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# A Multi-method Assessment of the Impact of Stress on Families' Mental Health During the COVID-19 Pandemic

Andrew R. Daoust, *Western University*

Supervisor: Hayden, Elizabeth P., *The University of Western Ontario*

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## Abstract

The COVID-19 pandemic was a pervasive disaster, creating stress for people across the globe. As such, understanding how pandemic-related stress has impacted individuals' mental health is vital for guiding intervention programs and limiting the impact of future similar crises. This is especially true for youth, who are at heightened risk for mental disorder and may experience pandemic-related social stress as particularly aversive, given the developmental challenges unique to this period. Although substantial efforts have been made to measure the impact of the pandemic-related stress on individuals' mental health, the pandemic's relatively sudden onset has limited researchers' abilities to conduct fulsome longitudinal investigations. Longitudinal assessments of youths' mental health, especially with shorter intervals between follow-ups, will contribute to a more nuanced understanding of how youths responded to this crisis on a week-by-week basis. I addressed these gaps in the literature by developing and factor analyzing a measure of pandemic-related stress responses in youths and caregivers (Study 1), examining how youths' pre-pandemic psychophysiological stress responses shaped their adjustment during the COVID-19 pandemic (Study 2), and by examining associations between youths and caregivers internalizing symptoms at the onset of COVID-related lockdowns (Study 3). Findings included that my measure of pandemic-related stress responses could be used similarly for caregivers and youths (Study 1), that stress-related cortisol output differentially predicted boys' and girls' internalizing symptoms (Study 2), and that caregivers' and youths' depressive symptoms influenced each other reciprocally over time, while youths' depressive symptoms

unidirectionally predicted caregivers' anxious symptoms (Study 3). Implications for mental health interventions in the context of future global crises are discussed.

KEYWORDS: COVID-19, Pandemic, Depression, Anxiety, Youths, Caregivers, Cortisol, Risk

## Summary for Lay Audience

The COVID-19 pandemic created significant stress for community-dwelling individuals. This is especially true for youths and their caregivers, who faced additional stressors such as school closures and limited access to childcare. Given that youths are at greater risk for developing symptoms of anxiety and depression even outside of significant stressors, it is especially important that we understand pandemic-related factors that may further contribute to this risk. Although researchers have made efforts measure changes in youths' mental health during the pandemic, the stress and chaos of the pandemic has limited our ability to thoroughly assess these changes on a week-by-week basis. My dissertation has helped to answer some of these questions by (1) developing a measure that we can use to assess youths' and caregivers' responses to pandemic-related stress, (2) examining if biological responses to short-term stress before the pandemic could help us predict youths' well-being during the pandemic, and (3) examining if caregivers' and youths' symptoms of anxiety and depression effect one another over time. In summary, I found that both social and biological factors can help us predict which youths and caregivers were more likely to have difficulty with mental health problems during the early weeks of the COVID-19 pandemic. Future research would benefit from incorporating these and other risk factors into a larger model predicting risk of mental health difficulties so that we can identify who would benefit most from support in the event of future crises.

## Co-authorship Statement

Several co-authors have contributed to the manuscripts comprising this doctoral dissertation, namely Dr. Elizabeth P. Hayden, Dr. Kate L. Harkness, Dr. Kasey Stanton, Dr. Thomas M. Olino, Dr. Pan Liu, Dr. Matthew R. J. Vandermeer, and Ms. Haley Green. As the primary author of these manuscripts, I (Andrew R. Daoust) contributed to the design of the research projects, the development of research questions and hypotheses, and data collection (i.e., facilitating laboratory stress tasks, collecting biological samples, collecting symptom data from families). I was also responsible for data cleaning and preparation, statistical analyses and their interpretation, and the preparation and submission of resulting manuscripts.

The three manuscripts in this dissertation are based upon data from a long-running longitudinal research project on which Dr. Hayden is the principal investigator. As such, she has contributed significantly to the conceptualization and design of these studies. In addition, as my doctoral supervisor, Dr. Hayden provided significant guidance in the formulation of research questions and the interpretation of research data.

All co-authors contributed their expertise towards the conceptualization and development of the larger longitudinal research project led by Dr. Hayden. Dr. Harkness provided clinical supervision for the collection of clinical study data involving youths. Dr. Stanton provided consultation and support in the development of items for the PACS and in developing the factor analytic models for Study 1, and Dr. Olino provided consultation and support in conceptualizing and building the hierarchical linear models for Study 3. Dr. Vandermeer and Dr. Liu both guided data collection practices, and Ms.

Green contributed to data collection and cleaning. All co-authors were given the chance to review the manuscripts to which they contributed and provide feedback.

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# Chapter 1 – General Overview & Introduction

## Introduction

A stressor can be any event, whether internal or external, that challenges an individual's well-being (American Psychological Association, 2007). Stressors invoke emotional, cognitive, and physiological adaptations that prepare individuals to interact with, and resolve, the challenge (Denhardt, 2017). Once the stressor has been sufficiently managed, healthy individuals will experience a return to baseline functioning. The human stress response system is well suited for short-term stressors; however, longer-term exposure to stress may overwhelm the stress response system (Lu et al., 2021). This is true of exposures to extreme and overwhelming stress (Beaglehole et al., 2018; McKay et al., 2020), but may also apply to less severe stressors experienced in a modern context, which may have unclear onsets and offsets and have no clear or immediate solutions (Hobfoll, 2004). Less severe yet chronic stressors also have implications for health; for example, occupational stress has been estimated to cost Canadians 2.5 to 9.6 billion dollars annually through lost productivity (Hassard et al., 2018). Excessive life stress is also known to make significant contributions to physical illness, including increased risk for infection, stomach ulcers, heart disease, and cancer (Salleh, 2008). Stress is additionally implicated in the development of nearly every psychological disorder (Harkness & Hayden, 2020), disorders that collectively cost Canadians an estimated 48 billion dollars annually (Mental Health Commission of Canada, 2011). However, it is well established that, despite negative impact of long-term stress exposure, not all exposed to significant stress develop physical or psychological disorders (Selye, 1956). Indeed, there is substantial interindividual variation in individuals' ability to adapt to

stress, and as such, the impact of the stressor on that person. Stress is thought to contribute to mental health disorder through diverse pathways, including biological, cognitive, social, and environmental vulnerabilities (Jackson et al., 2010; Marin et al., 2011; Robins & Block, 1989); these same factors and others may also portend vulnerability to disorder if stress exposure occurs (Haglund et al., 2007; Swartz et al., 2015; Widows et al., 2000). Given the role of stress in the development of disorder, understanding the factors that mediate and moderate relationships between stressors and outcomes is vital for conceptualizing effective preventative interventions.

Interindividual variation in responses to standardized stressors has long been used as a means of assessing vulnerability to stress (i.e., diathesis; Monroe & Simons, 1991; Zuckerman, 1999). Researchers have used standardized stress induction paradigms to this end, linking differences in behavioural and neuroendocrine responses to controlled stressors (Allen et al., 2017; Man et al., 2023) with later mental health outcomes (Daoust et al., 2018; Miller & Kirschbaum, 2019; Zorn et al., 2017). However, while responses to mild acute stressors can be reliably and ethically evoked in a laboratory setting, the ability to study responses to more severe and chronic stressors is constrained in several respects. Studies of chronic or severe stress exposure in humans are necessarily naturalistic, largely centered around individuals who have previously been exposed to extreme adversity (e.g., abuse in childhood, risk of death or serious injury). Meta-analyses of this body of research have found strong associations between exposure to natural disasters (Beaglehole et al., 2018) or childhood trauma (McKay et al., 2020) and later mental disorder. These and other studies (e.g., Juster et al., 2010; McEwen et al., 2017) have proven valuable in identifying the effects of severe and pervasive chronic

stress on health outcomes. However, whether these effects are relevant to individuals exposed to less severe chronic stressors remains unclear. Studies examining adjustment to naturalistic stressors of moderate intensity will contribute to our understanding of how variations in stressor length and intensity may impact individuals' mental health outcomes.

**The COVID-19 Pandemic**

In December 2019, an outbreak of an acute respiratory disease was documented in Wuhan, China. The causal pathogen, SARS-CoV-2, was highly contagious, quickly spreading across international borders and being declared a global health crisis by the World Health Organization on March 12th, 2020 (Ciotti et al., 2020). The resulting "COVID-19 pandemic" was a pervasive global source of stress. The direct effects of the disease included significant and sometimes overwhelming strain on the healthcare system due to COVID-related illness (Czeisler et al., 2020; Verma & Razak, 2021). Further, given the highly contagious nature of the disease, many communities were put into lockdown, with individuals asked to isolate themselves from friends and family living outside of their households (Panda et al., 2021). Business closures during lockdowns also led to concerns about income instability and financial hardship (Mann et al., 2020), while supply chain disruptions and resource hoarding led to significant scarcity of vital resources and personal protective equipment (Alabi & Ngwenyama, 2022; Cohen & van der Meulen Rodgers, 2020). Vaccines to protect against the virus were not publicly available until December of 2020 (Aiello & Forani, 2020), and the COVID-19 pandemic continued to be a global health crisis through March 2023 (World Health Organization, 2023). The COVID-19 pandemic negatively impacted the lives of individuals all over the

world, but also provided a unique opportunity to examine the potential short- and long-term impacts of such pervasive, chronic stress.

### *Psychological Research in the Context of the COVID-19 Pandemic*

The three-year period of the COVID-19 pandemic has been a crisis for both physical and mental health. An estimated 53 million new cases of major depressive disorder and 76 million new cases of anxiety-related disorders developed globally during the COVID-19 pandemic (Santomauro et al., 2021), each with a mid-pandemic prevalence of three-to-four times pre-pandemic rates (Cénat et al., 2021; Santabárbara et al., 2021). Given the novel circumstances, the potential long-term effects of extended isolation and routine disruption on global mental health were unknown (Brooks et al., 2020; Pfefferbaum & North, 2020). However, researchers were also poorly equipped to assess this impact, with extant measures of disaster-related stress failing to account for factors relevant to a modern pandemic (i.e., community lockdowns, increases in digital communication). In the rush to assess individual adjustment during the early weeks of the pandemic, many researchers created new measures that, understandably, lacked psychometric validation, given the limited timeframe for their development. The few measures that were analyzed for their psychometric qualities were often lengthy (e.g., Epidemic-Pandemic Impacts Inventory; Grasso et al., 2020) or of relevance only to specific populations (e.g., the Pandemic Stress Questionnaire, validated for use with youths; Kujawa et al., 2020). The three years since the onset of the pandemic have allowed for significant improvements in the availability of well-characterized assessment tools (e.g., Lotzin et al., 2022; Taylor et al., 2020), although notable gaps in the literature still exist. The continued development of measures of pandemic-related stress that are

psychometrically validated for use with a wider range of vulnerable populations will continue to be important so that researchers are better prepared for future crises.

Looking at broad trends across populations, distress related to the COVID-19 pandemic was relatively short-lived, peaking in the initial months of the pandemic before trending back towards normative levels (Green et al., *in press;* Prati & Mancini, 2021; Robinson et al., 2022). However, effect sizes of COVID-related distress varied substantially between studies (Dragioti et al., 2022; Prati & Mancini, 2021) and specific demographic groups, such as youth, females, and caregivers of children appear to have more negatively impacted than others (Pierce et al., 2020; Sachs et al., 2022). Understanding how pandemic-specific stressors interact with within-person characteristics to predict mental health outcomes is a vital step towards developing effective targeted mental health interventions for those most affected.

## Risk Factors for Maladjustment During the COVID-19 Pandemic

### *Adolescence*

Many mental health problems first onset in adolescence (Jones, 2013), potentially due in part to changes in neural organization, notably in the prefrontal cortex. These changes are associated with decreased impulse control and increased risk-taking behaviour (Best & Bam, 2020), both established vulnerabilities for mental health disorder (Watanabe, 2017). Hormonal changes (e.g., cortisol, testosterone) across adolescent development have also been linked to a wide variety of behavioural and mental health difficulties (Marceau et al., 2015). Adolescence is also a period of significant social change, in which youths begin to assert their independence from caregivers (Ryan & La Guardia, 2000; Sanders, 2013; Steinberg, 1989) and experience greater interpersonal

influence from peers (Brechwald & Prinstein, 2011; Brown, 2004). Increases in interpersonal conflict are observed across social domains during adolescence (Branje, 2018; Laursen & Collins, 1994), alongside increases in youths' perceived importance of these relationships (Crone & Dahl, 2012; Nelson et al., 2016).

Adolescent changes in neural and hormonal functioning, as well as the heightened social sensitivity associated with this developmental stage, are highly relevant to understanding adolescent adjustment during the COVID-19 pandemic. Indeed, pandemic-related disruptions in youths' social functioning (Branje & Morris, 2021) have been linked to increases in their depressive and anxious symptoms (Loades et al., 2020). As significant stress experienced during adolescence may contribute to negative outcomes that persist across the lifespan, understanding the avenues through which pandemic-related stress impacts adolescents' adjustment is vital to making sure that they are appropriately supported during future crises.

### *Caregiving for Children*

Parenting during the COVID-19 pandemic was also associated with substantially increased stress. This assertion is supported by research showing that adults caring for youths were at greater risk for pandemic-related maladjustment than non-caregivers (Panda et al., 2021; Sachs et al., 2022), potentially due to the novel caregiving stressors that emerged during the pandemic. For example, with sudden pandemic-related school closures, caregivers of children were responsible for managing childcare (Kalluri et al., 2021; Lee & Parolin, 2021) and coordinating their children's at-home learning (Abuhammad, 2020; Stites et al., 2021). Mid-pandemic studies showed that home-schooling caregivers reported increased psychological distress (Calear et al., 2022) that

may have had additional negative impacts on parenting (Adams et al., 2021). Other research suggests that caregivers of children may have been more strongly impacted by common pandemic stressors than non-caregivers. For example, although income instability was experienced by many community-dwelling adults during the pandemic, many parents reported that pandemic-related changes to caregiving further interfered with their ability to attend to attend to their occupational responsibilities (Kochhar, 2020). Caregivers struggling to provide for their families may also experience this adversity as threatening to their identity as a caregiver (Kalluri et al.., 2021; Prime et al., 2020). Overall, caregivers reported significant increases in parenting-specific stress throughout the pandemic (Adams et al., 2021), which may account for their greater risk for pandemic-related maladjustment (Panda et al., 2021; Sachs et al., 2022).

***Family Factors***

The context of the family may contribute to maladjustment in its members, especially during the pandemic. Some research has suggested that families functioned as interpersonal supports during lockdowns (Skeens et al., 2023) by reducing loneliness (Bu et al., 2020; Hoffart et al., 2020) and allowing for sharing of emotional experiences (Zhang & Ma, 2020). However, the additional time spent together also increased opportunities for conflict between family members (Günther-Bel et al., 2020; Sinko et al., 2021). During lockdowns, strategies for managing social stress within families (e.g., physical distancing, accessing other social supports) may have been less effective or available (Agha, 2020; Mariani et al., 2020), potentially generating additional stress. Further, given the higher risk of caregivers and youths for the development of anxious and depressive symptoms during the pandemic (Sachs et al., 2022), their own symptoms

may have generated stress for their family members, whether through negative social interactions, concern regarding another's well-being, or increased caretaking responsibilities (Li & Zhou, 2021).

Caregivers' and youths' specific social roles may have further contributed to the transmission of negative emotions within families during the pandemic. Parenting behaviours have a significant and lasting impact on youths' functioning, with harsh or neglectful parenting associated with a variety of negative mental health outcomes in offspring (Clayborne et al., 2020; Keisjer et al., 2020; Khoury et al., 2021; McLeod et al., 2007). As increased personal (Jackson & Choi, 2018) and COVID-specific stress (Chung et al., 2020; Connell & Strambler, 2021; Lee et al., 2022) have been linked to the use of negative parenting strategies, parenting behaviours may function as a pathway through which caregivers' negative adjustment influences youths' well-being. Conversely, youth also likely played a role in shaping their caregivers' adjustment during the pandemic, given research finding that youths' behaviours longitudinally predicted changes in harsh parenting over time (Eisenberg et al., 1999; Kerr et al., 2012). Less directly, youths' personal distress (e.g., physical or mental disorder) can be conceptualized as a social and environmental stressor for caregivers, who may worry about their children and bear responsibility for assisting the youth with symptom management (Li & Zhou, 2021; Scherer et al., 2019).

Overall, distressed caregivers and youths may create reciprocal and negative influences on one another's mental well-being during lockdowns. However, much of the research examining youth-caregiver relationships and adjustment during the pandemic has been cross-sectional or has included a limited number of waves of assessment. To

better understand these potential relationships, longitudinal multiwave research is required.

***Biological Sex***

A large body of pre-pandemic research shows that adolescent and adult females are at greater risk for internalizing problems (e.g., anxious and depressive disorders) while males are at greater risk for externalizing problems (e.g., oppositional defiant disorder; Afifi, 2007). Physiologically, differences in gonadal hormones (i.e., testosterone, estrogen) and genetics (i.e., sex chromosomes) between men and women are known to contribute to changes in the functioning of the physiological stress response system, shaping behavioural responses to stress (Bale & Epperson, 2015). Sex differences have also been identified in the subjective evaluation of stressors, in that males and females may tend to perceive different stressors (e.g., interpersonal, economic) as more (or less) personally salient and therefore more impactful on their functioning (Charbonneau et al., 2009; Hankin et al., 2007; Rudolph, 2002). Further, research indicated that pandemic-specific stressors (e.g., changes in social activity) were perceived as more stressful by women (Ahuja et al., 2020; Prowse et al., 2021; Kangxing et al., 2020), and that stress coping strategies typically used by women (e.g., seeking emotional support from others; Tamres et al., 2002) were less available or effective during community lockdowns. Other research suggested that pandemic-related stressors had a greater direct negative impact on the lives of women than men (Giel, 2021; Laufer & Shechory Bitton, 2021). For example, as Canadian women were more likely than men to take on roles as primary caregivers for their children (Statistics Canada, 2022), they shouldered greater responsibility for managing pandemic-related parenting difficulties,

including managing changes to childcare and their children's education. However, although sex differences in risk for pandemic-related maladjustment have been identified in adults (Sachs et al., 2022), whether adolescent girls were more strongly impacted by stressors stemming from COVID-19 is unclear.

### *HPA Axis Activity*

Individual differences in stress-related hormonal functioning are related to risk for psychological disorder. When an individual perceives a stressor, a cascade of hormonal responses across the hypothalamic-pituitary-adrenal axis, a neuroendocrine system responsible for facilitating the human stress response. These hormonal signals allow the body to mobilize resources to respond to the stressor, including increasing glucogenesis and constricting blood vessels to deliver blood to muscles more quickly (Viblanc et al., 2018) and increasing inflammatory responses to prepare for potential injury or infection (Cruz-Topete et al., 2015). The physiological stress response also results in cognitive changes, including a tendency towards less complex decision-making (Margittai et al., 2015) and improved memory for emotionally charged stimuli (Lupien et al., 2005). Cortisol, a downstream product of HPA axis functioning, circulates through the bloodstream and binds to target tissues (e.g., muscles, liver, amygdala, hypothalamus; Thau et al., 2022) to evoke these physiological and cognitive responses. Cortisol passively diffuses into accessible bodily substrates (e.g., saliva, hair) in concentrations that are well correlated with serum levels (Kirschbaum & Hellhammer, 1989). Given the availability of non-invasive sampling techniques and its role in the physiological stress response, cortisol concentrations can be used to index individual differences in HPA axis functioning (Gunnar & Talge, 2008), and, by extension, sensitivity to stress exposure

(Kirschbaum & Hellhammer, 1989; Kudielka et al., 2009). These physiological differences in cortisol functioning have been linked to mental health outcomes both cross-sectionally (Zorn et al., 2017) and longitudinally (Daoust et al., 2018; Ellenbogen et al., 2011; LeMoult et al., 2015; Morris et al., 2012). Sex differences have also been observed in adolescents' cortisol stress responses (Ordaz & Luna, 2012) and in how their psychophysiological response to stress relates to the development of mental health disorders (Daoust et al., 2018; Mazurka et al., 2017).

While HPA axis activity helps mobilize short-term responses to acute stressors, it can be harmful in the context of a chronic, inescapable stressor (de Kloet et al., 2005; Russell & Lightman, 2019). Long-term exposure to cortisol has neurotoxic effects (de Kloet et al., 1998), impairing immune system responses (Miller et al., 2002) and increasing risk for physical disease (Russell & Lightman, 2019). The adverse biological effects of chronic stress exposure may be a mechanistic pathway through which chronic stress may be linked to the development of disease and psychopathology (Miller et al., 2007). Prolonged HPA axis activation may also impact individual adjustment through cognitive and behavioural pathways such as subjective differences in stress appraisal (Pruessner et al., 1999; van Eck et al., 1996) and coping strategies (Sladek et al., 2016). The effects of chronic stress in human populations are normally explored in the context of significant trauma exposure, especially early in life. However, it is unclear if the psychophysiological effects of such extreme stress exposure (Carpenter et al., 2011; Carrion et al., 2012; Fogelman & Canli, 2018; Heim et al., 2000) would be relevant to less severe, albeit chronic stressors, such as the COVID-19 pandemic.

The COVID-19 pandemic provided a novel opportunity to investigate the impact of less severe, yet long-term, stress exposure. Indeed, while multiple descriptive studies confirmed that self-reported symptoms of post-traumatic stress disorder in community-dwelling individuals were substantially higher than pre-pandemic rates (Karatzias et al., 2020; Liang et al., 2020; Shevlin et al., 2020), most individuals did not meet clinical criteria for trauma exposure. Given this opportunity, thoughtfully designed research can help to elucidate how HPA axis functioning may be prospectively related to individuals' adjustment to moderately severe chronic stressors like the COVID-19 pandemic.

**Overview of this Dissertation**

Substantial effort has been made by the larger scientific community to characterize youths' and caregivers' adjustment to the COVID-19 pandemic. However, given practical constraints to pandemic-related research, there is a dearth of intensive longitudinal studies, especially in samples whose pre-pandemic functioning has been documented. Additional research in this area will improve our understanding of how pre-pandemic factors (e.g., age, biological sex, role as a caregiver, physiological responses to stress) influenced individuals' adjustment to this longer-term stressor, as well as the effects of exposure to chronic stress in populations who are not otherwise at high risk for disorder. Further, exploring how these factors may interact with one another to augment risk for maladjustment will help to build more nuanced predictive models and contribute to our understanding of potential mechanistic pathways that lead to mental health disorders. In this dissertation, I use data from an ongoing longitudinal study of youths and their caregivers to assess and predict community-dwelling youths' and caregivers' adjustment during the early weeks of the COVID-19 pandemic.

### *Study 1: Development and Preliminary Validation of the Pandemic Avoidance and Concern Scales (PACS)*

The COVID-19 pandemic has led to profound and novel stress for individuals and families, but there are few measures available for indexing behavioural responses associated with a modern pandemic. Given the likelihood of future pandemics, validated tools for assessing pandemic-related behaviour relevant to mental health adjustment are needed. This need is especially salient for measures validated for use with families (i.e., caregivers and youths), a demographic which has been disproportionally affected by pandemic-related stress (Sachs, 2022). Toward this goal, I created and provided preliminary validation of the Pandemic Avoidance and Concern Scales (PACS), a brief self-report measure for assessing caregivers' and youths' adjustment to COVID-19 and future pandemics.

### *Study 2: Total Cortisol Output During an Acute Stressor Predicts Youths' Internalizing Symptoms During the COVID-19 Pandemic*

Extant literature indicates that individual differences in acute psychophysiological stress functioning predict adolescents' mental health adjustment in response to normative life stress. While relationships between psychophysiological functioning and youths' adjustment to more severe and chronic stressors (e.g., trauma, disaster) are also apparent, the relevance of premorbid functioning in these contexts remains unclear. As such, I examined whether pre-pandemic cortisol functioning, assessed approximately three years prior to the pandemic, predicted change in adolescents' internalizing symptoms early during the COVID-19 pandemic. Further, I assessed whether sex differences in these relationships, which have previously been observed pre-pandemic, remain relevant in the

context of COVID-19-related stress. Results from this study provide insight into how HPA axis responses to acute stress may shape healthy individuals' adjustment to chronic stress.

***Study 3: Associations between Adolescents' and Primary Caregivers' Internalizing Symptoms During the COVID-19 Pandemic***

While caregivers and youth were each subject to unique stressors generated by the COVID-19 pandemic, it is unclear whether there are associations between youths' and caregivers' symptoms, or whether caregiver symptoms influence the development of youth symptoms (or vice-versa); this information could have important preventative implications. To investigate these potential relationships, I examined whether caregivers' and youths' anxious and depressive symptoms predicted one another across successive two-week intervals during the early weeks of the COVID-19 pandemic. Results from this study highlight pathways through which anxious and depressive symptoms may spread through families during crises.

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# Chapter 2 – Development and Preliminary Validation of the Pandemic Avoidance and Concern Scales (PACS)

## Introduction

The COVID-19 pandemic continues to have a substantial global impact on individuals' psychological well-being, leading to anxiety about financial hardship (Mann et al., 2020), health, increased loneliness (Tull et al., 2020), and general psychological distress (Findlay & Arim, 2020; Li et al., 2021) world-wide. While there are extant measures designed to assess reactions to major stressful life events (e.g., McCubbin et al., 1991; Horowitz et al., 1979) and relatively minor everyday hassles (e.g., Cohen, 1994), the COVID-19 pandemic may be associated with unusual behavioural responses that are not well captured by existing stress measures. For example, unlike other large-scale disasters, the COVID-19 pandemic has led to community lockdowns, social distancing practices, and mandated business closures (Dubey et al., 2020). Despite recent advancements in vaccine technology, complete eradication of the COVID-19 virus may not be possible given widespread infection and genotypic variants (Jabbari & Rezaei, 2020), and future pandemics are likely to increase in both frequency and severity (Tabish, 2020) given recent trends (Castillo-Chavez et al., 2015), current globalization, and governmental policies (Frutos et al., 2020; Tabish, 2020). Thus, given the limited scope of extant stress measures and the strong potential for widespread viral outbreaks in the future, there is a need for measures designed to assess responses to the unique sequalae of pandemics.

Ideally, such measures can assess pandemic-related behavioural responses across a range of ages. While adults are experiencing the aforementioned novel stressors in the

context of the pandemic, the social isolation caused by school closures and community lockdowns may be especially detrimental to youths' short- and long-term mental health (Ellis et al., 2020; Fegert et al., 2020; Magson et al, 2021). School and work closures stemming from the pandemic have also led to increased parenting stress (Brown et al., 2020; Hiraoka & Tomoda, 2020; Spinelli et al., 2020), potentially impairing caregiving which could lead to further youth impairment (Spinelli et al., 2020). Given adolescents' potentially heightened sensitivity to social isolation (Ellis et al., 2020) and the potential for increased stress within locked-down families (Lee et al., 2020), measures that assess the behavioural impact of pandemics on family members who vary in age and developmental stage are needed.

Several groups developed pandemic impact measures early in the pandemic, including the Epidemic–Pandemic Impacts Inventory (EPII; Grasso et al., 2020) and the COVID Stress Scales (Taylor et al., 2020). However, many of these measures were developed for adults and have not been extensively vetted from a psychometric standpoint (i.e., rationally derived, lacking an investigation of factor structure which identifies underlying constructs). Additionally, given that repeated assessment may be needed to capture the dynamic nature of pandemics' impact, these measures may be impractical (e.g., the EPII is over 90 items and therefore may be difficult to integrate into brief assessment batteries). While other measures are brief and developed for use with emerging adults (e.g., Kujawa et al., 2020), these have not been validated for use with both adults and adolescents, and often contain items tapping content less relevant to younger individuals (e.g., younger children may be less aware of financial strain).

*The Current Study*

The current study describes the development the Pandemic Avoidance and Concern Scales (PACS), a relatively brief measure of behavioral and emotional responses to the COVID-19 pandemic, as well as a preliminary assessment of its psychometric properties. While this measure was developed specifically in response to the COVID-19 pandemic, items were designed to assess stress related to any large-scale disease outbreak, and to be developmentally appropriate for a broad age range, including adolescents and adults. With respect to study hypotheses, I predicted that youths' and parents' scores on the PACS would be positively correlated, given that the pandemic was likely to have a somewhat similar impact on members of the same family. I also predicted that the factor structure of the PACS would be similar for adults and adolescents, although this hypothesis was more tentative given the lack of relevant prior research. Finally, given established associations between life stress and internalizing symptoms (Harkness & Monroe, 2016), and given that the PACS was designed to capture disruption and behavioral changes stemming from the pandemic, I predicted that the PACS would be moderately associated with depressive and anxious symptoms in both caregivers and adolescents.

## Methods

### Participants

Participants were caregiver-youth dyads drawn from an ongoing longitudinal study of children's emotional development (N = 409) that began when children were three-year-olds; families have been followed up multiple times over the past 13 years (e.g., Daoust et al., 2020). Families were originally recruited from the community using a combination of local and digital advertisements, as well as contacting individuals in the

Western University participant pool. Children with serious mental or physical problems, as assessed by parent report in an initial screening interview, were ineligible to participate. A proxy measure of children's cognitive ability (i.e., the Peabody Picture Vocabulary Test – Fourth Edition; Dunn & Dunn, 2007), administered when children were 3 years old, showed that participating children were, on average, in the normal range of cognitive ability (M = 113.31, SD = 14.81). Families were representative of the Ontario community from which they were recruited (Statistics Canada, 2017).

