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Characterizing and Predicting Canadian Adolescents' Internalizing Symptoms in the First Year of the COVID-19 Pandemic

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Abstract

Most studies of adolescents' internalizing symptoms during the COVID-19 pandemic have included few data waves, limiting long-term conclusions about adolescents' mental health during the pandemic. Collecting only a few waves of data precludes examination of intraindividual symptom variability, which may have implications for adjustment beyond mean symptoms. We characterized mean n = 192 adolescents' internalizing symptoms from March 2020-April 2021 and used mixed effect location scale models to examine established risk factors as predictors of mean trends and intraindividual variability in adolescents' internalizing symptoms. Adolescents' symptoms were relatively stable and low over the first year of the pandemic; severity peaked in February and April 2021. Girls showed greater symptoms and greater intraindividual variability in symptoms. Adolescents' internalizing symptoms and intraindividual variability in symptoms increased as parents' depressive symptoms increased, while intraindividual variability in adolescents' internalizing symptoms decreased as parents' anxious symptoms increased. Implications for intervention and prevention are discussed.

Keywords: internalizing, COVID-19, pandemic, intraindividual, variability, adolescent

Summary for Lay Audience

Although many have speculated that the COVID-19 pandemic has hurt adolescents' mental health, most research so far has only studied adolescents' symptoms of depression and anxiety in the early months of the pandemic, limiting conclusions that can be drawn about the long-term impact of the pandemic on adolescents' mental health. Only studying adolescents' symptoms at a few times early in the pandemic also prevents researchers from examining variation in symptoms within individual adolescents, which may be important for understanding adolescents' adjustment to the pandemic. In this study, we examined the depressive and anxious symptoms of a large number of adolescents over the first year of the pandemic (March 2020-April 2021; average number of adolescents at each time point = 192). We also studied adolescent sex, socioeconomic status, and parents' depressive and anxious symptoms during the pandemic as predictors of adolescents' symptoms during the pandemic, as well as within-person variability in adolescents' symptoms. Compared to boys, girls showed greater symptoms of depression and anxiety, as well as more within-person variation in symptoms over the first year of the pandemic. As parents' depressive symptoms increased, adolescents' depressive and anxious symptoms increased, along with within-person variability in adolescents' symptoms. As parents' anxious symptoms increased, within-person variability in adolescents' depressive and anxious symptoms decreased. Takeaways for efforts to treat and prevent adolescents' depressive and anxious symptoms are discussed.

Co-Authorship Statement

Andrew R. Daoust, MSc. assisted with design and preparation of online questionnaires, overall study design, participant recruitment, data cleaning, and data analysis. Dr. Matthew R.J. Vandermeer also assisted with participant recruitment and design and preparation of online questionnaires. Dr. Pan Liu, Dr. Kasey Stanton, and Dr. Kate L. Harkness assisted with design of online questionnaires and overall study design. Dr. Elizabeth P. Hayden assisted with design of online questionnaires, overall study design, statistical consultation, and proofreading and editing this thesis.

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Introduction

Background

The World Health Organization declared the severe acute respiratory syndrome coronavirus 2, which causes coronavirus disease-2019 (COVID-19), an international pandemic on March 11th, 2020. As of May 2022, 525,467,084 confirmed cases of COVID-19 and 6,285,171 COVID-19-related deaths have been reported globally (WHO Coronavirus (COVID-19) Dashboard, 2021). In addition to the physical health impact of COVID-19, the unprecedented social and economic disruption resulting from emergency public health measures has impacted individuals across the globe, fueling widespread speculation about the mental health consequences of the pandemic (Cullen et al., 2020; Pfefferbaum & North, 2020). Adolescents may be especially vulnerable to developing internalizing symptoms during the pandemic (Gruber et al., 2021; Hawes et al., 2021; Rogers et al., 2021), as depression and anxiety become increasingly prevalent in adolescence (Kessler et al., 2005; Rapee et al., 2009), with depression, in particular, sharply increasing through young adulthood (Costello et al., 2011). Additionally, adolescence is characterized by increased independence from caregivers and a heightened emphasis on peer relationships (Blakemore & Mills, 2014; Orben et al., 2020); given that many adolescents have spent less in-person time interacting with peers and more time at home during the pandemic, decreased peer interactions may be especially harmful to this age demographic. Limited data support this assertion: During the COVID-19 pandemic, youth report fewer social contacts, strain in relationships with friends (Ravens-Sieberer et al., 2021; Saurabh & Ranjan, 2020), and increased conflict

with parents (Kapetanovic et al., 2021; Magson et al., 2021). Neuromaturation processes relevant to social cognition and executive function, including the prefrontal cortex, undergo considerable development in adolescence (Blakemore & Choudhury, 2006; Lebel & Beaulieu, 2011), which may also render adolescents more vulnerable to social isolation than adults.

Early cross-sectional studies supported speculation (Caffo et al., 2020; Courtney et al., 2020; Fegert et al., 2020; Golberstein et al., 2020; Gruber et al., 2021; Guessoum et al., 2020; Imran et al., 2020; Mittal et al., 2020; Power et al., 2020; Sharma et al., 2020) about negative associations between the pandemic and adolescent mental health. For example, two studies showed that almost half of Chinese adolescents met clinical cutoffs for depression and anxiety, respectively, in early March 2020, when COVID-19 was first becoming prevalent (Qi et al., 2020; Zhou et al., 2020). Similarly, up to half of adolescents in samples from North America, Europe, and South America reported clinically significant depressive or anxious symptoms in the early months of the pandemic (Craig et al., 2020; Ellis et al., 2020; Hawes et al., 2021; Rios-González & Palacios, 2020).

While these cross-sectional findings show elevated internalizing symptoms in adolescents at the start of the pandemic, longitudinal studies are needed to determine the long-term course of adolescents' mental health during the pandemic. To date, most longitudinal studies are relatively short term, comparing pre-pandemic internalizing symptoms with symptoms in the early months of the pandemic; these studies have reported significant increases in adolescents' depressive and anxious symptoms. A collaborative study of more than 1,000 9-18-year-olds from three countries found

increases in depressive, but not anxious, symptoms during the early months of the pandemic (Barendse et al., 2021). A large study of Icelandic adolescents reported increases in depressive symptoms for girls and boys during the pandemic, although girls' depressive symptoms were significantly higher than boys (Thorisdottir et al., 2021), while a two-wave study conducted in March-May 2020 found increased symptoms of generalized anxiety and social anxiety in both boys and girls, as well as increased depressive, panic, and somatic symptoms in girls in the U.S.(Hawes et al., 2021). Another two-wave study of Australian 13-16-year-olds also found increases in anxiety and depression from May 2019 to May 2020 (Magson et al., 2021). Additionally, a five-wave study using latent growth modeling found that Canadian adolescents' anxious and depressive symptoms were significantly higher during the pandemic than predicted based on pre-pandemic symptom trajectories (De France et al., 2022). In contrast, a two-wave study found no change in Dutch adolescents' internalizing symptoms from 2019 to the first weeks of the pandemic in spring 2020, although life satisfaction ratings decreased (van der Laan et al., 2021).

