current study underscore the nature of healthcare disruptions, such that 23% of the sample had prenatal appointments cancelled, 73% switched to telehealth care and 48% had difficulty accessing prenatal classes or other services during pregnancy,\textsuperscript{31} which is in accordance with a nationwide Canadian sample where 40% experienced cancelled prenatal care appointments.\textsuperscript{32} A scoping review indicated that reductions in prenatal care visits and limits to support people during labour adversely affected maternal mental health and well-being.\textsuperscript{33} In addition, parents, particularly those caring for infants and young children, were more likely to experience heightened stress due to increased caregiving demands, isolation from extended family and community supports, elevations in relationship conflict and financial hardship.\textsuperscript{34,35}

The stressful burden of the COVID-19 pandemic on perinatal women is evinced by elevations in mental health problems worldwide, with prevalence rates of psychological distress reaching 70%, depression between 25%-31% and anxiety 34%-42%, all rates exorbitantly higher than those measured prepandemic.\textsuperscript{2-5} During the initial months of the pandemic, a Canada-wide study showed that 37% experienced clinically elevated symptoms of depression and 57% endorsed clinically significant anxiety.\textsuperscript{36} It is essential to uncover how elevated perinatal distress is associated with child outcomes.

COVID-19 and infant and early child outcomes

Research has begun to explore the effects of COVID-19-related prenatal stress on infant and early childhood outcomes, however, to date, longitudinal data are limited. In a longitudinal study of American women, prenatal distress was associated with higher risk for preterm birth.\textsuperscript{37} Similarly, in a Canadian sample, fear of COVID-19 during pregnancy was associated with greater risk for lower gestational age at birth and lower infant birth weight.\textsuperscript{38} Additional research is beginning to demonstrate the impact of COVID-19 prenatal stress on later infant development. For example, higher levels of postnatal stress during the pandemic were indirectly associated with infant regulatory capacity at age 3 months through higher parenting stress and mother–infant bonding, however, prenatal stress was retrospectively reported at birth in this study.\textsuperscript{39} In addition, higher pregnancy distress was associated with greater infant socio-emotional problems through continued experience of stress in the postpartum period.\textsuperscript{40} Similarly, in a longitudinal sample, complex interactions between trait level anxiety and COVID-19 related fear during pregnancy were related to infant language and motor development at 12 months.\textsuperscript{41} In contrast, another longitudinal study found that prenatal COVID-19-related stress and hair cortisol during the COVID-19 lockdown were not significantly associated with infant temperament at 6 months.\textsuperscript{42} Additional longitudinal research is needed to understand how prenatal stress related to COVID-19 is associated with diverse developmental outcomes across the first years of life.

In addition to COVID-19-related stress during pregnancy, caregivers are also experiencing elevated distress and mental health problems.\textsuperscript{2,43-45} Like the prenatal environment, the postnatal caregiving environment is critical to child development, such that caregiver postpartum distress,\textsuperscript{15-17,39} mental health,\textsuperscript{17,46,47} as well as caregiving behaviour,\textsuperscript{48-50} contribute to child psychosocial outcomes. It is possible that the effects of prenatal stress may be mitigated or exacerbated by the postnatal environment. Although prior research well documents the adverse parent and child outcomes associated with natural disasters and epidemics, the longer-term effects of a chronic stressor with the widespread scope as the COVID-19 pandemic, remains unclear.

How prenatal stress alters development: fetal programming of biological stress markers

In addition, it is critical to understand the mechanisms responsible for how prenatal stress impacts child development. The fetal programming hypothesis suggests that
excessive exposure to stress during pregnancy alters the structure and function of fetal stress biology which can, in turn, impact different facets of later development.51–53 There are several biological stress systems that begin developing during the prenatal period. First, the primary stress system in humans, the hypothalamic–pituitary–adrenal (HPA) axis, is highly vulnerable to the effects of prenatal stress.54–56 Exposure to stress during pregnancy is strongly associated with altered child acute and chronic HPA activity, indexed by salivary and hair cortisol levels, respectively.57–59 A handful of studies have examined the HPA activity, indexed by salivary and hair cortisol levels, is strongly associated with altered child acute and chronic cell death.65 Telomere biology is, in part, shaped by the stress system in humans, the hypothalamic–pituitary–adrenal system, which can have subsequent impact on child health and development.