Of the original 409 families involved in the study, 301 parent-child dyads (73.6%) participated in the current study focused on family adjustment in response to the COVID-19 pandemic. My research group initiated the first wave of data collection for the current study in March 2020, contemporaneously with local implementation of COVID-19 related public health measures. Participants were recruited on an ongoing basis throughout data collection unless they requested not to be contacted. The current study included twelve waves of data collection, with each wave spaced approximately two weeks apart. Fourteen families (3%) from the original sample dropped out of the larger study prior to the current study, 35 families (9% of the original sample) declined to participate in the current study, and 59 (14% of the original sample) did not respond to invitations to participate.

Wave 6 of data collection, collected in mid-June 2020, was used for scale development as it had the largest cross-sectional sample; 234 primary caregivers (224 mothers; $M_{age}$ = 44.92 years, SD = 4.79) and 223 children (124 girls; $M_{age}$ = 14.34 years, SD = 1.17) completed surveys at this time point, yielding data from 236 families (i.e., 57.7% of the original sample of 409 families provided data for current study analyses).

For an 11-year-long follow-up study, this retention rate is better than expected (Teague et al., 2018). Chi-square and t-tests were used to compare the current subsample to members of original sample who did not participate in this follow-up study; the groups did not significantly different when compared on caregiver or youth age, socioeconomic status, ethnicity, maternal lifetime history of anxious or depressive disorders (assessed via clinical interview; see Vandermeer et al., 2020, for more details), or youths' depressive or anxious symptoms at age 11 (i.e., the most proximal previous assessment wave available; all ps > .05). Data were collected using Qualtrics XM (Qualtrics, USA), with separate individual survey links sent by email to parents and youths to allow for independent self-report.

## Measures

During each wave of data collection, potential PACS items (i.e., those covering pandemic-related concerns and behaviours) were administered first, followed by items assessing pandemic-related stressful events and relevant internalizing symptom measures.

### *Pandemic-related Concerns and Behaviours*

I initially created a pool of 18 items to assess adolescents' and caregivers' responses to the pandemic, 17 of which were ultimately used in the PACS[1]. Items were developed based on theoretical considerations (e.g., individuals may vary in their level of concern about infection), expert opinion, review of item content from existing scales (i.e., EPII; Grasso et al., 2020; Pandemic Stress Questionnaire; Kujawa et al., 2020) and findings from other recent studies that did not focus explicitly on measure development

[1] In developing the item pool, two of the co-authors (E.H. & K.H.) contributed their expertise in the assessment of stressful life events and in the development of depression and anxiety. Another co-author (K.S.) contributed expertise in questionnaire development more specifically.

(i.e., Hawes et al., 2020). Items inquired about pandemic-related concerns (e.g., perceived likelihood of becoming infected with COVID-19) and behaviors (e.g., sanitizing surfaces because of COVID-19), as well as general mental well-being. These items were administered at every wave of data collection (i.e., at Waves 1 through 12), which occurred once every two weeks.

To examine relations between pandemic-related concerns and behavioural change, 25 items covering more stable phenomena (e.g., occupational status/activities, requirements to shelter in place, COVID status of family/friends) were administered once per month (i.e., at Waves 2, 4, 6, 8, 10, and 12 of data collection) to examine associations between the PACS and life events related to the pandemic. All monthly items were completed by the primary caregiver and a subset were also completed by participating youths in cases in which youths were likely to be knowledgeable regarding the item in question (e.g., items related to their own thoughts and behaviour). As these items are causal indicators (i.e., indicators that instantiate or give rise to experiences of life stress) rather than reflective of an underlying construct (Ellwart & Konradt, 2011), I did not expect the life events data to possess a higher-order factor structure. As such, these were excluded from analyses of factor structure and internal consistency.

A full list of questionnaire items used in the present study can be found in Table 2.1. After accounting for the influence of pandemic-related language (i.e., use of the phrases “COVID-19” and “pandemic”, an understanding of which was a prerequisite for participation in my study), post-hoc analyses of readability (Flesch Reading Ease, 73.8; Flesch-Kincaid Grade Level, 6.5) suggested that my measure should be easily comprehended by both adults and adolescent-aged youth.

### *Caregivers' and Youths' Internalizing Symptoms*

Given the large literature showing associations between stressful life events and anxiety and depression (Haig-Ferguson et al., 2021; Harkness & Hayden, 2020), I examined associations between pandemic-related behaviour and caregiver and youth symptom measures completed by the relevant respondent at the selected wave of data collection to assess my measure's predictive validity for emotional adjustment in the context of pandemic-related disruption.

**General Anxiety Disorder-7 (GAD-7).** Caregivers completed the GAD-7 (Spitzer et al., 2006), a brief 7-item self-report measure for indexing symptoms of anxiety in adults. Developed based on criteria for generalized anxiety disorder from the DSM-IV-TR, items include "feeling nervous, anxious, or on edge" and "worrying too much about different things." Participants respond to items on a scale of 0 to 3, reflecting "not at all" to "nearly every day" based on their experiences over the past 2 weeks. Responses are summed into a single overall score; scores of 5, 10, and 15 are recommended as benchmarks of mild, moderate, and severe anxiety respectively. The GAD-7 showed excellent internal consistency ($N = 223$, $\alpha = .90$) in my sample.

**Patient Health Questionnaire-9 (PHQ-9).** Caregivers also completed the PHQ-9 (Kroenke et al., 2001), a brief self-report measure for indexing symptoms of depression in adults. The PHQ-9 has items representing each of the 9 diagnostic criteria for depression in the DSM-IV; items include "little interest or pleasure in doing things" and "feeling down, depressed, or hopeless." Respondents rate items on a scale of 0 to 3, reflecting "not at all" to "nearly every day" based on their experiences over the past two weeks. Responses are summed into a single overall score; scores of 5, 10, 15, and 20 are

recommended as benchmarks of mild, moderate, moderately severe, and severe depression, respectively. 70.4% of caregivers reported minimal symptoms, 19.3% reported mild symptoms, 6% reported moderate symptoms, 1.7% reported moderately severe symptoms, and 2.6% reported severe symptoms. The PHQ-9 showed excellent internal consistency (N = 223, α = .90) in my sample.

**Youth Self-Report (YSR).** The YSR (Achenbach & Rescorla, 2001) was used to assess participating adolescents' emotional and behavioral problems. The YSR is a 105-item self-report measure designed for ages 11 to 18 which describe behaviors related to internalizing and externalizing disorders. Adolescents rated themselves on each item on a scale of 0 ("not true"), 1 ("sometimes true"), or 2 ("very true") based on their experience of the past two weeks; individual items were summed into relevant subscale scores. In in order to limit participant burden, only the anxious/depressed (12 items, α = .90), withdrawn/depressed (8 items; α = .84), and somatic complaints (10 items; α = .80) subscales were administered. The somatic complaints subscale was included given a posited increase in health-related anxiety in youth facing pandemics (Haig-Ferguson et al., 2021).

**Data Analytic Approach**

Exploratory factor analyses (EFAs) were conducted using MPlus version 8 (Muthén & Muthén, 2017) to determine the factor structure of pandemic-related behaviors and beliefs (i.e., Q1 through Q5.8). EFAs were chosen over Confirmatory Factor Analyses (CFAs) as no specific factor structure was hypothesized during model development. Given that individual items had different response formats (e.g., *not at all* to *extremely* for some items, *never* to *many times per day for others*), all items were

transformed into standardized z-scores prior to conducting EFAs. A maximum likelihood estimator was used in all models and an oblique geomin rotation was applied given that emergent factors were expected to be correlated.

To examine the construct validity of the aforementioned items designed to tap pandemic-relevant behaviour, I used bivariate correlations to characterize associations between scales tapping these behaviours and internalizing symptoms and life events impacting the family. Factor analyses were not conducted on items covering stressful life events, which are formative constructs, rather than indicators of a latent construct (Ellwart & Kondrat, 2011). More specifically, these theoretically independent events contribute towards family stress rather than reflecting it as a latent construct. Instead, these were summed to create scale scores of "routine disruption," "income instability," and "COVID exposure" (for a description of these aggregate variables, see Table 2.2).

## Results

### Descriptive Statistics

Descriptive statistics for participating caregivers and youths are in Table 2.3. Participating families were primarily Caucasian (92.4%, African-Canadian = .4%, Asian = 2.1%, Hispanic = 2.5%, Other = 2.5%) and largely middle- to upper-class in socioeconomic status (SES; 3.1% < $20,000, 10.2% = $20,000-$40,000, 26.1% = $40,001-$70,000, 29.6% = $70,001-$100,000, 31.0% > $100,000; annual household income in Canadian Dollars).

In terms of symptoms, 85.1% of youths reported subclinical anxious-depressed symptoms, while 7.2% reported elevated symptoms, and 7.1% reported clinical levels of symptoms. Similarly, 88.7% of youths reported subclinical withdrawn-depressed

symptoms, while 5% reported elevated symptoms, and 6.3% reported clinical levels of symptoms. 90.6% of youths reported subclinical somatic complaints, while 8.1% reported elevated complaints, and 1.3% reported clinical levels of complaints. Means fell below clinical thresholds for the all subscales and means from the anxious-depressed and withdrawn-depressed scales were consistent with prior work involving non-referred normative samples (Achenbach & Rescorla, 2001). The sample mean of somatic complaints scores was elevated but sub-clinical compared to a reference sample (Achenbach & Rescorla, 2001), likely due to normative increases in health-related concern in the context of the pandemic.

Of the caregivers, 70% reported minimal anxious symptoms, 21.5% reported mild symptoms, 5.6% reported moderate symptoms, and 3% reported severe symptoms. 70.4% of caregivers reported minimal depressive symptoms, 19.3% reported mild symptoms, 6% reported moderate symptoms, 1.7% reported moderately severe symptoms, and 2.6% reported severe symptoms. Rates of moderate-to-severe anxious or depressive symptoms in my sample were somewhat lower than those of parents in a comparable, large-scale study (Sequeira et al., 2021); this may be accounted for by the relatively higher socioeconomic status of my sample.

Descriptive statistics for caregivers' and youths' item-level responses are in Tables 2.4 and 2.5. Correlations between item-level responses for caregivers and youths are in Tables 2.6 and 2.7 respectively. The majority of PACS items were significantly correlated with one another, notably within items tapping concern (i.e., Q1 through Q4.3; $M_{correlation}$ = .23, $Range_{correlation}$ = -.03 - .53) and within items tapping avoidance (i.e., Q5.1 through Q5.8; $M_{correlation}$ = .31, $Range_{correlation}$ =.-.01 - .60). Item 3.5 (i.e., called a COVID

helpline or accessed health materials on the internet) was minimally correlated with other PACS items in both the caregiver and youth data.

**Factor structure of pandemic-related behaviours.**

As noted in study hypotheses, I had no reason to anticipate differences between youths and adults in my measure's factor structure. To examine the similarity of the factor structure of pandemic-related behaviors and beliefs between caregivers and adolescents, parallel analyses (Horn, 1965) were used on the EFA-derived factors in each group with principal components using 100 replications of simulated data in each group to inform the number of factors to extract in each dataset (i.e., caregiver and youth); parallel analysis indicated that a maximum of three potential factors could be extracted in the parent data (Figure 2.1) and two in the youths' data (Figure 2.2). The third potential factor in the parents' data consisted of only three items reflecting purchases during the pandemic, which I felt was not a clearly interpretable construct; thus, I focused on the more parsimonious and interpretable two-factor solutions in data from youths and caregivers.

The results of the EFA suggested that an overall two-factor model of: 1) Pandemic Concern (Q1 through Q4.3 and Q5.6) and 2) Pandemic Avoidance (Q5.1 through Q5.5, Q5.7, and Q5.8) best reflected the structure of parent and youth data, leading us to call this measure the Pandemic Avoidance and Concern Scales (PACS). Item Q3.5 was excluded from conducted EFAs as it was not associated with any factor in the parent data and had no variance in youth data. The inter-factor correlation was .30 and .26 in the parent and youth data, respectively.

See Table 2.8 for the identified two-factor structure of the biweekly questionnaire data for both parents and youth. In both caregivers and youths, items assessing anxious anticipation of pandemic-related dangers loaded moderately to strongly onto Factor 1 (Concern; $M_{loading}$ = .47; $Range_{loadings}$ = .15 - .86), while items assessing avoidance of physical locations and social activities that may increase the risk for catching COVID loaded moderately to strongly onto Factor 2 (Avoidance; $M_{loading}$ = .63; $Range_{loadings}$ = .27 - .86). In the parent data, item Q3.4 (i.e., checked self for symptoms) did not load significantly on either factor, while item Q5.6 (i.e., avoided touching face) loaded significantly on both factors, albeit more strongly on the Concern factor. In the youth data, items Q2 (i.e., perceived chance of infection) and Q3.2 (i.e., purchased extra food/drink) did not load significantly on either factor. Despite these suboptimal loadings, items which loaded onto a factor in at least one subsample were retained and attributed to the factor with which they loaded most strongly to allow for a unified measure between caregivers and youths. Cronbach's alpha and McDonald's omega for Caregiver Concern (9 items; $\alpha$ = .73, $\omega$ = .7), Caregiver Avoidance (8 items; $\alpha$ = .79, $\omega$ = .80), and Youth Avoidance (8 items; $\alpha$ = .82, $\omega$ = .83) indicated acceptable internal consistency for the item sets identified as reflecting each resulting factor, but the Cronbach's alpha for Youth Concern (9 items; $\alpha$ = .69, $\omega$ = .71) fell slightly short of traditional cut-offs for acceptable internal consistency. The identified factor structures for parent and youth data appeared consistent, with 14 of 17 items having significant primary loadings on the same factor (e.g., Q1 assessing disease-related concern loaded moderately strongly onto the Concern factor and very weakly onto the Avoidance factor in both the parent and youth data). I formally evaluated the similarity of factor loadings in youths and caregivers using

Tucker's congruence coefficients, in which coefficients ≥ .90 indicate strong similarity in factor loadings (Lorenzo-Seva & ten Berge, 2006). These analyses indicated that factors loadings were very similar across caregiver and youth subsamples for both the Concern ($r$ = .93) and Avoidance ($r$ = .96) factors.

**Correlations between the PACS and other study variables.**

See Table 2.9 for correlations between major study variables. Concern and Avoidance scores were unrelated to demographic variables, with the exception of girls reporting greater concern than boys. Notably, caregiver Concern and Avoidance were positively, weakly-to-moderately correlated with both caregiver anxiety and depression symptom measures, but not youth symptoms. Youth Concern was significantly, weakly positively related to all youth symptom scales, while youth Avoidance was not. The number of individuals that caregivers contacted in person or over technology was not significantly related to their own reports of Concern or Avoidance, but the number of people caregivers contacted in person was positively correlated with youths' reported Concern. Parents' Concern was negatively correlated with the number of individuals youths saw in person, and positively correlated with the number of individuals youths contacted via technology; youths' own Concern was only correlated with the number of people they contacted via technology. Inter-item correlations for the PACS (i.e., item-level responses at Wave 6) are in Tables 2.6 and 2.7 respectively; patterns of correlations indicate significant relationships within groups of items contributing to the Concern and Avoidance factors. Correlations between PACS scores at the two largest waves of data collection are in Table 2.10, and correlations between item-level responses to the PACS at the two largest waves of data collection are in Tables 2.11 and 2.12. Patterns of

correlations indicate significant relationships for item-level responses and scale scores between Waves 6 and 7 of the study (i.e., a two-week gap between administrations).

## Discussion

I developed and examined the psychometric properties of a measure of parents' and youths' behaviour during the COVID pandemic. Although pandemics appear to be increasing in frequency, a trend that will likely continue, there are few extant measures designed to assess behaviour specifically in response to the unique context of a pandemic; those that do exist have received limited psychometric scrutiny, been developed for either youth or adults (e.g., Kujawa et al., 2020), and may be unsuitable for examining behaviour over time, given their length (e.g., Grasso et al., 2020). Thus, measures of pandemic-related behaviour with formally evaluated factor structures are needed to guide assessment efforts when administering caregiver and youth measures. My results suggest that a two-factor structure of concern and avoidance behaviors related to COVID yields scales with good psychometric properties in both youths and adults and shows that these factors are related to extant measures of parent and youth symptoms in a meaningful way.

As hypothesized, parent and offspring PACS scores were moderately correlated, indicting similarity in parent-child dyads in terms of experiences and behavioral changes related to the pandemic. Relatedly, the factor structure of the PACS was similar in adults and adolescents. I intended to design PACS items that would be useful across a relatively wide developmental range, and increases in autonomy observed in adolescence (Helwig, 2006) may have allowed for youth to display more of the "adult-like" active coping behaviours assessed by the PACS (e.g., purchasing products, avoiding activities). While

further validation efforts are needed, my findings suggest that the PACS is valid when used with both adults and adolescent-aged participants.

My results suggest that the PACS scales were related to maladaptation in community-dwelling families. Specifically, I found that caregivers' and youths' concern (as measured by the PACS) were correlated with their internalizing symptoms, as were caregivers' avoidance behaviors. While these correlations are significant, the proportion of shared variance suggests a degree of predictive and discriminant validity, in that symptom measures (i.e., anxiety and depression) are related to, but not redundant with, the Concern and Avoidance factors. This is unsurprising given that most measures of anxiety and depression emphasize depressive or anxious cognitions and somatic symptoms, whereas PACS items focus on the frequency of pandemic-relevant behaviours that may predict the development of anxious and depressive symptoms.

Results also indicate that common pandemic-related stressors may differentially affect parent and youth adjustment. For example, examining aggregate measures of life stress, parent-reported routine disruption and COVID exposure were significantly correlated with parent-reported Concern and Avoidance respectively, while income instability was related to youth Concern. However, given that the more general measures of life stress were completed by caregivers only, these items should be expected to be more strongly related to caregivers' symptoms. Developing a better understanding of individuals' experience of stress during the pandemic, as well as how these relationships might differ within families, may inform preventative efforts during future pandemics; for example, parents' PACS Concern was associated with youths' self-reported in-person social activity during COVID. Although examining causal relationships between stress

and other factors is beyond the scope of the current study, this pattern suggests that targeting parental concern may enhance social distancing practices in youth.

To the best of my knowledge, this study is the first to create a parallel measure of pandemic-related adjustment for caregivers and youth. While some measures are designed to allow multi-informant assessment of individuals' adjustment, parallel measures allow for comparison of behaviors between groups (e.g., Radloff, 1991; Whiteside-Mansell & Corwyn, 2003). My creation of a parallel measure for caregivers and youth will better equip studies to speak to the potential influence of parental behaviors and beliefs about the pandemic on children's adjustment. Further, given the understandably short development time of many measures created to assess adjustment during the COVID-19 pandemic, a limited number of existing measures have had their psychometric properties assessed. Having a measure of familial adjustment with an established factor structure will enhance the rigor of future studies of adjustment during future waves of COVID and other pandemics. The relative brevity of the PACS also enhances its utility as a minimally burdensome assessment tool, which is especially important in the context of the stress of a global crisis.

Based on parallel analysis, there was a slight discrepancy in the number of indicated factors between the caregiver and the youth data, with a possible third factor in the parent data consisting of items covering the purchase of supplies. In parallel analysis of caregivers' data, this third factor could be interpreted as "stockpiling," although it may simply function as a proxy measure of socioeconomic status (i.e., the ability to afford to stockpile goods), especially considering its significant negative correlation with parent-reported income instability. While descriptive statistics show variance in these

"stockpiling" items in both caregivers and youths (see Tables 2.4 and 2.5), youths are likely less responsible than their caregivers for purchasing goods in their households, which may have resulted in lower endorsement of these items, resulting in the lower alpha of the PACS Concern scale in adolescents. However, retaining a two-factor structure in both parents and youth enhanced parsimony and additional analyses showed high factor congruence between subsamples when using the two-factor model. I further note that, while a unified factor structure provides significant utility when examining patterns of association between caregiver and youth behaviors, I cannot assume that comparisons of mean adult and adolescent Concern and Avoidance are valid, based on current study data. Due to my relatively small sample, I was unable to test measurement invariance in my factors, whether within individuals across time or between parents and children, an important direction for future research. Similarly, my sample size was too small to partition my data for follow-up CFAs to further evaluate identified factor structures.

While my choice to develop a pandemic-related assessment tool during a global crisis should enhance the validity of my measure, it also led to several methodological difficulties. I chose to limit the length of my measure to minimize the burden on the participants during this period of high stress, as well as to increase its utility in a repeated measures study design. While its relative brevity makes the PACS an effective tool in meeting these goals, the need for brevity limited my ability to develop a more comprehensive measure based on a large item pool. In a less stressful and time-sensitive context, initially piloting my scale with a larger pool of items would have allowed us to select items for the final scale which most closely related to constructs of interest.

Similarly, I did not include distractor or attentional items to minimize participant burden during a high-stress period, which meant that I could not examine these indices of validity. Future studies including the PACS may wish to include distractor or attentional items to increase confidence in collected data, especially when used in the context of a repeated-measures study. I also acknowledge that my data was collected in an ethnically homogenous, relatively high socioeconomic status community with a low proportion of individuals meeting criteria for moderate-to-severe clinical symptoms, which may limit the generalizability of my findings. Indeed, larger studies investigating larger samples have found elevated levels of COVID-related psychosocial impairment in families with lower-income, parental mental illness, and children with pre-existing physical or mental health challenges (Tso et al., 2020). Future studies with a wider catchment area may wish to investigate these demographic factors as moderators of children's adjustment. Further, while COVID and its societal impact has reached communities worldwide, cases of COVID in my sample community were relatively limited at this point in data collection. As such, the factor structure of my questionnaire may differ depending on the demographics of a target sample, as well as the severity of the impact of COVID in that community. Within my own sample, the relatively limited sample size also prevented us from splitting my sample to conduct a complementary confirmatory factor analysis (CFA) on my proposed factor structure. In future studies, researchers interested in further validating the psychometric properties of the PACS may wish to recruit a larger size or to involve a second independent sample of participants for comparison.

While many pandemic-related stressors (i.e., lockdowns, social distancing, resource scarcity) were novel, these stressors are likely to occur in future pandemics. The

PACS is constructed such that the text “COVID-19” can be replaced with other diseases and may be edited accordingly for use in future pandemics (Castillo-Chavez et al., 2015; Frutos et al., 2020; Tabish, 2020). However, given that the psychometric properties of my measure were only assessed in the context of COVID-19, I cannot be sure that the factor structure will remain consistent in the face of other social or disease stressors. Future research involving the PACS in other contexts should using confirmatory factor analysis to further validate its factor structure.

In conclusion, I developed a measure designed to assess pandemic-related stress in youth and parents. Avoidance and concern factors were found in both youth and adults; these factors were meaningfully correlated with internalizing symptoms and the impact of COVID-19 on households.

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Tables

**Table 2.1.** P*andemic Avoidance and Concern Scales (PACS) Questionnaire Items*

| Item Designation | Item Text | Response Options |
|---|---|---|
| *Biweekly Items* | | |
| Q1 | How concerned have you been about the coronavirus (COVID-19) during the past two weeks? | 0 - Not at all<br>1 - A little bit<br>2 - Moderately<br>3 - Quite a bit<br>4 - Extremely |
| Q2 | How likely do you think it is that you could become infected with the coronavirus (COVID-19)? | |
| Q3 | *During the past two weeks, which of the following behaviours have you engaged in due to the coronavirus (COVID-19) pandemic? (check all that apply)* | |
| Q3.1 | Purchased hygiene products (e.g., Purell, disinfectant spray/wipes, hand soap) | 0 - No<br>1 – Yes |
| Q3.2 | Purchased extra food and/or beverages | |
| Q3.3 | Purchased extra health and/or beauty aid products (e.g., toilet paper, toothpaste) | |
| Q3.4 | Checked your body for signs of illness (e.g., taken temperature) | |
| Q3.5 | Called a helpline or accessed health materials on the internet for information | |
| Q4 | *During the past two weeks, how often have you done the following things due to the coronavirus (COVID-19) pandemic?* | |
| Q4.1 | Checked the news (newspaper, online, phone, TV) for updates on COVID-19 | 0 – Never<br>1 - Several times a week<br>2 - Once a day/daily<br>3 - Several times a day<br>4 - Many times a day |
| Q4.2 | Used a hygienic product (e.g., Purell/hand sanitizer, disinfectant spray/wipes, washed hands for much longer than usual with soap) as a precaution for COVID-19 | |
| Q4.3 | Cleaned surfaces (e.g., doorknobs, keyboards, cell phones) as a precaution for COVID-19 | |

| | | |
|---|---|---|
| Q5 | *During the past two weeks, how often did you purposely avoid the following activities because of the coronavirus (COVID-19) pandemic?* | |
| Q5.1 | Avoided going to work or school | 0 - Never or Not Applicable<br>1 - Once or twice<br>2 - Three or four times<br>3 - Every day |
| Q5.2 | Avoided public places (e.g., grocery store, restaurants, shops, gym) | |
| Q5.3 | Avoided social activities (e.g., visiting friends, clubs, extracurricular activities | |
| Q5.4 | Avoided going on a date with a friend or partner | |
| Q5.5 | Avoided public transportation (e.g., airplane, train, bus, subway) | |
| Q5.6 | Avoided touching my face | |
| Q5.7 | Avoided touching another person (e.g., shaking hands, hugging, kissing) | |
| Q5.8 | Avoided going to the doctor or hospital | |
| Q5.9 | *If you avoided any of the activities listed above, why (check all that apply)?* | 0 - No<br>1 – Yes |
| Q5.9.1 | I was concerned about being infected | |
| Q5.9.2 | I was concerned about infecting other people | |
| *Monthly Items* | | |
| MQ1 [a] | Think about your life circumstances prior to the COVID-19 pandemic, or what your life is usually like. Compared to your typical life, to what extent has the COVID-19 pandemic changed your life circumstances during the past month? Consider both positive and negative changes in making your rating. | 0 - Not at all; the COVID-19 pandemic has not impacted my life in the last month<br>1 - A little; the COVID-19 pandemic had a small impact on my life this past month<br>2 - Moderate; the COVID 19 pandemic has moderately changed my life this past month<br>3 - Quite a bit; the COVID-19 pandemic has had a strong impact on my life this past month |

| | | |
|---|---|---|
| | | 4- Extreme; the COVID-19 pandemic has had an extremely strong impact on my life this past month |
| MQ2 [a] | Again, think about your life circumstances prior to the COVID-19 pandemic, or what your life is usually like. Generally speaking, how do you feel about these changes that COVID-19 has brought to your life during the past month? | -4 - Extremely negative; all the changes to my life due to COVID-19 are extremely undesirable<br>-3 - Very negative<br>-2 - Moderately negative<br>-1 - A little bit negative<br>0 - Neutral; either no changes occurred due to COVID-19 this past month or the changes were a mix of welcome and unwelcome changes<br>1 - A little bit positive<br>2 - Moderately positive<br>3- Very much Positive<br>4 - Extremely positive; all the changes to my life due to COVID-19 are extremely welcome or positive |
| MQ3 [a] | *During the past month, have you or others living in your home been impacted by the COVID-19 pandemic in any of the following ways? When relevant, you can indicate that something happened to both yourself and someone else in the home by selecting BOTH 'a' and 'b'* | 0 - No / Not applicable<br>1 - Yes |
| MQ3.1 [a] | Your child(ren)'s school/classes moved to online instruction. | |
| MQ3.2 [a] | Change of residence | |
| MQ3.3 [a b] | Shelter in place (avoiding leaving the house, except to be outdoors) | 0 – No / Not applicable<br>1 – Yes, this happened to another person/people in my home<br>2 – Yes, this happened to me<br>3 – Yes, this happened to me AND another person/people in my home |
| MQ3.4 [a b] | Self-quarantine (completely avoiding contact with other people) | |
| MQ3.5 [a b] | Job/occupation/work moved to at home/remote/online | |
| MQ3.6 [a b] | Reduced hours or laid off from work | |
| MQ4.1 [a b] | Had to work even though in close contact with people who might be infected (e.g., customers, patients, co-workers). | |

| | | |
|---|---|---|
| MQ4.2 [a] [b] | Hard time doing job well because of needing to take care of people in the home. | |
| MQ4.3 [a] [b] | Job entailed providing care of any kind to people with COVID-19 (e.g., physician, nurse, support staff, custodial). | |
| MQ4.4 [a] [b] | Had to take over teaching or instructing a child (or children) at home due to COVID-19. | |
| MQ4.5 [a] [b] | Did not have the ability or resources to talk to family or friends while separated. | |
| MQ4.6 [a] [b] | Unable to access medical care for a serious condition (e.g., dialysis, chemotherapy). | |
| MQ5 [a] | In the past month, have you been tested for coronavirus (COVID-19)? | 0 - No<br>1 - Yes |
| MQ5.1 [a] | If yes, what was the result of the test? | 0 - Negative<br>1 - Do not know<br>2 - Positive |
| MQ6 [a] | In the past month, has your child (the one in our study) been tested for coronavirus (COVID-19)? | 0 - No<br>1 - Yes |
| MQ6.1 [a] | If yes, what was the result of the test? | 0 - Negative<br>1 - Do not know<br>2 - Positive |
| MQ7 [a] | In the past month, do you know anyone who has tested positive for coronavirus (COVID-19)? | 0 - No<br>1 - Yes |
| MQ7.1 [a] [b] | If yes, who (check all that apply)? | 1 point each – Family member, romantic partner, friend, roommate, co-worker, other (please specify) |
| MQ8 [a] | In the past month, have you or has anyone close to you been hospitalized due to coronavirus (COVID-19)? | 0 - No<br>1 - Yes |
| MQ8.1 [a] [b] | If yes, who (check all that apply)? | 1 point each – Family member, romantic partner, friend, roommate, co-worker, other (please specify) |
| MQ9 [a] | In the past month, has anyone close to you died due to coronavirus (COVID-19)? | 0 - No<br>1 - Yes |

| | | |
|---|---|---|
| MQ9.1 [a b] | If yes, who (check all that apply)? | 1 point each – Family member, romantic partner, friend, roommate, co-worker, other (please specify) |
| MQ10 [a c] | What is your current occupational status (check all that apply)? | 1 - Temporarily unemployed due to COVID or Laid-off/fired due to COVID.<br>0 - Other (i.e., current student (college), current student (high school), full-time employed and going to work, full-time employed and working from home, work part-time and going to work, work part-time and working from home, unemployed prior to coronavirus outbreak) |
| MQ11 | Over the past month, how much privacy do you have? | 2 – Much more privacy than I want / Much less privacy than I want<br>1 – A little more privacy than I want / A little less privacy than I want<br>0 – Just as much privacy as I want |
| MQ12 [c] | During the past week, approximately how many people each day did you interact with in person (i.e., not through use of technology)? If you did not interact with anyone in person, enter 0. | 0 – 0-2 individuals<br>1 – 3-4 individuals<br>2 – 5-7 individuals<br>3 – 8-10 individuals<br>4 – 11+ individuals |
| MQ13 [c] | During the past week, approximately how many people each day did you interact with via technology (e.g., call, text, FaceTime, Skype)? If you did not interact with anyone via technology, enter 0. Do NOT include people you also saw in person. For example, if you texted your child while also seeing them at home, do not include them in your count. | |
| MQ14 | During the past month, has the coronavirus affected how emotionally close you and others living in your home feel toward one another? | 2 - We feel much closer to each other<br>1 - We feel somewhat closer to each other |

| | | |
|---|---|---|
| | | 0 - No change - we are as close as before<br>-1 - We feel somewhat less close to each other<br>-2 - We feel much less close to each other |
| MQ15 | During the past month, has the coronavirus affected the degree to which there is conflict among people living in your home? | 2 - There is much less conflict/problems<br>1 - There is somewhat less conflict/problems<br>0 - There has been no change in the degree of conflict or problems<br>-1 - There is somewhat more conflict/problems<br>-2 - There is much more conflict/problems |
| MQ16 [a] | During the past month, do you have enough food or basic household items (e.g., soap, toilet paper)? | 2 – Yes<br>1 – We have enough of some things but are lacking others<br>0 - No |
| MQ17 [a] | During the past month, have you experienced or are you expecting a substantial reduction in personal or family income? | 3 – No change or an increase<br>2 – Don't know<br>1 – Yes, some reduction<br>0 – Yes, substantial reduction |
| MQ17.1 [a] | If you chose a or b (i.e., you expect a reduction in income), how will this affect you, now or in the future? | 4 – Not at all<br>3 – Slight effect<br>2 – Moderate effect<br>1 – Strong effect<br>0 – Extremely strong effect |

Note: "COVID-19" and "coronavirus" can be swapped to a proximal disease event if needed in future studies. All items were translated to z-scores before entry into EFAs. [a] indicates questions were asked to caregivers only. [b] indicates items recoded as scores summed across multiple checked items. [c] indicates items recoded as categorical variables.

