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**Effects of Child Sleep, Maternal Sleep, and Covid-19 Related Stressors on Maternal Stress**

**A Thesis Presented**

**by**

**Jocelyn Chang**

**To the Keck Science Department**

**of**

**Claremont McKenna, Scripps, and Pitzer Colleges**

**In Partial Fulfillment of**

**The Degree of Bachelor of Arts**

**Senior Thesis in Biology & Psychology**

**December 12, 2022**

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## Abstract

Research has shown that poorer sleep quality can lead to increased stress and worse psychological functioning. In the parent-child dyad, sleep disturbances of both the child and parent can significantly affect parental functioning. However, in the context of parent-child relations, the contributions of maternal and child sleep to maternal outcomes are much less understood, especially in the context of a worldwide pandemic and global stressor such as COVID-19. Moreover, relations between stress and biological indicators have not been extensively studied, with most studies using self-reported measures of stress. This study aims to extend the findings of previous research by including self-report, as well as a physiological indicator of cumulative stress, hair cortisol, to examine the relationship between sleep and stress. Using longitudinal data from a study on family dynamics as well as their physiological and social-emotional development during the COVID-19 pandemic, the association between mothers' and child's sleep quality and their hair cortisol levels were examined. Participants were 117 mothers. Sleep quality of the mother and child was measured by using the Pittsburgh Sleep Quality Index and the PROMIS Sleep Impairment and Disturbance, respectively. Regression analyses demonstrated that after controlling for initial levels of cortisol, child sleep disturbance, but not maternal sleep problems predicted maternal hair cortisol at Time 2. The findings show that it is child sleep quality, not mothers' own sleep quality that is a predictor of maternal stress, indexed through hair cortisol. Specifically, child sleep impairment at Time 1 during the initial stages of a global pandemic predicted maternal cumulative stress later in the pandemic at Time 2. These results suggest that improving child sleep quality can decrease maternal chronic stress.

## **Effects of Child Sleep, Maternal Sleep, and Covid-19 Related Stressors on Maternal Stress**

The COVID-19 pandemic as a stressor has increased the prevalence of sleep disturbances in the general public (see Lin et al., 2021 for review). The increase in sleep disturbances in adults has been reported to be due to their mental health such as fear, anxiety, and stress that pertained to COVID-19 (Shillington et al., 2022). Mothers in particular have been disproportionately affected by COVID-19. A review looking at the domestic responsibilities difference between fathers and mothers found that mothers reported feeling overworked and overburdened due to the household responsibilities in addition to caretaking duties, especially as they were not able to hire help during COVID-19. Specifically, mothers noted the difficulty of managing these responsibilities in light of their child's altered school schedule. In contrast, fathers reported positive outcomes due to the pandemic, often stating that it helped increase the amount of quality time spent with their children (Borah Hazarika & Das, 2021). Such stark differences only highlight the exponential increase in stress levels that mothers in particular faced since the start of COVID-19. Increased stress can have many negative health outcomes. One important mechanism by which stress may affect health through sleep. The present study intends to explore the relationship between sleep and maternal stress, as indexed by hair cortisol, during the COVID-19 pandemic.

### **Stress and the Hypothalamic-Pituitary-Adrenal Axis**

Sleep quality has been shown across a variety of studies to be associated with stress levels. Psychologically, stressful life events, defined as undesired and unscheduled event(s) that trigger the onset of major life changes, have been found to disrupt and decrease the quality of life through neurological changes that impact mental health. In the same way, even smaller daily life stressors known as daily hassles, are associated with psychological symptoms (Lu, 1991).

Stressors, therefore, are commonly associated with disorders such as anxiety and depression. Such links are due to hormonal imbalances and dysregulation that are affected by the release of a stress hormone, cortisol (Bassett et al., 2015). Given that the COVID-19 pandemic is a major life stressor, it provides the optimal situation to study mothers' stress levels.

Under stress, cortisol is released through activation of the hypothalamic-pituitary-adrenal (HPA) axis. The HPA axis is part of the body's stress response system, which includes both the HPA axis and the sympathetic nervous system (SNS). The SNS is responsible for the "flight or fight" response that causes events to eventually stimulate the adrenal medulla and trigger the release of catecholamines such as epinephrine, also known as adrenaline. At the same time, the HPA axis is a neuroendocrine system that mediates the effects of stress through the regulation of physiological processes and includes different endocrine pathways involving the hypothalamus, anterior pituitary gland, and adrenal gland (Sheng et al., 2021). Regulation of these processes happens through negative feedback loops. Upon the presence of stress, the hypothalamus secretes the corticotropin-releasing factor (CRF) hormone. CRF then binds to its G-protein-coupled receptors, which are known as type-1 and type-2 CRF receptors (Slater et al., 2016). The binding of CRF to its receptors stimulates the release of Adrenocorticotrophic hormone (ACTH) from the posterior pituitary. ACTH is a polypeptide that triggers the production of the hormone cortisol in the adrenal cortex and stimulates the release of cortisol into the bloodstream via the binding to ACTH receptors embedded in the membrane of the cells (Dedovic et al., 2009). Cortisol, the last hormone released in the HPA axis, is a glucocorticoid that is synthesized from cholesterol (Lee et al., 2015). Cortisol production is regulated through a negative feedback loop. ACTH is responsible for decreasing the low-density lipoprotein receptors, which transport low-density lipoproteins into the cell to be broken down for the

release of cholesterol (Millar et al., 2005). Additionally, ACTH also increases the activity of cholesterol amylase when too much cortisol is present in the bloodstream. Cholesterol amylase regulates the rate-limiting step of cortisol synthesis by converting cholesterol to pregnenolone, a major inhibitor of cortisol production (Thau et al., 2022). Cortisol, through intracellular glucocorticoid receptors known as GRs, is able to shunt body processes towards functioning on immediate survival and homeostasis. In addition to ACTH, cortisol also has the ability to regulate itself through a negative feedback loop in the Central Nervous System (CNS) by binding to different receptors across the limbic system (Dedovic et al., 2009). Because the majority of the cells in the body have cortisol receptors, both acute and chronic cortisol present in the body due to stress can affect the metabolic, cardiovascular, and central nervous systems. Long-term cortisol release causes continual exposure of tissues to the hormone that leads to HPA axis dysregulation. This results in potential immunosuppression and/or neuron damage (Gulliams and Edwards, 2010). Because of these negative effects on the body, chronic stress has harmful impacts on aging, chronic diseases, poor quality of life, and mental well-being.