Child sex and gestational age
It is also important to assess timing of stress exposure during gestation and fetal sex as they may contribute to differing child outcomes. Prenatal stress impacts offspring biological stress and psychosocial outcomes differentially depending on the timing of prenatal stress exposure,72–75 likely related to sensitive periods of development for specific child outcomes. For example, prenatal stress experienced in early pregnancy, related to natural disasters (storms, floods), has more pronounced effects on child cognitive and language outcomes.26 76 77 In contrast, other research has found that stress exposure during the third trimester was more strongly linked to neurodevelopmental disorders.78 However, prenatal stress exposure early and late in pregnancy has a greater impact on child HPA activity79 80 and telomere shortening,69 70 compared with mid-pregnancy stress. In addition, there are sex differences related to the effects of prenatal stress, however, these findings are heterogeneous. For example, prenatal stress has been associated with lower infant birth weight, smaller head circumference and shortened gestational age in male but not female infants.81 82 In contrast, other studies have found stronger associations between prenatal stress and adverse birth outcomes83 and HPA axis functioning80 84 in females compared with males. Taken together, it is important to include timing of exposure to prenatal stress as well as sex when understanding the effects of the pandemic on child outcomes.

Study purpose
The overarching goal of the COVID-19 Wellbeing and Stress Study is to prospectively examine the impact of prenatal stress during the COVID-19 pandemic on early child biological stress markers and developmental outcomes. Study findings will continue to uncover the biopsychosocial consequences of the pandemic for both maternal and child health and will further inform prevention and intervention strategies.

Primary aims and hypotheses
This study has four primary aims (figure 1). First, we aim to examine the impact of prenatal stress, including objective hardship, perceived psychological distress and biological stress on child stress biology. Second, we will assess the association between child stress biology and child developmental outcomes. We hypothesise that prenatal stress is associated with indices of elevated child biological stress (accelerated telomere shortening and altered cortisol levels) and that these child stress profiles are associated with more adverse developmental outcomes. Third, we aim to examine whether child stress biology acts as a mechanism linking prenatal stress to adverse child developmental outcomes. We hypothesise that, over time, child stress biology plays a mechanistic role,
accounting for the indirect association between prenatal stress and child developmental outcomes, consistent with the biological programming and the DOHaD hypotheses. Fourth, we will assess whether gestational age (4a) and child sex (4b), moderate the aforementioned associations. Given inconsistencies in the literature, we do not hypothesise the direction of moderating effects for gestational age or child sex.

Secondary aims
This study also aims to understand how psychosocial factors are associated with perinatal stress, child stress biology and developmental outcomes. We will explore whether psychosocial factors moderate the impact of prenatal stress on child outcomes. We will examine psychosocial factors related to coping (coping, emotion regulation) as well as historical adversity in interpersonal relationships (ie, adverse childhood experiences) and current quality of interpersonal relationships (eg, social support, marital conflict, family functioning).

Lastly, this study aims to assess the influence of the postnatal environment on child outcomes. We are interested in examining the role of parenting practices, parenting behaviour and parent distress in the postpartum period, in relation to child outcomes. We will also examine the potential role of these postnatal environmental factors as moderators of the link between prenatal stress and child outcomes.

METHODS
Study design
This is a prospective longitudinal study (figure 2). A total of 304 pregnant people were recruited in Ontario, Canada between June and July 2020 (T1). This study consists of six time points: T1 (pregnancy, n=304), T2 (6 weeks postpartum, n=265), T3 (6 months postpartum, n=180), T4 (15 months postpartum, n=190), T5 (25 months postpartum, n=to be determined (TBD)) and T6 (35 months postpartum, n=TBD). This multimethod study is composed of (1) questionnaires, (2) biological samples, (3) behavioural observations and (4) developmental assessments. Across all time points, participants will complete online questionnaires to assess objective and subjective distress, interpersonal relationships, and child development. Mothers will provide hair samples to assess HPA activity at all time points, child hair samples will be collected from T4 to T6, and mother and child saliva will be collected from T4 to T6 to assess telomere attrition. Self-reported birth outcomes will be assessed at 6 weeks postpartum (T2). Lastly, parent–child interactions will be assessed via virtual (or home, T5–T6) videotaped interactions from 6 to 35 months postpartum (T3–T6).