Taken together, these studies suggest that the COVID-19 pandemic has contributed to increases in adolescent internalizing symptoms. However, to date, most longitudinal studies of adolescent mental health during the pandemic have included only one or two timepoints early during the pandemic (Rodman et al., 2021; Rosen et al., 2021; Zeytinoglu et al., 2021), limiting conclusions that can be drawn about the pandemic's impact on longer-term trajectories of adolescent internalizing symptoms. Additionally, when waves of data collection are limited, investigators cannot examine intraindividual variability in internalizing symptoms (Bolger et al., 2003; Hedeker et al.,

2008). This is an important limitation, given research showing that elevated within-person variability in negative affect and internalizing symptoms may have important implications for adjustment, above and beyond mean or “typical” affect and symptoms (e.g., Maciejewski et al., 2014; Neumann et al., 2011). For example, intraindividual variability in depressive symptoms predicted suicide risk in high-risk adolescent offspring of parents with mood disorders (Melhem et al., 2019). Intraindividual variability in negative affect (NA; the predisposition to experience negative mood states such as sadness, fearfulness, and irritability; Kotov et al., 2010; Watson et al., 1988; Watson & Walker, 1996) has been concurrently (Koval et al., 2013; Nelis & Bukowski, 2019; Silk et al., 2003, 2011) and prospectively (Maciejewski et al., 2014; Neumann et al., 2011) associated with adolescents’ internalizing symptoms. Intraindividual variability in negative emotions, which include internalizing symptoms such as sadness and fear, may reflect difficulties in emotion regulation (Kim-Spoon et al., 2013; Lougheed & Hollenstein, 2012; Naragon-Gainey et al., 2018), which may render youth especially vulnerable to stressors like the pandemic.

Predicting individual variation in psychological adjustment during the COVID-19 pandemic

Individual differences in stress reactivity are well established (Harkness & Hayden, 2020; Harkness & Monroe, 2016), such that some adolescents will exhibit greater symptomatology during the pandemic than others. Compared to boys, girls become more vulnerable to developing depressive symptoms around the onset of puberty (Costello et al., 2011), and childhood sex differences in anxiety disorders (i.e., higher rates of anxiety disorders in girls than boys) continue to increase through early adolescence (Roza et al., 2003). Additionally, links between internalizing symptoms and

stressful events characterized by interpersonal conflict or loss (e.g., loss of friends, family conflict, romantic breakups, etc.) may be particularly strong for adolescent girls (Hammen, 2005; Rudolph, 2002; Uliaszek et al., 2012). Accordingly, stressful interpersonal events related to public health measures restricting peer contact and increasing time at home with family may contribute to social isolation and relationship strain, which may, in turn, pose especially high risk for internalizing symptoms in adolescent girls.

Parental anxiety and depression are well-established markers of risk for internalizing disorders in offspring (Burstein et al., 2010; Hammen & Brennan, 2003; Rapee et al., 2009; Weissman et al., 2006). The risk associated with having a parent with anxiety or depression likely stems from both heritable (Bolton et al., 2006; Happonen et al., 2002) and environmental (Hicks et al., 2009) factors, suggesting that parents' own internalizing symptoms may predict adolescents' internalizing symptoms. During the COVID-19 pandemic, concurrent associations between parents' and adolescents' internalizing symptoms have been observed (Black et al., 2021; Crescentini et al., 2020; Khoury et al., 2021; X. Li & Zhou, 2021; Whittle et al., 2020). Parental internalizing symptoms early in the pandemic have also predicted adolescents' symptoms one month later, controlling for parents' current symptoms (Lorenzo et al., 2021).

Low SES is also an established predictor of adolescent internalizing symptoms (Goodman, 1999; McLeod & Shanahan, 1993; McNeilly et al., 2021; Mendelson et al., 2008), including during the pandemic. For example, a March 2020 study of several thousand 3-12-year-olds in China found that lower parental education predicted general

mental health concerns (Li et al., 2021), while a study of 1,586 families with 7-17 year olds found that youths with parents with less education reported significantly greater anxiety symptoms and general mental health problems (Ravens-Sieberer et al., 2021). Accordingly, youth from lower SES homes may be at greater risk for developing internalizing symptoms during the pandemic.

Current Study

We used an existing large, longitudinal cohort to characterize mean trends and intraindividual variability in Canadian adolescents' internalizing symptoms over the first year of the COVID-19 pandemic (March 2020 - April 2021). In addition to providing descriptive data on the course of adolescents' internalizing symptoms over the first year of the pandemic, we used mixed effect location scale models (Hedeker et al., 2008; McNeish, 2021; described below) to examine established risk factors for internalizing symptoms (sex, SES, and parents' internalizing symptoms during the pandemic) as predictors of mean trends and intraindividual variability in adolescents' symptoms of depression and anxiety. We hypothesized that female adolescents and adolescents from lower SES homes would show greater mean scores and greater intraindividual variability on measures of depression and anxiety. In line with etiological overlap among internalizing disorders (Barlow et al., 2014), we expected that parents' internalizing symptoms during the pandemic would also predict adolescents' internalizing symptoms.

Methods

Participants

Participants were families originally recruited through local advertisements and a departmental participant database for a longitudinal study of children's emotional development. At baseline recruitment, eligible children were three years old (M_{age} = 3.43 years, *SD* = 0.30), lived with at least one biological parent, and had no medical or psychological conditions that would prevent them from completing study measures. The original sample of 409 children (201 boys) participated with one primary caregiver (382 mothers, 27 fathers) and a secondary caregiver if available. The sample is predominantly white (93%; Asian = 2%, African Canadian = 0.5%, Hispanic = 1.7%, Other = 2.4%) and middle-high income (4% < $20,000, 11% = $20,000–$40,000, 24% = $40,001–$70,000, 30% = $70,001–$100,000, 31% > $100,000). At age 5, ($M_{age}$ = 5.49, *SD* = 1.58) 379 children (92.70% of the original sample) and their caregivers completed an additional wave of data collection, including a short measure of SES (see below). Before participating in the current study, parents completed informed consent, and youths provided assent. This study was approved by the Ethics Review Board of the University of Western Ontario.

Measures

SES. When children were 5 years old, SES was indexed by items querying family income and education for mothers and fathers. The family income item asked the primary caregiver to indicate their family's total income from the following options: less than $20,000/year; $20,000–$40,000/year; $40,001–$70,000/year; $70,001–$100,000/year, more than $100,000/year. The education item asked mothers and

fathers to separately indicate their highest level of education from the following options: less than eighth grade; some high school; high school graduate/GED; some college or two-year degree; bachelor's degree/four-to-five-year degree; Master's degree; doctoral degree. Maternal and paternal education, along with family income, were standardized and averaged to create a composite index of SES.

Adolescent and parent internalizing symptoms during the COVID-19 pandemic. At the onset of the COVID-19 pandemic in March 2020, the 303 youths remaining in the cohort (now approximately 14 years old; M_{age} = 14.16 years, *SD* = 0.67) and their primary caregivers (93.60% mothers, 5.70% fathers, 0.3% stepmothers, and 0.3% other caregivers) were invited to complete biweekly self-report measures of internalizing symptoms online to assess adjustment during the pandemic. Adolescent-parent dyads were invited to participate in the current follow-up study on an ongoing basis every two weeks from March 2020-April 2021, with pauses from July-September 2020 and November-January 2021 to minimize participant burden, for a total of 21 timepoints[1]. On average, almost 200 adolescents (*n* = 192; range 56[1]-223) participated at each wave, while an average of 204 parents participated at each wave (range = 49[1]-236). A total of 301 adolescent-parent dyads participated in at least one wave. Adolescents who participated in this follow-up study at any time point did not differ from adolescents who did not participate in terms of sex, race, or SES (lowest *p* = .06). Parents who participated at any time point did not differ from parents who did not participate in terms of race or SES (lowest *p* = .20).

[1] One data collection wave (May 19th, 2020 to May 31st, 2020) had a very small sample size (*n* = 56 adolescents; 49 parents) due to a change in data collection procedures. Specifically, prior to late May 2020, participants were assigned individualized two-week windows in which to complete questionnaires, based on when they began the study. Beginning in late May 2020, all participants were assigned the same two-week window to complete questionnaires.