**Table 2.2.** *Monthly Questionnaire Items and Descriptive Statistics Contributing to Aggregate Variables*

| Item Designation | Item Text | *M* | *SD* | Range |
|---|---|---|---|---|
| *Routine Disruption* | | | | |
| MQ3.1 | Child's school moved to online instruction | .990 | .093 | 0 – 3 |
| MQ3.2 | Change of residence | .020 | .145 | 0 – 3 |
| MQ3.3 | Shelter in place | 1.517 | 1.223 | 0 – 3 |
| MQ3.4 | Self-quarantine | .551 | 1.031 | 0 – 3 |
| MQ4.4 | Had to take over teaching or instructing a child at home | 1.681 | .973 | 0 – 3 |
| MQ4.5 | Wasn't able to see friends | .055 | .314 | 0 – 3 |
| MQ11 [a] | Dissatisfaction with privacy | 1.360 | .482 | 0 – 2 |
| *Income Instability* | | | | |
| MQ3.5 [b] | Job/occupation/work moved to at home/remote/online | 1.440 | 1.083 | 0 – 3 |
| MQ3.6 | Reduced hours or laid off from work | .852 | 1.011 | 0 – 3 |
| MQ4.2 | Difficult to do job because of changes at home | .964 | 1.095 | 0 – 3 |
| MQ10 | Job loss on account of pandemic | .164 | .371 | 0 – 1 |
| MQ16 [b] | Enough food/resources | .030 | .243 | 0 – 2 |
| MQ17 | Substantial change in income | .860 | 1.123 | 0 – 3 |
| MQ17.1[c] | Impact of income reduction | .350 | .775 | 0 – 4 |
| *COVID Exposure* | | | | |
| MQ4.1 | Had to work in contact with people who might have pandemic disease | .787 | .989 | 0 – 3 |
| MQ4.3 | Job entails caretaking for people with pandemic disease | .133 | .476 | 0 – 3 |
| MQ5 | Was tested for pandemic disease | .030 | .182 | 0 – 1 |
| MQ5.1[c] | Results of pandemic disease test | .010 | .085 | 0 – 2 |
| MQ6 | Child was tested for pandemic disease | 0 | 0 | 0 – 1 |
| MQ6.1[c] | Result of child's pandemic disease test | 0 | 0 | 0 – 2 |
| MQ7 | Know someone who tested positive for pandemic disease | .180 | .385 | 0 – 1 |
| MQ8 | Know someone who was hospitalized for pandemic disease | .030 | .171 | 0 – 1 |
| MQ9 | Know someone who had died from pandemic disease | .010 | .092 | 0 – 1 |
| MQ12 | How many people interacted with in-person | 1.917 | 1.363 | 0 – 4 |

Note: All items were translated to z-scores before summed into aggregate items. [a] indicates items recoded to reflect overall dissatisfaction, [b] indicates reverse-coded items, [c] indicates items that were offered to participants only if they had endorsed a previous relevant item and were scored as 0 if not offered.

**Table 2.3.** *Descriptive Statistics for Major Study Variables*

| Variable | Mean | (SD) | Range | Skewness | Kurtosis |
|---|---|---|---|---|---|
| Youth Age | 14.72 | (.41) | 13.92 – 15.68 | .25 | -.80 |
| Caregiver's Age | 44.76 | (4.83) | 32.35 – 61.11 | .14 | .52 |
| PPVT (Baseline) [a] | 113.31 | (14.81) | 59 – 147 | -.38 | .31 |
| Family Income [b] | 3.75 | (1.10) | 0 – 4 | .54 | -.48 |
| YSR Anxious/Depressed [c] | 5.06 | (5.13) | 0 – 22 | 1.14 | .72 |
| YSR Withdrawn/Depressed [c] | 3.35 | (3.27) | 0 – 16 | 1.35 | 1.99 |
| YSR Somatic Complaints [c] | 2.54 | (3.00) | 0 – 13 | 1.34 | 1.18 |
| Caregiver GAD-7 [d] | 3.77 | (4.03) | 0 – 21 | 1.77 | 3.66 |
| Caregiver PHQ-9 [e] | 3.91 | (4.70) | 0 - 23 | 1.97 | 4.15 |

[a] Standard Score on the Peabody Picture Vocabulary Test – Fourth Edition (Dunn & Dunn, 2007)
[b] 1 = < $20,000, 2 = $20,000-$40,000, 3 = $40,001-$70,000, 4 = $70,001-$100,000, 5 = > $100,000; all in Canadian dollars.
[c] Subscale Score on the Youth Self-Report (Achenbach & Rescorla, 2001)
[d] Total Score on the General Anxiety Disorder-7 (Spitzer et al., 2006)
[e] Total Score on the Patient Health Questionnaire-9 (Kroenke et al., 2001)

**Table 2.4.** *Descriptive Statistics for Caregivers' Item-Level Responses to the Pandemic Avoidance and Concern Scales (PACS) Questionnaires at Wave 6*

| | | Caregivers' Responses | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Item Designation | Item Summary | *M* | *SD* | Response Frequencies | | | | |
| | | | | 0 | 1 | 2 | 3 | 4 |
| Q1 | Concern about COVID-19 | 1.56 | .84 | 19 | 98 | 88 | 26 | 3 |
| Q2 | Belief in chance of infection | 1.30 | .79 | 24 | 135 | 56 | 15 | 3 |
| Q3.1 | Purchased hygiene products | .44 | .50 | 130 | 104 | - | - | - |
| Q3.2 | Purchased extra food/drink | .29 | .45 | 167 | 67 | - | - | - |
| Q3.3 | Purchased extra health products | .13 | .34 | 203 | 31 | - | - | - |
| Q3.4 | Checked body for illness | .18 | .38 | 193 | 41 | - | - | - |
| Q3.5 | Accessed information about COVID-19 | .04 | .19 | 225 | 9 | - | - | - |
| Q4.1 | Checked the news | 1.77 | 1.00 | 20 | 76 | 90 | 34 | 14 |
| Q4.2 | Used a hygienic product for COVID-19 | 2.51 | 1.19 | 9 | 54 | 30 | 86 | 52 |
| Q4.3 | Cleaned surfaces for COVID-19 | 1.45 | 1.04 | 34 | 109 | 55 | 23 | 13 |
| Q5.1 | Avoided work/school | .31 | .86 | 201 | 7 | 6 | 18 | - |
| Q5.2 | Avoided public places | 1.30 | 1.04 | 65 | 68 | 65 | 35 | - |
| Q5.3 | Avoided social activities | 1.51 | 1.30 | 82 | 35 | 32 | 84 | - |
| Q5.4 | Avoided dates | 1.13 | 1.33 | 120 | 28 | 13 | 69 | - |
| Q5.5 | Avoided public transportation | 1.33 | 1.48 | 124 | 4 | 0 | 100 | - |
| Q5.6 | Avoided touching face | 1.83 | 1.12 | 32 | 67 | 41 | 92 | - |
| Q5.7 | Avoided touching another person | 2.03 | 1.13 | 33 | 44 | 36 | 118 | - |
| Q5.8 | Avoided doctor/ hospital | .80 | 1.24 | 151 | 27 | 1 | 52 | - |

Note: Response frequencies marked as "-" when response choices were not available to participants. For the full text of each item, refer to Table 2.

**Table 2.5.** *Descriptive Statistics for Youths' Item-Level Responses to the Pandemic Avoidance and Concern Scales (PACS) Questionnaires at Wave 6*

| | | Youths' Responses | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Item Designation | Item Summary | *M* | *SD* | Response Frequencies | | | | |
| | | | | 0 | 1 | 2 | 3 | 4 |
| Q1 | Concern about COVID-19 | 1.11 | .89 | 60 | 93 | 57 | 11 | 2 |
| Q2 | Belief in chance of infection | 1.03 | .83 | 54 | 121 | 37 | 6 | 4 |
| Q3.1 | Purchased hygiene products | .26 | .44 | 163 | 56 | - | - | - |
| Q3.2 | Purchased extra food/drink | .25 | .43 | 164 | 55 | - | - | - |
| Q3.3 | Purchased extra health products | .12 | .32 | 193 | 26 | - | - | - |
| Q3.4 | Checked body for illness | .17 | .38 | 181 | 38 | - | - | - |
| Q3.5 | Accessed information about COVID-19 | .01 | .10 | 217 | 2 | - | - | - |
| Q4.1 | Checked the news | .93 | 1.00 | 94 | 67 | 47 | 7 | 6 |
| Q4.2 | Used a hygienic product for COVID-19 | 1.99 | 1.22 | 26 | 63 | 45 | 65 | 24 |
| Q4.3 | Cleaned surfaces for COVID-19 | .77 | .97 | 111 | 67 | 31 | 6 | 6 |
| Q5.1 | Avoided work/school | .34 | .91 | 192 | 7 | 1 | 22 | - |
| Q5.2 | Avoided public places | .95 | 1.22 | 122 | 36 | 17 | 47 | - |
| Q5.3 | Avoided social activities | .87 | 1.18 | 128 | 32 | 20 | 40 | - |
| Q5.4 | Avoided dates | .80 | 1.26 | 149 | 11 | 7 | 49 | - |
| Q5.5 | Avoided public transportation | .86 | 1.35 | 154 | 3 | 0 | 62 | - |
| Q5.6 | Avoided touching face | 1.18 | 1.06 | 70 | 73 | 38 | 36 | - |
| Q5.7 | Avoided touching another person | 1.33 | 1.27 | 87 | 39 | 30 | 65 | - |
| Q5.8 | Avoided doctor/ hospital | .75 | 1.29 | 159 | 4 | 0 | 53 | - |

Note: Response frequencies marked as "-" when response choices were not available to participants. For the full-text of each item, refer to Table 2.

**Table 2.6.** *Correlations Between Caregivers' Item-Level Responses to The Pandemic Avoidance and Concern Scales (PACS) Questionnaires at Wave 6*

| | **Caregivers' Responses** | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q2 | Q3.1 | Q3.2 | Q3.3 | Q3.4 | Q3.5 | Q4.1 | Q4.2 | Q4.3 | Q5.1 | Q5.2 | Q5.3 | Q5.4 | Q5.5 | Q5.6 | Q5.7 | Q5.8 |
| Q1 | .50** | .32** | .29** | .16* | .24** | .21** | .36** | .34** | .22** | .04 | .32** | .20** | .13* | .10 | .35** | .14* | .02 |
| Q2 | - | .15* | .14* | .07 | .24** | .18** | .16* | .26** | .25** | -.02 | .21** | .11 | .14* | .05 | .33** | .15* | -.05 |
| Q3.1 | | - | .35** | .29** | -.03 | .05 | .22** | .26** | .33** | .04 | .05 | .06 | -.05 | .08 | .23** | .17* | .03 |
| Q3.2 | | | - | .53** | .08 | .02 | .28** | .10 | .16* | .07 | .20** | .15* | .11 | .10 | .14* | .19** | .22** |
| Q3.3 | | | | - | .12 | -.01 | .23** | .15* | .16* | .08 | .14* | .07 | .06 | -.04 | .07 | .11 | .16* |
| Q3.4 | | | | | - | .14* | .12 | .17** | .11 | .07 | .13 | .05 | -.01 | -.06 | .26** | .12 | -.04 |
| Q3.5 | | | | | | - | .02 | .05 | .06 | .06 | .09 | -.01 | .06 | -.03 | .11 | .05 | .03 |
| Q4.1 | | | | | | | - | .31** | .19** | .09 | .17** | .13* | .10 | .20** | .18** | .15* | .14* |
| Q4.2 | | | | | | | | - | .52** | <-.01 | .08 | .11 | .07 | .16* | .38** | .23** | .07 |
| Q4.3 | | | | | | | | | - | -.01 | .14* | .12 | .20** | .21** | .34** | .26** | .14* |
| Q5.1 | | | | | | | | | | - | .27** | .19** | .14* | .10 | <.01 | .03 | .17** |
| Q5.2 | | | | | | | | | | | - | .55** | .45** | .41** | .27** | .29** | .31** |
| Q5.3 | | | | | | | | | | | | - | .65** | .49** | .26** | .39** | .38** |
| Q5.4 | | | | | | | | | | | | | - | .60** | .14* | .33** | .50** |
| Q5.5 | | | | | | | | | | | | | | - | .23** | .33** | .49** |
| Q5.6 | | | | | | | | | | | | | | | - | .35** | .12 |
| Q5.7 | | | | | | | | | | | | | | | | - | .38** |

Note: * p < .05, ** p < .01

**Table 2.7.** *Correlations Between Youths' Item-Level Responses to The Pandemic Avoidance and Concern Scales (PACS) Questionnaires at Wave 6*

| | **Youths' Responses** | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q2 | Q3.1 | Q3.2 | Q3.3 | Q3.4 | Q3.5 | Q4.1 | Q4.2 | Q4.3 | Q5.1 | Q5.2 | Q5.3 | Q5.4 | Q5.5 | Q5.6 | Q5.7 | Q5.8 |
| Q1 | .33** | .24** | .10 | .09 | .22** | .10 | .29** | .28** | .33** | .04 | .19** | .21** | .06 | .09 | .17* | .23** | .05 |
| Q2 | - | -.04 | -.06 | .05 | .07 | .17* | <.01 | .08 | .03 | .10 | .10 | .15* | .05 | <.01 | .03 | .10 | .07 |
| Q3.1 | | - | .43** | .43** | .12 | .06 | .33** | .28** | .42** | .18** | .11 | .16* | .09 | .14* | .18** | .09 | .12 |
| Q3.2 | | | - | .37** | -.07 | -.06 | .17** | .13 | .26** | .16* | .10 | .08 | .13 | .18** | .08 | .12 | .09 |
| Q3.3 | | | | - | -.06 | -.04 | .18** | .12 | .35** | .15* | -.01 | .02 | .06 | .08 | .15* | -.01 | .03 |
| Q3.4 | | | | | - | .08 | .20** | .18** | .18** | .12 | .15* | .15* | .06 | .05 | .18** | .08 | .08 |
| Q3.5 | | | | | | - | .15* | <.01 | -.03 | -.04 | .04 | .05 | .05 | .04 | -.11 | .01 | .06 |
| Q4.1 | | | | | | | - | .19** | .32** | .12 | .09 | .11 | .02 | .04 | .08 | .09 | -.02 |
| Q4.2 | | | | | | | | - | .44** | .13 | .15* | .17* | .08 | .10 | .30** | .21** | .15* |
| Q4.3 | | | | | | | | | - | .10 | .04 | .05 | .01 | -.05 | .29** | .06 | .04 |
| Q5.1 | | | | | | | | | | - | .43** | .34** | .40** | .34** | .16* | .23** | .24** |
| Q5.2 | | | | | | | | | | | - | .58** | .56** | .60** | .17* | .38** | .47** |
| Q5.3 | | | | | | | | | | | | - | .66** | .55** | .08 | .40** | .42** |
| Q5.4 | | | | | | | | | | | | | - | .67** | .02 | .38** | .51** |
| Q5.5 | | | | | | | | | | | | | | - | -.01 | .44** | .61** |
| Q5.6 | | | | | | | | | | | | | | | - | .23** | .08 |
| Q5.7 | | | | | | | | | | | | | | | | - | .32** |

Note: * p < .05, ** p < .01

**Table 2.8.** *Exploratory Factor Analysis Results for Pandemic Avoidance and Concern Scales (PACS) Questionnaire Items*

| Biweekly Questionnaire Items | | Parent Data | | Youth Data | |
|---|---|---|---|---|---|
| | | Factor A Loadings "PACS Concern" | Factor B Loadings "PACS Avoidance" | Factor A Loadings "PACS Concern" | Factor B Loadings "PACS Avoidance" |
| Q1 | Disease-related concern [C] | **.508** | .055 | **.461** | .028 |
| Q2 | Perceived chance of infected [C] | **.320** | .081 | .169 | -.054 |
| Q3.1 | Purchased hygiene products [C] | **.672** | -.052 | **.657** | .070 |
| Q3.2 | Purchased extra food/drink [C] | **.417** | .177 | .207 | .200 |
| Q3.3 | Purchased extra health products [C] | **.375** | .176 | **.406** | -.014 |
| Q3.4 | Checked self for symptoms [C] | .151 | .042 | **.390** | .115 |
| Q4.1 | Frequency of checking news [C] | **.446** | .044 | **.572** | .003 |
| Q4.2 | Frequency of hygiene product use [C] | **.742** | -.120 | **.695** | .022 |
| Q4.3 | Frequency of cleaning surfaces [C] | **.623** | .002 | **.864** | -.202 |
| Q5.1 | Avoided work/school [A] | -.106 | **.266** | .195 | **.428** |
| Q5.2 | Avoided public places [A] | .023 | **.691** | .090 | **.652** |
| Q5.3 | Avoided social activities [A] | -.027 | **.782** | .049 | **.812** |
| Q5.4 | Avoided dates [A] | -.143 | **.783** | -.095 | **.855** |
| Q5.5 | Avoided public transit [A] | .081 | **.634** | -.179 | **.802** |
| Q5.6 | Avoided touching face [C] | **.427** | **.241** | **.446** | -.028 |
| Q5.7 | Avoided touching others [A] | .293 | **.414** | .147 | **.447** |
| Q5.8 | Avoided doctor/hospital [A] | .043 | **.592** | .006 | **.607** |

Note: Bolded items are significant at the .05 level.

Items marked with [C] were used to calculate the Concern variable, while items marked with [A] were used to calculate the Avoidance variable.

**Table 2.9.** *Correlations Between Pandemic Avoidance and Concern Scales (PACS) Subscales and Other Study Variables of Interest*

| Study Variables | Caregiver Data | | Youth Data | |
|---|---|---|---|---|
| | PACS Concern | PACS Avoidance | PACS Concern | PACS Avoidance |
| Youth's Age | .019 | .009 | -.022 | .010 |
| Youth's Sex [a] | .016 | .023 | .215** | -.005 |
| Youth's PPVT Score [b] | -.097 | .033 | .051 | .011 |
| Caregiver's Age | .055 | .040 | .036 | -.004 |
| Caregiver's Relationship to Youth [c] | .120 | .058 | .027 | .127 |
| Ethnicity [d] | .041 | .026 | .042 | .021 |
| Family Income [e] | -.053 | .027 | .092 | .004 |
| Caregiver PACS Concern | - | .298** | .324** | .140* |
| Caregiver PACS Avoidance | .298** | - | .123 | .365** |
| Youth PACS Concern | .324** | .123 | - | .260** |
| Youth PACS Avoidance | .140* | .365** | .260** | - |
| Caregiver Routine Disruption (Aggregate) | .182** | .092 | .04 | -.028 |
| Caregiver Income Instability (Aggregate) | .111 | .030 | .152* | .009 |
| Caregiver COVID Exposure (Aggregate) | .119 | .154* | .100 | .007 |
| Caregiver # of People Seen In-Person | .120 | -.020 | .144* | .012 |
| Caregiver # of People Contacted via Technology | .066 | .087 | .011 | .035 |
| Caregiver Closeness with Family | -.087 | .082 | .018 | .037 |
| Caregiver Conflict with Family | .035 | .164* | .028 | .055 |
| Caregiver Anxiety (GAD-7) [f] | .389** | .198** | .118 | .102 |
| Caregiver Depression (PHQ-9) [g] | .236** | .175** | .061 | .083 |
| Youth # of People Seen In-Person | -.198** | -.046 | -.070 | -.029 |
| Youth # of People Contacted via Technology | .143* | -.066 | .168* | <.001 |
| Youth Closeness with Family | -.093 | .034 | .130 | .077 |
| Youth Conflict with Family | .124 | -.042 | .019 | -.012 |
| Youth Anxious/Depressed (YSR) [h] | .101 | .032 | .261** | .078 |
| Youth Withdrawn/Depressed (YSR) [h] | .098 | -.032 | .172* | -.013 |
| Youth Somatic Complaints (YSR) [h] | .095 | 0.04 | .150* | .029 |

Note: * p < .05, ** p < .01
[a] male = 0, female = 1
[b] Standard Score on the Peabody Picture Vocabulary Test – Fourth Edition (Dunn & Dunn, 2007)
[c] mother = 0, father = 1
[d] white = 0, other = 1
[e] 1 = < $20,000, 2 = $20,000-$40,000, 3 = $40,001-$70,000, 4 = $70,001-$100,000, 5 = > $100,000; all in Canadian dollars.
[f] Total Score on the General Anxiety Disorder-7 (Spitzer et al., 2006)
[g] Total Score on the Patient Health Questionnaire-9 (Kroenke et al., 2001)
[h] Subscale Score on the Youth Self-Report (Achenbach & Rescorla, 2001)

**Table 2.10.** *Correlations Between Item-Level Responses to the Pandemic Avoidance and Concern Scales (PACS) at the Two Largest Waves of Data Collection (i.e., Waves 6 and 7).*

| | Q1 | Q2 | Q3.1 | Q3.2 | Q3.3 | Q3.4 | Q3.5 | Q4.1 | Q4.2 | Q4.3 | Q5.1 | Q5.2 | Q5.3 | Q5.4 | Q5.5 | Q5.6 | Q5.7 | Q5.8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Caregiver W6*W7 | .666** | .648** | .448** | .441** | .363** | .606** | .224** | .678** | .640** | .688** | .473** | .533** | .400** | .440** | .576** | .686** | .432** | .564** |
| Youth W6 * W7 | .617** | .644** | .489** | .453** | .371** | .679** | -.010 | .759** | .665** | .708** | .591** | .527** | .533** | .524** | .638** | .628** | .460** | .700** |

Note: ** p < .01

**Table 2.11.** *Correlations Between Caregivers' Pandemic Avoidance and Concern Scales (PACS) at the Two Largest Waves of Data Collection (i.e., Waves 6 and 7)*

| | W6 Caregiver PACS Concern | W6 Caregiver PACS Avoidance | W7 Caregiver PACS Concern | W7 Caregiver PACS Avoidance |
|---|---|---|---|---|
| W6 Caregiver PACS Concern | - | .314** | .813** | .251** |
| W6 Caregiver PACS Avoidance | .314** | - | .328** | .676** |
| W7 Caregiver PACS Concern | .813** | .328** | - | .361** |
| W7 Caregiver PACS Avoidance | .251** | .676** | .361** | - |

Note: ** $p < .01$

**Table 2.12.** *Correlations Between Youths' Pandemic Avoidance and Concern Scales (PACS) at the Two Largest Waves of Data Collection (i.e., Waves 6 and 7)*

| | W6 Youth PACS Concern | W6 Youth PACS Avoidance | W7 Youth PACS Concern | W7 Youth PACS Avoidance |
|---|---|---|---|---|
| W6 Youth PACS Concern | - | .220** | .790** | .242** |
| W6 Youth PACS Avoidance | .220** | - | .371** | .744** |
| W7 Youth PACS Concern | .790** | .371** | - | .405** |
| W7 Youth PACS Avoidance | .242** | .744** | .405** | - |

Note: ** $p < .01$

Figures

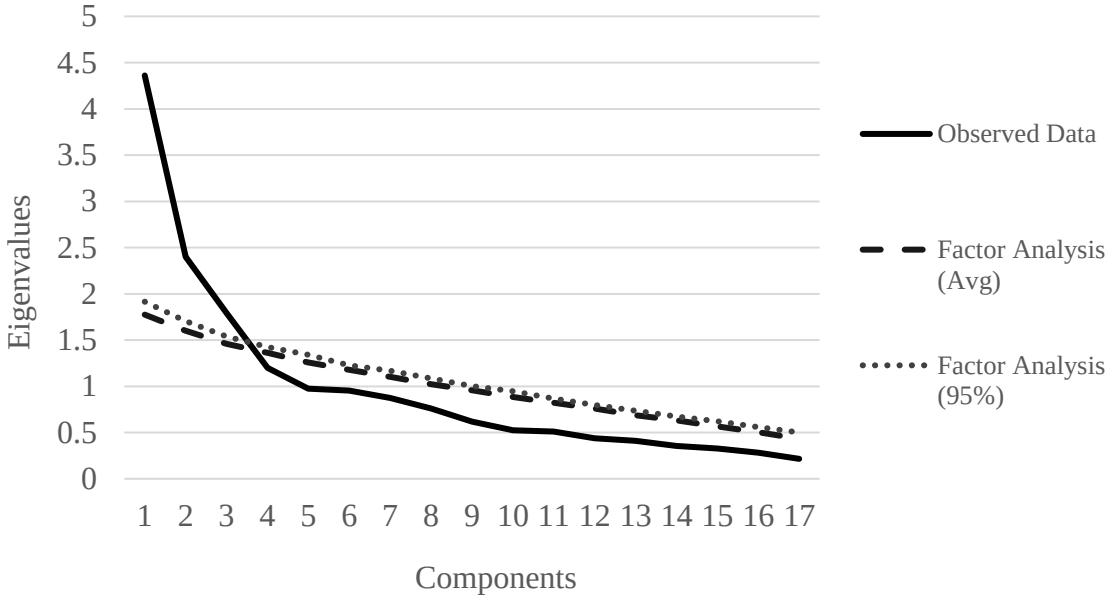


**Figure 2.1.** *Parallel Analysis of Caregivers' Pandemic Avoidance and Concern Scales (PACS) Responses*

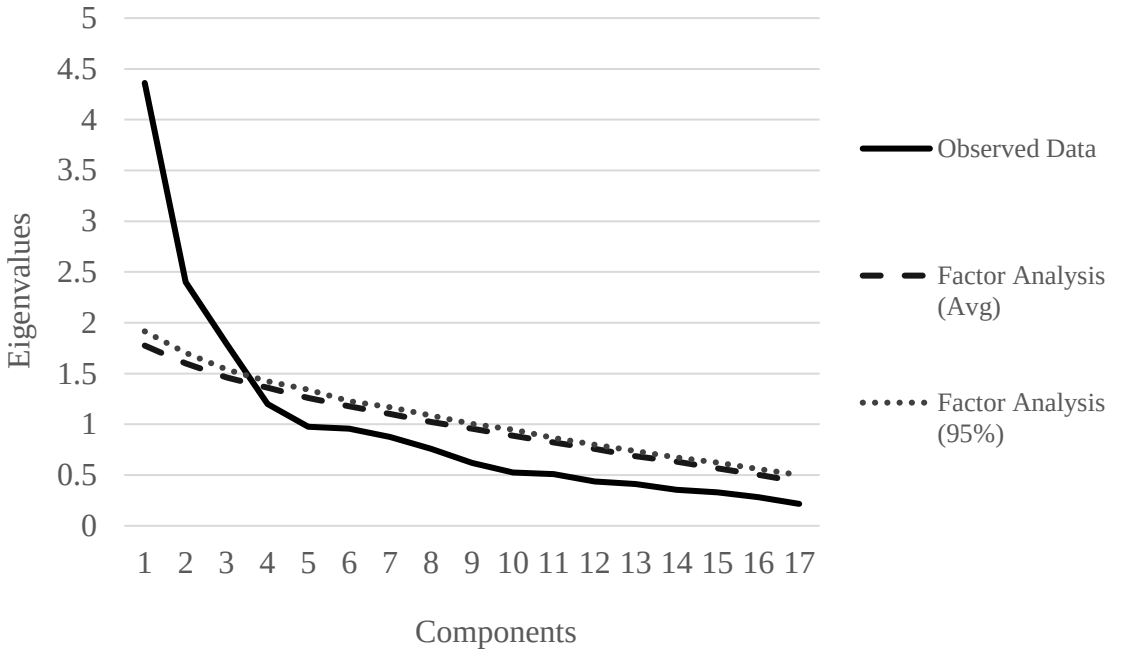


**Figure 2.2.** *Parallel Analysis of Youths' Pandemic Avoidance and Concern Scales (PACS) Responses*

# Chapter 3 – Total Cortisol Output During an Acute Stressor Predicts Youths' Internalizing Symptoms During the COVID-19 Pandemic

## Introduction

The COVID-19 pandemic led to widespread lockdowns, restricted social contact, and disruptions to work and community functioning. Based on past studies of smaller-scale quarantines (Brooks et al., 2020), the stress associated with these disruptions was expected to lead to mental health problems (Pfefferbaum & North, 2020). Some early studies of adjustment during the COVID-19 pandemic showed high perceived stress (LaCaille et al., 2021), poor sleep quality (Zhao et al., 2021), and difficulties maintaining self-care in adults (e.g., healthy eating, physical activity; Drieskens et al., 2021; LaCaille et al., 2021). Meta-analyses of the impact of COVID-related stress have reported increases in the prevalence of internalizing (i.e., anxious and depressive) and post-traumatic stress disorders during the pandemic that are three to four times higher than pre-pandemic rates (Cénat et al., 2021; Santabárbara et al., 2021).