Participant recruitment and eligibility
Participants include individuals living in Ontario, Canada, who were pregnant during the COVID-19 pandemic. Participants were recruited through social media (Facebook and Instagram) advertisements, pamphlets distributed to midwifery groups and word of mouth. As such, this work is based on an opportunistic sample and may not be representative of the diverse population in Ontario,
Canada. Inclusion criteria were that participants must (1) live in Ontario, Canada, (2) read and write in English, (3) be 18 years of age or older and (4) be ≤36 weeks gestation at the time of recruitment. Recruitment of pregnant individuals began in June 2020 and completed at the end of July 2020. Participants receive an Amazon gift card for completion of each study assessment.

Sample description
In total, 304 individuals completed the T1 surveys during pregnancy. At T1, online surveys were completed between June and August 2020. Thus far, participants have completed four waves of data collection (T1: pregnancy, n=304; T2: 6 weeks postpartum, n=265; T3: 6 months postpartum, n=180; T4: 15 months postpartum, n=190). In addition, T5 (25 months postpartum) data collection is currently ongoing and T6 (35 months postpartum) data collection will commence in summer 2023. A total of six participants withdrew after T1 (four due to miscarriage, two for undisclosed reasons), the remaining eligible participants who did not complete subsequent assessments did not respond to follow-up survey requests. T1 surveys were completed between June and August 2020, T2 surveys were completed between July 2020 and May 2021, T3 surveys were completed between February 2021 and October 2021, and T4 surveys were completed between October 2021 and June 2022. For context, a state of emergency was declared by the provincial government of Ontario three times between 17 March 2020 and 7 April 2021, which included over 300 days of lockdown.

At the onset of the study, participants were between 4 and 26 weeks gestation (M=21.44, SD=8.93 weeks), with 45.1% (n=137) of participants in the first trimester, 24.3% (n=74) in the second trimester, and 30.6% (n=93) in the third trimester of pregnancy. In total, 52.6% of the sample were primiparous at T1. Participants ranged from 19 to 44 years old (M=32.09, SD=4.27 years). A large portion of the sample identified as white (84.9%), married or in a common-law relationship (94.4%) and completed beyond high school education (96.1%). Participants reported a median annual household income range of $C110 000–$C149 999. Compared with national statistics (Statistics Canada, 2016, 2021), the current sample reports higher income and education, and is racially more homogeneous, likely due to sample recruitment methods. Of note, this sample is demographically similar to that of a Canada-wide COVID pregnancy sample.

Patient and public involvement
Research questions and measures were informed by past research and consideration of participant needs. Participants were not involved in study development or recruitment. Study findings will be disseminated to participants through newsletters, social media and website postings.

Study measures
Table 1 provides a full list of measures and the corresponding administration time point.

Questionnaires
Questionnaires are administered at each time point. Sociodemographic, pregnancy-related information and delivery/labour experiences were captured during pregnancy and post-delivery. Objective stress related to COVID-19 focused on the impact of COVID-19 on health (including infection), finances, social connections and relationships, and child adjustment. Subjective distress included anxiety, depression, stress and substance use. Coping and the quality of interpersonal relationships, including parenting, were also assessed. We also assessed sleep and physical activity. Measures are listed in table 1 and a complete list of questionnaires, along with brief descriptions, is included in online supplemental table S1.