There are many ways to measure cortisol levels, such as through saliva, urine, and hair samples. Cortisol found in saliva and urine is representative of a short time frame of at most a few days. In addition to only measuring acute stress, salivary cortisol can vary in amount depending on the time of day it is collected, with a 20%-30% increase in cortisol levels during the first 30-45 minutes of awakening. Such fluctuations and therefore the lack of consistency make salivary cortisol not a very reliable objective measure of stress. Similarly, urine samples used to measure cortisol levels can also include many confounding variables. For older adults, decreased urinary output commonly due to chronic renal failure can lead to inaccurate readings of cortisol levels. In contrast, hair cortisol measures cumulative stress over multiple months and

is a reliable source of cortisol assessment as cortisol is present in the core of the hair and is less likely to be affected by confounding variables. One cm typically equates to around one month of HPA axis activity when starting from the scalp (Wright et al., 2015). Therefore hair cortisol is commonly used as an accurate measurement of objective chronic stress (Liu & Doan, 2019). Using a measure that reflects continual stress allows researchers to obtain and analyze a more holistic and accurate overview of the participant's experienced stress.

Cortisol levels are affected by the presence of threats or perceived threats. In recent years, COVID-19 (coronavirus disease 2019) has posed a significant threat to many individuals. One cross-sectional study using online surveys found an individual's perceived susceptibility and severity of COVID-19 to be significantly associated with higher ratings of the stress response (Pourhaji et al., 2022). This suggests that when an individual perceives COVID-19 as a greater threat, they will have higher levels of cortisol. Using objective measures of stress, similar results were observed when assessing the relationship between the severity of COVID-19 infection. Amiri-Dashatan et al. found that when looking at different case reports in a meta-analysis, patients with more severe COVID-19 demonstrated higher serum cortisol levels (Amiri-Dashatan et al., 2022). Other studies highlight major stressors that have come with the COVID-19 pandemic such as job loss or increased job pressure, the death of a loved one, and financial stress, all of which have increased stress levels.

When the mandatory stay-at-home orders were put in place by various countries in response to the rising incidence of COVID-19, family structures and routines were heavily disrupted and even halted. Parents, especially, were significantly impacted. Following the shutdown of schools, parents were forced to take on multiple roles including supporting the family emotionally and financially while taking care of their child or children, helping provide



an education for them, and preventing disease transmission in their homes (Liu & Doan, 2019). Many of times, the caretaking role would fall on the mother rather than the father figure. Mothers with a greater perception of domestic responsibilities and a stronger belief that mothers are innately better caretakers than fathers showed lower well-being during COVID-19 (Thorsteinsen et al., 2022). More generally, COVID-19-related stress as well as family conflict have been shown to be associated specifically with maternal mental health (Guo et al., 2021). These associations point to the impact of COVID-19 on maternal health and are reflective of the increased challenges that mothers faced during the pandemic. Thus, for this current study, it is hypothesized that COVID-related stress will increase maternal stress, as indexed by hair cortisol.

### **The Importance of Sleep**

Another type of stressor this paper will examine is the quality of sleep. Sleep can be defined by five dimensions: sleep duration, sleep efficiency, timing, alertness, and sleep quality, with each associated with health outcomes (Buysse et al., 1989). Sleep duration refers to the length of sleep in 24 hours, calculated by subtracting the amount of time needed to fall asleep and the amount of time spent awake during the night from the total time spent in bed. Sleep efficiency can be defined as the ease of falling asleep and returning to sleep. Timing is when sleep occurs during the day and alertness is the ability to maintain attentive wakefulness. Sleep quality, however, is a more subjective measure and is defined as “an individual’s self-satisfaction with all aspects of the sleep experience” (Nelson et al., 2022). Because of this, sleep quality has been one of the most common ways to assess sleep.

The quality of sleep has been associated with a wide range of outcomes. Physiologically, sleep is crucial in maintaining the body’s homeostasis as it plays a large role in regulating the circadian sleep-wake cycle. When there is insufficient sleep or disturbances in sleep, it causes a

shift in the circadian rhythms that have many adverse health outcomes. The circadian system, divided into a light and dark cycle, is controlled by the suprachiasmatic nucleus (SCN) found in the anterior hypothalamus (Reddy et al., 2022). During the light cycle, signals are sent through retinal ganglion cells found in the eyes to the optic nerve located at the back of each eye. Once the signal is received, neurons send impulses to inhibit melatonin release during the day to prevent sleepiness. On the other hand, a lack of light during the dark cycle signals the release of melatonin by the pineal glands to cause sleepiness. However, beyond melatonin release, the circadian system also regulates other biological processes including body temperature, metabolic processes, components of the cell cycle, and feeding processes (Evans & Davidson, 2013). Therefore, circadian misalignment caused by a lack of sleep can lead to negative health outcomes such as increased blood pressure and even an increased risk of cancer (Evans & Davidson, 2013; McEwen & Karatsoreos, 2015).

Sleep deprivation can also explain and trigger the worsening of psychotic conditions, mood disorders, and antisocial behavior tied to prefrontal cortex dysfunction such as schizophrenia and unipolar depression (Kahn-Greene et al., 2007). On the other hand, high-quality sleep has been linked to increased positive relations with others, purpose in life, and self-acceptance, all of which act as a buffer for emotional disruption (Hamilton et al., 2007). Supporting its use as an assessment of sleep, multiple research studies have shown sleep quality to be associated with both physiological and physical health outcomes. One of the most used measurements of subjective sleep quality is the Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989). The PSQI is a questionnaire that assesses the different dimensions of sleep.

### **Sleep Quality and Cortisol**

Cortisol levels and therefore stress is also associated with sleep. Specifically, sleep

quality but *not* quantity influences the responses to daytime stressors in children and adolescents, with greater sleep-wake behavior problems associated with decreased cortisol responses (Capaldi et al., 2005). In a study by Laethem et al., a bidirectional relationship was found between the inverse association of work-related stress and sleep quality, highlighting the interactions of influences between sleep quality and stressors (Van Laethem et al., 2015). Another study comparing insomnia patients and control subjects found that those who reported worse sleep quality had low salivary awakening cortisol levels (Backhaus et al., 2004). Awakening cortisol levels, around 30-45 minutes of awakening, serve as an accurate measurement of the HPA axis activity. Low awakening cortisol levels may be reflective of higher nightly cortisol activation. This can be a result of increased waketime after sleep, leading to a decreased HPA axis activation after awakening (Backhaus et al., 2004). Therefore, findings suggest that worse sleep decreased the HPA axis activity and therefore the regulation of cortisol, which has harmful health implications. Similarly, maternal sleep quality's effect on cortisol levels found that at 36 weeks gestation, poor sleep quality was associated with greater evening cortisol concentrations (Bublitz et al., 2018). These studies highlight the inverse relationship between sleep quality and cortisol levels. Based on the literature, this study hypothesizes that worse maternal sleep quality will increase maternal stress, as indexed by hair cortisol.