To assess internalizing symptoms during the COVID-19 pandemic, adolescents completed the Anxious/Depressed and Withdrawn/Depressed subscales of the Youth Self-Report (YSR-AD and YSR-WD, respectively; Achenbach & Dumenci, 2001), a reliable and valid measure of youth psychopathology (Ebesutani et al., 2011; Morgan & Cauce, 1999). Internal consistency estimates for the YSR-AD and -WD were good for the 21 waves of data collection (mean α = .91, range = .88-.93; mean α = .87, range = .74-.91, respectively). Parents completed the Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001) to assess depressive symptoms and the Generalized Anxiety Disorder Scale (GAD-7; Spitzer et al., 2006) to assess anxious symptoms. Internal consistency of the PHQ-9 and GAD-7 was also good (mean α = .89, range = .83-.91; mean α = .91, range = .88-.93, respectively). Before beginning this portion of the study, parents signed informed consent, and adolescents provided assent. This follow-up study was approved by the Ethics Review Board of the University of Western Ontario.

Data Analysis Plan

Mixed effect location scale models. Traditional multilevel models (MLMs) use fixed and random subject effects to model change in mean values on an outcome variable as a function of predictors; these models typically treat intraindividual variability as constant across individuals and values of predictors. In contrast, mixed effect location scale models (MELSMs) model differences in variability within individuals (the "scale" portion of the model) as function of predictors, as well as how mean values of the outcome (the "location" portion of the model) change based on predictors (Hedeker et al., 2008, 2012; Piasecki et al., 2016). Both the "location" and "scale" are modeled simultaneously as two dependent variables in the same model, with intraindividual

variability (scale) modeled via a log-linear submodel. Although MELSMs are most often used with ecological momentary assessment (EMA) designs (e.g., Piasecki et al., 2016; Schmeer et al., 2019), due in part to their large number of data collection waves, the number of repeated measures nested within individuals in this study (21) was comparable to the number of repeated measures in published MELSM designs (e.g., Hedeker et al., 2008). MELSMs were used to estimate (via Bayesian Markov chain Monte Carlo (MCMC) models in Mplus 8.7; Muthen & Muthen, 2021) mean trends and intraindividual variability in YSR-AD and -WD scores from adolescent sex, SES, and parents' internalizing symptoms during the pandemic, using the syntax provided by McNeish (2021) as a template. For each parameter, Bayesian MCMC methods estimate a distribution of potential values (the posterior distribution), which can be summarized with the median (the posterior median). Uninformative priors were used so that all potential parameter values were equally possible, resulting in parameter estimates very similar to those obtained from maximum likelihood estimation (Muthén & Asparouhov, 2012).

Adolescents were Level 2 units, with symptoms nested within individuals. Parents' PHQ-9 and GAD-7 scores during the pandemic were individual-mean-centered, Level 1 variables; sex and SES were Level 2 predictors. Mean parental PHQ-9 and GAD-7 scores for each individual adolescent-parent dyad were grand-mean-centered Level 2 predictors. Because scale effects are on a log scale, coefficients can be exponentiated using Euler's number and multiplied by the exponentiated scale intercept[42] to be on the same scale as the outcome. For a one unit increase in a predictor, the predicted intraindividual variability is the exponentiated estimate multiplied

by the exponentiated scale intercept (e.g., the scale intercept for the YSR-AD model was 0.30, and the estimate for the fixed scale effect of parents' PHQ-9 scores on YSR-AD scores was 0.19; exp(0.30) = 1.35; exp(0.19) = 1.21; 1.35*1.21= 1.63; for every 1 unit increase in parents' individual mean PHQ-9 scores, intraindividual variability increases by 1.63 units). The exponent can be changed to model changes in the predictor. For example, to calculate the predicted intraindividual variance in YSR-AD scores for a 1.5 unit increase in individual means of parents' PHQ-9 scores, one would exponentiate the exponentiated estimate (1.21) to the 1.5 power (i.e., $1.21^{1.5} = 1.33$) and multiply by the exponentiated scale intercept (1.33*1.21 = 1.61).

Cases with no variation in YSR-AD and YSR-WD scores across all 21 data collection waves were removed from the dataset (*n* = 19 for the YSR-AD subscale and *n* = 32 for the YSR-WD subscale). Eighteen participants with missing YSR-AD data for all data collection waves and 12 missing YSR-WD data for all waves were also excluded from analyses, resulting in 259 (YSR-AD) and 252 (YSR-WD) participants available for data analysis.

Results

Descriptive Statistics

To visually depict the course of adolescents' internalizing symptoms over the first year of the COVID-19 pandemic, scatter plots of raw YSR-AD and -WD scores for boys and girls, including lines representing mean trajectories of symptoms (Figure 1), were created in R with the ggplot2 package (Wickham, 2016). Symptoms were generally stable from March 2020-April 2021, with peaks on the YSR-AD subscale in September

2020 (girls) and January 2021 (girls and boys). Similarly, YSR-WD scores show a peak in January 2021 for girls and in February 2021 for boys. These peaks coincided with the start of the first full academic year during the pandemic in September 2020 and Ontario's second state of emergency and lockdown in January 2021 (*Ontario Declares Second Provincial Emergency to Address COVID-19 Crisis and Save Lives*, 2021). Girls' mean trajectories of both YSR subscales were higher than boys', although this difference was more pronounced for the YSR-AD subscale.

Using the scoring procedures of Achenbach & Dumenci (2001), percentages of adolescents meeting clinical cutoffs at each data collection wave were calculated (Table 1). Most of the sample scored below clinical thresholds at all assessment waves, with 81%-89% scoring below threshold on the YSR-AD subscale and between 79%-90% scoring below threshold on the YSR-WD subscale from March 2020-April 2021. The data collection waves during which the largest percentage of adolescents scored in the clinical range on the YSR-WD subscale were the February 14th, 2021 wave and the April 4th, 2021 wave (12% at both waves). The highest percentage of adolescents scored in the clinical range on the YSR-AD subscale during the February 28thth, 2021 wave (13.30%); this may be related to Ontario's second stay-at-home order, which was extended in mid-February 2021. Similarly, March Break (spring vacation from school) was postponed during the April 4th wave (*March Break 2021 in Ontario Being Postponed for a Month, Lecce Says*, 2021). Peak symptom severity was calculated by examining frequencies of each adolescent's highest symptom severity across all 21 data collection waves (Figure 2). At any timepoint, up to 21.50% of adolescents scored

in the clinical range on the YSR-AD subscale, and 19.40% scored in the clinical range on the YSR-WD subscale.

Next, descriptive statistics and bivariate correlations among study variables were examined (Table 2); given the large number of data collection waves, Table 2 shows mean correlations between adolescent and parent symptoms and other study variables, aggregated across all 21 data collection waves. Adolescent age in March 2020 was modestly positively correlated with YSR-AD (mean r = .17, mean p = .03, range = .13-.20) and -WD scores (mean r = .17, mean p = .05, range = .11-.22), with symptoms increasing with age. Sex (coded male = 0, female = 1) also correlated positively with YSR-AD (mean r = .31, mean p = .001, range = .23, .37) and -WD scores (mean r = .22, mean p = .05, range = .04-.29), such that girls reported greater symptoms than boys.

Mixed Effect Location Scale Models

First, intraindividual internalizing symptom variability was first estimated in separate models with no predictors for YSR-AD and WD. The average intraindividual variability in anxious symptoms was 0.82, and intraindividual variability varied across adolescents by 2.36. The average intraindividual variability in depressive symptoms was 0.32, and across adolescents, intraindividual depressive symptom variability varied by 1.90.

Next, adolescent sex, SES, parents' PHQ-9 scores, and parents' GAD-7 scores were all added as simultaneous predictors in both models. Parents' individual mean-centered PHQ-9 and GAD-7 scores were added as Level 1 predictors of mean trends and intraindividual variability in adolescents' symptoms, and grand mean-centered individual means of parents' symptoms were added as Level 2 predictors of mean

trends and intraindividual variability in adolescents' symptoms. Predictors that significantly predicted either intraindividual variability or mean trends in adolescents' internalizing symptoms were retained in final versions of each model. Contrary to our expectations, SES did not predict mean trends or intraindividual variability in either adolescent anxious or depressive symptoms, most likely due to the restricted range. It was therefore dropped from final models; all other predictors were retained. MELSM results are presented in Table 3 (YSR-AD) and Table 4 (YSR-WD).