However, as with all stressors, there is tremendous individual variability in responses to the psychosocial stressors of the pandemic (Pierce et al., 2021, Shevlin et al., 2021). In adults, risk factors including cognitive vulnerabilities (e.g., intolerance of uncertainty, death anxiety; Shevlin et al., 2021), fear of COVID-19 (Şimşir et al., 2021), perceived stress (Achterberg et al., 2021), prior physical or mental health problems (Pierce et al., 2021; Shevlin et al., 2021), and socioeconomic disadvantage (e.g., living in a low-income neighbourhood; Pierce et al., 2021) were associated with poor acute adjustment during the early stages of the pandemic. Extant longitudinal research suggests that these same risk factors are linked to longer-term maladjustment during the

pandemic (Fancourt et al., 2021; Hawes et al., 2021). Relatedly, individuals of higher socioeconomic status or in geographic areas with fewer cases of COVID-19 reported internalizing symptoms that were relatively low and stable (Fried et al., 2022; Green et al., *in press;* van der Laan et al., 2021). Continuing to develop our understanding of risk for short- and long-term maladjustment in the context of pandemic-related stress is vital for helping to direct current and future intervention efforts, especially given the high probability of future pandemics (Castillo-Chavez et al., 2015; Frutos et al., 2020; Tabish, 2020).

Furthermore, the stress imposed by the pandemic may disproportionately impact adolescents, given that this is generally a high-risk developmental stage for internalizing problems (Beesdo-Baum & Knappe, 2012; Hankin et al., 1998). Given the increased importance of peer relationships during adolescence (Brown & Larson, 2009), emerging adolescent risk may be exacerbated by the pandemic due to widespread school closures, constraints on social activities, and other factors that have limited youth interactions (Courtney et al., 2020; Liang et al., 2020). Research examining pre-pandemic factors that indicate risk for adolescents' internalizing symptoms in the context of COVID-related stress may help guide targeted preventative efforts toward limiting long-term mental health problems in youth (Cho & Shin, 2013).

There may also be sex differences in risk for psychopathology during the pandemic. Outside of the context of the pandemic, it is well established that females are at greater risk for internalizing problems, with an approximate lifetime prevalence of anxiety and depressive disorders two times higher than males (Altemus et al., 2016; Piccinelli & Wilkenson, 2000). These differences in prevalence emerge early in

development and are thought to develop through complex interplay of biological (e.g., hormonal differences), cognitive (e.g., coping strategies, stress perception), and sociocultural (e.g., social roles) factors (Altemus et al., 2016; Piccinelli, & Wilkenson, 2000). Unsurprisingly, several studies have shown that females had elevated symptoms of anxiety and depression relative to males during the pandemic (e.g., Kolakowsky-Hayner et al., 2021; Pierce et al., 2021), although other recent evidence suggests that these differences are inconsistent (Shevlin et al., 2021) or were only apparent during initial, short-term reactions to the pandemic (Fancourt et al., 2021).

Sex differences in stress appraisal may partially account for observed differences in pandemic-related adjustment between males and females. In previous work, subjective appraisals of stress have been found to be a significant moderator of the relationship between stressful events and maladjustment, in that individuals who endorse events as more stressful report poorer psychological adjustment (Bovier et al., 2004; Chang, 2002) Notably, past research has indicated that adult females (Birditt & Fingerman, 2003; Verma et al., 2011) and adolescent girls (Charbonneau et al., 2009; Hankin et al., 2007; Rudolph, 2002) display greater emotional reactivity than males in response to similar social stressors. These sex differences in reactivity to stress have been replicated in studies of adults during the COVID-19 pandemic (Ahuja et al., 2020; Prowse et al., 2021; Kangxing et al., 2020), but few studies thus far have compared sex differences in adolescents' reactions to the COVID-19 pandemic. Magson and colleagues (2021) found that girls reported a significantly greater decrease in life satisfaction on account of the COVID-19 pandemic compared to boys, while Liu and Wang (2021) found no relationship between biological sex and self-reported perceived stress. Understanding the

mechanisms that account for adolescent females' greater risk for internalizing problems, especially in the context of stressful life events (Allgood-Mertin et al., 1990; Ge et al., 2001), may prove useful in identifying youth at greatest risk for maladjustment during chronic stressors, such as the pandemic.

Measuring neuroendocrine activity is a well-established approach to assessing interindividual differences in physiological responses to stressors (Everly Jr. & Lating. 2002). When triggered by perceived stress, the hypothalamic-pituitary-adrenal (HPA) axis activates physiological and psychological processes that facilitate coping with proximal stress, including reductions in inflammation (Katsu & Iguchi, 2016), reductions in glucose metabolism in the brain (Erikson et al., 2003), and enhancements in memory for emotionally charged stimuli (Lupien et al., 2005). These downstream effects of the HPA axis are triggered in part by cortisol, a stress hormone that is released in response to perceived stress. As such, in the context of stress exposure, changes in concentrations of cortisol can be used as a physiological index of the stress response.

Given associations between stressful life events and internalizing problems, a large literature examining cortisol functioning as an index of vulnerability has developed (Adam et al., 2010; Halligan et al., 2007; Ruttle et al., 2011). While cortisol activity is related to both adults' and youths' concurrent internalizing symptoms, associations between cortisol output and risk for internalizing problems may differ for males and females (Zorn et al., 2017). For example, adult men with major depression were found to have higher cortisol reactivity during a laboratory stress test relative to healthy controls, while depressed adult women had lower cortisol reactivity than healthy controls (Zorn et al., 2017). Other studies have shown that cortisol activity measured in early childhood

contributed to the prediction of internalizing and externalizing symptoms in later childhood (Barrios et al., 2017; Kuhlman et al., 2015), even in community samples of youth (Daoust et al., 2018; Ouellette et al., 2015). Given that neuroendocrine stress activity shows trait-like characteristics (Hankin et al., 2015) and is associated with concurrent and future maladaptation, it shows potential to contribute to models predicting risk for internalizing disorder. Further, given that cortisol output is evoked by scenarios involving uncontrollability and social difficulty (Dickerson & Kemeny, 2004), individual differences in the functioning of the HPA axis may be particularly relevant to responses to pandemic-related stress, which has been characterized by recurrent, unpredictable, and uncontrollable changes in social restrictions. The COVID-19 pandemic presents a unique opportunity to investigate the relationship between short-term physiological responses during acute stress and adjustment to a longer-term stressor in community-dwelling participants.

Only a few studies have examined associations between aspects of cortisol output and mental health outcomes during the pandemic (Goldfarb, 2020). Several of these studies have used cortisol concentrations in hair samples, which function as a longer term (i.e., months-long) index of cortisol production. Doan and colleagues (2022) found that mothers' hair cortisol concentrations two years prior to the pandemic predicted their offspring's depressive symptoms during the pandemic. Similarly, Feeney and Kenny (2022) found that older adults' pre-pandemic hair cortisol was associated with depressive symptoms during, but not before, the pandemic. Marcil and colleagues (2022) compared hair cortisol concentrations in health care workers assayed three months prior to the pandemic to concentrations reflecting cortisol output during the first three months of the

pandemic. While no associations were found between change in hair cortisol and self-reported internalizing symptoms, individuals with modest increases in hair cortisol concentrations peri-pandemic were at lower risk for burnout than individuals whose hair cortisol either decreased, showed a minute increase (<3%) or a moderate-to-large increase (>30%) in hair cortisol concentrations. Salivary cortisol concentrations, which can be used to assess shorter-term (i.e., within minutes) HPA axis functioning, have been minimally investigated in the context of pandemic-related adjustment. In a small sample of university students, Baliyan and colleagues (2022) found that the relationship between pre-pandemic diurnal salivary cortisol (i.e., the volume produced over the course of the day, calculated by extrapolating from repeated assessments of shorter-term functioning) and pandemic-related loneliness was moderated by self-reported extraversion; salivary cortisol and loneliness were positively associated in individuals who reported higher extraversion.

While studies thus far have investigated longer-term (i.e., daily or monthly) patterns of cortisol functioning, none examined pre-pandemic acute cortisol reactivity to stress in relation to peri-pandemic adjustment. This is a notable omission, given that the COVID-19 pandemic has been associated with repeated acute (e.g., announcement of lockdowns, changes in social restrictions) stressors, as well as more long-term chronic (e.g., supply shortages, financial instability) stress. Further, much of the pandemic-related physiological stress research thus far has focused on adult adjustment. Given physiological, cognitive, and social differences between adolescence and adulthood, these adult-based findings may be less generalizable to youth, and thus less effective at directing current and future psychological intervention efforts in this population.

Building on this past work, I used children's cortisol output during a social stress task that occurred several years prior to the pandemic as a potential predictor of risk for maladjustment in youth during what was arguably the most acutely stressful, initial phase of the COVID-19 pandemic. Further, given current mixed findings on sex differences in risk for maladjustment to pandemic-related stressors, I examined whether potential relationships between cortisol output during an acute stressor and youths' early pandemic symptoms differed for boys and girls. Past work from my research group indicates that cortisol output during a stress task in early childhood was positively associated with girls' internalizing symptoms but not boys, both cross-sectionally (Kryski et al., 2013) and longitudinally (Daoust et al., 2018). In light of these findings, although these hypotheses were not pre-registered, I predicted that adolescent girls' cortisol output would be positively associated with their initial internalizing symptoms as well as the slope of these symptoms across the pandemic, and that this association would be non-significant for adolescent boys.

## Methods

### Participants

All study protocols and procedures were approved by the Western University Research Ethics Board (Review #15121S). In all waves of data collection, informed consent for youths' participation was provided by caregivers, and assent for participation was provided by participating youth.

#### *Initial Recruitment (Age 3)*

Participants were youths drawn from an ongoing longitudinal study of children's emotional development ($n$ = 409) that began when participants were three years old (M =

3.43, SD = .30). Families were initially recruited from the community using a combination of local and digital advertisements, as well as contacting individuals in the Western University participant pool. Children with serious mental or physical problems, as assessed during an initial screening interview at age 3, were ineligible to participate. Families were primarily European Canadian (93%; Asian Canadian = 2%, African Canadian = 0.5%, Latin Canadian = 1.7%, Other = 2.4%) and varied in annual income (4% < $20,000; 11% = $20,000–$40,000; 24% = $40,001–$70,000; 30% = $70,001–$100,000; 31% > $100,000; all amounts CAD). A proxy measure of children's cognitive ability (i.e., the Peabody Picture Vocabulary Test – Fourth Edition; Dunn & Dunn, 2007), administered when children were 3 years old, showed that participating children were in the normal range of cognitive ability (M = 112.04, SD = 14.88). Families were representative of the community in Ontario, Canada from which they were recruited (Statistics Canada, 2018).

***Pre-pandemic Follow-up (Age 11)***

When the youths were approximately eleven years old (M =11.08, SD = .77), a subset of children from the initial study (*n* = 94), oversampled for a maternal history of internalizing disorders (Vandermeer et al., 2020), were invited to participate in a follow-up study (see Liu et al., 2020a, 2020b, 2022; Vandermeer et al., 2020, 2022). Youths were screened for medical conditions or medication use that could influence salivary cortisol functioning. Youths attended the laboratory for a single visit as part of a larger study, during which they completed the Trier Social Stress Test for Children (TSST-C) and salivary cortisol samples were collected. After the completion of the TSST-C and

fifty minutes of quiet play, youths independently completed all self-report measures of symptoms.

### *Early-pandemic Follow-up (Age 14)*

When the youths were approximately 14 years old (M = 14.35, SD = 1.15), the entirety of the original sample was invited to participate in a longitudinal follow-up study shortly after a local state of emergency was declared in March 2020 due to COVID-19. Self-report measures of youths' symptoms were administered every two weeks during March through June of 2020 (i.e., eight waves of data collection) via the Qualtrics XM (Seattle, USA) service to measure potential changes over time. Survey links were sent by email directly to participating youths, who were instructed to complete the measure independently from their parents. Of the participants from the original sample ($n$ = 301), 73.6% participated in at least one wave of data collection. Reasons for attrition included participants being unreachable by study staff ($n$ = 59; 14.4%), declining to participate ($n$ = 35; 8.6%), or having previously declined to participate in any follow-up data collection ($n$ = 14, 3.4%).

### *The Current Study*

The present study includes youths who participated in the pre-pandemic (i.e., age 11) and early-pandemic (i.e., age 14) waves of data collection ($n$ = 79; 43 boys, 36 girls). Demographic information for this subsample is in Table 3.1. An independent samples t-test was conducted to compare participants in the present study to the sample initially recruited at age 3; the current subsample did not differ significantly from non-participants in terms of biological sex, PPVT scores, pre-pandemic internalizing symptoms (assessed at age 11), or family income (all $ps > .05$).

## Measures

### *The Trier Social Stress Test (age 11)*

Youths participated in the Trier Social Stress Test for Children (TSST-C; Buske-Kirschbaum et al., 1997), a social stress induction task for youth aged 7 through 16. The TSST reliably produces increases in physiological indices of stress (Foley & Kirschbaum, 2010). Immediately prior to participating in the TSST-C, each youth participated in quiet play (e.g., colouring, playing checkers) with an experimenter for thirty minutes to allow the youth to acclimate to the testing environment. The youth was then informed that they would be tasked with telling a story to "expert story judges" based on a story prompt and were encouraged to perform as well as possible. After being given three minutes to prepare, the youth was escorted to a separate room to tell their story to two undergraduate research assistants who pretended to audio and video record the participant's performance; participants were not aware that these actors were research team members. Research assistants were trained to avoid facial expressions and provided no verbal feedback regarding youths' performance. A research assistant prompted the youth to continue telling their story if they stopped prior to five minutes. After completing the story task, the youth was asked by the research assistants to complete a difficult mental arithmetic task aloud over the course of five minutes; if an error was made, they were interrupted, informed of their mistake, and instructed to start over from the beginning. At the completion of this task, the experimenter returned to praise and debrief the youth, as is standard when using the TSST (Buske-Kirschbaum et al., 1997). The youths then returned to quiet play for fifty minutes while the remaining cortisol samples were collected. Measures of salivary cortisol indicated a statistically significant increase from

baseline after participants completed the TSST-C, followed by a return to baseline within 50 minutes, supporting the effectiveness of the task as a stress induction procedure in my sample.

***Salivary Cortisol (Age 11)***

Six saliva samples were collected from each youth by having them chew on cotton dental rolls (Salimetrics, USA) for two minutes until wet with saliva. A "baseline" sample was collected after a thirty-minute period of quiet play (i.e., prior to the TSST-C), to index their cortisol output after acclimating to the lab environment. A meta-analysis by Goodman and colleagues (2017) showed that salivary cortisol levels tend to peak 25 to 35 minutes after the completion of the TSST, though this timing varies between individuals. To permit a rich characterization of cortisol output during the TSST and during a recovery period, five additional saliva samples were collected every ten minutes after the completion of the TSST-C for fifty minutes (i.e., samples at ten, twenty, thirty, forty, and fifty minutes after the end of the TSST-C). All TSST-Cs were completed between 11 AM and 4 PM to minimize the influence of diurnal variations in cortisol output (Goodman et al., 2017). Supplementary analyses including time of day as a covariate did not significantly impact the pattern of results. Samples were immediately sealed and frozen at -20ºC for subsequent analysis for cortisol concentrations using an expanded-range, high sensitivity salivary cortisol enzyme immunoassay kit (Salimetrics, PA, USA). Assays were conducted according to the manufacturer's instructions. Optical density was read on a standard plate reader at 450 nm and corrected at 650 nm (Molecular Devices, Sunnyvale, CA, USA). Samples were assayed in duplicate, with indices of assay variation acceptably low both within (Intra-Assay CV = 2.1%) and

between (Inter-Assay CV = 2.3%) plates. Final values, measured in micrograms per decalitre (μg/dl), were calculated by averaging duplicate assays.

Cortisol concentrations from the six samples provided by each participant were used to calculate the Area Under the Curve with respect to Increase ($AUC_I$), which reflects the volume of cortisol produced in response to an acute stressor (i.e., the TSST-C), as well as Area Under the Curve with respect to Ground ($AUC_G$; Pruessner et al., 2003), a summary measure that reflects the total volume of cortisol produced over the sampling period. $AUC_G$ was included in my study as pandemic-related stress shares characteristics with both acute and chronic stressors, and as such, a measure incorporating baseline functioning may be relevant to youths' mental health outcomes (Fogelman & Canli, 2018; Zorn et al., 2017). As collected cortisol values were positively skewed, a log10 transformation was applied to normalize the data, allowing for analysis with parametric statistics (Gunnar & Talge, 2008).

***Internalizing Symptoms (Ages 11 and 14)***

Youths completed subscales of the Youth Self-Report (YSR; Achenbach, 2000), a 112-item self-report measure of emotional and behavioural problems for youths aged 11 through 17, with items rated as "0 = Not true", "1 = Somewhat or Sometimes True", or "2 = Very True or Often True." To minimize participant burden in the context of multiple waves of data collection, and in light of my research group's specific interest in internalizing problems and health-related concerns during a global pandemic (Imran et al., 2020; Loades et al., 2020), measures were limited to the Anxious-Depressed (12 items; $M_\alpha = .90$, $\alpha_{range} = .82 - .94$ in this sample), Withdrawn-Depressed (8 items; $M_\alpha =$

.83, $\alpha_{range}$ = .73 - .90 in this sample), and Somatic Complaints (10 items; $M_{\alpha}$ = .83, $\alpha_{range}$ = .74 - .91 in this sample) subscales.

### Analytic Plan

To model the baseline and course of youths' symptoms across the early weeks of the pandemic, structural equation modelling was conducted in the MPlus 8.7 (Muthén & Muthén, 2017) software package. Each symptom scale (i.e., anxious-depressed, withdrawn-depressed, somatic complaints) was modelled individually, and unconditional models were examined for significant variance in model intercepts and slopes (see Table 3.2). Significant variance was found in all slopes and intercepts except for the slopes of anxious-depressed symptoms; thus, I did not examine predictors of these slopes. In the following conditional models, youths' sex, cortisol output (indexed by $AUC_I$ or $AUC_G$), and sex-by-cortisol interaction (all assessed pre-pandemic) were regressed on symptom intercepts and slopes while controlling for pre-pandemic (i.e., age 11) symptoms which were assessed at the time of cortisol collection. Given that models using $AUC_I$ and $AUC_G$ are largely duplicate analyses, the Bonferroni correction was used to account for multiple comparisons (i.e., $p$ = .025).

## Results

### Correlations Between All Major Study Variables

Correlations between major study variables are in Table 3.1. Familial income was unrelated to internalizing symptoms at age 11 but was significantly negatively correlated with all internalizing symptoms at age 14. Girls did not show greater internalizing symptoms than boys at age 11 but did at age 14. Girls were also found to have smaller task-related changes in cortisol (i.e., $AUC_I$) than boys. Task-related changes in cortisol

were negatively correlated with mid-pandemic anxious-depressed symptoms but were not related to other symptom measures. At ages 11 and 14 internalizing symptom scores were positively correlated with each other. Longitudinally, age 11 anxious-depressed scores were significantly positively correlated with early-pandemic internalizing symptom scores, while age 11 withdrawn-depressed scores were unrelated to all age 14 measures. Age 11 somatic complaint scores were also correlated with age 14 somatic complaint scores. Given the small proportion of non-white participants (n = 3), correlations with ethnicity were not investigated due to their limited interpretability.

**Changes in Cortisol Output During the TSST-C**

Descriptive statistics for cortisol concentrations measured before and during the TSST-C are in Table 3.3. Changes in average cortisol concentrations across samples were assessed using paired samples t-tests (see Table 3.4). On average, participants experienced a significant increase in cortisol concentrations from baseline (M = .02; SD = .02) after exposure to the TSST (M = .09; SD = .06); [t(78) = -10.02, p = <.001]. Participants' cortisol concentrations were no longer observed to be significantly different from baseline 50 minutes after the conclusion of the TSST (M = .03; SD = .02); [t(78) = -1.77, p = .08].

**Conditional Models with $AUC_I$ Predicting Symptoms**

Regression statistics organized by symptom outcome using $AUC_I$ as a predictor are in Table 3.5.

***Anxious-Depressed Symptoms***

Within the conditional model, a main effect of $AUC_I$ was observed on the intercept of anxious-depressed symptoms, in that $AUC_I$ was negatively correlated with

anxious-depressed symptoms in the early weeks of the COVID-19 pandemic. A main effect of sex was also observed on the intercept of anxious-depressed symptoms, in that girls reported more anxious-depressed symptoms than boys in the early weeks of the COVID-19 pandemic. The interaction of $AUC_I$ and sex did not significantly predict model intercepts.

### *Withdrawn-Depressed Symptoms*

Within the conditional model, there was no main effect of $AUC_I$, sex, or their interaction on the intercept of withdrawn-depressed symptoms. A main effect of sex was observed on the slope of withdrawn-depressed symptoms, in that boys' withdrawn-depressed symptoms decreased more quickly than girls' over time. There was no significant effect of $AUC_I$ or the interaction of $AUC_I$ with sex on the slopes of withdrawn-depressed symptoms over time.

### *Somatic Complaints*

Within the conditional model, a main effect of sex was observed on the intercept of somatic complaints, in that girls reported significantly higher somatic complaints than boys during the early weeks of the COVID-19 pandemic. A main effect of sex was also observed on the slope of somatic complaints, in that boys' somatic complaints symptoms decreased more quickly than girls'. Neither $AUC_I$ or the interaction of $AUC_I$ with sex did not significantly predict symptom intercepts or slopes.

## Conditional Models with $AUC_G$ Predicting Symptoms

Regression statistics organized by symptom outcome using $AUC_G$ as a predictor are in Table 3.6.

***Anxious-Depressed Symptoms***

Within the conditional model, there was no main effect of $AUC_G$ or sex on the intercept of anxious-depressed symptoms. However, the interaction of cortisol output and sex significantly predicted the intercept of youths' anxious- depressed symptoms, in that girls with higher $AUC_G$ had higher self-reports of anxious-depressed symptoms in the first weeks of the pandemic compared to all boys and lower-cortisol girls.

*Withdrawn-Depressed Symptoms*

Within the conditional model, there was no significant main effect of cortisol output or sex on model intercepts, nor an effect of the interaction of the two variables in predicting these symptoms. However, symptom change was significantly predicted by the interaction of these two variables. An analysis of simple slopes indicated that boys with higher pre-pandemic cortisol output ($B = -.18$, $p < .01$) showed significantly decreased withdrawn-depressed symptoms over the first 16 weeks of the pandemic, while the symptoms of boys expressing less cortisol ($B = -.09$, $p = .38$), girls expressing more cortisol ($B = .02$, $p = .76$), and girls expressing less cortisol ($B = -.13$, $p = .23$) did not change significantly (see Figure 3.1). Of note, girls higher in pre-pandemic cortisol output appeared to have the most stably elevated withdrawn-depressed symptoms over the 16-week period. To evaluate this possibility more formally, I conducted post-hoc analyses in which I centered the model of withdrawn-depressed symptoms at the eighth wave of data and examined the effects of my independent variables on the new model's intercepts. In these post-hoc analyses, the interaction of cortisol output and sex significantly predicted symptoms ($B = 8.48$, $p = .01$) during the final wave (i.e., weeks 15

through 16) of data collection; girls expressing more cortisol had more withdrawn-depressed symptoms at this point compared to girls expressing less cortisol and all boys.

***Somatic Complaints***

Within the conditional model, there was no main effect of cortisol output or sex on symptom intercepts; however, the interaction of sex and pre-pandemic cortisol output significantly predicted the intercepts of somatic complaint symptoms. Specifically, while girls expressing more cortisol and all boys reported similarly high somatic complaints in the first weeks of the pandemic, girls expressing less cortisol had the lowest self-reports of somatic complaints at this time point. There was no significant effect of cortisol output, sex, or their interaction on the modelled slopes of reported somatic complaints.

## Discussion

Understanding individual differences in neuroendocrine functioning may help the prediction and prevention of mental health problems in response to stressful life events. I therefore examined whether youths' pre-pandemic cortisol output during an acute stressor predicted the intercepts and trajectories of their internalizing symptoms across the first 16 weeks of the COVID-19 pandemic. Based on past work indicating sex differences in responses to stress (Ahuja et al., 2020; Kryski et al., 2013; Prowse et al., 2021; Kangxing et al., 2020), I also examined whether boys and girls differ in terms of associations between pre-pandemic cortisol output and peri-pandemic internalizing symptoms. I found positive associations between cortisol output and self-reported anxious-depressed symptoms and somatic complaints at the onset of the pandemic for girls but not boys. Our findings are also consistent with past longitudinal work with this sample, which found that the interaction of sex and cortisol output at age 3 predicted symptoms in later

childhood (Daoust et al., 2018). In both the current and previous studies, girls with higher cortisol output had depressive symptoms that remained stably high over time, while girls with lower cortisol output and all boys had symptoms that remained stable or decreased over time (Daoust et al., 2018). Further, while being female and having higher cortisol output was associated with higher anxious symptoms at baseline, neither were associated with changes in anxious symptoms over time in either study (Daoust et al., 2018).

While previous research supports the notion that cortisol output during an acute stressor can contribute to risk for later psychopathology, this study and prior work from my research group (Daoust et al., 2018; Kryski et al. 2013) indicates that associations between cortisol and internalizing psychopathology are strongest for girls. In my models using task-specific increases in cortisol output (i.e., $AUC_I$) as a predictor of symptoms, direct effects of sex on model intercepts were observed, replicating past findings of sex differences in COVID-related adjustment in populations of adults (Kolakowsky-Hayner et al., 2021; Pierce et al., 2021). However, in models using total cortisol output (i.e., $AUC_G$) as a predictor of symptoms, these effects were better accounted for by the interaction of sex and cortisol output. These findings indicate that baseline cortisol output may provide additional information relevant to the prediction of mental health outcomes in addition to task-specific reactivity. Baseline cortisol has previously been found to be independently associated with mental health outcomes (Shirtcliff & Essex, 2008), but may also help to account for floor or ceiling effects (Segerstrom et al., 2017) that may be missed by using only $AUC_I$ as a predictor. These differences in our findings compared to previous work with adults may due to physiological and cognitive

differences that begin to emerge in adolescence (Goel et al., 2014; Ordaz & Luna, 2012; Zahn-Waxler et al., 2008). Sex differences in physiological and subjective responses to stress may stem from the effect of gonadal hormones on the corticolimbic system, resulting in differing patterns of neurological activity between males and females experiencing stress (Ordaz & Luna, 2012). While I would expect to see sex differences emerge more strongly as the adolescents in my sample progress into adulthood, the specific effects of these neuroendocrine and cognitive differences remain poorly understood (Kudielka & Kirschbaum, 2005; Viau et al., 2002). Our findings suggest that cortisol output during acute stress may function as a valuable, relatively low-cost addition to models of risk for maladaptation in youth, but they also affirm the importance of multimethod approaches in assessing risk for maladaptation to stress. Future research should consider including measures of gonadal hormones, cognitive functioning, and/or task-based neuroimaging to further our understanding of the fundamental mechanisms underlying observed sex differences in responses to stress.

Of the six models that I constructed, only one involved a significant interaction between biological sex and cortisol output in predicting internalizing symptom slopes over time: Boys with higher cortisol output reported significant decreases in withdrawn-depressed symptoms over the first 16 weeks of the pandemic, while girls and boys expressing less cortisol did not. While several contemporary studies have reported that most individuals experienced a decline in internalizing symptoms after the initial onset of the pandemic (Fancourt et al., 2021; Hawes et al., 2021), others have found that symptom changes during the pandemic were dependent on life events (Houghton et al., 2022) and pre-existing internalizing problems (Bendau et al., 2021; Panchal et al., 2021; Wang et

al., 2022). Our findings of stable depressive symptoms for girls and boys expressing lower cortisol echo concerns (Courtney et al., 2020) of potential enduring effects of internalizing symptoms experienced early in the pandemic, although symptoms were generally low for most study participants and cortisol only predicted changes in internalizing symptoms for boys.