Biological samples
Hair cortisol
Prenatal exposure to biological stress was assessed using hair cortisol samples collected during pregnancy and 6 weeks postpartum. Maternal and child hair cortisol was also sampled at 6 months, 15 months, 25 months and 35 months postpartum to capture parent and child biological stress in the postpartum period. Hair cortisol is a valid biomarker for chronic HPA activity,43–48 is a reliable index of stress during pregnancy,49–51 infancy and early childhood,52–54 and is linked to early risk and child psychosocial outcomes.49,55–57 Given the chronic nature of the COVID-19 pandemic, it is essential to use a biomarker that effectively measures long-term levels of cortisol. Mothers and children will provide hair samples (3 mm diameter, ~50 strands) that will be cut into 3 cm segments to reflect cortisol production in the prior 3 months.98 Cortisol will be assayed in duplicate using Cortisol ELISA Kits from Salimetrics

Salivary telomeres
The rate of telomere shortening during early childhood will be assessed as a biomarker of stress, as well as an important marker for later health. Given the link between parent and child telomere length,99 both mother and child saliva will be sampled and assayed for telomere length (and attrition) at 15 months, 25 months and 35 months postpartum (T4–T6). Telomeres will be measured using swabs to absorb saliva, collected from participant’s cheeks. Given normative telomere attrition early in life,67,68 we will examine the rate of telomere shortening. DNA will be collected using Oragene kits and buccal cell telomere length will be determined by using a qPCR relative telomere length assay.100–108 We will use DNA extracted from Human TR146 cells, a model of human buccal cells (Millipore-Sigma, Oakville ON), as an internal quality control.

Child development outcomes
Child social-emotional, cognitive and language development will be assessed at 6 months, 15 months, 25 months and 35 months postpartum (T3–T6) via questionnaires...
### Table 1: Study measures

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<th>Time points</th>
<th>T2 6 weeks postpartum</th>
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* Measure created for this study.  ** Measure only administered for subset of home visits.
and behavioural observation (for those who complete home visits, T5–T6).

**Child development questionnaires**

Child development will be measured at 6 months, 15 months, 25 months and 35 months postpartum using the gold-standard, norm-referenced and parent-reported Ages and Stages Questionnaire-3 (ASQ-3). The ASQ-3 developmental screener captures child development in areas of language/communication, gross and fine motor, problem solving, and personal social. The ASQ-3 is a valid tool for capturing dimensional variations in development and is highly sensitive for detecting infants with developmental delays. Language development will also be measured using the MacArthur-Bates Communicative Developmental Inventory Third Edition at 15 months, 25 months and 35 months postpartum and the Preschool Language Scale-5 at 25 months and 35 months postpartum for those completing in-person home assessments. In addition, child social-emotional functioning will be assessed using the Brief Infant Toddler Social Emotional Assessment Scale, which is a standardised assessment of socioemotional problems and competencies in children ages 12–35 months.

**Behavioural observation of child development**

Home visit assessments at 25 months and 35 months postpartum will include additional behaviour tasks designed to observe child development (see table 1). These tasks include the Imitation Sorting Task, designed to assess early cognitive and executive functioning, the Toy Frustration Task, designed to elicit frustration and emotion regulation strategies, and the Delay of Gratification task, designed to assess ability to forego a smaller, immediate reward in favour of a future, larger reward. Child affect and behaviour will be coded from these observation tasks.

**Behavioural observation of parent–child interaction**

At 6 months, 15 months, 25 months and 35 months postpartum, behavioural observation will occur at participants’ homes either via virtual (Zoom) or in-person observation. Parents and children will be observed during a 12 min free-play interaction, consisting of 5 min of playing with toys, 5 min playing without toys and 2 min of a divided attention task. Parental sensitivity to the child will be coded using the 25-item short Maternal Behaviour Q-Set (MBQS-25). The MBQS-25 is highly reliable and is related to markers of perinatal stress, early child cognitive development and social-emotional functioning.

**Data management**

Questionnaire data will be collected and managed using Qualtrics, a secure web-based application to enable data collection for research studies. Qualtrics software stores data on a secure sever housed in Canada. Personal identifiable data (eg, name, email address, DOB) will be stored separate from deidentified (questionnaire response) data and once downloaded will be stored in password encrypted electronic databases separate from other research data.