Mixed Effect Location Scale Models – Adolescents' Anxious Symptoms

The final model predicting adolescents' anxious symptoms scores included adolescent sex as a predictor of mean trends in YSR-AD scores, with girls showing higher scores than boys (γ_{01} = 3.37, 95% CI = [2.17, 4.54]). Additionally, adolescent sex was included in the final model as a predictor of intraindividual variability in adolescents' anxious symptoms, with girls showing greater intraindividual variability than boys (ω_1 = 0.85, 95% CI = [0.46, 1.25]). Parents' individual mean PHQ-9 and GAD-7 scores were also included as predictors of intraindividual variability in adolescents' anxious symptoms in the final model. As parents' individual mean PHQ-9 scores increased, intraindividual variability in adolescents' anxious symptoms increased (ω_2 = 0.18, 95% CI = [0.10, 0.26]). Conversely, and contrary to expectations, as parents' individual mean GAD-7 scores increased, intraindividual variability in adolescents' anxious symptoms *decreased* (ω_3 = -0.16, 95% CI = [-0.25, -0.07]).

Mixed Effect Location Scale Models – Adolescents' Depressive Symptoms

The final model predicting adolescents' YSR-WD scores showed that girls had greater depressive symptoms, on average, than boys (γ_{01} = 1.72, 95% CI = [0.91,

2.48]). Regarding intraindividual variability in YSR-WD scores, sex was also included in the final model, with girls showing higher intraindividual variability in symptoms (ω_1 = 0.57, 95% CI = [0.23, 0.93]). As parents' individual mean PHQ-9 scores increased, intraindividual variability in adolescents' depressive symptoms decreased (ω_2 = -0.18, 95% CI = [-0.27, -0.09]). Similarly, as parents' individual mean GAD-7 scores increased, intraindividual variability in adolescents' depressive symptoms decreased (ω_3 = -0.18, 95% CI [-0.27, -0.09]).

Discussion

Although extant longitudinal studies of adolescent mental health during the COVID-19 pandemic indicate that adolescents' internalizing symptoms increased during the first months of the pandemic (Barendse et al., 2021; De France et al., 2022; Hawes et al., 2021; Magson et al., 2021; Thorisdottir et al., 2021), few studies have included more than two waves of data collected during the pandemic, which limits conclusions that can be drawn about long-term trajectories of adolescents' depressive and anxious symptoms during the COVID-19 pandemic. Additionally, longitudinal studies with a small number of data collection waves are unable to examine predictors of intraindividual variability in symptoms, which may be a useful indicator of adolescents' adjustment (e.g., Melhem et al., 2019). We addressed these gaps in the literature and provided novel information concerning Canadian adolescents' mental health during the first year of the COVID-19 pandemic (March 2020-April 2021) by examining established demographic risk factors (sex and SES), as well as parents' internalizing symptoms during the pandemic, as predictors of adolescents' mean trends and intraindividual variability in internalizing symptoms.

Over the first year of the COVID-19 pandemic, most adolescents (79%-90%) scored below clinical thresholds on measures of internalizing symptoms. Although this finding is consistent with some studies finding improvements in general mental health and no change in internalizing symptoms among young adults (Fried et al., 2022) and adolescents during the pandemic (van der Laan et al., 2021), these results contrast sharply with early speculation about the mental health consequences of the COVID-19 pandemic (Caffo et al., 2020; Courtney et al., 2020; Golberstein et al., 2020; Gruber et al., 2021) and studies demonstrating symptom increases in the first months of the pandemic (Barendse et al., 2021; De France et al., 2022; Hawes et al., 2021). Lower case and death counts in the area from which the sample was drawn (Ontario COVID-19 Data Tool, 2022), compared to the settings of other studies (e.g., the U.S.; Hawes et al., 2021; Rodman et al., 2021 and Europe; Barendse et al., 2021; Magson et al., 2021; Thorisdottir et al., 2021), may have contributed to lower symptom severity that was generally found in adolescents in the current study.

However, beyond COVID-19 case numbers, social isolation and relationship strain as a result of public health measures have been speculated to be the driving forces behind increasing adolescent internalizing symptoms (De France et al., 2022; Gruber et al., 2021). Although it is important to note that the COVID-19 pandemic is still unfolding, and adolescents' internalizing symptoms likely showed further change after the first year of the pandemic, our results do not suggest widespread, pervasive aspects of social isolation in the first year of COVID-19-related public health measures. Indeed, our results are consistent with the notion that public health measures or other aspects of

the pandemic have the greatest impact on adolescents' internalizing symptoms in the context of other risk factors (i.e., female sex and parents' depressive symptoms).

In line with our hypotheses, girls had greater symptoms and intraindividual variability in anxious and depressive symptoms than boys. This finding is consistent with sex differences in the prevalence of internalizing disorders in adolescence (Costello et al., 2011), but also provides novel information concerning sex differences in individual variability in symptoms. Past work suggests that adolescents who do not show especially elevated symptoms but do experience high variability in symptoms over time may still be at risk for maladaptive outcomes (Koval et al., 2013; Maciejewski et al., 2014; Nelis & Bukowski, 2019; Neumann et al., 2011; Silk et al., 2003, 2011). While far less is known about associations between intraindividual symptom variability and long-term adjustment, adolescent girls may be especially vulnerable to developing internalizing symptoms in the context of interpersonal conflict or loss (Hammen, 2005; Rudolph, 2002; Uliaszek et al., 2012); it is possible that these contexts also predict intraindividual symptom variability, an important outcome for future research to consider.

SES did not predict mean trends or intraindividual variability in adolescents' anxious or depressive symptoms, a finding inconsistent with literature linking internalizing symptoms during the pandemic to low SES (Li et al., 2021; Ravens-Sieberer et al., 2021). Because our sample is largely middle-high income, with 61% of families earning more than $70,000 per year, it is possible that not a large enough proportion of the sample has sufficiently low SES to observe robust associations with internalizing symptoms. Future studies should use more diverse samples to examine

SES as a predictor of long-term trajectories of adolescent internalizing symptoms during the pandemic, as well as more fine-grained measures of socioeconomic problems during the pandemic specifically.

As parents' depressive symptoms increased, intraindividual variability of adolescents' anxious and depressive symptoms increased, consistent with hypotheses. Given links between intraindividual variability in internalizing symptoms and negative emotions (e.g., Koval et al., 2013; Maciejewski et al., 2014; Nelis & Bukowski, 2019; Neumann et al., 2011; Silk et al., 2003, 2011), this finding suggests that adolescents with parents with elevated depressive symptoms may have comparatively poor emotion regulation capabilities (Kim-Spoon et al., 2013; Lougheed & Hollenstein, 2012; Naragon-Gainey et al., 2018) and were at particular risk for fluctuations in internalizing symptoms over the first year of the COVID-19 pandemic.

Conversely, contrary to hypotheses and established connections between parents' and adolescents' internalizing symptoms (Burstein et al., 2010; Hammen & Brennan, 2003; Rapee et al., 2009; Weissman et al., 2006), parents' individual mean depressive and anxious symptoms did not predict mean trends in adolescents' anxious or depressive symptoms. Because mean trends and intraindividual variability in adolescents' symptoms were estimated in the same model, stronger relations between parents' individual mean symptoms and adolescent intraindividual variability, compared to mean trends in adolescents' symptoms, may have rendered associations with adolescents' mean symptoms nonsignificant. Supporting this notion, supplemental analyses predicting adolescents' anxious and depressive symptoms using a "buildup" approach, with individual predictors added one at a time and nonsignificant predictors

dropped, found that parents' depressive and anxious symptoms were sometimes related to mean trends in adolescents' symptoms, but not after other predictors were added. While current findings suggest a stronger pattern of associations between parent's symptoms and adolescent symptom variability, compared to adolescent mean symptoms, future work should examine different model-building approaches in location scale models to elucidate predictors of both mean trends and intraindividual variability in adolescents' internalizing symptoms.