Sex differences in the relationship between neuroendocrine functioning in the context of stress and psychological outcomes may also be accounted for by cognitive and emotional differences in stress appraisal. Past research has indicated that females may display greater emotional reactivity than males in response to similar stressors (Charbonneau et al., 2009), a finding that has been replicated in studies of adults during the COVID-19 pandemic (Ahuja et al., 2020; Prowse et al., 2021; Kangxing et al., 2020). Pre-pandemic studies of adolescents have similarly found that girls report a greater number of perceived stressors in specific social contexts (Hankin et al., 2007). As such, changes related to the COVID-19 pandemic may be subjectively experienced as more stressful by girls than boys, which may then result in a greater impact on their adjustment. Alternatively, a study by Laufer and Shechory Bitton (2021) suggests that pandemic-related difficulties may have a greater direct negative impact on the lives of females than males, and that this disparity may be driving observed sex differences. Given these competing theories, it is unclear whether pre-pandemic findings about differences in cognitive stress appraisal would be maintained in studies of early-pandemic populations of youths.

Insofar that cortisol output is a physiological correlate of threat perception, its relation to outcomes during the COVID-19 pandemic may be rooted in differences in

stress-coping strategies. Although relevant research is limited, higher cortisol reactivity in community-dwelling adults was associated with adaptive/active coping strategies and lower cortisol reactivity with avoidant coping strategies (Johnson et al., 2019); in turn, avoidant coping is consistently related to greater psychological distress both before (Bendezú et al., 2021; Compas et al., 2017) and during (Dawson & Golijani-Moghaddam, 2020; Minahan et al., 2021) the pandemic. Considering this research as a whole, although heightened cortisol stress reactivity is often linked to increased symptoms (Roelofs et al., 2009; Zorn et al., 2017), higher cortisol reactivity may, in some individuals, motivate adaptive coping. However, active coping styles (e.g., positive reframing, planning; Compas et al., 2017; McLaughlin et al., 2022) have been found to be weakly and inconsistently associated with positive outcomes during the pandemic (Dawson & Golijani-Moghaddam, 2020; Minahan et al., 2021), perhaps due to quarantines and other COVID-related constraints on behavior that thwart active coping styles. While speculative, adolescents with higher cortisol output may experience internalizing problems in contexts in which adaptive, active coping is impossible.

Given the waxing and waning of COVID-related stressors over the past two years, longer-term assessments of youths' adjustment are warranted. Although my findings and others' (Fancourt, Steptoe, & Bu, 2021; Hawes et al., 2021) have found brief, initial increases in internalizing symptoms during the pandemic, these patterns of adjustment may change over time, especially given past research indicating the potential negative effects of long-term stress exposure in youth (Snyder et al., 2019). As the length and severity of the pandemic continues to grow far beyond initial predictions (Murray et al., 2020), pandemic "fatigue" may have harmful effects on individuals' long-term

adjustments (Bonanomi et al., 2021; Morgul et al., 2021). Given research associating intraindividual changes in cortisol functioning over time with future anxiety (Schiefelbein & Susman, 2006), including measures of longer-term cortisol functioning (i.e., hair cortisol) and investigating potential changes in acute cortisol output in the context of stress in future follow-ups may help to provide insight into the longer-term impacts of pandemic-related stress.

In terms of study strengths, this is the first study to my knowledge to examine pre-pandemic cortisol output as a predictor of internalizing symptoms during the pandemic. Assessments of youths' symptoms during the early stages of the COVID-19 pandemic were temporally dense, permitting a more nuanced investigation of changes in symptoms over time. While many studies understandably rely on retrospective reports of pre-pandemic functioning or collected a very limited number of follow-ups, my dataset allows us to investigate more nuanced changes in youths' symptoms over time.

Several pragmatic considerations may limit the generalizability of my findings. First, while the pragmatic importance of considering interactive effects between risk factors should not be overlooked, I cannot say whether biological sex and neuroendocrine responses during stress play a mechanistic role in maladaptation or serve as indices of other causal physiological or cognitive processes. Indeed, given evidence suggesting sex differences in cortisol reactivity to stress in the TSST in adult populations (Liu et al., 2017) and potential cognitive differences in the appraisal of pandemic-related stress (Ahuja et al., 2020; Prowse et al., 2021; Kangxing et al., 2020), future studies should consider examining stress reactivity across multiple levels of analysis (e.g., including measures of cognitive vulnerability to stress, diurnal or chronic cortisol functioning),

which may help shed light on mechanisms underlying stress-related adjustment. As I examined associations with youths' biological sex rather than gender (i.e., a social construct), it is also unclear the degree to which these sex differences in vulnerability to internalizing problems are socialized versus biological. Findings may also have been influenced by gender differences in self-report behaviours, specifically related to internalizing problems (Giel, 2021; Schiefelbein & Susman, 2006). In future studies, more nuanced relationships between sex, gender, and mental health outcomes could be investigated by including measures of gender role beliefs as a control variable, as well as by including alternative measures (e.g., informant reports, observational estimates) of youths' internalizing symptoms.

Second, to minimize participant burden during this longitudinal study, I chose to limit the volume of data collected at each wave, which in turn limited the kinds of psychological maladaptation I was able to assess. Given the kinds of stressors I expected to be associated with the COVID-19 pandemic (i.e., social isolation, uncertainty, increase in health-focused behaviours), I chose to focus on internalizing problems; thus, I cannot examine influences on externalizing symptoms in the context of the pandemic (i.e., multifinality). Indeed, while many studies have found females to be at greater risk for internalizing problems during the pandemic (Fancourt et al., 2021; Hawes et al., 2021), other studies found that, compared to females, males reported poorer diet and hygiene (Rodriguez-Besteiro et al., 2021), poorer adherence to stay-at-home advisories (DeGrace et al., 2021), and worse outcomes related to substance use (Prowse et al., 2021); further, a limited body of research has specifically documented increases in boys' externalizing problems during the pandemic (Frigerio et al., 2022). Pre-pandemic work indicates that

lower cortisol reactivity in boys may portend externalizing problems (Daoust et al., 2018; Kao et al., 2018). Therefore, future research should consider the potential contribution of cortisol output to models predicting risk for different symptom categories in the context of chronic stress.

Third, the characteristics of my sample may have influenced my findings. Although my study is the first of its kind to include measures of pre-pandemic cortisol output, this limited the number of participants to those who participated in my pre-pandemic study. Larger samples may be needed to detect less pronounced sex differences in functioning. Our sample was also largely White, of relatively high socioeconomic status, and at a relatively low relative risk for serious disorder. As pandemic-related stress is thought to have more significant effects on vulnerable populations (e.g., possessing pre-existing physical or mental health conditions, ethnic minorities, socioeconomic disadvantage, or high conflict families; Gabrielli & Lund, 2020; Pierce et al., 2021; Shevlin et al., 2021), future studies should investigate whether my findings are maintained in higher risk populations of youths, or in individuals already experiencing significant internalizing problems. The pandemic was also relatively well-managed in the local community (i.e., London, Ontario, Canada), potentially limiting the degree of stress experienced relative to other communities (see Green et al., *in press*). While many studies of communities expected to be at higher risk for maladaptation have found pandemic-related changes (e.g., stay-at-home orders) to result in greater maladaptation (e.g., Lin et al. 2021; McKnight-Eily, 2021), these same changes have been found to be protective influences in other contexts (e.g., Penner et al., 2021), highlighting the

importance of thoughtful consideration of factors affecting the local community before generalizing my findings.

Finally, while my findings are statistically significant, the small effect sizes may limit the clinical relevance of cortisol output as a predictor of risk for disorder. While statistically significant variation in symptoms was observed both within and between participants, the mean symptoms reported by my sample were relatively low across the study. This floor effect may have limited my ability to observe more robust changes in adaptation to pandemic-related stress. However, given that effective models of risk for psychological maladjustment are composed of many small, additive effects, I maintain that even the small predictive effects observed here could make important contributions to a larger biopsychosocial model. In order to further assess whether cortisol output in the context of acute stress is a functional statistical and clinical predictor of later adjustment, I recommend that my findings be further replicated in populations at greater risk for disorder.

In summary, I found that adolescents' pre-pandemic cortisol output predicted their internalizing symptoms during the onset of the COVID-19 pandemic, and that these patterns of association differed for boys and girls. As such, cortisol output should be considered in larger predictive models when assessing risk and intervention targets during future pandemics and similarly ubiquitous stressors.

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Tables

**Table 3.1.** *Descriptive Statistics and Correlations Between Study Variables*

| | M | (SD) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Youth's Age | 14.36 | (.70) | - | .16 | -.09 | -.01 | -.20 | .03 | .09 | .08 | -.08 | .17 | .20 | .15 |
| 2. Sex [1] | - | - | | - | -.02 | -.06 | -.26* | -.05 | .10 | -.16 | -.08 | .42** | .37** | .35** |
| 3. PPVT Score (Age 3) [2] | 111.95 | (15.03) | | | - | .31** | .02 | -.04 | -.17 | -.09 | -.07 | -.13 | -.13 | -.13 |
| 4. Familial Income [3] | 3.75 | (1.18) | | | | - | .05 | .08 | -.20 | -.19 | -.12 | -.26* | -.28* | -.24* |
| 5. $AUC_I$ [4] | .02 | (.25) | | | | | - | .42** | -.02 | .07 | .11 | -.22* | -.15 | -.11 |
| 6. $AUC_G$ [5] | .28 | (.19) | | | | | | - | -.04 | .01 | -.07 | .10 | 0.12 | .19 |
| 7. Age 11 YSR Anxious-Depressed Score [6] | 8.36 | (4.30) | | | | | | | - | .53** | .72** | .30** | .25* | .33** |
| 8. Age 11 YSR Withdrawn-Depressed Score [6] | 3.13 | (2.63) | | | | | | | | - | .49** | .02 | .18 | 0.04 |
| 9. Age 11 YSR Somatic Complaints Score [6] | 5.22 | (3.63) | | | | | | | | | - | .18 | .20 | .28* |
| 10. Age 14 YSR Anxious-Depressed Score [6, 7] | 4.61 | (4.84) | | | | | | | | | | - | .86** | .82** |
| 11. Age 14 YSR Withdrawn-Depressed Score [6, 7] | 3.14 | (2.89) | | | | | | | | | | | - | .74** |
| 12. Age 14 YSR Somatic Complaints Score [6, 7] | 2.35 | (2.77) | | | | | | | | | | | | - |

* $p < .05$, ** $p < .01$

[1] male = 0, female = 1; ($n$ = 79; 43 boys, 36 girls)

[2] PPVT = Peabody Picture Vocabulary Test

[3] 1 = < $20,000, 2 = $20,000-$40,000, 3 = $40,001-$70,000, 4 = $70,001-$100,000, 5 = > $100,000; all in Canadian dollars.

[4] Area Under the Curve with Respect to Increase for cortisol

[5] Area Under the Curve with Respect to Ground for cortisol

[6] YSR = Youth Self-Report (Achenbach et al., 2001)

[7] Scores averaged across 8 waves of data collection between March through June 2020.

**Table 3.2.** *Variance in Unconditional Models of Symptoms*

| | Intercepts | | | | Slopes | | | |
|---|---|---|---|---|---|---|---|---|
| | *B* | *S.E.* | *t* | *p* | *B* | *S.E.* | *t* | *p* |
| Anxious-Depressed | 21.03 | 5.34 | 3.94 | <.001 | -.01 | .03 | -.21 | .83 |
| Withdrawn-Depressed | 5.09 | 1.34 | 3.79 | <.001 | .05 | .02 | 2.55 | .01 |
| Somatic Complaints | 6.76 | 1.66 | 4.07 | <.001 | .04 | .02 | 2.60 | .01 |

**Table 3.3.** *Means and Standard Deviations of Salivary Cortisol Concentrations*

| Index | Mean (μg/dl) | SD |
|---|---|---|
| Baseline (Pre-TSST-C) | .02 | .02 |
| 10 min after TSST-C | .09 | .06 |
| 20 min after TSST-C | .08 | .06 |
| 30 min after TSST-C | .06 | .04 |
| 40 min after TSST-C | .04 | .03 |
| 50 min after TSST-C | .03 | .02 |
| $AUC_I$ | .02 | (.25) |
| $AUC_G$ | .28 | (.19) |

**Table 3.4.** *Changes in Cortisol Concentrations over Time Analyzed Using Paired T-tests*

| Effect | M | SD | SE | *t*-Value |
|---|---|---|---|---|
| Baseline to 10 min | -.06 | .06 | .01 | -10.02*** |
| Baseline to 20 min | -.06 | .06 | .01 | -9.10*** |
| Baseline to 30 min | -.03 | .04 | <.01 | -7.07*** |
| Baseline to 40 min | -.02 | .03 | <.01 | -4.37*** |
| Baseline to 50 min | -.01 | .03 | <.01 | -1.77 |
| 10 min to 20 min | .01 | .03 | <.01 | 2.33* |
| 10 min to 30 min | .03 | .03 | <.01 | 8.81*** |
| 10 min to 40 min | .05 | .04 | <.01 | 11.09*** |
| 10 min to 50 min | .06 | .04 | <.01 | 12.06*** |
| 20 min to 30 min | .02 | .02 | <.01 | 9.65*** |
| 20 min to 40 min | .04 | .04 | <.01 | 10.30*** |
| 20 min to 50 min | .05 | .04 | <.01 | 11.13*** |
| 30 min to 40 min | .02 | .02 | <.01 | 7.58*** |
| 30 min to 50 min | .03 | .03 | <.01 | 9.41*** |
| 40 min to 50 min | .01 | .01 | <.01 | 7.77*** |

* $p < .05$, *** $p < .001$.
All conducted t-tests had 78 degrees of freedom.

**Table 3.5.** *Regression Statistics using Area Under the Curve with Respect to Increase ($AUC_I$) as a Predictor*

| Anxious-Depressed Symptoms | | | | | |
|---|---|---|---|---|---|
| | | *B* | *S.E.* | *t* | *p* |
| Intercept on | $AUC_I$ | -3.19 | 1.27 | -2.51 | .01 |
| | Sex | 3.48 | 1.06 | 3.26 | <.01 |
| | $AUC_I$*Sex | 1.47 | 13.44 | .43 | .67 |
| Intercepts | Symptoms | 1.23 | .99 | 1.24 | .22 |
| Residual Variances | Symptoms | 17.36 | 4.34 | 4.00 | <.001 |
| Withdrawn-Depressed Symptoms | | | | | |
| | | *B* | *S.E.* | *t* | *P* |
| Intercept on | $AUC_I$ | -.78 | .91 | -.85 | .39 |
| | Sex | 1.07 | .61 | 1.77 | .08 |
| | $AUC_I$*Sex | .49 | 1.87 | .26 | .80 |
| Slopes on | $AUC_I$ | -.26 | .14 | -1.84 | .07 |
| | Sex | .24 | .08 | 3.22 | <.01 |
| | $AUC_I$*Sex | .01 | .01 | .73 | .46 |
| Intercepts | Symptoms | 2.15 | .57 | 3.80 | <.001 |
| | Slope | -.17 | .06 | -2.84 | <.01 |
| Residual Variances | Symptoms | 4.49 | 1.16 | 4.07 | <.001 |
| | Slope | .03 | .02 | 1.84 | .07 |
| Somatic Complaints Symptoms | | | | | |
| | | *B* | *S.E.* | *t* | *p* |
| Intercept on | $AUC_I$ | -1.67 | .92 | -1.81 | .07 |
| | Sex | 1.49 | .64 | 2.33 | .02 |
| | $AUC_I$*Sex | 1.99 | 2.22 | .90 | .37 |
| Slopes on | $AUC_I$ | .07 | .14 | .49 | .63 |
| | Sex | .14 | .06 | 2.41 | .02 |
| | $AUC_I$*Sex | -.13 | .34 | -.37 | .71 |
| Intercepts | Symptoms | .77 | .52 | 1.49 | .14 |
| | Slope | -.13 | .05 | -2.56 | .01 |
| Residual Variances | Symptoms | 5.48 | 1.27 | 4.31 | <.001 |
| | Slope | .03 | .01 | 2.50 | .01 |

Note: The Bonferroni correction was used to correct for multiple comparisons, with significant results achieving p <.025.
$AUC_I$ = Area Under the Curve with respect to Increase for cortisol.
Sex coded as 0 = Male, 1 = Female.

**Table 3.6.** *Regression Statistics Using Area Under the Curve with Respect to Ground ($AUC_G$) as a Predictor*

| Anxious-Depressed Symptoms | | | | | |
|---|---|---|---|---|---|
| | | *B* | *S.E.* | *t* | *p* |
| Intercept on | $AUC_G$ | -3.10 | 2.71 | -1.14 | .25 |
| | Sex | .25 | 1.71 | .15 | .88 |
| | $AUC_G$*Sex | 13.07 | .11 | 2.58 | .01 |
| Intercepts | Symptoms | 1.56 | 1.49 | 1.05 | .30 |
| Residual Variances | Symptoms | 15.66 | 3.52 | 4.45 | <.001 |
| Withdrawn-Depressed Symptoms | | | | | |
| | | *B* | *S.E.* | *t* | *P* |
| Intercept on | $AUC_G$ | -.38 | 1.55 | -.25 | .81 |
| | Sex | .11 | .96 | .12 | .91 |
| | $AUC_G$*Sex | 3.73 | 3.00 | 1.24 | .21 |
| Slopes on | $AUC_G$ | -.26 | .17 | -1.50 | .14 |
| | Sex | .08 | .09 | .860 | .39 |
| | $AUC_G$*Sex | .68 | .25 | 2.76 | .01 |
| Intercepts | Symptoms | 2.23 | .71 | 3.13 | <.01 |
| | Slope | -.14 | .08 | -1.76 | .08 |
| Residual Variances | Symptoms | 4.36 | 1.06 | 4.11 | <.001 |
| | Slope | .03 | .02 | 1.76 | .08 |
| Somatic Complaints Symptoms | | | | | |
| | | *B* | *S.E.* | *t* | *p* |
| Intercept on | $AUC_G$ | -1.19 | 1.30 | -.92 | .36 |
| | Sex | -.84 | .80 | -1.05 | .30 |
| | $AUC_G$*Sex | 9.08 | 2.24 | 4.05 | <.001 |
| Slopes on | $AUC_G$ | .15 | .27 | .54 | .59 |
| | Sex | .20 | .11 | 1.70 | .09 |
| | $AUC_G$*Sex | -.24 | .35 | -.70 | .48 |
| Intercepts | Symptoms | .86 | .62 | 1.38 | .17 |
| | Slope | -.16 | .10 | -1.66 | .10 |
| Residual Variances | Symptoms | 4.48 | 1.02 | 4.37 | <.001 |
| | Slope | .03 | .01 | 2.53 | .01 |

Note: The Bonferroni correction was used to correct for multiple comparisons, with significant results achieving $p < .025$.
Note: $AUC_G$ = Area Under the Curve with respect to Ground for cortisol.
Sex coded as 0 = Male, 1 = Female.

Figures

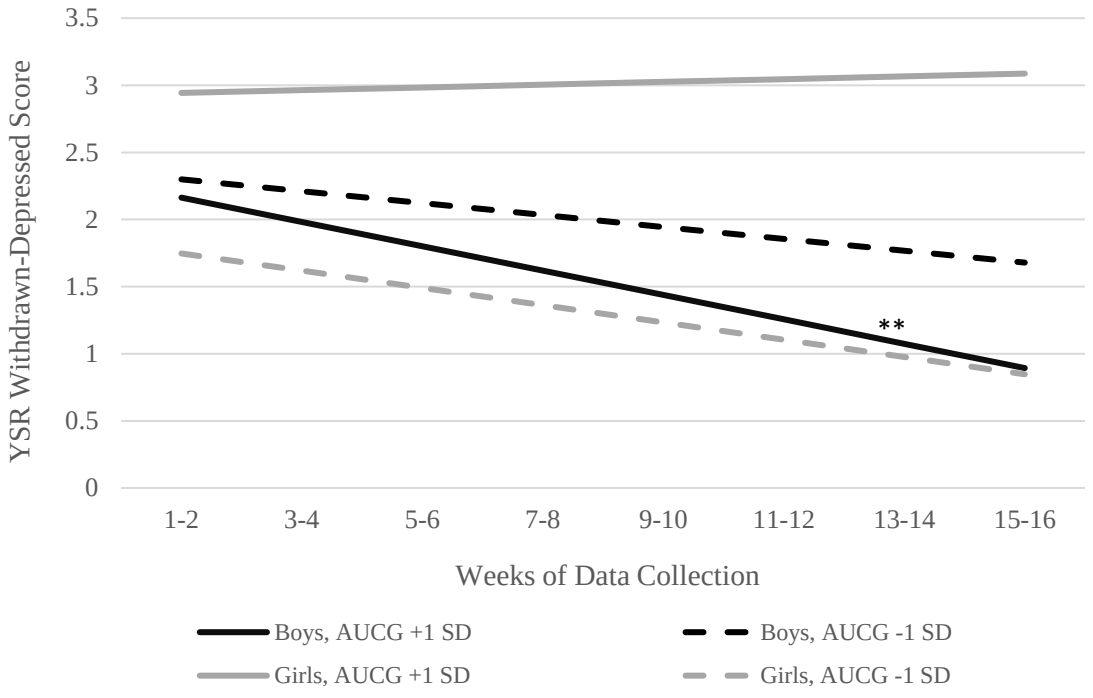


**Figure 3.1.** *Graph Illustrating Simple Slopes Analysis of Youths' Withdrawn-Depressed Symptoms*
Note: ** $p < .01$

# Chapter 4 – Associations between Adolescents' and Primary Caregivers' Internalizing Symptoms During the COVID-19 Pandemic

## Introduction

The COVID-19 pandemic was a source of stress in multiple domains and research has documented the negative mental health impact of COVID-related stressors. These stressors included disease-related threat, such fears of becoming ill or spreading the disease to others (Taylor et al., 2020; Zheng et al., 2021), but also pandemic-related social changes, including social distancing, school and work closures, changes in financial wellness, and supply shortages (Daoust et al., 2022; Kunzler et al., 2021; Taylor et al., 2020; Zheng et al., 2021). Despite the pervasive impact of COVID-related stressors, like all other stressors, there are individual differences in psychological adjustment. Indeed, meta-analyses have shown that while increases in anxious and depressive symptoms developed during the COVID-19 pandemic were short-lived in the general population (Prati & Mancini, 2021), these initial increases were significant (Robinson et al., 2022) and showed substantial heterogeneity in effect sizes between studies (Dragioti et al., 2022; Prati & Mancini, 2021). Risk factors for poor psychological adjustment during the pandemic included cognitive vulnerabilities (e.g., intolerance of uncertainty, death anxiety; Shevlin et al., 2021), fear of COVID-19 (Şimşir et al., 2021), and pre-existing physical and mental health problems (Lewis et al., 2022; Panda et al., 2021; Pierce et al., 2021; Shevlin et al., 2021). Further, a lifetime history of clinically significant anxiety or mood disorders prior to the pandemic was associated with decreased mental health during the pandemic (Asmundson et al., 2020; Lewis et al.,

2022). As such, anxiety and depressive disorders functioned as both a risk factor for, and consequence of, pandemic-related maladaptation.

While many factors are implicated as vulnerabilities to stressful life events (Harkness & Hayden, 2020), caregivers and children in particular reported poorer adjustment in the context of the pandemic relative to the larger population (Pierce et al., 2020; Sachs et al., 2022), including cross-sectional increases in parenting stress and youths' maladjustment (Csikos et al. 2020, Giannotti et al., 2020; Giordano et al., 2021; Morgül et al., 2020). An array of genetic, social, and environmental factors could account for familial risk for pandemic-related maladaptation. Given heritable influences on anxiety and mood disorders (Hettema et al., 2001; Levinson, 2009), family members may share genetic vulnerabilities that contribute towards maladjustment in the face of social stress (Meyer-Lidnenberg & Tost, 2012; Shevlin et al., 2021; Vrshek-Schallhorn et al., 2015). Maladaptation may also propagate through unpleasant social interactions between family members, which may increase in frequency during lockdowns (Prime, 2020). For example, the increased parenting stress associated with the COVID-19 pandemic has been linked to an increased use of negative (i.e., harsh or neglectful) parenting strategies (Chung et al., 2020; Connell & Strambler, 2021; Lee et al., 2022), which is known to negatively influence youths' emotional adjustment (Clayborne et al., 2020; Keisjer et al., 2020; Khoury et al., 2021; McLeod et al., 2007). Alarmingly, the novel stress experienced by caregivers during the pandemic may have increased rates of child maltreatment, although these changes are harder to quantify on account of social isolation from potential reporters (e.g., teachers and friends; Brown et al., 2020; Caron et al. 2020; Kovler et al, 2021; Roje Đapić et al., 2020).

Past work has focused largely on the effect of caregivers' maladjustment on offspring adaption. Meta-analyses report that caregivers' own symptoms of mental health problems were cross-sectionally and longitudinally associated with higher risk for negative mental (Ivanova et al., 2022; Lawrence et al., 2019) and physical health outcomes in their children (Pierce et al., 2020). The influence of parental mental health problems on youths' adjustment may function in part through their use of negative parenting styles (e.g., harsh control, neglect; Middleton et al., 2009), which have been independently associated with an increased risk for internalizing (Pinquart, 2017a) and externalizing problems (Pinquart, 2017b) in youths, and may also have implications for youths' academic achievement (Pinquart, 2016), self-esteem (Pinquart & Gerke, 2019), and engagement in delinquent behaviour (Hoeve et al., 2009). In contrast, potential effects of youths' adjustment on caregivers' well-being are less clear. Within generally healthy community-dwelling samples, youths' anxious or depressive symptoms may contribute to behaviors that generate stress and worry for their attending caregiver. Indeed, children's negative behaviour and caretaking hassles have been associated with increased parenting stress (Östberg & Hagekull, 2000; Östberg et al., 2007), which may in turn be associated with poorer mental health in caregivers (Babore et al., 2023; Kwok & Wong, 2000). While caregiving stress has been associated with increased symptoms of anxiety, depression, and physical illness, these concepts are most often explored in caregivers of children with developmental disabilities (Barroso et al., 2018; Hayes & Watson, 2012) or severe chronic illnesses (Cousino & Hazen, 2013), as well as caregivers of (Amirkhanyan & Wolf, 2003; Son et al., 2007). While speculative, potential

bidirectional effects between youths' and caregivers' symptoms may promote a cycle of negative influences on well-being within families.

Social exposure to family members' anxious or depressive symptoms is itself a risk of the development of similar symptoms (Joiner & Katz, 1999). The effect of individuals' mood states on cohabitants has been observed within households pre-pandemic (Chi et al., 2019; Kristensen et al., 2022; Umberson & Thomeer, 2020), and the strength of these effects may increase given extensive time spent together during government-mandated lockdowns (Liu & Doan, 2020). A study by Zhang and Ma (2020) found that, compared to prior to the onset of the COVID-19 pandemic, community-dwelling individuals reported sharing more of their emotional experience with their family members and being more attentive to their family's emotional experiences in return (Zhang & Ma, 2020). As well, families in lockdown may have less opportunity to distance themselves from each other during periods of low mood, limiting the effectiveness of emotional regulation (Mariani et al., 2020) and avoidant coping strategies (Agha, 2020). Altogether, given compounding vulnerability across family members and within the family unit, families with children should be considered a high priority target for study and intervention in the context of pandemic-related stress.

**Caregivers During the Pandemic**

A meta-analysis of studies of caregivers of children during the COVID-19 pandemic reported that 27% of caregivers reported significant depressive symptoms and 52% reported significant anxious symptoms (Panda et al., 2021), indicating heightened maladjustment when compared to the 26% prevalence for any major adverse psychological symptoms of pandemic-related stress in the general population (Arora et

al., 2022). This increased risk may be partially due to the specific stressors associated with caring for young children during the pandemic. Indeed, a mid-pandemic study found that 71% of community-dwelling parents reported a significant increase in parenting-specific stress (Adams et al., 2021). Among others, these stressors included difficulty finding childcare (Kalluri et al., 2021; Lee & Parolin, 2021) and the rollout of at-home learning programs, which required many caregivers to take on additional responsibilities of teaching and monitoring their child's educational progress (Abuhammad, 2020; Stites et al., 2021). These changes in schooling and childcare also contributed to caregivers' reduced ability to attend work or to complete their occupational responsibilities during the pandemic (Kochhar, 2020) and were found to have a negative impact on caregivers' psychological well-being (Racine et al., 2021). Ubiquitous pandemic-related stressors may also have been subjectively experienced as more stressful by caregivers than for individuals without dependants. For example, caregivers may subjectively experience disruptions in income, food insecurity, and housing instability as more threatening (Kalluri et al., 2021; Prime et al., 2020) than non-caregivers, given their obligation to provide for their dependent youth. Thus, caregivers' roles may increase their risk for maladjustment.

**Adolescents During the Pandemic**

Pandemic-related stressors may also be especially impactful on adolescents, which, pandemic aside, are already at heightened risk for psychopathology (Bergen et al., 2007). During the first year of the pandemic, a study of community-dwelling caregivers found that 79% reported a worsening of their youth's behavioural or psychological symptoms (Panda et al., 2021). Social isolation could be particularly detrimental to

adolescents, given the increased importance of interpersonal relationships during this developmental stage (Smetana et al., 2006). School closures and the cancellation of extracurricular activities may have reduced the quality of youths' educational experiences, which may in turn have negative impacts on their long-term development (Lee & Parolin, 2021; Eime et al., 2013). Extant research further suggests that the transition to at-home learning was difficult for many youths and was associated with feelings of frustration (Muñoz-Fernández & Rodríguez-Meirinhos, 2021), losses in academic learning (Aurini & Davies, 2021; Whitley et al., 2021), and youths feeling like they matter less to others (Vaillancourt et al., 2022).