### **Stress and Sleep in the Mother-Child Dyad**

While the mother's sleep quality may affect her cortisol levels, her child's sleep quality may also have influences on her well-being given that mother and child outcomes are closely connected. Mothers' individual distress is associated with parenting stress, which increased the child's depressive levels (Babore et al., 2021). Similarly, maternal depression and anxiety also influences their child's well-being, leading them to have an increased risk of depression and

anxiety, respectively, among other externalizing disorders. This can partially be explained by the fact that depressed and anxious mothers are likely to be less engaged in parenting practices (Kahn-Greene et al., 2007). Dysfunction of parenting was found in a separate study to negatively impact the mother's sleep duration and quality as well as vice versa where poorer sleep quality led to worse parenting (McQuillan et al., 2019). These interactions between mother and child dyads are reflective of the association between parent and child well-being when analyzing responses from multiple questionnaires such as the Personal Well-Being Index (PWI) (Bedin & Sarriera, 2014). Additionally, using the Parent-Child Sleep Interactions Scale (PSIS), significant associations were found with parenting, maternal psychopathology, family stress, and child psychopathology and functioning (Smith et al., 2014). When considering the pandemic, COVID-19 health risks were also shown to predict maternal mental health, which predicted the child's early pandemic levels of adjustment problems (Thompson et al., 2022). These established associations between mother and child relationships highlight the interconnectedness of maternal and child mental health.

Mother outcomes are therefore integrally linked to child outcomes. However, while poor sleep quality has been established to be associated with increased stress levels, the relative contribution of maternal and child sleep on maternal stress is much less understood. Evidence suggests that mothers were 19% less likely to meet required sleep guidelines due to the unit increase in maternal stress observed during the COVID-19 lockdown. The lack of sleep was also then associated with household chaos and stress (Kracht et al., 2021). In mothers of school-age children, child sleep disturbances negatively influence maternal sleep quality, which is related to greater maternal distress (Meltzer & Mindell, 2007). Overall, studies demonstrate correlations between child behavior, specifically sleep, and not only maternal sleep but also maternal stress

levels. Therefore, poorer child sleep quality is hypothesized to increase maternal stress.

Because of the health implications that increased cortisol levels and stress have on important regulatory biological processes, it is crucial to investigate the relationships between both mother and child sleep and their effect(s) on maternal stress levels during the presence of a global stressor, COVID-19. While there are some studies investigating the different relationships between child sleep and mother sleep or the overall effects of sleep quality on stress levels, extant studies have utilized self-report surveys as measures of subjective stress. Therefore, there is a dearth of research that has examined the physiological impact of maternal sleep, especially during the COVID-19 pandemic. Subjective stress measures allow confounding variables such as inaccurate reporting by participants or the presence of participant bias, to affect findings and conclusions being made from these results. In contrast, objective measures of stress provide a more accurate analysis of stress by using the biological marker of stress, cortisol, as an indicator and method of assessment. Therefore, based on previous studies and findings, as well as in an effort to fill in the gaps in research, this current study will analyze objective measures of stress by examining hair cortisol and exploring the relationship between mother-child dyads. Using longitudinal data acquired from a larger study from the Applied Mind and Health (AMH) Lab about COVID-19 on maternal experiences and temperament, this study aims to examine the influence of maternal and child sleep, as well as COVID-19 on maternal stress, as indexed by hair cortisol. To do so, the following paper will test three hypotheses: Higher COVID-related stress will increase maternal hair cortisol levels, worse maternal sleep quality will increase maternal stress, and poorer child sleep quality will increase maternal stress.

## **Materials and Methods**

### **Participants**

Participants were recruited through Southern California, with the requirement that the child was between the ages of 36 and 60 months, could speak and understand English, and was typically developing with no reported diagnoses of developmental disorders. Our final sample included 117 mothers, with Mage = 36.75 years, SD = 5.19 years. They identified as 59.8% White/Caucasian, 18.8% Biracial (Latinx), 10.3% Asian/Asian-American, 7.7% Latinx only, and .9% other. 15% reported an income above \$175,000, 29% reported an income between \$101,000 to \$175,000, 29% reported an income between \$20,000 to \$100,000, and 7% reported an income below \$20,000. 51% of mothers had graduate degrees. 49% of children were girls, as identified by their mothers, with a mean child age of 72.69 months (around 6 years old). Data for this study were collected at two time points: T1 from June-August 2020 and T2 from February- April 2021. Mothers consented to the study, filled out an online survey, and mailed in biological data. The procedures for this study were approved by [Institution Masked] Institutional Review Board and mothers were compensated for their time.

### **Materials and Procedure**

Data for this project was acquired from a larger longitudinal study on Maternal Experiences and Temperament (COMET) during COVID-19. The study collected several measures of biological data, questionnaire data, and interview data from mother and child dyads. In this study, we examined the following variables through a Qualtrics survey.

### ***Child Sleep Quality***

Child sleep quality was reported by their mother using the Patient-Reported Outcomes Measurement Information System (PROMIS) Questionnaire at T1 and T2, which is divided into the Sleep Impairment and Sleep Disturbance subscales (HealthMeasures, 2016). Each subscale contained 4 items such as “My child had difficulty falling asleep.” The PROMIS Questionnaire was slightly adapted to reference the pandemic with items such as “Since the coronavirus/COVID-19 pandemic began on March 13, 2020...” All items were measured on a 5-point scale (1-“Never” to 5- “Always”) and scored through the HealthMeasures scoring service using a standard scores with a mean of 50 and a standard deviation of 10 in the reference population (Rothrock et al., 2020). The variable Child Sleep Problems used in the study was calculated by averaging and standardizing the Sleep Impairment and Sleep Disturbance subscale scores. A higher score indicates worse sleep quality.

### ***Maternal Sleep Quality***

Mothers reported on their own sleep quality at T1 and T2 using the Pittsburgh Sleep Quality Index (PSQI, (Buysse et al., 1989)). The questionnaire combines scores measuring the 7 components of sleep for one total global score. The seven components include: subjective sleep quality, sleep latency, sleep duration, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. This measure assessed the mothers’ pattern and quality of sleep over the last month using 19 items (i.e “During the past two weeks, how often have you had trouble sleeping because you...” on a scale of 0- “Not during the past two weeks” to 3- “Three or more times a week”). Each subscale was on a 4-point scale. For the purpose of this study, the global score was used: a higher score indicates worse sleep quality.

### ***COVID-related Stressors***

This was a 30-item scale to capture the impact of COVID-related stressors such as losing income, trouble concentrating on work, missing events with family, and becoming sick with COVID-19, used previously in Doan *et al.* (2022) & Liu *et al.* (2022). The questionnaire made by the AMH lab was based on existing measures related to stressful life events, including the Social Readjustment Rating Scale (Holmes & Rahe, 1967) and the Recent Life Events Questionnaire (Brugha *et al.*, 1985). Additional items pertaining to COVID-19 were also added (i.e. fear of disease transmission, self or family member testing positive for COVID-19). The impact of each event, if it had occurred for the participant, was rated on a scale of 1-“not really negative” to 3 -“very negative”. Impact scores were summed to give a composite score for the participant, with high scores indicating more negative COVID-related stressors.