As parents' anxious symptoms increased, intraindividual variability in adolescents' anxious and depressive symptoms decreased. While far less is known about the predictors of internalizing symptom variability, compared to predictors of mean or typical symptoms, this finding was somewhat unexpected. While speculative, it is possible that parents with elevated anxious symptoms were particularly likely to exert control over the home environment and adolescents' activities by establishing routines and rules for adolescents, which could stabilize adolescents' internalizing symptoms (Cohodes et al., 2021; Liu et al., 2021; Ren et al., 2021). Indeed, limited work suggests that family adherence to routines (Cohodes et al., 2021; Liu et al., 2021; Ren et al., 2021) and perceived family cohesion (Fosco et al., 2022; Li et al., 2021) may buffer adolescents' internalizing symptoms during the pandemic. Importantly, while parents' symptoms were not the focus of the current study, few parents in our sample reported clinically significant anxiety during the pandemic; specifically, a mean of n = 144 parents reported anxiety symptoms considered minimal according to established cutoffs (Spitzer et al., 2006) from March 2020-April 2021 (range = 31-179). Subthreshold parental anxiety may motivate caregiving behaviors (e.g., exerting control over adolescents'

activities and schedules; Epkins & Harper, 2016; Woodruff-Borden et al., 2002) that may be adaptive during relatively high-risk contexts, such as the pandemic.

Associations between parents' individual mean symptoms and intraindividual variability in adolescents' symptoms during the pandemic also suggest meaningful links between parents' and adolescents' symptoms. Although the focus of the current study was on predicting adolescents' symptoms, supplementary analyses suggest that as adolescents' individual mean anxious symptoms increased, parents' depressive symptoms increased (γ_{01}= 1.00, 95% CI = [0.99, 1.01]). Additionally, as adolescents' individual mean anxious (ω_1 = 1.93, 95% CI = [1.50, 2.34]) and depressive (ω_2 = 0.27, 95% CI = 0.11, 0.46]) symptoms increased, intraindividual variability in parents' depressive symptoms increased. Adolescents' individual mean anxious (ω_1 = 1.34, 95% CI = [0.34, 2.22]) and depressive symptoms (ω_2 = 1.34, 95% CI = [0.34, 2.22]) also predicted intraindividual variability in parents' anxious symptoms. In line with literature linking family stability and discord to internalizing symptoms in parents and adolescents (Ivanova & Israel, 2005; Nomura et al., 2002; Schleider & Weisz, 2017), these findings suggest reciprocal associations between family members' symptoms and that family-level factors may contribute to both parents' and adolescents' symptoms. Accordingly, interventions targeted at improving adolescents' symptoms may be improved by also addressing family processes. This notion is consistent with research demonstrating the efficacy of family-based interventions (Compas et al., 2015; Perrino et al., 2016), which target not only adolescents' internalizing symptoms, but also parents' internalizing symptoms, parenting skills, and strategies for coping with family conflict and stress.

This study is among the first to examine long-term trajectories of adolescent internalizing symptoms over the first year of the COVID-19 pandemic. In addition to allowing us to describe adolescents' internalizing symptoms over the first year of the COVID-19 pandemic, the large number of repeated measures in this study (21) allowed us to examine predictors of both mean trends and intraindividual variability in internalizing symptoms, which results suggest may be equally relevant to understanding the mental health impact of the pandemic. However, this study also has several important limitations. Although we examined an array of putative risk factors as predictors of internalizing symptoms during the pandemic, we were unable to examine race as a predictor due to the low diversity of the sample (93% white). Similarly, the lack of significant associations between SES and adolescents' internalizing symptoms is likely partly due to our middle-high income sample's lack of representation of the full range of SES; additionally, we did not examine financial strain specifically during the pandemic in the current study. It is also unclear to what extent the findings in the current study generalize to other regions with varying levels of public health restrictions and COVID-19 case counts. Future studies should examine long-term trajectories of internalizing symptoms in more diverse samples. Additionally, although we speculate that the internalizing symptoms observed in this study are partly attributable to the stress and disruption of the COVID-19 pandemic, it is not possible to test this claim without measures of COVID-19-related stress or data characterizing pre-pandemic symptoms. Finally, although the descriptive data reported in this study characterize adolescents' internalizing symptoms over the first year of the pandemic, the COVID-19 pandemic is still unfolding, and future studies should continue to examine the

pandemic's long-term impact on adolescent mental health. Some adolescents – particularly adolescent girls and those with parents with depressive symptoms – may be at particular risk and benefit most from intervention. Future work should identify protective factors to improve intervention and prevention.

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Table 1

Adolescent anxious and depressive symptom severity from March 2020-April 2021

Data Collection Wave	*N*	Below Threshold	At Risk	Clinical
March 23rd, 2020 – April 5th, 2020	180	YSR-AD: 88.90% (160)	YSR-AD: 2.80% (5)	YSR-AD: 8.30% (15)
		YSR-WD: 90.00% (162)	YSR-WD: 5.60% (10)	YSR-WD: 4.40% (8)
April 6th, 2020 – April 19th, 2020	83	YSR-AD: 84.30% (70)	YSR-AD: 7.20% (6)	YSR-AD: 8.40% (7)
		YSR-WD: 89.20% (74)	YSR-WD: 7.20% (6)	YSR-WD: 3.60% (3)
April 20th, 2020 – May 3rd, 2020	133	YSR-AD: 84.20% (112)	YSR-AD: 6.00% (8)	YSR-AD: 9.80% (13)
		YSR-WD: 88.70% (118)	YSR-WD: 3.80% (5)	YSR-WD: 7.50% (10)
May 4th, 2020 – May 17th, 2020	167	YSR-AD: 83.20% (139)	YSR-AD: 6.60% (11)	YSR-AD: 10.20% (17)
		YSR-WD: 88.00% (147)	YSR-WD: 3.60% (6)	YSR-WD: 8.40% (14)
May 19th, 2020 – May 31st, 2020	56	YSR-AD: 75.00% (42)	YSR-AD: 5.40% (3)	YSR-AD: 19.60% (11)
		YSR-WD: 78.60% (44)	YSR-WD: 14.30% (8)	YSR-WD: 7.10% (4)
June 1st, 2020 – June 14th, 2020	223	YSR-AD: 85.20% (190)	YSR-AD: 7.20% (16)	YSR-AD: 7.60% (17)
		YSR-WD: 88.80% (198)	YSR-WD: 4.90% (11)	YSR-WD: 6.30% (14)
June 15th, 2020 – June 28th, 2020	212	YSR-AD: 82.10% (174)	YSR-AD: 10.40% (22)	YSR-AD: 7.50% (16)
		YSR-WD: 89.20% (189)	YSR-WD: 5.20% (11)	YSR-WD: 5.70% (12)
June 29th, 2020 – July 12th, 2020	223	YSR-AD: 85.20% (190)	YSR-AD: 6.30% (14)	YSR-AD: 8.50% (19)
		YSR-WD: 85.20% (190)	YSR-WD: 7.60% (17)	YSR-WD: 7.20% (16)