**Relevance to Future Crises**

While COVID-19 is no longer considered a global health emergency at the time of publication, the World Health Organization (2023) and others (Sach et al., 2022) note the potential for SARS-CoV-2 to mutate further, as well as potential pathogens that may result in similar crises in the future. Indeed, the risk for future pandemics continues to rise on account of increasing globalization, as well as ongoing anthropogenic social and ecological processes (Thoradeniya & Jayasinghe, 2021). Given that a lack of global preparedness greatly contributed to the severity of the COVID-19 pandemic (Kandel et al., 2020; Yu et al., 2020), research that characterizes individuals' responses to COVID-related stress is needed to minimize the impact of future crises. This is especially true in the context of mental health, as pandemic-related stress was found to disproportionally affect young adults and parents of young children (Pierce et al., 2020a; Sachs, 2022).

**The Current Study**

Past research indicates that youth and their caregivers are at significant risk for anxious and depressive disorders in the context of pandemic-related stress, but extant research has largely examined youths and caregivers independently. Additionally, most past work on familial adjustment during COVID has been cross-sectional; of the limited number of longitudinal studies, most have been conducted with only a few waves of data collection. Further, these longitudinal studies were often conducted with long intervals between waves of data collection, which limits our ability to understand the rate at which caregivers' and adolescents' symptoms may impact one another. Examining relationships between cohabitating caregivers' and youths' symptoms over shorter time periods (i.e., 2-week intervals) will improve our understanding of how mental health difficulties may develop and perpetuate within families in the context of global stressors. Resulting findings may allow us to develop and schedule mental health intervention efforts to maximize their positive effect on the greater community. As such, I examined reciprocal, cross-lagged associations between the depressive and anxious symptoms of dyads of community-dwelling adolescents and their primary caregivers across 16 weeks early in the COVID-19 pandemic. Given pre-pandemic research supporting potential bidirectional relationships between parents' and youths' adjustment (Ivanova et al., 2022; Li & Zhou, 2021; Lawrence et al., 2019; Scherer et al., 2019), I predicted that that caregivers' and adolescents' symptoms will predict the symptoms of their dyadic partner two weeks later.

# Methods

## Participants

Participants were caregiver-adolescent dyads drawn from an ongoing longitudinal study of children's emotional development (N = 409) that began when children were three years old (M = 3.43, SD = .30); families have been followed up multiple times over the past 13 years (e.g., Daoust et al., 2018). Families were initially recruited from the community using a combination of local and digital advertisements, and by contacting individuals in the Western University Psychology participant pool. Children with serious mental or physical problems, as assessed by a trained research assistant during an initial screening interview with the primary caregiver, were ineligible to participate. A proxy measure of children's cognitive ability (i.e., the Peabody Picture Vocabulary Test – Fourth Edition; Dunn & Dunn, 2007), administered when children were 3 years old, showed that participating children were in the normal range of cognitive ability (M = 112.00, SD = 14.05). Families were representative of the Ontario community from which they were recruited (Statistics Canada, 2018).

Of the original 409 families involved in the study, 273 caregiver-child dyads (67% retention at 13 years from study recruitment) participated in at least one wave of the current study, which was focused on family adjustment in response to the COVID-19 pandemic. The current study includes 8 waves of data collection across 16 weeks (i.e., each wave spaced approximately two weeks apart). Given the lack of clearly relevant data concerning rate of symptom change during COVID-19, we opted to collect data at two-week intervals to capture potential shorter-term changes in symptom scores over time.

An overview of participant demographics in the current sample can be found in Table 4.1. Independent samples t-tests indicated that participants (N = 273) and non-participants (N = 136) in the current follow-up did not differ significantly on youth age, caregiver age, youth sex, race, or familial income (all ps > .05). Participants did differ significantly from non-participants on PPVT scores ($t_{397}$ = -2.07, p = .04), in that participants had a mean score 3.1 points higher than non-participants. Most families completed six waves of data collection; among participants in the current follow-up, families who provided data in six or more of the eight waves were more likely to have a younger caregiver (44.13 ± 4.04 years old) than families who provided data in five or fewer waves (45.67 ± 8.14 years old; $t(231.12) = 2.05$, $p = .04$). Families who participated in six or more waves did not otherwise differ significantly from those who provided data in five or fewer waves on youth's age, youth's sex, race, PPVT scores, or familial income (all ps > .05).

**Measures**

Symptom measures were collected every two weeks over a sixteen-week period (i.e., a total of eight waves of data collected) in March through June 2020. All survey data were collected remotely using Qualtrics XM (Qualtrics, USA), with separate individual survey links sent by email to caregivers and adolescents to allow for independent participation.

***General Anxiety Disorder-7 (GAD-7)***

Caregivers completed the GAD-7 (Spitzer et al., 2006), a brief 7-item self-report measure for indexing symptoms of anxiety in adults. Developed based on criteria for generalized anxiety disorder from the DSM-IV-TR, items include "feeling nervous,

anxious, or on edge" and "worrying too much about different things." Participants respond to items on a scale of 0 to 3, reflecting "not at all" to "nearly every day" based on their experiences over the past two weeks. Responses are summed into a single overall score; scores of 5, 10, and 15 are recommended as benchmarks of mild, moderate, and severe anxiety respectively. At the initial assessment, 53.6% of caregivers reported minimal symptoms, 31.3% reported mild symptoms, 10.1% reported moderate symptoms, and 5.0% reported severe symptoms. The GAD-7 showed excellent internal consistency ($\alpha_{range}$ = .88 - .93) across administrations in my sample.

***Patient Health Questionnaire-9 (PHQ-9)***

Caregivers also completed the PHQ-9 (Kroenke et al., 2001), a brief self-report measure for indexing symptoms of depression in adults. The PHQ-9 has items representing each of the nine diagnostic criteria for depression in the DSM-IV; items include "little interest or pleasure in doing things" and "feeling down, depressed, or hopeless." Respondents rate items on a scale of 0 to 3, reflecting "not at all" to "nearly every day" based on their experiences over the past two weeks. Responses are summed into a single overall score; scores of 5, 10, 15, and 20 are recommended as benchmarks of mild, moderate, moderately severe, and severe depression, respectively. At the initial assessment, 70.9% of caregivers reported minimal symptoms, 21.8% reported mild symptoms, 3.9% reported moderate symptoms, 2.8% reported moderately severe symptoms, and 0.6% reported severe symptoms. The PHQ-9 showed excellent internal consistency ($\alpha_{range}$ = .83 - .91) across administrations in my sample.

### *Youth Self-Report (YSR)*

The YSR (Achenbach & Rescorla, 2001) was used to assess participating adolescents' emotional and behavioral problems. The YSR is a 105-item self-report measure designed for ages 11 to 18 which describe behaviors related to internalizing and externalizing disorders. Adolescents rated themselves on each item on a scale of 0 ("not true"), 1 ("sometimes true"), or 2 ("very true") based on their experience of the past two weeks; individual items were summed into relevant subscale scores. To minimize participant burden, a limited set of subscales were assessed; relevant to this study, the anxious/depressed (12 items, $\alpha_{range}$ = .88 - .91) and withdrawn/depressed (8 items; $\alpha_{range}$ = .78 - .88) subscales were administered. 88.9% of adolescents reported subclinical anxious-depressed symptoms, while 2.8% reported elevated symptoms, and 8.3% reported clinical levels of symptoms. Similarly, 90.0% of adolescents reported subclinical withdrawn-depressed symptoms, while 5.6% reported elevated symptoms, and 4.4% reported clinical levels of symptoms. Means fell below clinical thresholds for all subscales and were consistent with prior work involving non-referred normative samples (Achenbach & Rescorla, 2001).

## Data Analytic Approach

### *Latent Curve Model with Structured Residuals (LCM-SR)*

LCM-SRs (Curran et al., 2014), constructed in MPlus (Muthén & Muthén, 2017), were used to model cross-lagged relationships between caregivers' and adolescents' symptoms over time. LCM-SRs were chosen over Cross-Lagged Panel Models (CLPMs) to account for expected population-level changes in adjustment to the COVID-19 pandemic over time (Green et al., *in press)*, and because CLPMs do not distinguish

between within-person and between-person variance (Orth et al., 2021; Shi et al., 2021). As such, the cross-lagged relationships in the below models describe relationships between deviations from sample means (i.e., residualized symptom scores). Given that autoregressive relationships between caregivers' and adolescents' symptoms were not expected or observed (see Green et al., *in press*) to systematically vary over time, I chose to model these variables as fixed effects to examine general relationships between caregivers' and adolescents' symptoms.

As parental mental health difficulties have been identified as a non-specific risk marker for offspring maladjustment (Ivanova et al., 2022; Lawrence et al., 2019; Pierce et al., 2020b), I constructed four models of relationships between symptoms in dyadic partners, notably symptoms predicting similar symptoms (i.e., anxiety predicting anxiety, depression predicting depression) and symptoms predicting different internalizing symptoms (i.e., anxiety predicting depression and vice versa).

***Missing Data***

Sample size varied across waves of collection due to rolling recruitment, participant availability, and changes in study protocol. 273 caregiver-adolescent dyads provided at least one data point across the study, with an average of 168 caregivers and 159 adolescents participating at each wave. A full information maximum likelihood estimator was implemented in the model to account for missingness in caregiver and adolescent data.

# Results

## Correlations Between Study Variables

Correlations between notable study variables are in Table 4.1. Given high correlations between self-reported symptoms across waves of data collection, average symptom scores were used to streamline these analyses. In terms of participating youths, girls were slightly older than boys, and participating individuals who identified as non-White were slightly older than those who identified as White. Caregiver age was associated with caregiver sex, in that participating fathers were older than participating mothers. Adolescent age, adolescent sex, and caregiver sex were also associated with adolescents' average depressive and anxious symptoms, in that older adolescents, girls, and adolescents with mothers as primary caregivers reported higher average symptoms. Caregiver sex was also associated with adolescents' PPVT scores at age 3, in that youths with mothers as primary caregivers scored higher than youths with fathers as primary caregivers. Family income was negatively correlated with caregivers' and adolescents' average anxious and depressive symptoms. Family income was also positively correlated with caregiver age and adolescents' PPVT scores. Adolescents' own average anxious and depressive symptoms were strongly positively correlated, as were caregivers'. Across participating dyads, caregivers' average anxious and depressive symptoms were positively correlated with adolescents' average anxious and depressive symptoms.

Cross-sectional correlations between caregivers' and adolescents' symptom scores at each wave of data collection can be found in Appendix B. Caregivers' and adolescents' symptom scores were frequently cross-sectionally associated, with the non-

significant associations in the early weeks of the study likely accounted for by a reduction in power due to relatively small sample sizes.

**Unconditional Models**

Caregivers' and adolescents' anxious and depressive symptom intercepts and slopes were modelled without additional predictors to assess variance (see Table 4.2). A linear slope provided acceptable model fit in all unconditional models, and significant variance was found in all modelled intercepts and slopes (all ps < .01), allowing for further investigation of factors that may influence these parameters.

**Predictive Models**

***Adolescents' and Caregivers' Anxious Symptoms***

Results from the LCM-SR analyses for anxious symptoms are in Figure 4.1. Model fit was found to be acceptable (SRMR = .070), and the AIC and BIC indicated an improved fit from the unconditional model. Caregivers' anxious symptoms at the first assessment (i.e., the model intercept) were significantly positively associated with adolescents' own anxious symptoms at the same timepoint (r = 2.98, $p$ = .01). Additionally, caregivers' baseline anxious symptoms were negatively associated with the slopes of their own anxious symptoms over time ($r$ = -.80, $p$ = .001), in that higher initial symptoms predicted more negative symptom slopes over time. Surprisingly, caregivers' anxious symptoms did not predict adolescents' anxious symptoms two weeks later ($b$ = -.05, $p$ = .46), nor did adolescents' anxious symptoms predict caregiver's anxious symptoms two weeks later ($b$ = -.02, $p$ = .65).

### *Adolescents' and Caregivers' Depressive Symptoms*

Results from the LCM-SR analyses for depressive symptoms are in Figure 4.2. Model fit was found to be acceptable (SRMR = .058), and the AIC and BIC indicated an improved fit from the unconditional model. Caregivers' depressive symptoms at the first assessment (i.e., the model intercept) were significantly positively associated with adolescents' own depressive symptoms at the same timepoint ($r = 2.31$, $p < .01$). Adolescents' depressive symptoms were related to caregivers' later depressive symptoms ($b = .17$, $p = .04$); when adolescents' depressive symptoms were higher than sample means, caregivers' symptoms were also higher than sample means two weeks later. Caregivers' depressive symptoms were also related to adolescents' later depressive symptoms ($b = .06$, $p = .04$); when caregivers' depressive symptoms were higher than sample means, adolescents' symptoms were also higher than sample means two weeks later.

### *Adolescents' Anxious Symptoms and Caregivers' Depressive Symptoms*

Results from the LCM-SR analyses for depressive symptoms are in Figure 4.3. Model fit was found to be acceptable (SRMR = .059), and the AIC and BIC indicated an improved fit from the unconditional model. During the first wave of assessments (i.e., the model intercept), adolescents' anxious symptoms were positively correlated with caregivers' depressive symptoms ($b = 3.07$, $p = .02$). However, adolescents' anxious symptoms did not predict caregivers' depressive symptoms two weeks later ($b = -.04$, $p = .64$), nor did caregivers' symptoms predict adolescents' later anxious symptoms ($b = .04$, $p = .41$).

### *Adolescents' Depressive Symptoms and Caregivers' Anxious Symptoms*

Results from the LCM-SR analyses for depressive symptoms are in Figure 4.4. Model fit was found to be acceptable (SRMR = .069), and the AIC and BIC indicated an improved fit from the unconditional model. As in the previous model involving caregivers' anxious symptoms, their initial symptoms (i.e., model intercepts) were negatively correlated with the slope of their symptoms over time ($r$ = -.79, $p$ = <.01). Caregivers' anxious symptoms were unrelated to adolescents' later depressive symptoms ($b$ = .01, $p$ = .82); however, adolescents' depressive symptoms were related to caregivers' anxious symptoms two weeks later ($b$ = .15, $p$ = .02). Specifically, when adolescents' depressive symptoms were above sample means, caregivers' anxious symptoms were also above sample means two weeks later.

## Discussion

Examining relationships between adolescents' and caregivers' internalizing symptoms during the COVID-19 pandemic may help to understand how mental health difficulties develop during crises, therefore allowing us to identify efficient and effective intervention targets. Given this, I examined cross-lagged relationships between community-dwelling caregivers' and adolescents' anxious and depressive symptoms across the first 16 weeks of the COVID-19 pandemic, finding bidirectional, cross-lagged associations between adolescents' and caregivers' depressive symptoms. Additionally, I found unidirectional effects of adolescents' depressive symptoms on caregivers' anxious symptoms.

In partial satisfaction of my hypothesis, I found that adolescents' and caregivers' depressive symptoms predicted one another two weeks later during the early weeks of the

COVID-19 pandemic. Our results align with recent findings of mood states being shared within households (Chi et al., 2019; Kristensen et al., 2022; Umberson & Thomeer, 2020), but contrast with the pre-pandemic findings of Griffith and colleagues (2021) who observed no prospective cross-lagged relationships between caregivers' and adolescents' depressive symptoms. This difference in findings from Griffith and colleagues (2021) may be partially accounted for by the shorter intervals between waves of assessment in my study; recently observed (i.e., within the last two weeks) symptoms in a dyadic partner may have a stronger effect on current adjustment than more distal (i.e., three months prior) functioning (Hogarth & Einhorn; 1992). This difference in findings could also indicate that the context of the COVID-19 pandemic strengthened relationships between caregivers' and adolescents' depressive symptoms, potentially creating a pathway of risk transmission that was not evident pre-pandemic. This dyadic transmission may result in a positive feedback cycle between adolescents and caregivers, prolonging the experience of symptoms despite symptoms generally declining over time (Green et al., *in press*). As such, mental health intervention strategies supporting an individual may also benefit from offering preventative care for their larger family (Collins & Dozois, 2008; Jorm & Griffiths, 2005). Such preventative interventions may help to reduce the reciprocal transmission of depressive symptoms between caregivers and adolescents, reducing the disease burden of depression on the family and on the larger mental health care system (Mihalopoulos et al., 2011).

I also found that adolescents' anxious symptoms predicted caregivers' depressive symptoms two weeks later, but caregivers' depressive symptoms did not predict youths' later anxious symptoms. Given associations between youths' symptoms and maladaptive

behaviours during the COVID-19 pandemic (Li et al., 2021; Panda et al., 2021), behaviours driven by adolescents' symptoms (e.g., repeated checking, avoidance behaviours) may generate additional parenting stress for their caregivers (Östberg & Hagekull, 2000; Östberg et al., 2007), thereby increasing their depressive symptoms (Babore et al., 2023; Kwok & Wong, 2000). These findings could be interpreted in the context of Scourfield and colleagues' (2003) findings that environmental influences on adolescents' symptoms become less significant as they age into adolescence, rendering them less likely to be influenced by caregivers' own symptoms. This may be partially due to adolescence being a period of growing independence from caregivers (Ryan & La Guardia, 2000; Sanders, 2013; Steinberg, 1989). Given the developmental stage of the adolescents in my study, they may be less engaged with their caregiver relative to younger children, potentially mitigating the impact of caregivers' symptoms. Differences in emotional regulation skills between youths and caregivers may also partially account for these unidirectional findings. Emotional regulation has been conceptualized as a factor that moderates the impact of others' mood states on an individual (Liu & Doan, 2020); symptoms in an individual with strong emotion regulation skills may not be perceived by others, thus limiting the impact of these symptoms on others. Emotional regulation skills have been found to improve with age (Magai et al., 2006), with neural markers of functioning suggesting that self-regulation may be more effortful for children and adolescents (Helion et al., 2019). While caregivers may be better equipped to manage expressions of their own symptoms, youths' greater difficulty with emotional regulation skills may have made their mental health difficulties more evident, therefore increasing the impact of their anxious symptoms on their caregivers' well-being.

While I found significant relationships between adolescents' and caregivers' depressive symptoms in my study, observed effect sizes were expectedly small. These small effects may still be clinically relevant in predicting individuals' risk for disorder (Cuijpers et al., 2014), especially when incorporated into a larger predictive model. However, the statistical power of my study may have limited my ability to detect other small but potentially relevant relationships between adolescents' and caregivers' anxious symptoms. This is especially notable given past research indicating that anxious symptoms may have a weaker effect on others' well-being than depressive symptoms (Joiner & Katz, 1999). While statistical power may be increased by achieving a larger sample size, leveraging a more specific and accurate conceptual model of these effects may also contribute to this effort. Accounting for potential sex differences in the relationships between adolescents' and caregivers' symptoms may contribute to a more nuanced understanding of relationships between adolescents' and caregivers' symptoms. Indeed, previous research has established differing effects of mothers' and fathers' adjustment on boys and girls (Chi et al., 2019; Davies & Windle, 1997) and sex differences in youths' vulnerability to their peers' mood states (Prinstein, 2007). As the effect of caregivers' or adolescents' symptoms on family members may vary depending on their biological sex, future studies should consider biological sex as a potential moderator of the relationship between caregivers' and adolescents' symptoms over time.

Adolescents' and caregivers' internalizing symptoms were expectedly cross-sectionally correlated. These findings reflect a substantive body of research which suggests that shared genetic and environmental influences shape how adolescents and their caregivers respond to shared stressors (Flancbaum et al., 2011; Griffith et al., 2021).

While these cross-sectional associations do not share the same predictive (and therefore preventative) value of cross-lagged associations, they still indicate that the maladjustment of one family member may provide information about the adjustment of other members of the family. Contrasting these findings, no associations were found between the trajectories (i.e., slopes) of adolescents' and caregivers' symptoms. While several studies have documented brief, initial increases in internalizing symptoms in response to the COVID-19 pandemic in both adults (Fancourt et al., 2021) and adolescents (Green et al., *in press*; Hawes et al., 2021), no other study to my knowledge has examined potential relationships between the trajectories of the symptoms of caregiver-adolescent dyads in this context. Although pandemic-related stressors influence caregivers' and adolescents' functioning in similar ways (Daoust et al. 2022), my results suggest that the relevance of these stressors, and therefore their effect on symptom trajectories, may differ between groups.

Several methodological characteristics of my study limit the interpretability of my findings. Given the relatively quick rollout of my project in response to the COVID-19 pandemic and my research group's strategy of ongoing recruitment, my achieved sample size varies across waves of data collection. Despite my use of statistical methods to account for missing data, this missingness may have negatively impacted the accuracy of modelled symptom trajectories. Our sample also consists primarily of White, higher socioeconomic status individuals with relatively low rates of serious mental health difficulties, representative of the community from which the data were collected (Statistics Canada, 2018). These narrowly defined characteristics of my sample may limit the generalizability of my findings to other populations, especially given the

disproportionate effect of the economic impacts of the COVID-19 pandemic on lower socioeconomic status families. Further, symptoms of anxiety and depression may have a stronger negative impact on family members' adjustment when the symptoms are more severe, and therefore more visible. Future studies should consider replicating my methods with higher-risk populations of community-dwelling families.

Our study was also limited in scope; internalizing symptoms were chosen as the focus for my study given the large literature showing associations between these and stressful life events (Haig-Ferguson et al., 2021; Harkness & Hayden, 2020), and to minimize the burden on participants in my repeated-measures study. However, a commonly experienced stressor may lead to different symptom manifestations across individuals on account of interactions with different risk factors (e.g., temperament, stress reactivity, biological sex; Daoust et al., 2018; Gaylord et al., 2003; Steeger et al., 2017; Yap et al., 2007). Given that extant research has identified increases in adolescents' externalizing problems during the COVID-19 pandemic (Giannotti et al., 2020; Whittle et al., 2020), I recommend that future studies also investigate whether these increases are related to caregivers' own symptoms.

Potential issues related to measurement should also be considered when interpreting my results. I chose to rely on self-report measures of symptoms to limit the burden of my study on participants, but these self-report measures reflect the degree to which internalizing symptoms (e.g., low mood, anhedonia, low energy) are personally experienced, rather than the degree to which they are observable in the home. As these differences in expression may influence the degree to which symptoms have an impact on family members, informant reports of adjustment or emotionality may better reflect

family members' observable behaviour, and therefore be more relevant to future studies of relationships between family members' symptoms.

Our longitudinal, repeated measures design provides an uncommon opportunity to investigate prospective relationships between caregivers' and adolescents' symptoms. Based on previous research (Haig-Ferguson et al., 2021; Harkness & Hayden, 2020), I assumed that primary caregivers would have the greatest impact on the adjustment of adolescents in my study; however, adolescents are likely affected by the behaviour of other members of their household. While pre-pandemic studies have explored the independent effects of siblings' (Buist et al., 2013), and one or more parents' (Chi et al., 2019; Davies & Windle, 1997) adjustment on adolescents' well-being, no studies to my knowledge have comprehensively modelled the effects of relationships between immediate family members. Contextualizing my results within the functioning of the larger family will be important to accurately identify factors that most strongly contribute to familial maladjustment.

Additionally, more comprehensive models should also consider factors that may moderate family members' influence on each other in terms of symptoms. Prinstein and colleagues (2007) identified factors that may increase adolescents' susceptibility to others' mood states within their peer groups, notably social anxiety symptoms, perceived popularity, and perceived friendship quality. Future research could explore whether similar factors (e.g., self-reported quality of relationship between family members) also account for potential transmission of psychopathological symptoms within family units. While the value of assessing risk for maladjustment during global crises is clear, it is equally important to consider factors which may also help to build resilience. Indeed,

other researchers have found evidence for the impact of adaptive mood states (Chi et al., 2019) and traits (Qi et al., 2023) on others' well-being within families. Given that other research has identified the potential for interactions between family members to have protective influences on individuals' adjustment during the pandemic (Mari et al., 2020; Mariani et al., 2020), a more comprehensive model of familial functioning may be warranted.

In summary, I modelled cross-lagged associations between adolescents' and caregivers' anxious and depressive symptoms across the first 16 weeks of the COVID-19 pandemic. I found bidirectional cross-lagged relationships of adolescents' and caregivers' depressive symptoms, with higher symptoms in either member predicting higher symptoms in their dyadic partner two weeks later. While I found no relationships between adolescents' and caregivers' anxious symptoms over time, adolescents' higher depressive symptoms did predict increases in caregivers' anxious symptoms two weeks later.

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# Tables

**Table 4.1.** *Descriptive Statistics and Correlations Between Variables in the Current Study*

| | M | (SD) | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Adolescent Age | 14.16 | (.67) | - | .10 | .14* | .01 | -.01 | -.03 | .14* | .18** | .15* | .07 | .05 |
| 2. Caregiver Age | 44.99 | (6.68) | | - | -.02 | -.12* | -.01 | .28** | <.01 | .13* | .13* | .11 | .11 |
| 3. Adolescent Sex [1] | - | - | | | - | -.05 | .06 | -.03 | .10 | .33** | .22** | -.02 | -.02 |
| 4. Caregiver Sex [2] | - | - | | | | - | .15* | -.10 | .06 | .02 | .05 | .04 | .08 |
| 5. Adolescent PPVT Score (Age 3) [3] | 113.01 | (14.29) | | | | | - | .16** | .06 | .03 | .01 | -.11 | -.11 |
| 6. Familial Income [4] | 3.76 | (1.10) | | | | | | - | -.09 | -.12* | -.19** | -.19** | -.22** |
| 7. Race [5] | - | - | | | | | | | - | .09 | .07 | .05 | .04 |
| 8. Adolescent Average YSR Anxious-Depressed Score [6] † | 5.10 | (4.80) | | | | | | | | - | .77** | .25** | .22** |
| 9. Adolescent Average YSR Withdrawn-Depressed Score [6] † | 3.39 | (2.95) | | | | | | | | | - | .22** | .24** |
| 10. Caregiver Average GAD-7 Score [7] † | 3.92 | (3.49) | | | | | | | | | | - | .80** |
| 11. Caregiver Average PHQ-9 Score [8] † | 3.86 | (3.92) | | | | | | | | | | | - |

* $p < .05$, ** $p < .01$

† Scores averaged across 8 waves of data collection between March through June 2020.

[1] male = 0, female = 1; (n = 273; 126 boys, 147 girls)

[2] male = 0, female = 1; (n = 273; 14 fathers, 259 mothers)

[3] PPVT = Peabody Picture Vocabulary Test

[4] 1 = < $20,000, 2 = $20,000-$40,000, 3 = $40,001-$70,000, 4 = $70,001-$100,000, 5 = > $100,000; all in Canadian dollars.