### ***Maternal Stress***

Maternal stress was measured through hair cortisol samples because the presence of stress leads to the release of the hormone cortisol, a common biological marker for stress (Cay *et al.*, 2018). Upon providing consent, mothers were mailed a hair kit including detailed instructions along with a video on how and where to cut the hair, a hair questionnaire, and supplies for hair collection. Hair was put in foil by the mothers and the date was written on the aluminum foil and placed in an envelope. Mothers’ hair mailed into the lab was cut from three to four locations at the back of the head, with only the first 3 cm of hair proximal to the scalp analyzed to measure chronic stress. Cortisol values were winsorized and natural log-transformed for analysis.



## Results

Descriptives were first run to understand the relationships between this study's variables of interest. Race and child age were not related to study variables and were hence not included in further analysis. Maternal income and education were positively related to each other,  $r = .708$ ,  $p = <.001$ , and were hence standardized and averaged to create a new socio-economic status variable (SES). Previous research has shown that income and education are related to parent stress (Cohen et al., 2006). Mom age and CRS were related and controlled,  $r = .194$ ,  $p = .038$ .

Linear regression was run using the Full Information Maximum Likelihood method (comparative results were found with listwise deletion) using child sleep disturbance, maternal sleep quality, COVID-related stressors, and maternal hair cortisol at T1 to predict maternal hair cortisol at T2, controlling for child gender, socio-economic status (SES), maternal age and CRS. Child sleep disturbance,  $b = .270$ ,  $SE = .104$ ,  $p = .009$  and maternal hair cortisol,  $b = .328$ ,  $SE = .081$ ,  $p < .001$  at T1 positively predicted maternal hair cortisol at T2 (*Table 1-3*). Our findings show that it is child sleep quality, not mothers' own sleep quality or COVID-related stressors that is a predictor of maternal stress, indexed through hair cortisol.

## **Discussion**

The purpose of the present study was to explore the relationship between sleep quality and hair cortisol levels in mother-child dyads using longitudinal data acquired from the COMET study. Based on previous literature and findings, the hypotheses that poorer maternal and child sleep quality, as well as increased COVID-related stressors, would predict maternal cortisol levels were tested. Interestingly, findings show that child sleep quality at T1 predicted maternal hair cortisol levels at T2, whereas poorer child sleep quality predicted higher maternal cortisol levels over time. Therefore it is child sleep quality, not mothers' own sleep quality or COVID-related stressors that is a predictor of maternal stress, indexed through hair cortisol. This suggests child sleep quality negatively impacts mothers' chronic stress levels. Consistent with the fact that hair cortisol is an indicator of chronic stress over time and indicates stress 3-4 months prior to when the sample is taken, the findings are not unexpected. In addition, given the interconnectedness of the child and mother's well-being, it is not surprising to find child sleep quality as a significant predictor of maternal hair cortisol levels.

Research on the relationship between sleep and stress levels during COVID-19 on mother-child dyads is crucial in understanding parental functioning and health in the context of parent-child relations. Previous studies have shown that poorer sleep quality can lead to increased stress by looking at self-reported measures of stress. However, much less is known about the mother and child relationships, especially when considering the effects of a major global stressor, COVID-19. Given the established direct relationship between COVID-19 and stress, it is especially important to study COVID-19's effect on stress levels in mothers. Moreover, few studies have looked at an objective measure of stress, cortisol, and have mostly relied on self-reported measures of stress. There is a small but growing body of work directly

linking child sleep and maternal stress. increased sleep disturbances in children are significantly correlated to greater parental stress (Meltzer & Mindell, 2007). Additionally, research has shown poorer child sleep quality to be associated with poorer maternal sleep quality, which is closely tied to increased maternal stress levels (Wells & Vaughn, 2012).

This has important applications as cortisol levels have been shown to have many effects on the body's biological processes. While cortisol plays a vital role in homeostasis through the HPA axis, chronic stress and therefore continual cortisol release can lead to adverse health outcomes. Long-term elevated cortisol levels have been associated with Cushing disease, and diabetes complications, among other health complications (Wosu et al., 2013). Additionally, elevated levels of cortisol have also been linked to depression (Joseph & Golden, 2017). Thus, the current study's findings provide vital contributions and insights to not only a better understanding of dynamics between mother and child but also to the understanding of health interactions with child sleep quality.

This study, however, surprisingly found maternal sleep quality to be a not significant predictor of maternal stress. This nonsignificant finding contradicts previous research that demonstrates the relationship between sleep quality and stress levels. While fewer studies examine the relationship between sleep quality and stress in a sample of mothers, it has been shown that overall, poorer sleep quality leads to increased stress (Alotaibi et al., 2020). A possible explanation for child sleep being the only significant predictor of maternal sleep out of the variables tested could be due to the fact that child sleep problems have many impacts on the family system. Given the large role family functioning plays in a child's life, child behavior, specifically sleep, cannot be isolated and must be considered in relation to family.

Child sleep problems are significantly linked to decreased family functioning including decreased parental sleep and daytime function. It has been shown that child sleep problems are associated with maternal sleep problems, which may lead to mood disruptions, marital dissatisfaction, and stress (Meltzer & Montgomery-Downs, 2011). The multifactorial negative impacts of child sleep on family functioning can even more so have significant impacts on maternal stress, given the increased role of mothers in the family, especially during Covid-19. While child sleep quality may predict mother's sleep quality and, therefore, increased stress levels, the reciprocal has not been shown to hold. One study found that while child sleep predicts mother's sleep, the relationship was only significant unidirectional (Mindell et al., 2015). Thus, child sleep quality is more likely to be indicative of family systems and, therefore, maternal stress. Accordingly, the effect of a mother's poor sleep can be viewed as more isolated from the family system when considering the additive stress effects of poor child sleep quality. This, therefore, could provide an explanation for why maternal sleep quality was not found to be a significant predictor of maternal cortisol levels.

The finding of COVID-related stressors not being a significant predictor of increased maternal cortisol is also inconsistent with previous literature. Research has established COVID-19 to be associated with increased stress levels and similar findings in mothers were expected. The difference in findings may be accounted for due to two main reasons. The lack of significance between COVID-related stressors could first be attributed to the time range in data collection at time one, from June to August 2020. Given that the California lockdown to prevent the spread of COVID-19 occurred on March 19, 2020, and data collection from the COMET study started in June, cortisol levels reflecting the pandemic may not have been reflected in the hair samples of participants who responded at the beginning of June. This is because cortisol

levels as accessed by hair are measurements of chronic stress over a few months and variables such as when mothers began to experience stress in relation to when they sent in their hair sample could account for the insignificant finding. In addition, COMET, where data for this study was acquired, being the first study to use CRS to measure COVID-19 stressors, also comes with some limitations. Given the novelty of the CRS Questionnaire as a result of the sudden surge of COVID-19 prevalence, it may not have been the most accurate and best assessment of COVID stressors because little was known about COVID at the time. However, with the now increasing literature on COVID-19 and its effects as a stressor, future studies should evaluate the reliability and validity of the CRS Questionnaire and explore the use of different possible measures of COVID-related stressors.