Sept. 7th, 2020 – Sept. 20th, 2020	215	YSR-AD: 82.30% (177)	YSR-AD: 7.00% (15)	YSR-AD: 10.70% (23)
		YSR-WD: 87.40% (188)	YSR-WD: 5.60% (12)	YSR-WD: 7.00% (15)
Sept. 21st, 2020 – Oct. 4th, 2020	214	YSR-AD: 84.10% (180)	YSR-AD: 7.50% (16)	YSR-AD: 8.40% (18)
		YSR-WD: 86.90% (186)	YSR-WD: 7.00% (15)	YSR-WD: 6.10% (13)
Oct. 5th, 2020 – Oct. 18th, 2020	211	YSR-AD: 84.40% (178)	YSR-AD: 5.70% (12)	YSR-AD: 10.00% (21)
		YSR-WD: 84.80% (179)	YSR-WD: 7.10% (15)	YSR-WD: 8.10% (17)
Oct. 19th, 2020 – Nov. 1st, 2020	212	YSR-AD: 85.40% (181)	YSR-AD: 4.70% (10)	YSR-AD: 9.90% (21)
		YSR-WD: 86.30% (183)	YSR-WD: 5.70% (12)	YSR-WD: 8.00% (17)
Nov. 2nd, 2020 – Nov. 15th, 2020	218	YSR-AD: 81.20% (177)	YSR-AD: 7.30% (16)	YSR-AD: 11.50% (25)
		YSR-WD: 84.40% (184)	YSR-WD: 7.30% (16)	YSR-WD: 8.30% (18)
Nov. 16th, 2020 – Nov. 29th, 2020	207	YSR-AD: 85.50% (177)	YSR-AD: 4.80% (10)	YSR-AD: 9.70% (20)
		YSR-WD: 85.00% (176)	YSR-WD: 7.20% (15)	YSR-WD: 7.70% (16)
Jan. 4th, 2021 – Jan. 17th, 2021	212	YSR-AD: 82.10% (174)	YSR-AD: 5.20% (11)	YSR-AD: 12.70% (27)
		YSR-WD: 78.80% (167)	YSR-WD: 11.30% (24)	YSR-WD: 9.90% (21)
Jan. 18th, 2021 – Jan. 31st, 2021	209	YSR-AD: 83.30% (174)	YSR-AD: 5.30% (11)	YSR-AD: 11.50% (24)
		YSR-WD: 84.20% (176)	YSR-WD: 4.30% (9)	YSR-WD: 11.50% (24)
Feb. 1st, 2021 – Feb. 14th, 2021	216	YSR-AD: 83.30% (180)	YSR-AD: 5.10% (11)	YSR-AD: 11.60% (25)
		YSR-WD: 82.40% (178)	YSR-WD: 6.00% (13)	YSR-WD: 11.60% (25)
Feb. 15th, 2021 – Feb. 28th, 2021	211	YSR-AD: 82.00% (173)	YSR-AD: 4.70% (10)	YSR-AD: 13.30% (28)
		YSR-WD: 80.10% (169)	YSR-WD: 9.50% (20)	YSR-WD: 10.40% (22)

March 1st, 2021 – March 14th, 2021	211	YSR-AD: 82.90% (175)	YSR-AD: 6.60% (14)	YSR-AD: 10.40% (22)
		YSR-WD: 80.60% (170)	YSR-WD: 9.50% (20)	YSR-WD: 10.00% (21)
March 15th, 2021 – March 28th, 2021	213	YSR-AD: 84.00% (179)	YSR-AD: 3.80% (8)	YSR-AD: 12.20% (26)
		YSR-WD: 83.10% (177)	YSR-WD: 8.50% (18)	YSR-WD: 8.50% (18)
March 29th, 2021 – April 4th, 2021	215	YSR-AD: 80.50% (173)	YSR-AD: 8.80% (19)	YSR-AD: 10.70% (23)
		YSR-WD: 80.90% (174)	YSR-WD: 7.40% (16)	YSR-WD: 11.60% (25)

Table 2

Descriptive statistics and correlations among study variables

	M(SD)/%	1	2	3	4	5	6	7
1. Adolescent age in March 2020	14.16(.67)	--						
2. Sex (% male)	49%	.12*	--					
3. Race (% white)	93%	.12*	.06	--				
4. SES	-.03(2.46)	-.06	.01	.01	--			
5. YSR-AD	4.90(5.51)	.17* (.13, .20*)	.31** (.23, .37**)	.05 (-.12, .16)	-.07 (-.19, -.01)	--		
6. YSR-WD	3.35(3.65)	.17† (.11, .22*)	.22† (.04, .29**)	.02 (-.16, .13)	-.13 (-.22**, -.02)	.80** (.60**, .87**)	--	
7. PHQ-9	3.51(4.43)	.01 (-.08, .11)	-.02 (-.09, .08)	.04 (-.09, .12)	-.24* (-.47**, -.11)	.12 (.01, .28)	.18† (.09,.24*)	--
8. GAD-7	3.52(4.05)	.02 (-.09, .15*)	-.01 (-.13, .18)	.08 (-.03, .16*)	-.17 (-.49**, -.03)	.14 (-.02, .30†)	.16 (.06, .28**)	.78** (.63**, .86**)

Note. * $p < .05$. ** $p < .01$, † p = .05. For symptom measures collected across the first year of the COVID-19 pandemic (March 2020-April 2021), mean correlations are presented, with ranges in parentheses. Sex was coded 0 = male, 1 = female. Because the sample is 93% white, race was coded as 0 = white, 1 = nonwhite. The SES variable was created by transforming variables reflecting maternal and paternal education and family income to z-scores, then averaging. Higher values indicate higher SES. SES = socioeconomic status.

Table 3

Sex, SES, and Parents' Internalizing Symptoms Predicting Mean Trends and Intraindividual Variability in Adolescents' Anxious Symptoms from March 2020-April 2021

YSR-AD

	Full Model	Retained in final model?	Final Model
Location Fixed Effects			
Intercept	3.30 [2.42, 4.18]		3.33 [2.41, 4.18]
Sex	3.59 [2.38, 4.76]	✓	3.37 [2.17, 4.54]
SES	-0.14 [-0.39, 0.10]		
Parent PHQ-9 (Individual Means)	-0.01 [-0.29, 0.29]		
Parent GAD-7 (Individual Means)	0.23 [-0.09, 0.54]		
Location Random Effect			
Covariance Structure			
Intercept	21.91 [17.91, 26.92]		22.00 [18.50, 26.73]
Parent PHQ-9	0.02 [0.01, 0.04]	✓	0.02 [0.02, 0.04]
Parent GAD-7	0.02 [0.01, 0.03]	✓	0.02 [0.01, 0.03]
Corr(Intercept, PHQ-9)	-0.34 [-0.57, -0.03]		-0.26 [-0.58, 0.06]
Corr(Intercept, GAD-7)	-0.22 [-0.47, 0.02]		-0.23 [-0.47, 0.05]
Scale Fixed Effects			
Intercept	0.30 [0.001, 0.61]		0.35 [0.07, 0.61]

Sex	0.93 [0.54, 1.32]	✓	0.85 [0.46, 1.25]
SES	-0.02 [-0.11, 0.05]		
Parent PHQ-9 (Individual Means)	0.19 [0.08, 0.29]	✓	0.18 [0.10, 0.26]
Parent GAD-7 (Individual Means)	-0.12 [-0.23, -0.01]	✓	-0.16 [-0.25, -0.07]
Scale Random Effect Covariance			
Structure			
Intraindividual variance	2.09 [1.71, 2.55]		2.13 [1.76, 2.61]
Corr(Intercept, Scale Variance)	0.54 [0.43, 0.63]		0.57 [0.47, 0.66]
Corr(PHQ-9, Scale Variance)	-0.25 [-0.51, 0.01]		-0.16 [-0.39, 0.11]
Corr(GAD-7, Scale Variance)	-0.09 [-0.32, 0.18]		-0.09 [-0.33, 0.15]
Model Summary			
R^2 (mean trends in YSR-AD)	0.09		0.06
R^2 (intraindividual variability in YSR-AD)	0.19		0.18

Note. Posterior median estimates are presented for each parameter. 95% credible intervals are included in brackets. To interpret loglinear, multiplicative scale effects, estimates can be exponentiated and multiplied by the exponentiated scale intercept (e.g., the scale intercept = 0.30; exp(0.30) = 1.35; posterior median of the effect of sex on intraindividual variability = 0.93; exp(0.93) = 2.53; 2.53* 1.35= 3.42). GAD-7 = Generalized Anxiety Disorder-7. PHQ-9 = Patient Health Questionnaire-9. SES = socioeconomic status.