[5] White = 0, Other = 1 (n = 273; 259 White, 14 other)

[6] YSR = Youth Self-Report (Achenbach et al., 2001)

[7] GAD-7 = General Anxiety Disorder-7 (Spitzer et al., 2006)

[8] PHQ-9 = Patient Health Questionnaire-9 (Kroenke et al., 2001)

**Table 4.2.** *Unconditional Models Examining Variance Within Symptom Scores*

| | | | *b* | *S.E.* | *t* | *p* |
|---|---|---|---|---|---|---|
| Anxiety | Caregiver | Intercept | 10.26 | 1.40 | 7.31 | <.001 |
| | | Slope | .09 | .03 | 2.63 | <.01 |
| | Adolescent | Intercept | 20.14 | 2.30 | 8.76 | <.001 |
| | | Slope | .11 | .02 | 5.40 | <.001 |
| Depression | Caregiver | Intercept | 12.92 | 2.18 | 5.92 | <.001 |
| | | Slope | .11 | .04 | 2.79 | <.01 |
| | Adolescent | Intercept | 7.18 | .96 | 7.46 | <.001 |
| | | Slope | .06 | .01 | 4.84 | <.001 |

Figures

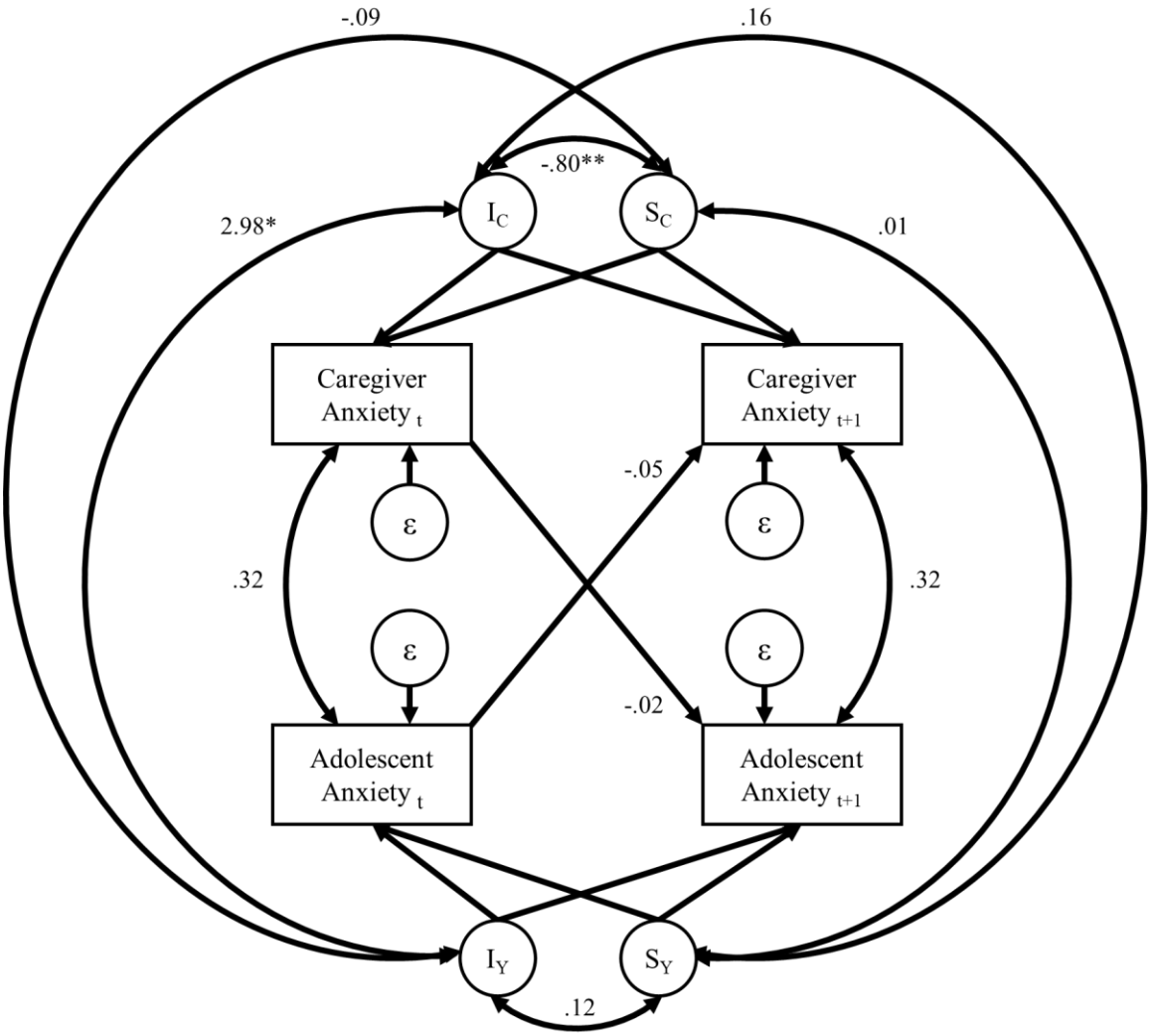


**Figure 4.1.** *Cross-lagged LCM-SR of Adolescents' and Caregivers' Anxious Symptoms Over Time*

Note: * p < .05, ** p < .01, *** p <.001

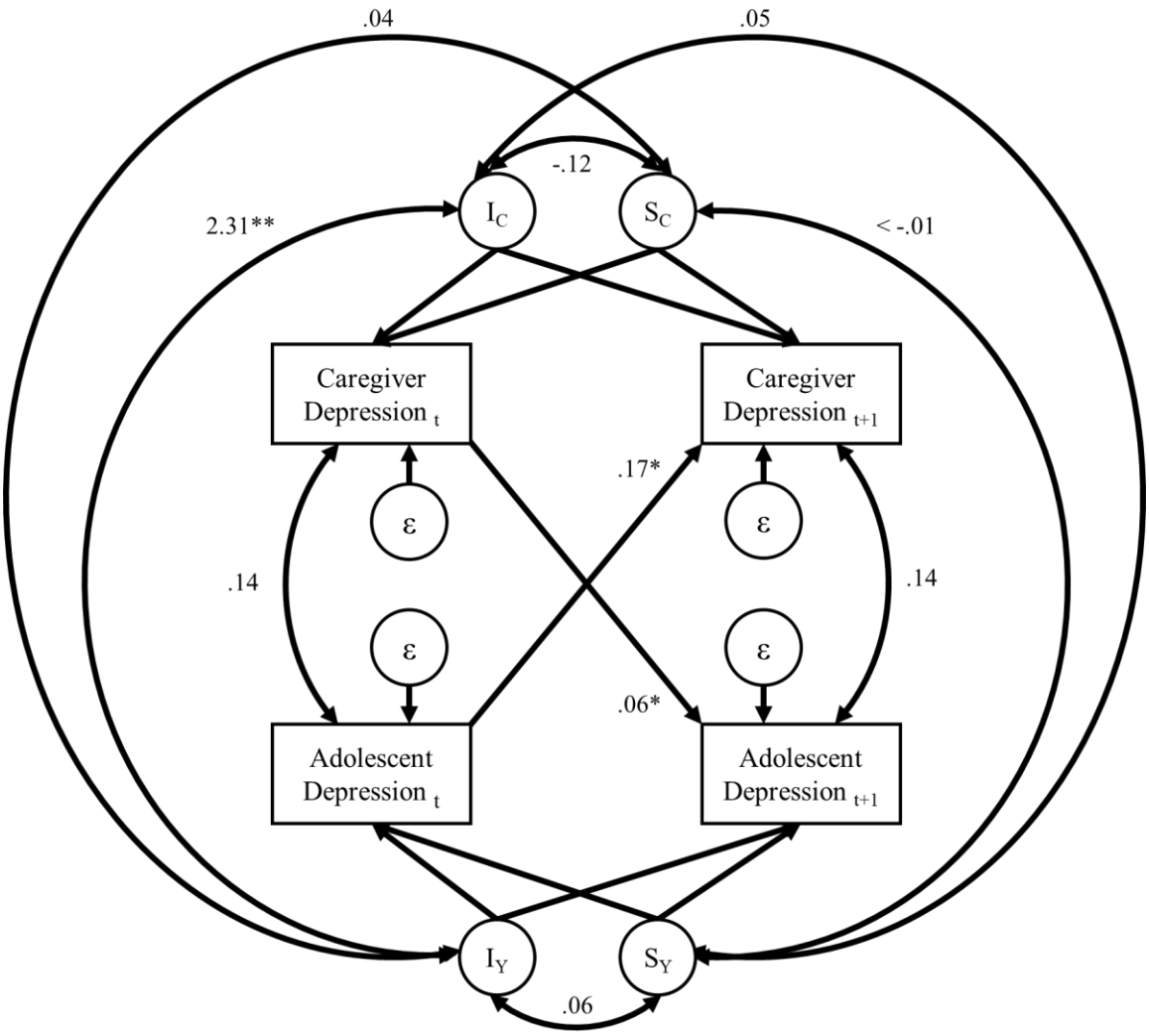


**Figure 4.2.** *Cross-lagged LCM-SR of Adolescents' and Caregivers' Depressive Symptoms Over Time*

Note: * p < .05, ** p < .01

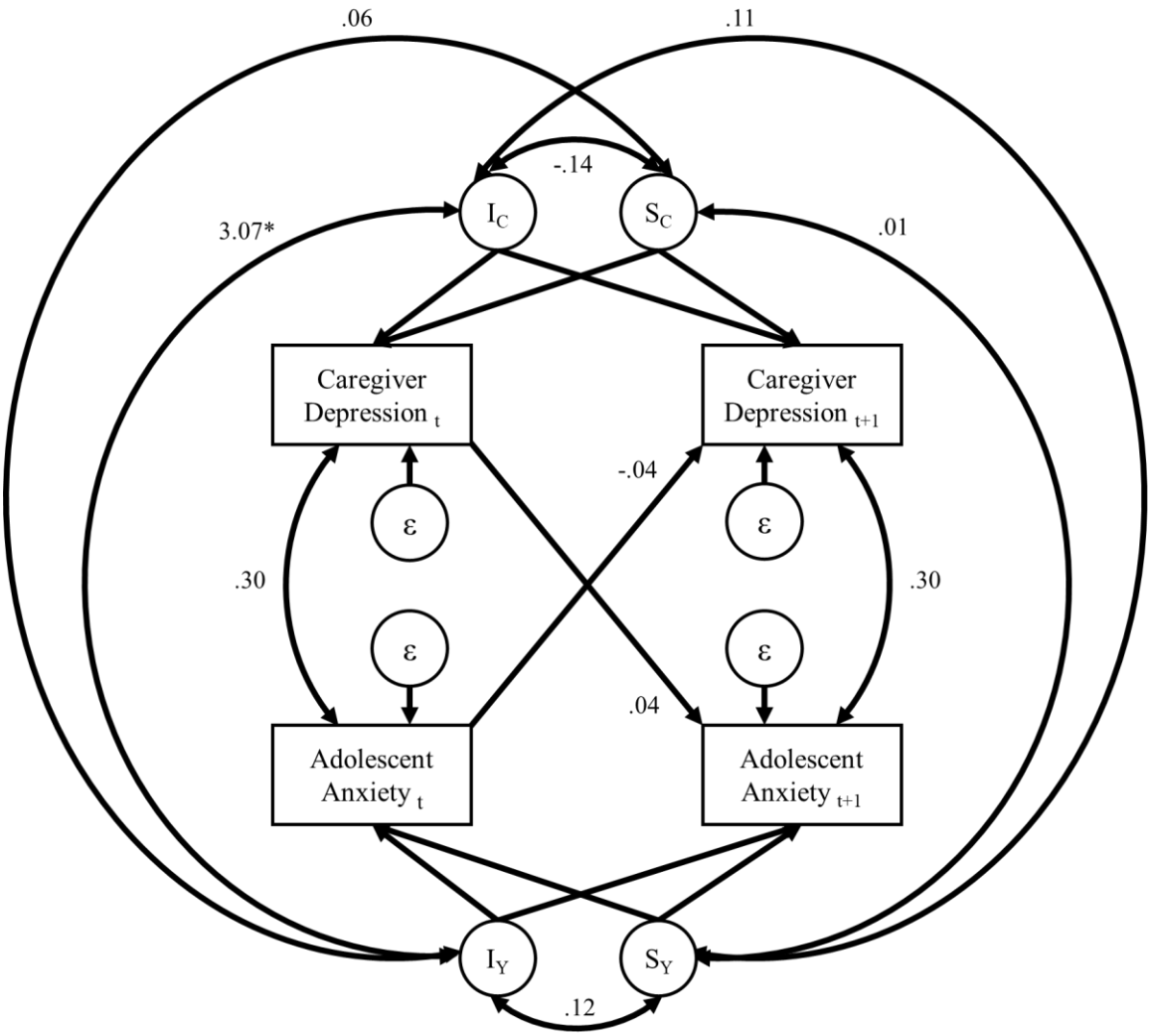


**Figure 4.3.** *Cross-lagged LCM-SR of Adolescents' Anxious Symptoms and Caregivers' Depressive Symptoms Over Time*

Note: * p < .05, ** p < .01

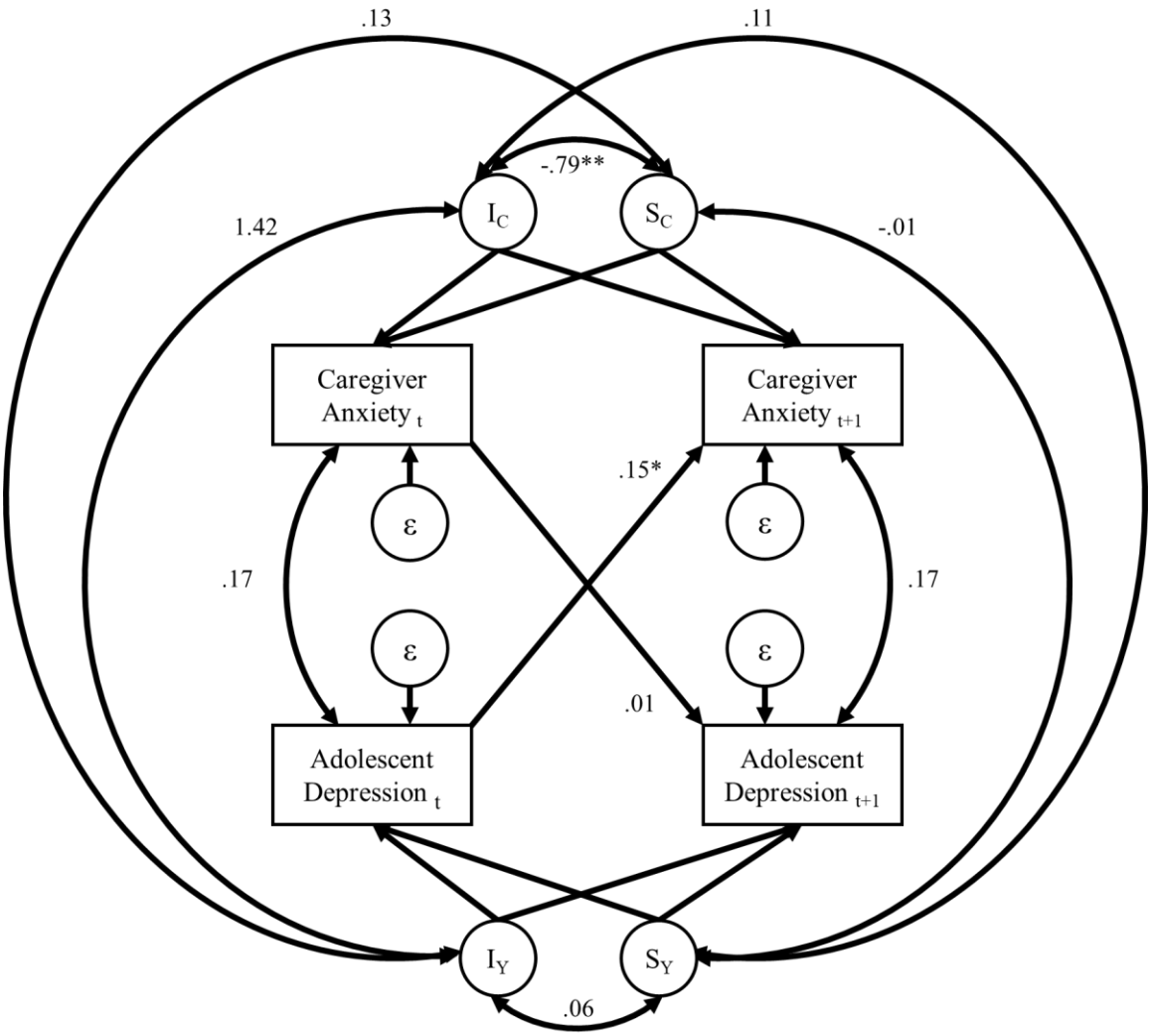


**Figure 4.4.** *Cross-lagged LCM-SR of Adolescents' Depressive Symptoms and Caregivers' Anxious Symptoms Over Time*

Note: * p < .05, ** p < .01

# Chapter 5 – General Summary & Discussion

Prolonged stress exposure contributes to negative physical and mental health outcomes in some individuals (Harkness & Hayden, 2020; Salleh, 2008). Understanding the markers of risk and pathways that connect stress exposure and later disorder will help us to develop effective intervention strategies to reduce the impact of widespread stressors. The COVID-19 pandemic provided an opportunity to study the effects of prolonged stress on community-dwelling individuals. While early research suggested that youths and caregivers may be at particular risk for disorder when exposed to pandemic-related stress (Sachs, 2022), rigorous longitudinal research is limited, especially studies with measures of pre-pandemic functioning, biological markers of risk, or measures designed to gauge adjustment in the context of the COVID-19 pandemic. I aimed to address some of these limitations in the three studies that comprise this dissertation.

## Summary & Review of Studies

In this dissertation, I examined risk for maladjustment in community-dwelling youths and their caregivers during the early weeks of the COVID-19 pandemic. Specifically, I designed and provided preliminary validation of a novel measure of pandemic-related adjustment in families (Study 1), examined youths' pre-pandemic cortisol stress response as a predictor of their internalizing symptoms over time (Study 2), and looked at prospective relationships between caregivers' and youths' internalizing symptoms on a biweekly basis (Study 3).

***Study 1***

In Study 1, I designed and provided preliminary psychometric validation of the Pandemic Avoidance and Concern Scales (PACS), a measure of caregivers' and youths' adjustment to pandemic-related stress. Factor analyses indicated the presence of two underlying factors – Concern and Avoidance – that were related to, but distinct from, symptoms of anxiety and depression. Additionally, while the factor structure of my measure was conserved across caregivers and youths, these factors were differentially associated with indices of youths' and caregivers' adjustment. For example, caregivers' Concern scores were correlated with self-reported disruptions to their routines, while youths' Concern scores were correlated with instability in their family's income. These findings suggest that, while pandemic-related stress results in similar kinds of behaviours across caregivers and adolescents, these behavioural outcomes may be associated with different facets of pandemic-related stress. As such, the PACS may be especially useful as a tool for examining the different relationships of qualitative stressors (e.g., financial, social) on families' adjustment during future crises.

Given the relatively sudden onset of the COVID-19 pandemic, new measures of pandemic-specific stress were often published quickly, for use in specific contexts, and with limited psychometric validation of their structure or content. Conclusions resulting from these measures must be interpreted cautiously within studies, as resulting composite scores may be contaminated with statistical noise from statistically unrelated items, and across studies, as two studies using different assessment measures may have constructs which appear similar but have been operationalized in dissimilar ways. As the PACS has evidence supporting its validity across adolescents and adults and is suitable for a wider

range of study designs (e.g., cross-sectional, repeated measures), its use in future research may improve the interpretability of findings both within and between studies.

***Study 2***

In Study 2, I investigated whether pre-pandemic cortisol expression during a laboratory stress task would predict youths' internalizing symptoms across the first sixteen weeks of the COVID-19 pandemic. Given prior work showing sex differences in responses to stress and related symptom development (Barrios et al., 2017; Daoust et al., 2018; Kuhlman et al., 2015; Ouellette et al., 2015), I also examined whether these relationships differed for boys and girls. I found that higher cortisol output was associated with higher initial anxious-depressed symptoms and somatic complaints for girls, but not boys. I also found that higher cortisol output was associated with decreases in withdrawn-depressed symptoms over time for boys, but not girls. Overall, these findings are consistent with those of my (Daoust et al., 2018) and others' (Kao et al., 2018) past work associating higher cortisol output with risk for internalizing problems for girls but not boys. Notably, in the models examining total cortisol output (i.e., $AUC_G$), youths' depressive symptoms were accounted for by the interaction of cortisol output and biological sex, rather than by the direct effects of either variable. This finding highlights the importance of investigating more complex predictive models of risk for disorder. Sex differences in the relationship between cortisol output and internalizing problems may be accounted for by sex differences in the perceived severity of COVID-related stress (Magson et al., 2021) or in the choice or effectiveness of coping strategies (Dawson & Golijani-Moghaddam, 2020; Minahan et al., 2021). My findings extend past work relating cortisol output and mental health outcomes by identifying acute cortisol output as

a potential risk marker for maladjustment in the context of longer-term stressors, and by highlighting potential sex differences in the utility of this marker.

***Study 3***

In Study 3, I used hierarchical linear modelling to examine potential prospective associations between caregivers' and youths' internalizing symptoms across biweekly assessments. I found significant cross-lagged associations between caregivers' and youths' symptoms of depression, such that both youths' and caregivers' depressive symptoms predicted each other's symptoms two weeks later. Relevant research is limited, although my findings contrast those of Griffiths and colleagues (2021), who found cross-sectional, but not prospective, relationships between caregivers' and adolescents' depressive symptoms across three-month intervals in a pre-pandemic study. These differences may indicate the importance of using shorter-term intervals when assessing potential cross-lagged relationships, as family members' more recent functioning may have a more significant impact on youths' and caregivers' adjustment. My findings may also highlight a potential feedback loop through which associations between depressive symptoms within families may be heightened during crises like the COVID-19 pandemic; the elevated stress and social context of the pandemic (i.e., lockdowns spent with family members) may have contributed to increases in social sharing of symptoms with families.

I did not find associations between caregivers' and youths' anxious symptoms over time, consistent with past meta-analytic work indicating relatively weak social contagion effects for anxious symptoms (Joiner & Katz, 1999). Increases in social independence observed in adolescence (Ryan & La Guardia, 2000; Sanders, 2013;

Steinberg, 1989) and the limited average severity of symptoms in my sample may have further limited the already weaker effects of anxious symptoms on dyadic partners. Lastly, I found a unidirectional effect of youths' depressive symptoms on caregivers' later anxious symptoms. Youths' symptoms have been correlated with increases in maladaptive behaviour during the pandemic (Li et al., 2021; Panda et al., 2021), which may generate worry and parenting stress for caregivers, thereby negatively influencing their adjustment (Babore et al., 2023; Kwok & Wong, 2000). The relative lack of caregiver-to-youth effects may be accounted for by adults' generally stronger emotional regulation skills (Liu & Doan, 2020) or that adolescents are simply less impacted by caregiver anxiety for reasons that we do not yet understand. Overall, my findings indicate that effective mental health interventions should target both individuals and their families, as early preventative intervention may reduce the disease burden on both the family and the health care system.

**Integration**

This dissertation examines behavioural, biological, and environmental factors that characterized and predicted youths' and caregivers' mental health symptoms during the COVID-19 pandemic. In Study 1, associations between stressors and pandemic-related behaviours differed between youths and caregivers. While both youths and caregivers were exposed to common pandemic-related stressors (e.g., income instability, changes in the home environment), the impact of these stressors may have differed depending on developmental needs and social roles in adolescence versus adulthood. For example, caregivers' pandemic-related concerns were related to disruptions to their routines (e.g., isolation from friends, changes in children's schooling) while youths' pandemic concerns

were associated with familial income instability (e.g., job loss, lack of food or resources). Results of Study 3 showed that youths' and caregivers' adjustment influenced one another over time, particularly in the context of depressive symptoms. As such, stressors that impact either youths or their caregivers could potentially impact the broader environment, even if these effects are indirect. These more complex conceptualizations of familial adjustment indicate that intervention programs that support any member of the family unit may benefit the family as a whole. However, given the unidirectional effects of adolescents' depressive symptoms on caregivers' later anxious symptoms observed in Study 3, interventions targeting youths' symptoms may have a relatively greater positive impact on familial adjustment.

My dissertation also establishes the relevance of pre-pandemic (i.e., psychophysiological responses to stress, identity as caregiver or youth) factors to individuals' mental health symptoms. Extant research has established that pandemic-related stress had a disproportionate impact on the mental health of already-vulnerable populations (e.g., prior history of psychological disorder, lower socioeconomic status; Sachs et al., 2022). These negative mental health outcomes for at-risk populations emphasize the outstanding need for accessible mental health supports in Canada (Statistics Canada, 2019), which can help to build resilience against stress in populations at risk for stress-related maladjustment (Meichenbaum, 2005). In addition to these previously identified high-risk populations, my findings in Study 2 identified a less potent pre-pandemic risk marker (e.g., physiological responses to stress) that also significantly contributed to individuals' adjustment to pandemic-related stress. Factors that emerged mid-pandemic (e.g., pandemic-related symptoms and behaviours of family

members; Studies 1 and 3) were also related to mental health symptoms in youths and caregivers. These pre- and mid-pandemic correlates and predictors of maladjustment are especially notable as they highlight populations who would not necessarily have been considered particularly "high risk" prior to the onset of the pandemic.

While efforts are being made to increase accessibility to free, efficient, and evidence-based mental health interventions (e.g., Ontario Structured Psychotherapy; Ontario Health, 2021), these interventions largely target individuals already experiencing clinically significant symptoms. As such, individuals who are nevertheless at risk for maladjustment may be underserved by existing mental health intervention programs. Preventative care can limit the incidence and severity of disorder (Andrews & Wilkinson, 2002; Biesheuvel-Leliefeld et al., 2015; Cuijpers et al., 2005) and reduce the financial and practical burden on the health care system (Le et al., 2021), a significant concern during the COVID-19 pandemic. Thus, investing resources in preventative mental health interventions that broadly target community-dwelling individuals are needed.

***Strengths, Limitations, and Future Directions***

The most notable strength of my dissertation studies is the longitudinal design of the underlying research project. The relatively sudden and unexpected onset of the COVID-19 pandemic imposed constraints on research interested in mental health during this time. My research group was fortunate to be well-positioned to initiate a follow-up wave of data collection as part of an ongoing longitudinal research study in the early weeks of the pandemic, with our most recent follow-up having occurred approximately two years prior to the onset of the COVID-19 pandemic. As such, my sample's pre-pandemic functioning was better characterized than many other samples. The frequency

and temporal proximity of the waves of data collection in the larger project also contributed to the statistical power of my studies.

The longitudinal design of my dataset also enabled me to investigate research questions that were normally limited by the COVID-19 pandemic. While the volume of data required for my proposed analyses was high, my research group's positive working relationship with participants and high sample retention increased the feasibility of families participating in our reasonably onerous study, even in the context of a significant global stressor. In Study 2, although the notable transmission vectors of COVID-19 (e.g., touching the mouth or face, respiratory aerosols; Public Health Agency of Canada, 2021) severely limited in-person research and the collection of biological substrates, I was able to examine salivary cortisol concentrations collected pre-pandemic as a predictor variable of mid-pandemic adjustment. As such, my work provides insight into the field's very limited understanding of how individuals' psychophysiological functioning related to their well-being during the COVID-19 pandemic. Given the above, my studies provide unique insight into scientifically important questions which were practically infeasible for many researchers to address during the pandemic.

While the characteristics of my longitudinal sample are a significant strength of my studies, they also limit the generalizability of my findings. While my study population is representative of the larger community in which it resides (London, Ontario; Statistics Canada, 2018), this also means that the sample is largely White and of higher socioeconomic status. Other research suggests variation in the salience of different pandemic-related stressors across cultural and demographic groups (Azevedo et al., 2023; Moore et al., 2021; Rajkumar, 2021). Even compared to other samples of

similar demographic qualities, the COVID-19 pandemic was well-managed in our country (i.e., Canada; Pew Research Center, 2022) and local area (Green et al., *in press*). Given that the strength and even the direction of associations between potential risk markers and outcomes may differ across demographic groups, my findings should be thoughtfully replicated with other demographic populations before they are broadly generalized.

While the COVID-19 pandemic has been a unique and meaningful context in which to examine adjustment to significant stress, this same stress understandably limited individuals' willingness and ability to participate in voluntary psychological research. Anticipating the additional burden that my research group's study would place upon our sample during this difficult time, I opted to limit the number of assessment measures used in our repeated-measures design. While we anticipated that limiting participants' biweekly time investment in our project would increase sample retention, this also meant that I was restricted in the number of variables I could measure. Based on extant research (Harkness & Hayden, 2020) and expert consensus, we hypothesized that symptoms of internalizing problems (e.g., symptoms of anxiety and depression) would be highly relevant to pandemic-related stress, and as such made these symptom measures the focus of my study. While our hypothesis has been supported by early- and mid-pandemic research (Racine et al., 2021; Prati & Mancini, 2021; Robinson et al., 2022), other research has suggested that youths' externalizing symptoms (e.g., symptoms of oppositional defiant disorder and attention-deficit/hyperactivity disorder) may have also been significantly influenced by pandemic-related stress (Bussières et al., 2021; Parola et al., 2020). My current data cannot speak to externalizing problems during the pandemic,

although my research group is currently assessing these symptoms in a follow-up study using structured clinical interviews.

The clinical significance of some of my predictors (e.g., salivary cortisol) is unclear. This question is particularly difficult to address in my community-dwelling sample, which generally endorsed sub-clinical symptoms. Future studies should consider replicating my findings within higher-risk or clinical samples. Further, while variables observed in each study predicted mental health outcomes on their own, their potential interactions may also be relevant to predicting individuals' mental health adjustment. For example, Wade and colleagues (2021) found that pre-pandemic risk factors (i.e., experience of adverse childhood experiences) and peri-pandemic risk factors (i.e., female sex and caregiver status) interacted to predict negative mental health outcomes. These findings are similar to those in Study 2, where the interaction of pre-pandemic cortisol output and biological sex significantly predicted the trajectory of youths' depressive symptoms over time. These findings suggest that the interactions two independent risk markers may have greater relevance for individual outcomes than the sum of their parts. As such, future research should consider exploring other potential interactions between risk markers (e.g., biological sex, biological markers of stress-related functioning, socioeconomic status) predicting maladjustment to crisis-related stress.

## Conclusions

The three studies composing this dissertation affirm other findings of risk for mental health maladjustment in community-dwelling youths and their caregivers during the early weeks of the COVID-19 pandemic. In addition, they identify a variety of social and biological risk factors which contribute to youths' adjustment, thus affirming the

importance of using multimethod models of risk. Future research incorporating these risk factors into a larger predictive model will be important to assessing their relative contributions to predictive models and their contribution of unique predictive variance. Given the potential complexity of these models, future studies should also consider the predictive value of these risk factors in populations of lower socioeconomic status individuals, given the potential for familial income to moderate the impact of pandemic-related stress (e.g., income instability, resource scarcity) on individual adjustment. Even so, the studies comprising this dissertation contribute uniquely to the literature given their uncommonly dense longitudinal design and thoughtful approach to measurement during a global pandemic. My findings contribute to our understanding of the mechanisms underlying youths' and caregivers' risk for maladjustment in the context of acute and chronic stress, and more importantly, how to mitigate this risk in the face of future crises.