It is also important to note the additional limitations of this study. This current study was limited by self-report measures of sleep through PSQI and PROMIS, despite using an objective measure of stress. Although both PSQI and PROMIS, developed by Buysse et al., and NIH, respectively, are widely accepted and reliable, the two surveys could still introduce bias or inaccuracies given their subjective nature. Especially as child sleep was reported by mothers, the results could have been an inaccurate reflection of the child's true sleep quality. For future studies, a more objective measure of sleep can be incorporated such as the use of an Actiwatch, which is a wrist-worn watch that objectively measures sleep patterns and statistics. Actigraphy data collected from an Actiwatch is a validated way of measuring objective sleep that has been used in many studies such as one by Tu et al.'s study on the relationship between sleep duration and quality, attachment, and adolescent adjustment (Tu et al., 2017).

Additionally, the relatively small sample size of 117 mothers could limit the generalizability of the study findings. Demographics, due to the size, were skewed towards

white, Caucasian mothers with higher education earning an income equal to or over \$100,000. Having an increased number of participants with greater diversity in future studies would provide a more representative sample that can increase the accuracy of the conclusions on the relationships between sleep and maternal stress during COVID-19. Despite the limitations, the study also had a number of strengths that give it validity and reliability. The longitudinal nature of the study and the use of hair cortisol as an objective measure of stress levels in mothers allowed the establishment of a casual relationship and the minimization of confounding variables such as bias present in self-reported measures of stress. Therefore, this study's finding still provides invaluable applications and contributions to current research.

The present study emphasized the negative impact of poor child sleep quality on maternal stress, as measured by cortisol levels, during COVID-19. This study fills gaps in the literature given the lack of objective measurements of stress and research on mother-child relations pertaining to sleep and stress in previous research. Using cortisol as an objective measurement of stress not only provides more accurate reflections of maternal stress but also allows insight into the downstream biological and psychological effects cortisol can have on mothers. It is particularly important to study factors impacting cortisol levels in mothers during the pandemic given the increased caretaking roles mothers have taken on. The findings suggest that mothers' chronic stress levels can be decreased by improving child sleep quality and highlight the role of child sleep quality on family systems. Future studies could explore improving child sleep quality as a potential target for approaching adverse health outcomes associated with increased cortisol levels. This study, therefore, has not only important implications for interventions and programs for reducing stress, mental health, and family functioning but also informs mothers of how to improve their well-being by reducing their own stress.

## **Acknowledgements**

I would like to express thanks to my advisors, Professor Catalino and Professor Solomon-Lane for their expertise and input that shaped my thesis. Additionally, I would like to extend my gratitude to Dr. Doan, my research lab advisor, for her guidance and insights throughout my thesis as well as my time working at her research lab, the Applied Mind and Health (AMH) Lab. Additionally, I would like to thank those at the AMH lab and Sam for providing me with the resources and continual support to complete my thesis. To Alexa Aringer, my lab manager, thank you for your endless care, assistance, and encouragement.

I'm also grateful for Shruthi Venkatesh, one of my AMH lab mentors, whose invaluable feedback and insights greatly influenced how I conducted my experiments and interpreted my findings. To my friend, lab mate, and research partner, Christine Ha, thank you so much for your feedback on this thesis as well as your love and support. I would not have been able to complete my thesis without the important contributions of these people.

**Table 1: Participant Demographics**

<b>Measure</b>	<b><i>n</i></b>	<b>% (rounded to nearest integer)</b>
<b>Maternal education</b>		
High school	7	6
Some college	18	15.4
Community college	7	6.0
Bachelor's degree	25	21.4
Graduate degree	60	51.3
<b>Maternal race</b>		
White/Caucasian	70	59.8
Asian/Asian-American	12	10.3
Latinx Only	9	7.7
Biracial (Latinx)	22	18.8
Biracial (Non-Latinx)	3	2.6
Multiracial/other	1	.9
<b>Income (from 2019)</b>		
<\$20,00	12	10.3
\$20,000- \$40,000	12	10.3
\$41,000- \$60,000	11	9.4
\$61,000- \$80,000	14	12.0
\$81,000- \$100,000	13	11.1
\$101,000- \$120,000	13	11.1
\$121,000- \$150,000	11	9.4
\$151,000- \$175,000	14	14.5
Greater than \$175,000	17	14.5



**Table 2: Correlation Matrix for Key Measures**

Measure	2	3	4	5	6	7	8	9
1. Mother age	-.012	-.285**	.598**	.012	.005	.194*	.056	-.043
2. Child sex		-.021	.034	-.044	-.089	.012	.071	-.237*
3. Mother race			-.459*	.022	.127	-.158	-.018	-.039
4. SES				.008	-.122	.097	-.026	-.124
5. Child Sleep Problems					.235**	.046	.032	.314**
6. Mother Sleep Quality						.168*	.104	.251*
7. COVID-related stressors							.769	.975
8. Maternal Hair Cort T1								.468**
9. Maternal Hair Cort T2								

*Note.* Race was coded as 0 for White and 1 for Non-White mothers. \*  $p < .05$  \*\*  $p < .01$ .

**Table 3:** Predicting maternal hair cortisol at T2 using maternal hair cortisol, maternal sleep quality and child sleep quality at T1

Predictor	<i>b</i>	CI <sub>95%</sub>		SE	<i>z</i>	<i>p</i>
		Lower	Upper			
Child Sex	-.432	-.773	-.091	.174	-2.485	.013*
Socio-economic status	-.220	-.471	.032	.128	-1.712	.087
Mother Race	.050	-.362	.461	.210	.236	.813
Mom Age	-.004	-.044	.037	.021	-.172	.863
Maternal Sleep Quality at T1	.003	-.054	.060	.029	.104	.917
Child Sleep Problems at T1	.270	.066	.474	.104	2.598	.009**
COVID-19 Related Stressors	-.015	-.036	.006	.011	-1.410	.158
Maternal hair cortisol at T1	.328	.170	.486	.081	4.064	.000***

*Note.* Race was coded as 0 for White and 1 for Non-White mothers. Child gender was coded as 1 for males, 2 for females. Hair cortisol measures were natural log transformed. \*  $p < .05$  \*\*  $p < .01$  \*\*\*  $p < .001$  Fit for model  $R^2 = .34$ , CFI and TLI = 1.00.

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## Appendix A

### Informed Consent for Participation in the COMET Research Study

#### COMET FUP Survey

##### Start of Block: Consent and Compensation

SurveyIntro Hello from the CARE Lab!

Thank you so much for continuing in our study. The coronavirus/COVID-19 pandemic has undoubtedly influenced families in a wide variety of ways. By participating, you're contributing to our understanding of the varied effects of pandemics and the ways we can help future families.