**Data analysis plan**

First, data visualisation and normality tests will be conducted to determine whether variables need to be transformed prior to analyses. A combination of regression-based analyses and longitudinal structural equation modelling (SEM) will be used to examine study hypotheses. Prior to the main analyses, potential covariates will be explored using bivariate correlations. For example, sociodemographic variables, pregnancy-related variables (eg, pregnancy health, access to prenatal care), infant birth-related variables and COVID-19-related variables (eg, time since initial lockdown at T1), will be explored as potential covariates. Regression analyses will be used to assess the associations between prenatal stress and child stress biology (Aim 1) and child stress biology and developmental outcomes (Aim 2). SEM will be used to assess longitudinal mediation models (Aim 3) and moderation effects of sex and gestational age (Aim 4a and 4b). Gestational age will be assessed as a continuous moderator and sex will be assessed using subgroup analyses. Separate models will be conducted to test each potential moderator. Prior to SEM, factor analysis will be used to derive latent factors for pregnancy stress (perceived distress, objective stress and biological stress), child stress biology (hair cortisol, telomere length), and child development (social-emotional, cognitive, language). Should these indicators not load onto the expected latent factors, the number and composition of latent factors will be adjusted, or variables will be treated as manifest variables.

**Participant attrition**

Attrition can be difficult to avoid when conducting longitudinal studies, and attrition has been particularly prevalent for studies conducted during the COVID-19 pandemic. To address potential biases that might influence participant attrition, prior to conducting main analyses, we will compare participants who completed follow-up surveys with participants who did not, based on sociodemographic information and primary variables of interest. Any variables that are associated with attrition will be included in regression and SEM models as covariates or auxiliary variables. In addition, models will be conducted using full information maximum likelihood estimation with robust or bootstrapped standard errors to account for missing data.

**Power analysis**

Power analyses for the most complex SEM model were assessed using the RMSEA method, a widely accepted method to determine SEMs power requirements. Using conservative RMSEA H<sub>0</sub>=0.05, RMSEA H<sub>1</sub>=0.01, with 160 degrees of freedom (based on the number of model parameters minus the number of free parameters), and power=0.80, we require a minimum sample size of 136.


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Open access

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Ethics and dissemination
This study was initially approved by the Hamilton Integrated Research Ethics Board under Project #11034, on 3 June 2020. It has also been approved by the Mount Saint Vincent University Research Ethics Board under Project #2020-187, #2021-075 and #2022-008. At each new study assessment, caregivers provide consent for their continued participation and are informed of their right to stop participation, or not participate in any aspect of the study, at any time. Participants are required to sign the electronic informed consent form prior to providing data.

Deidentification and data storage plans comply with the Tri-Council Policy Statement-2. All questionnaire data collected are deidentified, labelled only with the data collection date and unique participant ID. Identifiable data are stored separately and is password protected. Videos are stored on secure/encrypted drives on password-protected computers within locked laboratories. Biological samples are labelled with unique participant ID and stored in locked cabinets and freezers within locked laboratories.

Study findings will be disseminated in several ways, including peer-reviewed journal articles; presentations at researcher conferences; presentations to members of the community, policy partners and practitioners; and updates to study participants through electronic newsletters and website postings.

As of January 2023, data collection is complete up to 15 months postpartum (T4) and 25 months postpartum data collection is underway. Initial findings related exclusively to questionnaire data have been published.28 31

DISCUSSION
Extensive evidence indicates that pregnancy and the early postpartum are critical periods which set the stage for later health and development. Initial pandemic research shows that pregnant people and parents are experiencing heightened levels of distress, and that this distress is, in turn, associated with adverse birth and early developmental outcomes.2–5 37–40 Related literature demonstrates that the COVID-19 pandemic has had a significant impact on child and adolescent mental health and learning outcomes. However, very little is known about the long-term impact of COVID-19 on infants and toddlers and what mechanisms are responsible for these effects. This longitudinal study will elucidate how prenatal stress during the pandemic is associated with biological stress and developmental outcomes in the first 3 years of life. Furthermore, we will identify risk and resilience factors that amplify or ameliorate these associations. This research will address public health priorities by understanding how the pandemic is impacting early childhood biopsychosocial development and how to foster child health and well-being.