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Wade, M., Prime, H., Johnson, D., May, S. S., Jenkins, J. M., & Browne, D. T. (2021). The disparate impact of COVID-19 on the mental health of female and male caregivers. *Social science & medicine, 275*. https://doi.org/10.1016/j.socscimed.2021.113801

# Appendix A – Ethics Approval Forms

Western Research

Research Ethics

**Western University Health Science Research Ethics Board**
**HSREB Full Board Initial Approval Notice**

**Principal Investigator**: Prof. Elizabeth Hayden
**Department & Institution**: Social Science\Psychology,Western University

**Review Type**: Full Board
**HSREB File Number**: 106617
**Study Title**: Children's brain and hormonal responses to mild stress
**Sponsor**: Ontario Mental Heath Foundation

**HSREB Initial Approval Date**: August 18, 2015
**HSREB Expiry Date**: August 18, 2016

**Documents Approved and/or Received for Information**:

| Document Name | Comments | Version Date |
|---|---|---|
| Instruments | Questionnaire Package - Caregiver Report on Self | 2015/04/06 |
| Instruments | Questionnaire Package - Child Report on Self | 2015/04/06 |
| Instruments | Questionnaire Package - Caregiver Report on Child | 2015/04/06 |
| Assent | | 2015/05/15 |
| Other | Resources for Local Mental Health Services and Other Concerns | 2015/05/15 |
| Other | Qs Child Report on Self | 2015/05/15 |
| Other | Qs Caregiver Report on Child | 2015/05/15 |
| Other | Qs Caregiver Report on Self | 2015/05/15 |
| Other | Debriefing Script for TSST | 2015/05/15 |
| Recruitment Items | Recruitment Letter Template | 2015/05/15 |
| Recruitment Items | OMHF Recruitment Email Template | 2015/05/15 |
| Recruitment Items | Recruitment Telephone Script | 2015/05/15 |
| Western University Protocol | Received May 15, 2015 | 2015/05/15 |
| Letter of Information & Consent | Caregiver Consent for Child | 2015/08/18 |
| Letter of Information & Consent | Caregiver Consent for Self | 2015/08/18 |

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

HSREB approval for this study remains valid until the HSREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review.

The Western University HSREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use Guideline for Good Clinical Practice Practices (ICH E6 R1), the Ontario Personal Health Information Protection Act (PHIPA, 2004), Part 4 of the Natural Health Product Regulations, Health Canada Medical Device Regulations and Part C, Division 5, of the Food and Drug Regulations of Health Canada.

Members of the HSREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

[redacted] on behalf of Dr. Doreen Matsui, HSREB Vice Chair

Ethics Officer to Contact for Further Information

| Erika Basile [redacted] | Grace Kelly [redacted] | Mina Mekhail [redacted] | Vikki Tran [redacted] |
|---|---|---|---|

*This is an official document. Please retain the original in your files.*

Western Research

**Date:** 21 April 2020

**To:** Prof. Elizabeth Hayden

**Project ID:** 5246

**Study Title:** Gene-Environment Interplay and the Development of Child Temperament - 15121S

**Application Type:** HSREB Amendment Form

**Review Type:** Delegated

**Full Board Reporting Date:** 05/May/2020

**Date Approval Issued:** 21/Apr/2020 20:43

**REB Approval Expiry Date:** 11/Jun/2020

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Dear Prof. Elizabeth Hayden,

The Western University Health Sciences Research Ethics Board (HSREB) has reviewed and approved the WREM application form for the amendment, as of the date noted above.

**Documents Approved:**

| Document Name | Document Type | Document Date | Document Version |
|---|---|---|---|
| CLEAN_5246_Revised_Protocol_for_COVID-19_Qs_v20200416 | Protocol | 16/Apr/2020 | COVID-19 Qs |
| CLEAN_COVID-19 - Instructions_2020_04_15 | Other Materials | 15/Apr/2020 | |
| CLEAN_COVID-19 - Recruitment Script_2020_04_16 | Information Update Letter | 16/Apr/2020 | COVID-19 Script 0416 |
| COVID-19 - Assent_2020_04_20 | Implied Consent/Assent | 20/Apr/2020 | |
| COVID-19 - Biweekly Questionnaire - Caregiver | Online Survey | 06/Apr/2020 | |
| COVID-19 - Biweekly Questionnaire - Youth | Online Survey | 06/Apr/2020 | |
| COVID-19 - Caregiver_Relationship_to_Child | Other Materials | 16/Apr/2020 | |
| COVID-19 - GAD-7 PHQ-9 - Youth and Caregiver | Online Survey | 06/Apr/2020 | |
| COVID-19 - LOI_Caregiver_Consent_for_Child_2020_04_20 | Implied Consent/Assent | 20/Apr/2020 | |
| COVID-19 - LOI_Caregiver_Self_Report_2020_04_20 | Implied Consent/Assent | 20/Apr/2020 | |
| COVID-19 - Monthly Questionnaire - Caregiver | Online Survey | 06/Apr/2020 | |
| COVID-19 - Monthly Questionnaire - Youth | Online Survey | 06/Apr/2020 | |
| COVID-19 - YSR - Youth - 2020_04_15 | Online Survey | 15/Apr/2020 | |
| COVID-19 - YSR - Youth - 2020_04_15 | Other Materials | 15/Apr/2020 | |

REB members involved in the research project do not participate in the review, discussion or decision.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario. Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB. The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

Please do not hesitate to contact us if you have any questions.

Sincerely,

Katelyn Harris, Research Ethics Officer on behalf of Dr. Joseph Gilbert, HSREB Chair

***Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).***

# Andrew R. Daoust

Curriculum Vitae

## Personal Information

Address Department of Psychology & the Brain and Mind Institute
Western Interdisciplinary Research Building, Rm 2172
Western University
N6A 3K7

E-Mail XXXXXXXXXX

Telephone XXXXXXXXXX

## Education

Predoctoral Clinical Psychology Residency 2022 – 2023
*Northern Ontario Psychology Internship Consortium, Thunder Bay, Ontario*
Rotations: Chronic Pain, Adult Outpatient, Adult Inpatient, Child and Youth

Ph.D., Clinical Science and Psychopathology 2018 – 2023
*Western University, London, Ontario*
Dissertation: "Stress and Psychopathology in Families during the COVID-19 Pandemic"
Supervisor: Elizabeth P. Hayden, Ph.D.

M.Sc., Clinical Science & Psychopathology 2016 – 2018
*Western University, London, Ontario*
Thesis: "Examining Child Sex as a Moderator of the Relationship Between Cortisol Reactivity and Symptoms Over Time"
Supervisor: Elizabeth P. Hayden, Ph.D.

H.B.Sc., Life Science, with High Distinction 2011 – 2015
*University of Toronto, Mississauga, Ontario*
Majors: Psychology & Biology for Health Science
Minor: Philosophy of Science
Thesis Project: "Examining the Role of Physiological Reactivity as a Way to Predict Performance Among SWAT Team Officers"
Supervisor: Judith Andersen, Ph.D.

## Academic Awards & Research Grants

Alexander Graham Bell Canada Graduate Scholarship (CGS-D) 2019 – 2022
Natural Sciences and Engineering Research Council $105,000

Quality of Life Graduate Research Fellowship 2018 – 2019

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|---|---|
| Children's Health Research Institute | $16,000 |
| Ontario Graduate Scholarship (OGS)<br>Western University | 2018 – 2019<br>$15,000 |
| Quality of Life Graduate Research Fellowship<br>Children's Health Research Institute | 2017 – 2018<br>$16,000 |
| Ralph S. Devereux Award in Psychology<br>Western University | 2017 – 2018<br>$1,800 |
| Ontario Graduate Scholarship (OGS)<br>Western University | 2017 – 2018<br>$15,000 |
| Quality of Life Graduate Research Fellowship<br>Children's Health Research Institute | 2016 – 2017<br>$16,000 |
| Ontario Graduate Scholarship (OGS)<br>Western University | 2016 – 2017<br>$15,000 |
| Best Student Presentation<br>Toronto Forensic Research Exchange | 2016<br>$20 |
| Dean's List (3.5+ GPA)<br>University of Toronto | 2011-2015<br>n/a |
| Entrance Scholarship<br>University of Toronto | 2011<br>$2,000 |
| Academic Achievement Scholarship<br>Rotary Club of Oakville | 2011<br>$2,000 |

## Teaching Experience

Abnormal Psychology (Undergraduate – PSYCHOL-2310) 2018
*Department of Psychology, Western University*
Role: Teaching Assistant
Instructor: Kathryn Turnbull, M.Sc.

Abnormal Child Psychology (Undergraduate – PSYCHOL-2320) 2017
*Department of Psychology, Western University*
Role: Teaching Assistant
Instructor: Elizabeth Hayden, Ph.D.

## Public Lectures

An Introduction to Mindfulness for Chronic Pain 2023
*St. Joseph's Care Group*
Community Education Talk

An Introduction to Chronic Pain 2022
*St. Joseph's Care Group*
NORPIC Residency Didactics Series

Moderator, London Health Sciences Centre Psychologist Q&A 2021, 2022
*London Public Library*
Advocacy Through Action Lecture Series

Healthy Aging 2020, 2021
*London Public Library & Bostwick YMCA*
Advocacy Through Action Lecture Series

Mindfulness Workshop 2018, 2019, 2020, 2021
*London Public Library*
Advocacy Through Action Lecture Series

Mindfulness Workshop 2018, 2019, 2021
*Western University*
Laura Evans Lecture Series

**Clinical & Research Supervision**

Karin Onno 2023
*Mental Health Outpatient Program, St. Joseph's Care Group*
Clinical Practicum Co-Supervisor

Jillian Zitars 2022 - 2023
*Chronic Pain Management Program, St. Joseph's Care Group*
Clinical Practicum Co-Supervisor

Leo Ye 2022
*Department of Psychology, Western University*
Undergraduate Student Research Internship Co-Supervisor
Project Title: "Parent-youth Similarities on Negative Affect: Analyses of Language Parameters in Semi-structured Interviews"

Bianca Iddolis 2021 – 2022
*Department of Psychology, Western University*
Honours Thesis Co-Supervisor
Thesis Title: "Associations Between Youths' Emotional Language Use, Stress Reactivity, and Internalizing Symptoms"

Lifespan Study of Emotion and Personality (LEAP) Lab 2020 - 2022
*Department of Psychology, Western University*
Biweekly Peer Supervision for Clinical Research Interviews

Andrea Sandstrom 2017 – 2018
*Department of Psychology, Western University*
Honours Thesis Co-Supervisor
Thesis Title: "Hair Cortisol Concentrations Predict Change in Girls' Depressive Symptoms"

## Professional & Departmental Service

Student Representative, Clinical Student Advisory Committee 2021 – 2022
*Clinical Science & Psychopathology Program, Western University*

Member, EDI Committee of Graduate Students in Psychology 2021 – 2022
*Department of Psychology, Western University*

Member, EDI Committee of Clinical Students in Psychology 2021 – 2022
*Clinical Science & Psychopathology Program, Western University*

Panelist, Diversifying Clinical Science: Demystifying the Application Process 2021
*Clinical Science & Psychopathology Program, Western University*

Graduate Student Mentor 2020
*Clinical Science & Psychopathology Program, Western University*

Co-founder, "Students in Psychology Talk" Student Support Group 2018 – 2022
*Clinical Science & Psychopathology Program, Western University*

## Peer-review Experience

Ad-Hoc Manuscript Reviewer 2021
*Biological Psychiatry: Global Open Science*

Ad-Hoc Manuscript Reviewer 2020
*Developmental Psychobiology*

## Manuscripts in Preparation

1. **Daoust, A. R.**, Green, H., Vandermeer, M. R. J., Liu, P., Stanton, K., … & Hayden, E. P. (in preparation). *Associations between adolescents' and primary caregivers' internalizing symptoms during the COVID-19 pandemic*.

2. Mohamed Ali, O., Vandermeer, M. R. J., **Daoust, A. R.**, Liu, P., Joanisse, M. F., … & Hayden, E. P. (In preparation). *The association between perceived parent-*

*child relationship quality and adolescent reactivity to maternal feedback is moderated by early irritability.*

3. Vandermeer, M. R. J., Liu, P., Mohamed Ali, O., **Daoust, A. R.**, Joanisse, M. F., … & Hayden, E. P. (in preparation). *Resting state functional connectivity as a putative marker of depression vulnerability in never-depressed youth.*

**Manuscripts Under Review**

1. Iddolis, B. C., **Daoust, A. R.**, Mullen, J. N., Kotelnikova, Y. & Hayden, E. P. (under review). Automated coding of children's spoken language predicts internalizing symptoms and cortisol reactivity to stress. *Submitted for publication.*

2. **Daoust, A. R.**, Green, H., Vandermeer, M. R. J., Liu, P., Stanton, K., … & Hayden, E. P. (under review). Pre-pandemic cortisol reactivity predicts youths' trajectories of internalizing symptoms during the COVID-19 pandemic. *Submitted for publication.*

**Peer-reviewed Publications**

1. Green, H., **Daoust, A. R.,** Vandermeer, M. R. J., Liu, P., Stanton, K., Harkness, K. L., & Hayden, E. P. (in press). Characterizing and predicting Canadian adolescents' internalizing symptoms in the first year of the COVID-19 pandemic. *Canadian journal of behavioural science.*

2. Gabel, L. N., **Daoust, A. R.**, Olino, T. M., Grahn, J. A., Durbin, E. C. & Hayden, E. P. (in press). Children's emotional reactivity to emotionally evocative stimuli: Associations with internalizing and externalizing spectra. *Research on child and adolescent psychopathology.*

3. **Daoust, A. R.,** Stanton, K., Vandermeer, M. R. J., Liu, P., Harkness, K. L., Hayden, E. P. (2022). Development and preliminary validation of the pandemic avoidance and concern scales (PACS). *Journal of psychopathology and behavioral assessment.* https://doi.org/10.1007/s10862-022-09995-3

4. Vandermeer, M. R. J., Liu, P., Mohamed Ali, O., **Daoust, A. R.,** Joanisse, M.F., … & Hayden, E. P. (2022). Children's neural reactivity to maternal praise and criticism: associations with early depressive symptoms and maternal depression. *Development and psychopathology,* 1-16. https://doi.org/10.1017/S0954579422000840

5. **Daoust, A. R.**, Thakur, A., Kotelnikova, Y., Kleiber, M. L., Singh, S. M., & Hayden, E. P. (2021). Associations between children's telomere length, caregiving, and the early environment. *Child psychiatry and human development.* https://doi.org/10.1007/s10578-021-01279-3

6. Liu, P., Vandermeer, M. R. J., Mohamed Ali, O., **Daoust, A. R.**, Joanisse, M. F., ... & Hayden, E. P. (2020) Maternal depression, child temperament and early life stress predict never-depressed preadolescents' functional connectivity during a negative mood induction. *Clinical psychological science.* https://doi.org/10.1177/21677026211016419

7. Sandstrom, A., **Daoust, A. R.**, Russel, E., Koren, G., & Hayden, E. P (2020). Hair cortisol concentrations predict change in girls' depressive symptoms. *European journal of developmental psychology,* 1-15. https://doi.org/10.1080/17405629.2020.1774359

8. Vandermeer, M. R. J., Liu, P., Mohamed Ali., O., **Daoust, A. R.**, Joanisse, M. F., … & Hayden, E. P (2020). Orbitofrontal cortex grey matter volume is related to children's depressive symptoms. *Neuroimage: Clinical, 28,* 102395. https://doi.org/10.1016/j.nicl.2020.102395

9. Gabel, L. N., Salisbury, M. R., **Daoust, A. R**., Grahn, J. A., Durbin, C. E. & Hayden, E. P. (2019). Development and validation of a battery of emotionally evocative film clips for use with young children. *Psychological assessment, 31* (8), 1040-1051. https://doi.org/10.1037/pas0000726

10. **Daoust, A. R.**, Kotelnikova, Y., Kryski, K. R., Sheikh, H. I., Singh, S. M. & Hayden, E. P. (2018). Examining child sex as a moderator of the relationship between cortisol reactivity and symptoms over time. *Comprehensive psychiatry, 87*, 161-170. https://doi.org/10.1016/j.comppsych.2018.10.009

11. MacDougall, M. J., Tabor, N. J., Woodhead, J., **Daoust, A. R.**, & Reisz, R. R. (2017). The unique preservational environment of the Early Permian (Cisuralian) fossiliferous cave deposits of the Richards Spur locality, Oklahoma. *Palaeogeography, palaeoclimatology, palaeoecology, 475*, 1-11. https://doi.org/10.1016/j.palaeo.2017.02.019

## Conference Presentations

1. Iddolis, B. C.*, **Daoust, A. R.**, Ye, L., Kotelnikova, Y., & Hayden, E. P. (2023, September 21-24). *Children's temperament and personality measured via automated language coding, observational coding, and self-report* [poster presentation]. Annual Meeting of the Society for Research in Psychopathology, St. Louis, MI

2. Green, H. E.*, **Daoust, A. R.,** Vandermeer, M. R. J., Liu, P., Stanton, K., Harkness, K., Hayden, E. P. (2022, September). *Symptom centrality and stability of adolescent internalizing symptom networks during the COVID-19 pandemic* [poster presentation]. Annual Meeting o the Society for Research in Psychopathology, Philadelphia, PA.

3. Mohamed Ali, O.*, Vandermeer, M. R. J., **Daoust, A. R.**, Liu, P., Joanisse, M. F., … & Hayden, E. P. (2021, September 23-26). *The association between perceived parent-child relationship quality and adolescent reactivity to maternal feedback is moderated by early irritability* [poster presentation]. Annual Meeting of the Society for Research in Psychopathology.

4. Green, H. E.*, **Daoust, A. R.**, Vandermeer, M. R. J., Chan, T., Liu, P., … & Hayden, E. P. (2021, September 23-26). *Adolescent and parent internalizing symptoms, avoidance, and concern in the first year of the COVID-19 pandemic* [poster presentation]. Annual Meeting of the Society for Research in Psychopathology.

5. **Daoust, A. R.***, Green, H., Vandermeer, M. R. J., Liu, P., Stanton, K., … & Hayden, E. P. (2021, May 26-27). *Associations between adolescents' and parents' depressive symptoms during the COVID-19 pandemic* [poster presentation]. Association for Psychological Science Virtual Convention.

6. Green, H.*, **Daoust, A. R.,** Vandermeer, M. R. J., Liu, P., Stanton, K., … & Hayden, E. P. (2021, May 226-27). *Self-referential processing at age 11 predicts adolescents' internalizing symptoms during the COVID-19 pandemic* [poster presentation]. Association for Psychological Science Virtual Convention.

7. Stewart, E.*, Gabel, L., **Daoust, A. R.**, Owen, A. M., Segal, Z. V., Hayden, E. P. (2021, May 26-27). *A brief mindfulness practice influences children's executive functioning* [poster presentation]. Association for Psychological Science Virtual Convention.

8. **Daoust, A. R.***, Green, H., Vandermeer, M. R. J., Liu, P., Stanton, K., … & Hayden, E. P. (2021, May 6-8). *Pre-pandemic cortisol reactivity predicts youths' trajectories of internalizing symptoms during the COVID-19 pandemic* [symposium presentation]. Canadian Stress Research Summit.

9. Green, H.*, **Daoust, A. R.**, Vandermeer, M. R. J., Liu, P., Stanton, K., … & Hayden, E. P. (2021, May 6-8). *Stable early behavioural inhibition predicts within-person variability in adolescents' internalizing symptoms during the COVID-19 pandemic* [poster presentation]. Canadian Stress Research Summit.

10. **Daoust, A. R.*,** Stanton, K., Vandermeer, M. R. J., Liu, P., Harkness, K. & Hayden, E. P. (2021, April 7-9). *Measuring parents' and children's responses to the COVID-19 pandemic* [poster presentation]. Society for Research in Child Development Virtual Biennial Meeting.

11. Liu, P.*, **Daoust A. R.**, Vandermeer, M. R. J., Stanton, K., Harkness, K., & Hayden, E. P. (2021, April 7-9). *Default mode network resting-state functional*

*connectivity predicts COVID-19 related concerns in youth* [poster presentation]. Society for Research in Child Development Virtual Biennial Meeting.

12. Liu, P.*, Vandermeer, M. R. J., Mohamed Ali, O., **Daoust, A. R.**, Joanisse, M. F., … & Hayden, E. P. (2020, August 17-18). *Maternal depression, child temperament, and early family stress predict preadolescent' functional connectivity during a negative mood induction* [paper presentation]. Virtual HBHL Research Day, McGill University, Montreal, QB.

13. **Daoust, A. R.***, Mackrell, S. M. V., Kotelnikova, Y., Singh, S. M. & Hayden, E. P. (2020, June 1 – September 1*). Parents' history of psychopathology is related to children's cortisol stress reactivity* [poster presentation]. Association for Psychological Science Virtual Poster Showcase.

14. **Daoust, A. R.*,** Mackrell, S. M. V., Kotelnikova, Y., Singh, S. M. & Hayden, E. P. (2020, May 21-24). *Parents' history of psychopathology is related to children's cortisol stress reactivity* [poster presentation]. Annual Convention of the Association for Psychological Science, Chicago, IL.

15. **Daoust, A. R.***, Vandermeer, M. R. J., Mohamed Ali, O., Singh, S. M. & Hayden, E. P. (2019, September 19-22). *Investigating the stability of cortisol stress reactivity across development: A pilot study* [poster presentation]. Annual Meeting of the Society for Research in Psychopathology, Buffalo, NY.

16. Vandermeer, M. R. J.*, Liu, P., Mohamed Ali, O., **Daoust, A. R.**, Joanisse, M. F., ... & Hayden, E. P. (2019, September 19-22). *A neuroimaging study of high-risk children's reactivity to maternal expressed emotion* [poster presentation]. Annual Meeting of Society for Research in Psychopathology, Buffalo, NY.

17. Mohamed Ali, O.*, Vandermeer, M. R. J., **Daoust, A. R.**, Liu, P., Kryski, K. R., ... & Hayden, E. P. (2019, September 19-22). *Associations between early parenting and children's neural development* [poster presentation]. Annual Meeting of Society for Research in Psychopathology, Buffalo, NY.

18. **Daoust, A. R.***, Kotelnikova, Y., Kryski, K. R., Sheikh, H. I., Singh, S. M. & Hayden, E. P. (2018, September 20-23). *The role of child sex in the stability of cortisol stress reactivity and its associations with symptoms* [poster presentation]. Annual Meeting of the Society for Research in Psychopathology, Indianapolis, IN.

19. Vandermeer, M. R. J.*, **Daoust, A. R.**, Mohamed Ali, O., Joanisse, M. F., Barch, D. M. & Hayden, E. P. (2018, September 20-23). *Associations between children's resting state functional connectivity and maternal history of depression* [poster presentation]. Annual Meeting of the Society for Research in Psychopathology, Indianapolis, IN.

20. Gabel, L. N.*, Salisbury, M. R., **Daoust, A. R.**, Grahn, J. A., Durbin, C. E. & Hayden, E. P. (2018, September 20-23). *Development and validation of a developmentally appropriate battery of emotionally evocative stimuli for use with young children* [poster presentation]. Annual Meeting of the Society for Research in Psychopathology, Indianapolis, IN.

21. Vandermeer, M. R. J.*, **Daoust, A. R.**, Mohamed Ali, O., Joanisse, M. F., Barch, D. M., & Hayden, E. P. (August 30-September 1). *Gray matter concentrations in never-depressed children at risk for depression* [poster presentation]. Flux Congress, Berlin, Germany.

22. **Daoust, A. R.**, Thakur, A., Kotelnikova, Y., Kleiber, M. L., Singh, S. M., & Hayden, E. P. (2017, September 14-17). *Associations between children's telomere length and vulnerabilities in the early environment* [poster presentation]. Annual Meeting of the Society for Research in Psychopathology, Denver, CO.

23. Vandermeer, M. R. J.*, Joanisse, M. F., **Daoust, A. R.**, Mohamed Ali, O., Salisbury, M., ... & Hayden, E. P. (2017, September 14-17). *Resting state functional connectivity in children at high risk for depression* [poster presentation]. Annual Meeting of the Society for Research in Psychopathology, Denver, CO.

24. Andersen, J.P., Papazoglou, K., Pitel, M, Weerasinghe, A., & **Daoust A. R.*** (2016, June 6). Examining the role of physiological reactivity as a way to predict performance among SWAT team officers [oral presentation]. Toronto Forensic Research Exchange; Toronto, ON.

25. Andersen, J.P., Papazoglou, K., Pitel, M*, Weerasinghe, A., & **Daoust A**. **R.** (2016, March 29 – April 2). *Examining the role of physiological reactivity as a way to predict performance among SWAT team officers* [paper presentation]. Academy of Criminal Justice Sciences, Denver, CO.

26. Andersen, J.P., Papazoglou, K., Pitel, M, Weerasinghe, A., & **Daoust A. R**.* (2016, March 9 -12). *Examining the role of physiological reactivity as a way to predict performance among SWAT team officers* [poster presentation]. American Psychosomatic Society, Denver, CO.

27. **Daoust, A. R.*** (2014, March 22-23). *Fossil taphonomy in the early Permian Richards Spur locality, Oklahoma, USA* [poster presentation]. Ontario Biology Day, Mississauga, ON.

**Additional Research Experience**

Graduate Research Assistant 2020 - 2021
Older Adults Attitudes Towards Video Communication Technology During COVID-19
*Dr. Leora Swartzman, Western University*

Research Intern & Research Assistant 2015 - 2016
HART ("Health Adaptation Research on Trauma") Laboratory
*Dr. Judith Andersen, University of Toronto at Mississauga*

Research Assistant 2014
Polivy "Market Research" Laboratory
*Christine Nguyen under Dr. Janet Polivy, University of Toronto at Mississauga*

Independent Research 2014 - 2015
BIO318 Animal Behaviour Research Project
*University of Toronto at Mississauga*

Research Opportunity Project 2013 - 2014
Reisz Paleontology Laboratory
*Dr. Robert Reisz, University of Toronto at Mississauga*

**Clinical Experience**

Adult Mental Health, Inpatient Unit 2023
*Thunder Bay Regional Health Sciences Centre*
Supervisor: Kristine Knauff, C.Psych.

Mental Health Outpatient Program 2022 – 2023
*St. Joseph's Care Group, Thunder Bay, Ontario*
Supervisors: Wendy Lindstrom-Forneri, Ph.D., C.Psych; Alexandra Popowich-Kerr, Ph.D.; Lauren Mount, M.A., Psychological Associate; Sara Hagstrom, Ph.D., C.Psych.

Children's Centre Thunder Bay 2022 – 2023
*Community Mental Health Centre, Thunder Bay, Ontario*
Supervisor: Fred Schmidt, Ph.D., C.Psych

Chronic Pain Management Program 2022 – 2023
*St. Joseph's Care Group, Thunder Bay, Ontario*
Supervisors: Mary Donaghy, Ph.D., C.Psych.; Kerri-Lynne Capulak Andrychuk, M.A., Psychological Associate

Lifespan Study of Emotion and Personality (LEAP) Lab 2017 – 2022
*Western University, London, Ontario*
Supervisors: Kate Harkness, Ph.D., C. Psych; Elizabeth Hayden, Ph.D.

Old North Psychology 2021 – 2022
*Private Practice, London, Ontario*
Supervisors: Lisa Destun, Ph.D., C.Psych; Elspeth Evans, Ph.D., C.Psych.

Student Wellness Services 2021

*Western University, London, Ontario*
Supervisor: Susan Ruscher, Ph.D., C.Psych.

Older Adults and Communication Technology Project 2020 – 2021
*Western University, London, Ontario*
Supervisor: Leora Swartzman, Ph.D. & Akshya Vasudev, M.D.

Dr. Benn and Associates 2020
*Private Practice, London, Ontario*
Supervisor: Kelly Benn, Ph.D., C.Psych.

Child and Youth Development Centre 2019 – 2020
*Western University, London, Ontario*
Supervisor: Colin King, Ph.D., C.Psych.

Student Development Centre, Psychological Services 2018 – 2019
*Western University, London, Ontario*
Supervisor: Elspeth Evans, Ph.D., C.Psych.

Child and Parent Resource Institute 2018
*London, Ontario*
Supervisor: Wendy den Dunnen, Ph.D., C.Psych.

University Hospital, Neuropsychology 2018
*London, Ontario*
Supervisor: Michael Harnadek, Ph.D., C.Psych.

Student Development Centre, Psychological Services 2017
*Western University, London, Ontario*
Supervisor: Nicole Cormier, M.Sc., supervised by Elspeth Evans, Ph.D., C.Psych.

**Clinical & Professional Development Workshops**

Ethical Decision Making in Palliative Care (2023). Hosted by Lakehead University Center for Health Care Ethics, presented by Christine W. Pun, M.D.; 1-hour online webinar.

Trans Affirming Care and Practices (2023). Hosted by PESI, presented by Em Matsuno, Ph.D., Jay Bettergarcia, Ph.D., & Tyler Lefevor, Ph.D.; 2-hour online webinar.

How to engage and work with diverse local communities in a good way (2023). Presented by Alexandra Levine, Ph.D.; 1-hour online webinar.

Psychological Treatment for OCD: Effective and Practical Strategies (2023). Presented by Martin M. Antony, Ph.D; 1.5-day online workshop.

Meeting the Needs of Trans and Non-Binary People in 2023 (2023). Hosted by the Canadian Association of Cognitive Behavioural Therapies, presented by lore m. dickey, Ph.D.; 3-hour online webinar.

Rainbow Health Ontario in Conversation: Current and Future Issues in 2SLGBTQ Health Care (2022). Hosted by Rainbow Health Ontario; 2-hour webinar.

Chronic Pain Masterclass (2022). Hosted by noiGroup, presented by Lorimer Mosely, Ph.D., Tasha Stanton, Ph.D., Mark Hutchinson, Ph.D., & David Butler, Ed.D.; 3-day virtual workshop.

Rainbow Health Ontario 2022 Symposium: LGBT2SQ Health in Focus (2022). Hosted by Rainbow Health Ontario; 6-hour webinar.

LGBT2SQ Foundations Course (2021). Hosted by Rainbow Health Ontario; online training course.

Somatic Awareness for Trauma (2021). Presented by Neil Ferguson, RTC; 4-hour workshop.

Gender-based Violence Safety Planning (2021). Presented by Allison Preyde via Anova; 2-hour workshop.

ACT as a Process-Based Approach (2019). Presented by Steven Hayes, Ph.D.; 2-day workshop.

Growth Modelling with MPlus (2017). Presented by Scott Colwell, Ph.D. via Enablytics; 2-day workshop.

SafeTALK Crisis Management (2014). Presented by LivingWorks, 2-hour workshop.