We understand your time is valuable. After you complete this online survey, we will **compensate you with an online gift card (\$37.50)** for your time.

Please note that this survey can take **between 30-45 minutes** to complete, so feel free to finish it in chunks if you cannot complete it all in one sitting. Clicking the link again will return you to the last page you had seen.

These surveys will ask about parenting and your emotional and physical experiences. As with before, you are welcome to skip any questions that you do not feel comfortable answering, and your participation is voluntary. Please **save the original email** so that you can return to the link should you decide to take a break!

Thank you!

Page Break

Page Break

CompBreak Please note that this study comprises of 2 phases that are 6 months apart. You already completed the first phase (thank you!). This survey is part of the 2nd phase, for which you will be compensated \$37.50.

If you completed a hair sample in the first phase, you will also be asked to submit a 2nd hair sample (roughly 6 months from the previous one) for another \$37.50 - we will reach out to you regarding the 2nd hair sample based on when you sent in your first one. So if you are completing both the survey and hair sample in this 2nd phase, you will receive \$75 total.

Page Break

pptSig Your Name

---

pptChName What is the name of the child **who participated in this study's first phase?**

---

pptPhone What is the best phone number to reach you?

---



pptEmail What is the best email address to reach you?

---



GiftCard Please select the \$37.50 online gift card you want to receive for completing the online questionnaire:

- Amazon (1)
- Target (2)
- ULTA (3)
- DoorDash (4)

- GameStop (5)



GiftCardEmail Do you want us to send your gift card to this email address or a different email address?

- The above email address (1)
- A different email address (please enter): (2)

---

compText After you submit this survey, our research staff will confirm receipt and email you a \$37.50 online gift card within a week of submission date.

pptPostalAddress If you submitted a hair sample in the 1st phase of this study and your address has changed, please provide your new postal address below.

- Address Line 1 (4) \_\_\_\_\_
- Address Line 2 (5) \_\_\_\_\_
- City, State, Zip (6) \_\_\_\_\_

End of Block: Consent and Compensation

## Appendix B

### Pittsburgh Sleep Quality Index Questionnaire

#### Start of Block: Sleep (PSQI)

##### PSQI explainer

The following questions will ask about your sleep habits **during the past two (2) weeks**. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.



PSQI\_1 **During the past two weeks**, what time have you usually gone to bed at night?

	Hour	Minutes	AM/PM
(HH:MM AM/PM) (PSQI_1_1)	▼ 1 (1 ... 12 (12))	▼ 00 (1 ... 55 (12))	▼ AM (1 ... PM (2))



PSQI\_2 During the past two weeks, how long (in minutes) has it usually taken you to fall asleep each night?

---

PSQI\_3 **During the past two weeks**, what time have you usually gotten up in the morning?

	Hour	Minutes	AM/PM

(HH:MM AM/PM)  
(PSQI\_3\_1)

▼ 1 (1 ... 12 (12)

▼ 00 (1 ... 55 (12)

▼ AM (1 ... PM (2)



PSQI\_4 During the past two weeks, how many **hours of actual sleep**, did you get per night?  
(This may be different than the number of hours you spent in bed.)

---



PSQI\_4a During the past two weeks, how many **hours were you in bed** per night, asleep and awake?

---

PSQI5explainer For each of the remaining questions, check the one best response. Please answer all questions.



PSQI\_5 During the past two weeks, how often have you had trouble sleeping because you . . .

	Not during the past two weeks (0)	Less than once a week (1)	Once or twice a week (2)	Three or more times a week (3)
Cannot get to sleep within 30 minutes (PSQI_5a)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Wake up in the middle of the night or early morning (PSQI_5b)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have to get up to use the bathroom (PSQI_5c)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cannot breathe comfortably (PSQI_5d)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cough or snore loudly (PSQI_5e)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feel too cold (PSQI_5f)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feel too hot (PSQI_5g)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have bad dreams (PSQI_5h)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Have pain (PSQI_5i)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other reason (please specify; e.g., external factors) (PSQI_5j)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

•

PSQI\_6 How often have you taken medicine to help you sleep (prescribed or "over-the-counter")?

- Not during the past month (0)

- Less than once a week (1)
- Once or twice a week (2)
- Three or more times a week (3)

•

PSQI\_7 How often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

- Not during the past month (0)
- Less than once a week (1)
- Once or twice a week (2)
- Three or more times a week (3)

•

PSQI\_8 How much of a problem has it been for you to keep up enough enthusiasm to get things done?

- No problem at all (0)
- Only a very slight problem (1)
- Somewhat of a problem (2)
- A very big problem (3)

•

PSQI\_9 How would you rate your sleep quality overall?

- Very good (0)
- Fairly good (1)
- Fairly bad (2)
- Very bad (3)

End of Block: Sleep (PSQI)

**Appendix C**  
**Patient-Reported Outcomes Measurement Information System (PROMIS)**  
**Questionnaire**

Start of Block: Child Behavior (PROMIS, BRIEF-P)

CBCL\_Intro Please fill out this form to reflect *your* view of your child

[\\${pptChName/ChoiceTextEntryValue}](#)'s behavior even if other people might not agree. **Be sure to answer all items.**

Page Break



PROMIS\_SD Please respond to each question or statement by marking one box per row, and think about your child [\\${pptChName/ChoiceTextEntryValue}](#) as you answer these questions.

**Since the coronavirus/COVID-19 pandemic began on March 13, 2020...**

	Never (1)	Almost never (2)	Sometimes (3)	Almost always (4)	Always (5)
My child had difficulty falling asleep... (PROMIS_SD_1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



My child slept through the night...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(PROMIS_SD_2)					
My child had a problem with his/her sleep...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(PROMIS_SD_3)					
My child had trouble sleeping...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
(PROMIS_SD_4)					



PROMIS\_SRI Please respond to each question or statement by marking one box per row, and think about your child [\\${pptChName/ChoiceTextEntryValue}](#) as you answer these questions.

**Since the coronavirus/COVID-19 pandemic began on March 13, 2020...**

	Never (1)	Almost never (2)	Sometimes (3)	Almost always (4)	Always (5)
--	-----------	---------------------	---------------	----------------------	------------

---

<p>My child was sleepy during the daytime... (PROMIS_si_1)</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<p>My child had a hard time concentrating because he/she was sleepy... (PROMIS_si_2)</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<p>My child had a hard time getting things done because he/she was sleepy... (PROMIS_si_3)</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<p>My child had problems during the day because of poor sleep... (PROMIS_si_4)</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Appendix D

### COVID-Related Stressors Questionnaire

#### COVID19exp

The following section will ask questions about your experiences in the current coronavirus/COVID-19 pandemic.