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## Supplementary Table 1

### Description of Study Questionnaires

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
<th>Scale</th>
<th>Example item</th>
<th>Psychometric properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-delivery questionnaire (birth outcomes) *</td>
<td>Collects details of birth and birth outcomes</td>
<td></td>
<td>“What was the method of delivery”</td>
<td>n/a</td>
</tr>
<tr>
<td>Breastfeeding questionnaire*</td>
<td>Collects details about breastfeeding and other feeding experiences</td>
<td></td>
<td>“Did you breastfeed or try to breastfeed, even if only for a short time?”</td>
<td>n/a</td>
</tr>
</tbody>
</table>
| COVID-19 Experiences Questionnaire*   | Assesses the impact of COVID-19 on participants/their family; financial assistance (i.e., CERB) and vaccine status | Check all that apply of list of experiences; ratings on 7-point scale ranging from “A lot” to “Not at all”; yes/no | “Unable to pay for rent or mortgage”; “I follow social media coverage on COVID-19” | Financial subscale: $r_{inter-item} = .44$
Isolation subscale: $r_{inter-item} = .22$ |
<p>| The COVID Stress Scales              | Assesses feelings of stress associated with COVID-19                         | Responses are rated on a 5-point scale, ranging from “Extremely” to “Not at all” | “I am worried about catching the virus”                                     | $\alpha=.95$ (at T3)    |
| Center for Epidemiological Studies Depression (CES-D) short form | Self-report depression scale                                                 | Responses are rated on a 4-point scale, ranging from “Rarely or never (less than 1/day) to “All of the time (5-7 times) | “How often did you feel depressed”                                          | $\alpha=.87$            |
| Edinburgh Postnatal Depression Scale (EPDS) | Screening for postnatal depression, items correspond to symptoms (guilt feeling, sleep disturbance, low energy, anhedonia, and suicidal ideation) | Responses are rated on a varying 4-point scale, e.g., “Yes most of the time” to “Never”; “As much as I ever did” to “Hardly at all” | “I have been able to laugh and see the funny side of things”               | $\alpha=.87$ (at T3)    |</p>
<table>
<thead>
<tr>
<th>Scale Name</th>
<th>Description</th>
<th>Response Rating</th>
<th>Example Question</th>
<th>Reliability (α)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambridge Worry Scale</td>
<td>Assesses worries or concerns during pregnancy, association with COVID-19</td>
<td>Responses are rated on a 6-point scale, ranging from “Major worry” to “Not a worry”, yes/no if associated with COVID-19</td>
<td>“Your housing”</td>
<td>α=.88</td>
</tr>
<tr>
<td>Generalized Anxiety Disorder Questionnaire (GAD)</td>
<td>Assesses worry and anxiety symptoms</td>
<td>Responses are rated on a 4-point scale, ranging from “Not at all” to “Nearly every day”</td>
<td>“Feeling nervous anxious or on edge”</td>
<td>α=.90</td>
</tr>
<tr>
<td>Perceived Stress Scale (PSS)</td>
<td>Assesses stress levels</td>
<td>Responses are rated on a 5-point scale, ranging from “Never” to “Very often”.</td>
<td>“In the last month, how often have you felt nervous or stressed?”</td>
<td>α=.90</td>
</tr>
<tr>
<td>AUDIT-C Questionnaire</td>
<td>Alcohol screening test, can identify hazardous drinking behaviour</td>
<td>Responses are rated on varying 5-point scale, e.g., “Never” to “4 or more times per week”; “Never” to “Daily or almost daily”</td>
<td>“How often do you have a drink containing alcohol”</td>
<td>α=.70</td>
</tr>
</tbody>
</table>
| Brief COPE                                      | Assesses ways of coping with stressful events or experiences                | Responses are rated on a 4-point scale, ranging from “I haven’t been doing this at all” to “I’ve been doing this a lot” | “I’ve been turning to work or other activities to take my mind off things” | Whole scale: α=.80  
Dysfunctional coping:  
α=.70  
Problem-focused coping:  
α=.76  
Emotion-focused coping:  
α=.76 |
| Difficulties in Emotion Regulation Questionnaires (DERs) | Assesses emotion regulation                                                 | Responses are rated on a 5-point scale, ranging from “Almost never” to “Almost always” | “When I’m upset, I feel like I’m weak”        | α=.95           |
| Difficulties in Emotion Regulation Questionnaires (DERs) Short Form | 18-item short form of DERS                                                  | Responses are rated on 5-point scale, ranging from “Almost never” to “Almost always” | “When I’m upset, I become out of control”     | α=.89 (at T3)   |
| Multidimensional Scale of Perceived Social Support (MSPSS) | Assesses perceived adequacy of social support from three sources: family, friends, & significant other | Responses are rated on 7-point scale, ranging from “Very strongly disagree” to “Very strongly agree” | “My family really tries to help me”           | α=.95           |
| Supplemental material | BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s) | BMJ Open | doi: 10.1136/bmjopen-2023-071926 | 13 | 2023; BMJ Open, et al. Khoury JE | BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance
Supplemental material which has been supplied by the author(s) BMJ Open