Table 4

Sex, SES, and Parents' Internalizing Symptoms Predicting Mean Trends and Intraindividual Variability in Adolescents' Depressive Symptoms from March 2020-April 2021

YSR-WD

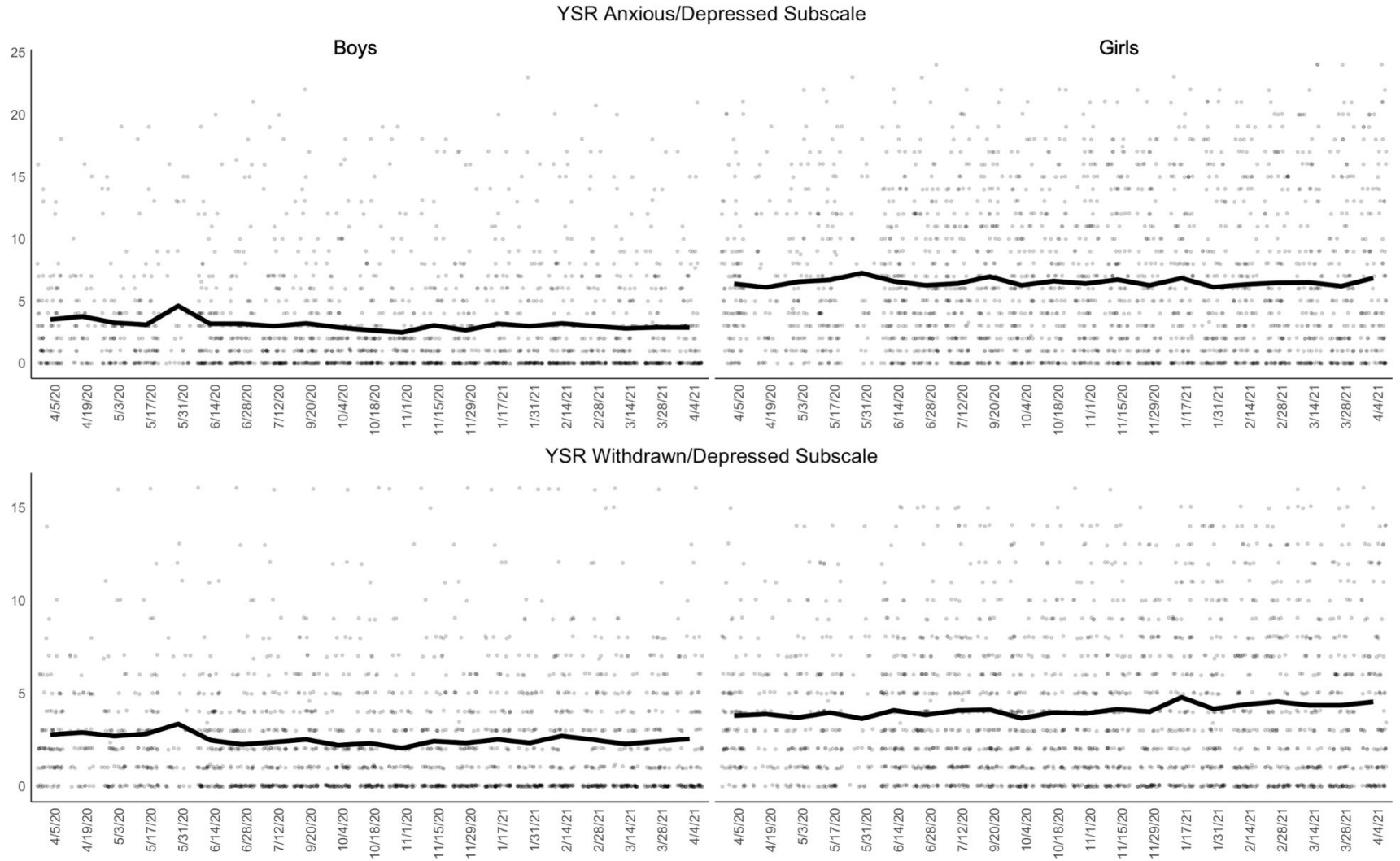
	Full Model	Retained in final model?	Final Model
Location Fixed Effects			
Intercept	2.59 [1.97, 3.23]		2.66 [2.07, 3.23]
Sex	1.90 [1.05, 2.73]	✓	1.72 [0.91, 2.48]
SES	-0.13 [-0.29, 0.04]		
Parent PHQ-9 (Individual Means)	0.05 [-0.17, 0.27]		
Parent GAD-7 (Individual Means)	0.13 [-0.13, 0.36]		
Location Random Effect			
Covariance Structure			
Intercept	9.79 [8.00, 12.00]		9.81 [8.20, 11.76]
Parent PHQ-9	0.01 [0.01, 0.02]	✓	0.01 [0.01, 0.02]
Parent GAD-7	0.01 [0.003, 0.02]	✓	0.004 [0.001, 0.01]
Corr(Intercept, PHQ-9)	-0.24 [-0.49, 0.09]		-0.25 [-0.49, 0.02]
Corr(Intercept, GAD-7)	-0.22 [-0.46, 0.14]		-0.12 [-0.43, 0.26]
Scale Fixed Effects			
Intercept	-0.04 [-0.28, 0.22]		0.003 [-0.25, 0.26]

Sex	0.62 [0.26, 0.97]	✓	0.57 [0.23, 0.93]
SES	-0.07 [-0.14, 0.01]		
Parent PHQ-9 (Individual Means)	0.15 [0.06, 0.25]	✓	0.14 [0.06, 0.22]
Parent GAD-7 (Individual Means)	-0.15 [-0.27, -0.05]	✓	-0.18 [-0.27, -0.09]
Scale Random Effect			
Covariance Structure			
Intraindividual variance	1.78 [1.44, 2.23]		1.80 [1.48, 2.22]
Corr(Intercept, Scale Variance)	0.56 [0.45, 0.66]		0.58 [0.47, 0.66]
Corr(PHQ-9, Scale Variance)	-0.12 [-0.36, 0.21]		-0.09 [-0.33, 0.17]
Corr(GAD-7, Scale Variance)	-0.19 [-0.45, 0.12]		-0.16 [-0.41, 0.14]
Model Summary			
R^2 (mean trends in YSR-AD)	0.08		0.04
R^2 (intraindividual variability in YSR-AD)	0.18		0.18

Note. Posterior median estimates are presented for each parameter. 95% credible intervals are included in brackets. To interpret loglinear, multiplicative scale effects, estimates can be exponentiated and multiplied by the exponentiated scale intercept (e.g., the scale intercept = -0.04; exp(-0.04) = 0.96); posterior median of the effect of sex on intraindividual variability = 0.62; exp(0.62) = 1.86; 1.86* 0.96= 1.79). GAD-7 = Generalized Anxiety Disorder-7. PHQ-9 = Patient Health Questionnaire-9. SES = socioeconomic status.