Start of Block: ALEQ (Work - Self)



#### ALEQ\_1 Lost your job

- Yes (1)
- No (0)

*Display This Question:*

*If ALEQ\_1 = 1*



#### ALEQ\_impact\_1 What was the impact of this stressful life event: Lost your job

- Very negative (3)
- Sort of negative (2)
- Not really negative (1)



**ALEQ\_4 Your work hours or pay has been reduced**

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_4 = 1*



**ALEQ\_impact\_4 What was the impact of this stressful life event: Your work hours or pay  
has been reduced**

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**



**ALEQ\_7 You lost income/money**

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_7 = 1*



**ALEQ\_impact\_7 What was the impact of this stressful life event: You lost income/money**

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**

Page Break

**ALEQexplainer The next questions ask about whether certain events have happened to you since the coronavirus/COVID-19 pandemic began on March 13, 2020.**

*Display This Question:*

*If empChange != 3*



**ALEQ\_15 Your work changed in the past 2 weeks (e.g., moved to online or remote work)**

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_15 = 1*



**ALEQ\_impact\_15 What was the impact of this stressful life event: Your work changed in the past 2 weeks (e.g., moved to online or remote work)**

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**

*Display This Question:*

*If empChange != 3*



**ALEQ\_16 You had trouble accessing your work (e.g., due to poor internet or having to share a computer at home)**

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_16 = 1*



**ALEQ\_impact\_16 What was the impact of this stressful life event: You had trouble accessing your work (e.g., due to poor internet or having to share a computer at home)**

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**

*Display This Question:*

*If empChange != 3*



**ALEQ\_17 You had trouble concentrating on your work**

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_17 = 1*



**ALEQ\_impact\_17 What was the impact of this stressful life event: You had trouble concentrating on your work**

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**

*Display This Question:*

*If empChange != 3*



**ALEQ\_18 You had trouble keeping up with your work**

- Yes (1)**
- No (0)**



*Display This Question:*

*If ALEQ\_18 = 1*

**ALEQ\_impact\_18** What was the impact of this stressful life event: You had trouble  
keeping up with your work

- **Very negative (3)**
- **Sort of negative (2)**
- **Not really negative (1)**

End of Block: ALEQ (Work - Self)

Start of Block: ALEQ (General - Self)

**ALEQexplainer2** The next questions ask about whether certain events have happened to  
you since the coronavirus/COVID-19 pandemic began on March 13, 2020.

**ALEQ\_28** You became sick with symptoms of coronavirus/COVID-19

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_28 = 1*

•

**ALEQ\_impact\_28 What was the impact of this stressful life event: You became sick with symptoms of coronavirus/COVID-19**

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**

•

**ALEQ\_29 You tested positive for coronavirus/COVID-19**

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_29 = 1*

**ALEQ\_impact\_29** What was the impact of this stressful life event: You tested positive for coronavirus/COVID-19

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**

**ALEQ\_11** Someone in your family who does not live with you became sick with symptoms of coronavirus/COVID-19

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_11 = 1*

**ALEQ\_impact\_11** What was the impact of this stressful life event: Someone in your family who does not live with you became sick with symptoms of coronavirus/COVID-19

- Very negative (3)
- Sort of negative (2)
- Not really negative (1)

•

**ALEQ\_12** Someone in your family who does not live with you tested positive for coronavirus/COVID-19

- Yes (1)
- No (0)

*Display This Question:*

*If ALEQ\_12 = 1*

•

**ALEQ\_impact\_12** What was the impact of this stressful life event: Someone in your family who does not live with you tested positive for coronavirus/COVID-19

- Very negative (3)
- Sort of negative (2)
- Not really negative (1)

•

**ALEQ\_13** Your friend(s) became sick with symptoms of coronavirus/COVID-19

- Yes (1)
- No (0)

*Display This Question:*

*If ALEQ\_13 = 1*

•

**ALEQ\_impact\_13** What was the impact of this stressful life event: Your friend(s) became sick with symptoms of coronavirus/COVID-19

- Very negative (3)
- Sort of negative (2)

- **Not really negative (1)**

•

**ALEQ\_14 Your friend(s) tested positive for coronavirus/COVID-19**

- **Yes (1)**
- **No (0)**

*Display This Question:*

*If ALEQ\_14 = 1*

•

**ALEQ\_impact\_14 What was the impact of this stressful life event: Your friend(s) tested positive for coronavirus/COVID-19**

- **Very negative (3)**
- **Sort of negative (2)**
- **Not really negative (1)**

**ALEQexplainer3** The next questions ask about whether certain events have happened to you since the coronavirus/COVID-19 pandemic began on March 13, 2020.

•

**ALEQ\_21** There has been an increase in the level of arguing or conflict in your home over the past 2 weeks

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_21 = 1*

•

**ALEQ\_impact\_21** What was the impact of this stressful life event: There has been an increase in the level of arguing or conflict in your home over the past 2 weeks

- Very negative (3)**
- Sort of negative (2)**

- **Not really negative (1)**

•

**ALEQ\_22 There has been an increase in the level of arguing or conflict with your friends  
over the past 2 weeks**

- **Yes (1)**
- **No (0)**

*Display This Question:*

*If ALEQ\_22 = 1*

•

**ALEQ\_impact\_22 What was the impact of this stressful life event: There has been an  
increase in the level of arguing or conflict with your friends over the past 2 weeks**

- **Very negative (3)**
- **Sort of negative (2)**
- **Not really negative (1)**



ALEQ\_24 You have had to miss or cancel events with family (e.g., weddings, birthdays)

- Yes (1)
- No (0)

*Display This Question:*

*If ALEQ\_24 = 1*

ALEQ\_impact\_24 What was the impact of this stressful life event: You have had to miss  
or cancel events with family (e.g., weddings, birthdays)

- Very negative (3)
- Sort of negative (2)
- Not really negative (1)

**ALEQ\_25 You have had to miss or cancel events with friends (e.g., parties, games, outings)**

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_25 = 1*

**ALEQ\_impact\_25 What was the impact of this stressful life event: You have had to miss or cancel events with friends (e.g., parties, games, outings)**

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**

**ALEQ\_26 You have had to miss or cancel events at your child's school (e.g., sports games, dances, plays)**

- Yes (1)**

- No (0)

*Display This Question:*

*If ALEQ\_26 = 1*

**ALEQ\_impact\_26** What was the impact of this stressful life event: You have had to miss or cancel events at your child's school (e.g., sports games, dances, plays)

- Very negative (3)
- Sort of negative (2)
- Not really negative (1)

Page Break

**ALEQexplainer4** The next questions ask about whether certain events have happened to you since the coronavirus/COVID-19 pandemic began on March 13, 2020.

**ALEQ\_27 You have spent less time interacting with your friends**

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_27 = 1*

**ALEQ\_impact\_27 What was the impact of this stressful life event: You have spent less time interacting with your friends**

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**

**ALEQ\_30 You have had to take on additional childcare responsibilities**

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_30 = 1*

**ALEQ\_impact\_30** What was the impact of this stressful life event: You have had to take  
on additional childcare responsibilities

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**

**ALEQ\_31** You have had to take on additional home responsibilities (e.g. laundry, cooking,  
etc.)

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_31 = 1*

•

**ALEQ\_impact\_31** What was the impact of this stressful life event: You have had to take  
on additional home responsibilities (e.g. laundry, cooking, etc.)