<p>| <strong>Martial Conflict Questionnaire</strong> | Assesses conflict between spouses/partners | Responses are rated on a 4-point scale, ranging from “Not at all” to “A lot” | “I was angry at my partner/spouse” | α=.93 |
| <strong>Parenting Behaviour</strong> | Positive/negative feelings associated with parenting | Responses are rated on a 5-point scale, ranging from “Never” to “Almost always” | “How often do you get angry with your child” | n/a |
| <strong>Circle Questionnaire</strong> | Assesses relationship closeness (partner &amp; child) | Select from series of overlapping circles representing degree of closeness | n/a |
| <strong>Adverse Childhood Experiences Scale (ACEs)</strong> | Assesses adverse experiences that occurred during childhood | Yes/no response to items | “Were your parents ever separated or divorced?” | α=.74 |
| <strong>Insomnia Severity Index (ISI)</strong> | Assesses nature, severity and impact of insomnia | Responses are rated on a varying 5-point scale, e.g., “No problem” to “Very severe problem”; “Not at all” to “Very much” | “How worried/distressed are you about your current sleep problems?” | α=.88 |
| <strong>Pittsburgh Sleep Quality Index (PSQI)^</strong> | Assesses sleeping habits | Responses are fill in the blank (text) or rated on 4-point scale ranging from “Not during the past month” to “Three or more times a week” | “Cannot get to sleep within 30 minutes” | n/a |
| *<em>Frequency &amp; Extent of Physical Activity</em> | Collects information about exercise and physical activity | Responses are rated on a varying 5-point scale, e.g., “None” to “Very often” | “Mark how often you did physical activity (for example, playing sports, exercise classes, strenuous occupational activity).” | n/a |
| <strong>Ages and Stages Questionnaire (ASQ)</strong> | Assesses child’s ability in 5 developmental areas – Communication, Fine Motor | Responses are “Yes”, “Sometimes” or “Not yet” | “Does your child run fairly well, stopping herself” | Communication: α=.64 (at T4) |</p>
<table>
<thead>
<tr>
<th>Scale/Material</th>
<th>Description</th>
<th>Example/Notes</th>
<th>Alpha/Time Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Motor, Problem-solving and personal-social</td>
<td></td>
<td>“without bumping into things or falling?”</td>
<td>α=.84 (at T4)</td>
</tr>
<tr>
<td>Brief Infant Toddler Social Emotional Assessment Scale (BITSEA)</td>
<td>Screens for social-emotional and/or behavioural problems/delays in toddlers</td>
<td>Responses rated on 3-point scale, ranging from “Not true/rarely” to “Very true/often”</td>
<td>α=.70 (at T4)</td>
</tr>
<tr>
<td>MacArthur Bates Communicative Development Inventories (CDI)</td>
<td>Assesses early language development in children</td>
<td>Parent indicates if child can say words from a list of 100 items.</td>
<td>α=.65 (at T4)</td>
</tr>
</tbody>
</table>

Note: Cronbach’s alpha provided for measures at T1, unless a different time point is indicated (because measure not administered at T1); n/a = Cronbach’s alpha not available due to scale structure or because scale has not yet been administered; ^ only first three items of PSQI administered.