Figure 1

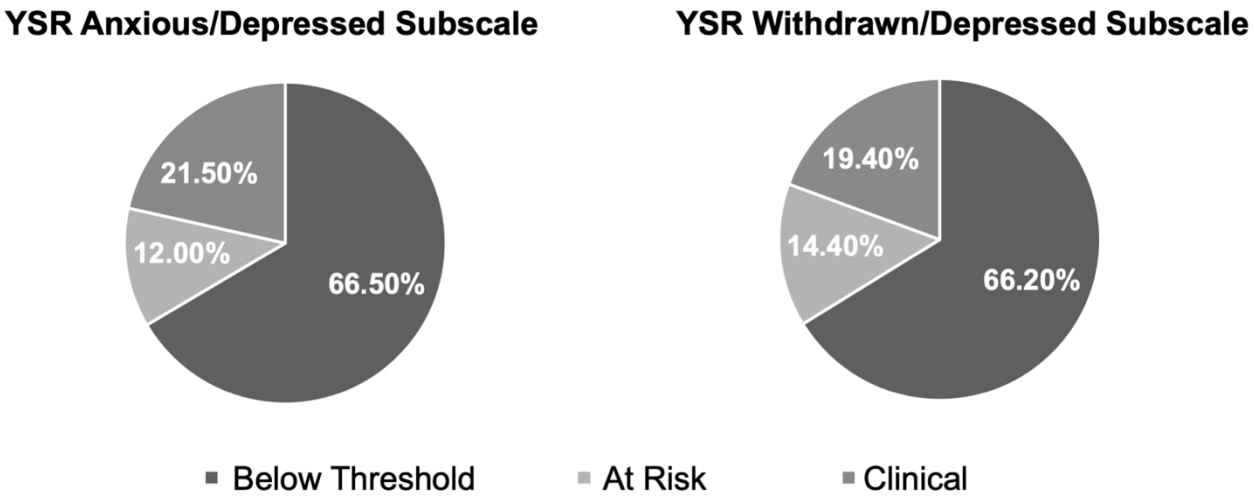
Raw adolescent YSR-AD and YSR-WD scores from March 2020-April 2021



Note. Lines represent mean trajectories of symptoms.

Figure 2

Peak adolescent internalizing symptom severity from March 2020-April 2021



Note. The categories *Below Threshold*, *At Risk*, and *Clinical Range* reflect symptom severity and were calculated according to the scoring procedures of Achenbach and Dumenci (2001). Peak symptom severity was calculated by examining frequencies of each adolescent's highest symptom severity across all 21 data collection waves.

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Dickey, L., West, M., Pegg, S., **Green, H**., Kujawa, A. (2021). Neurophysiological responses to interpersonal emotional images prospectively predict the impact of COVID-19 pandemic-related stress on internalizing symptoms. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging.*

Kujawa, A., **Green, H.,** Compas, B., Dickey, L., & Pegg, S. (2020). Exposure to COVID-19 pandemic stress: associations with depression and anxiety in emerging adults in the U.S. *Depression and Anxiety*. doi: 10.1002/da.23109

Pegg, S., Dickey, L., **Green, H.,** Kujawa, A. (2020). Differentiating clinically depressed adolescents with and without active suicidality: An examination of neurophysiological and self-report measures of reward responsiveness. *Depression and Anxiety.* doi: 10.1002/da.23012

Manuscripts:

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

Daoust, A. R., **Green, H.,** Vandermeer, M. R. J., Liu, P., Stanton, K., Harkness, K., Hayden, E. P. (in preparation). Associations between adolescents' and parents' depressive symptoms during the COVID-19 pandemic.

Daoust, A. R., **Green, H.**, Vandermeer, M. R. J., Liu, P., Stanton, K., Harkness, K., Hayden, E. P. (in preparation). Pre-pandemic cortisol reactivity predicts youths' trajectories of internalizing symptoms during the COVID-19 pandemic.

Dickey, L., Pegg, S., Cárdenas, E. F., **Green, H.**, Waxmonsky, J., Pérez-Edgar, K., Kujawa, A. (under review). Response to cognitive behavioral therapy for adolescent depression: role of reward responsiveness and emotion regulation. *Behavior Research and Therapy.*

Liu, P., Vandermeer, M. R. J., Daoust, A. R., **Green, H.,** Mohamed Ali, O., Stanton, K., Harkness, K. L., Barch, D. M., Joanisse, M. F., Hayden, E. P. H. (in preparation). Maternal depression, childhood resting-state brain connectivity, and their interaction predict adolescent depression during the COVID-19 outbreak.

Posters:

Green, H.*, Daoust, A. R., Vandermeer, M. R. J., Chan, T., Liu, P., Stanton, K., Harkness, K., Hayden, E. P. (2021, September). Adolescent and parent internalizing symptoms, avoidance, and concern in the first year of the COVID-19 pandemic. Poster presented at annual virtual meeting of the Society for Research in Psychopathology.

Dickey, L., Pegg, S., **Green, H.,** Kujawa, A. (2021, September). Predicting response to cognitive behavioral therapy for adolescent depression: an examination of neural reward responsiveness and emotion regulation. Poster presented at annual virtual meeting of the Society for Research in Psychopathology.

Gabel, L. N., Daoust, A. R., **Green, H.,** Stanton, K. J., Liu, P., Hayden, E. P. (2021, September). Mothers' internalizing symptoms, concern, and avoidance during the

COVID-19 pandemic predict vaccine openness and mask-wearing behavior. Poster presented at annual virtual meeting of the Society for Research in Psychopathology.

Green, H.*, Daoust, A. R., Vandermeer, M. R. J., Liu, P., Stanton, K., Harkness, K., Hayden, E. P. (2021, May). Self-referential processing moderates the link between parent and youth internalizing symptoms during the COVID-19 pandemic. Poster presented at annual Association for Psychological Science Virtual Convention.

Daoust, A. R., **Green, H.,** Vandermeer, M. R. J., Liu, P., Stanton, K., Harkness, K., Hayden, E. P. (2021, May). Associations between adolescents' and parents' depressive symptoms during the COVID-19 pandemic Poster presented at annual Association for Psychological Science Virtual Convention.

Green, H.*, Daoust, A. R., Vandermeer, M. R. J., Liu, P., Stanton, K., Harkness, K., Hayden, E. P. (2021, May). Behavioral inhibition in early childhood predicts adolescent internalizing symptoms during the COVID-19 pandemic. Poster presented at annual virtual meeting of the Canadian Stress Research Summit.

Daoust, A. R., **Green, H.**, Vandermeer, M. R. J., Liu, P., Stanton, K., Harkness, K., Hayden, E. P. (2021, May). Pre-pandemic cortisol reactivity predicts youths' trajectories of internalizing symptoms during the COVID-19 pandemic Symposium presentation at annual virtual meeting of the Canadian Stress Research Summit.

Green, H.*, Pegg, S., & Kujawa, A. (2019, September). Neural and self-reported reward responsiveness as predictors of response to group cognitive behavioral therapy for adolescent depression: a preliminary study. Poster presented at annual meeting of the Society for Research in Psychopathology, Buffalo, NY.

Green, H.*, Clayback, K., Morley, K., & Garber, J. (2019, March). Relations among children's social competence, theory of mind, and depressive symptoms. Poster presented at biennial meeting of the Society for Research in Child Development, Baltimore, MD.

Clayback, K., **Green, H.***, Morley, K., & Garber, J. (2019, March). Theory of mind moderated the relation between social competence and depression in children. Poster presented at biennial meeting of the Society for Research in Child Development, Baltimore, MD.

Nestor, B. A., Sutherland, S., Korelitz, K., **Green, H.**, Clayback, K., Morley, K., Garber, J. (2019, March). Moderators of parent-child agreement: measuring parenting behaviors. Poster presented at biennial meeting of the Society for Research in Child Development, Baltimore, MD.

Green, H.*, & Garber, J. (2018, May). Children's theory of mind, depressive symptoms, and social competence. Poster presented at Vanderbilt University Psychology Day, Nashville, TN.

Green, H.*, and Garber, J. (2017, November). Children's theory of mind, depressive symptoms, and social competence. Poster presented at annual meeting of the Tennessee Psychological Association, Nashville, TN.

Green, H.*, & Garber, J. (2017, September). Children's theory of mind, depressive symptoms, and social competence. Poster presented at Vanderbilt University Undergraduate Research Fair, Nashville, TN.