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**

•

**ALEQ\_oth** Has anything else stressful happened to you in the past two weeks?

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_oth = 1*

**ALEQ\_othText** Please describe:

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End of Block: ALEQ (General - Self)

Start of Block: ALEQ (Work - Partner)

*Display This Question:*

*If MarStatus = 2*

*Or MarStatus = 3*

**ALEQptrExplainer1** The next questions ask about whether certain events have happened to your partner since the coronavirus/COVID-19 pandemic began on March 13, 2020.

*Display This Question:*

*If MarStatus = 2*

*Or MarStatus = 3*

•

**ALEQ\_2** Partner lost their job

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_2 = 1*

**ALEQ\_impact\_2 What was the impact of this stressful life event: Partner lost their job**

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**

*Display This Question:*

*If MarStatus = 2*

*Or MarStatus = 3*

**ALEQ\_5 Partner had their work hours or pay reduced**

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_5 = 1*



•

**ALEQ\_impact\_5 What was the impact of this stressful life event: Partner had their work hours or pay reduced**

- **Very negative (3)**
- **Sort of negative (2)**
- **Not really negative (1)**

*Display This Question:*

*If MarStatus = 2*

*Or MarStatus = 3*

•

**ALEQ\_8 Your partner lost income/money**

- **Yes (1)**
- **No (0)**

*Display This Question:*

*If ALEQ\_8 = 1*

•

**ALEQ\_impact\_8** What was the impact of this stressful life event: Your partner lost  
income/money

- Very negative (3)
- Sort of negative (2)
- Not really negative (1)

End of Block: ALEQ (Work - Partner)

Start of Block: ALEQ (General - Partner)

*Display This Question:*

*If MarStatus = 2*

*Or MarStatus = 3*

**ALEQptrExplainer2** The next questions ask about whether certain events have happened  
to your partner since the coronavirus/COVID-19 pandemic began on March 13, 2020.

*Display This Question:*

*If MarStatus = 2*

*Or MarStatus = 3*

**ALEQ\_19** Your partner had problems handling the changes brought about by the coronavirus/COVID-19 pandemic

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_19 = 1*

**ALEQ\_impact\_19** What was the impact of this stressful life event: Your partner had problems handling the changes brought about by the coronavirus/COVID-19 pandemic

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**

*Display This Question:*

*If MarStatus = 2*

*Or MarStatus = 3*

**ALEQ\_20 Your partner has been worried or stressed about the coronavirus/COVID-19 pandemic**

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_20 = 1*

**ALEQ\_impact\_20 What was the impact of this stressful life event: Your partner has been worried or stressed about the coronavirus/COVID-19 pandemic**

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**

*Display This Question:*

*If MarStatus = 2*

*Or MarStatus = 3*

**ALEQ\_23** There has been an increase in the level of arguing or conflict with your romantic partner over the past 2 weeks

- Yes (1)**
- No (0)**

*Display This Question:*

*If ALEQ\_23 = 1*

**ALEQ\_impact\_23** What was the impact of this stressful life event: There has been an increase in the level of arguing or conflict with your romantic partner over the past 2 weeks

- Very negative (3)**
- Sort of negative (2)**
- Not really negative (1)**

End of Block: ALEQ (General - Partner)

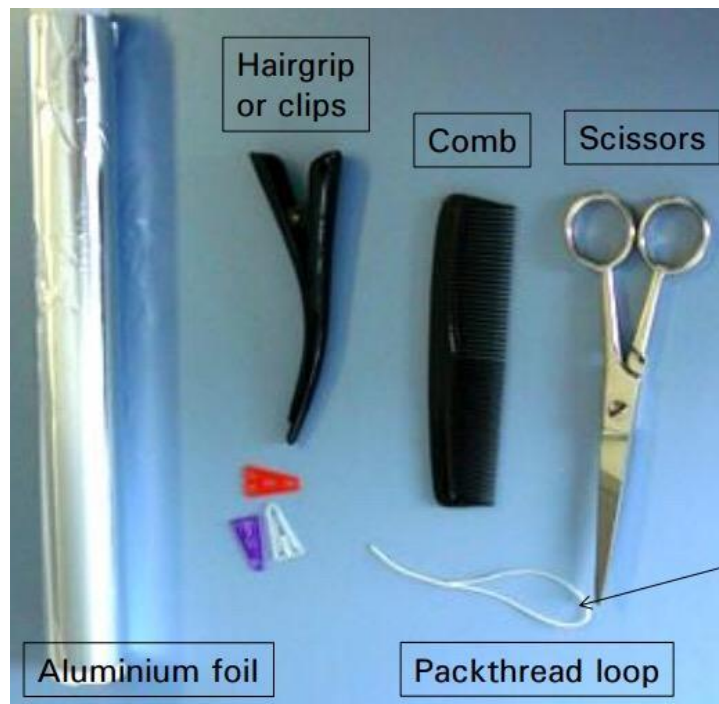
## Appendix E

### Hair Samples Instructions

Thank you for participating in Scientist Mommy: a study to help us understand how personality, biology, and parenting shape children's psychological well-being, and physical health. In order to obtain the most accurate information, we will need to collect a hair sample from you. Please follow the instructions below when collecting your hair sample. If you have any questions or concerns, please visit our website at [scientistmommy.com](http://scientistmommy.com) for informational videos.

#### Hair Sample Collection

**Materials Needed:** scissors, comb, floss or string, aluminum foil



#### Instructions

##### Collecting the Hair Sample

1. Trace a horizontal line from the end of each eyebrow and separate hair so that you divide two large sections (top & bottom section)
2. Use a hair clip to lift and hold the top section of hair, revealing the midsection of the scalp.



3. Collect a bundle of hair of about 3 - 5mm, which is about half the diameter of a pencil eraser. When you separate the sample, trace horizontally as well.
4. Comb the strand. Then use a piece of floss to tie a double knot around the bundle about 1/2 inch away from the scalp. The knot will indicate which side of the clipping was closest to the root.

**\*Do not tie too close to the scalp because the floss might fall off or untie when you cut the hair.**



5. Cut the hair above the knot and *as close as possible to the root*. Keep the tie on the hair when you store the clipping.



**Repeat these steps and collect a second hair clipping from a different section along the midline you created.**

Once you have collected two hair samples:



1. On a piece of aluminum foil, write “**Root**” with a black sharpie on the side that will line up with the double knot that is holding the sample.
2. Fold the aluminum foil *without bending the hair*. Fold the top and bottom sides first (perpendicular to the hair clipping), and then fold the long sides second (parallel to the hair clipping).
3. Write today’s date on the foil. Place the aluminum foil in an envelope and label the date on the front of the envelope.

