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Adolescent Mental Health Before and During COVID-19: Longitudinal Evidence From the 2004 Pelotas Birth Cohort in Brazil

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A B S T R A C T

Purpose: There is great interest in examining the consequences of the COVID-19 pandemic on adolescent mental health, but most studies were conducted in high-income countries. The identification of overall effects and protective factors is essential to understand the determinants of mental wellbeing in contexts of stress. We aimed to study changes in adolescent mental health during the pandemic and the risk and protective factors associated with these changes in a Brazilian birth cohort.

Methods: One thousand nine hundred forty nine adolescents from the 2004 Pelotas Birth Cohort were assessed prepandemic (T1, November 2019 to March 2020, mean age 15.69 years) and mid-pandemic (T2, August to December 2021, mean age 17.41 years). Mental health was assessed using the Strengths and Difficulties Questionnaire. Prepandemic and pandemic-related predictors were examined as predictors of change in multivariate latent change scores models.

Results: There was a mean increase in adolescent total mental health difficulties ($M = 1.071$, $p < .001$), hyperactivity/inattention ($M = 0.208$, $p < .001$), emotion symptoms ($M = 0.409$, $p < .001$), and peer problems ($M = 0.434$, $p < .001$) during the pandemic. This increase was associated with several negative family context variables, including harsh parenting and maternal depressive symptoms at T2. Higher emotion regulation levels protected against increases in adolescent mental health difficulties related to the COVID-19 pandemic.

Discussion: Family-context variables emerged as important risk factors for the deterioration of adolescent mental health during the COVID-19 pandemic. Interventions promoting emotion regulation strategies are a promising approach to protecting adolescent wellbeing in periods of stress.

IMPLICATIONS AND CONTRIBUTION

Using a Brazilian birth cohort, this study showed an increase in adolescent mental health problems during the COVID-19 pandemic. In addition, the data identified family-related risk factors for this deterioration. Finally, higher emotion regulation levels protected against increases in adolescent mental health difficulties related to the pandemic.

Conflicts of interest: The authors have no conflicts of interest to declare.

Ethics: All 2004 Pelotas Birth Cohort follow-ups were approved by the Federal University of Pelotas Medical School Research Ethics Committee. Principal caregivers of the participants signed an informed consent form. At ages 11, 15, and 17 years, adolescents signed an informed assent form. The present study was also approved by the Ethics Committee for Analysis of Research Projects of the Hospital de Clínicas, University of São Paulo School of Medicine (CAPPesq) (Research Protocol no. 4.951.457).

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During the COVID-19 pandemic, preventive measures to reduce virus transmission posed enormous challenges to the global population and disrupted almost every facet of daily life. In the early stages of the pandemic, research efforts were directed at understanding the biological aspects of the disease, treatments, and vaccine development [1]. However, as the pandemic progressed, the scientific community became increasingly concerned about the mental health crisis developing from the direct and indirect effects of the disease [2,3]. Although most countries have now reported decreased infection rates and have removed social distancing policies, studies on the toll of the pandemic on mental wellbeing, which may have repercussions for many years to come, are still one of the priorities to monitor its long-term consequences and support affected individuals [4].

Although adolescents are less likely to develop the severe symptoms of COVID-19 than adults, they represent one of the most vulnerable groups regarding consequences for psychosocial functioning [5]. Adolescence is a developmental stage marked by important changes in physical, emotional, and social domains, with increasing seeking of autonomy and a shift in interpersonal relationships [6]. In addition, adolescence constitutes a window of vulnerabilities and opportunities and many health behaviours' onset and trajectories are greatly influenced by experiences during this life phase [6]. School closures, home confinement, financial strain, and remote learning are expected to impact adolescent mental health, but empirical evidence is essential to understand the magnitude and direction of these effects [5]. Effects may also differ according to individual, family and socioeconomic contexts, and pandemic-related variables such as parental mental health and family conflict [5]. A recent meta-analysis involving 53 longitudinal studies from 12 countries found strong evidence that there was an increase in depressive symptoms and a slight increase in anxious symptoms in more than 40,000 children and adolescents examined by these studies. The authors also demonstrated that these effects are heterogeneous across certain sample characteristics, for example, female adolescents exhibited a greater increase in depressive symptoms than male adolescents [7]. Examining these differences will shed light on processes related to youth mental wellbeing during times of societal stress and help to identify the most at-risk groups.

A recent systematic review of youth mental health changes during the pandemic pointed out that rigorous studies identifying protective factors are still lacking [5]. The importance of such studies is to inform practitioners and researchers in their effort to develop interventions promoting adolescent psychosocial health in challenging situations, such as COVID-19 pandemic, or future events [5,8]. Potentially, adolescents with more personal socioemotional competencies, such as self-esteem and emotion regulation, might cope better with the challenges faced during the pandemic [5,8]. Growing evidence shows that socioemotional competencies and mental distress, although correlated, are distinct constructs and co-exist in a continuum of states [9]. In fact, gains in positive psychological abilities have been associated with a decline in mental illness [9,10]. In one Chinese study, adolescents experiencing strong positive changes in various domains (e.g., positive emotions, wellbeing, better relationships with family) during the pandemic presented lower levels of mental health problems when compared to peers experiencing limited or partial positive changes [8].

The present study aimed to address three issues: (1) to investigate changes in adolescent mental health from before (T1; November 2019 to March 2020) during the pandemic (T2; August to December 2021) and determine the magnitude of these changes if they occurred; (2) to examine socioeconomic factors at birth, prepandemic, and pandemic-specific variables that predicted the changes in mental health; and (3) to investigate if prepandemic levels of socioemotional competences (emotion regulation, self-esteem, and locus of control) protected against the development of mental health problems during the pandemic.

Methods

COVID-19 pandemic in Brazil

As one of the hardest-hit countries globally, the COVID-19 pandemic had a profound and devastating impact on Brazil, which faced significant challenges in combating the virus. The governments, primarily at the state level, implemented a series of lockdowns and restrictions in an attempt to prevent the spread of the virus, which had varying degrees of success. Unfortunately, these measures also had severe socioeconomic consequences, affecting vulnerable populations disproportionately [11]. The pandemic underscored existing healthcare disparities and social inequalities, highlighting the lack of comprehensive public health measures and a coordinated response from the federal government. The COVID-19 vaccination campaign in Brazil started on January 17, 2021, at a time when the country had already witnessed 210,000 deaths due to the virus. The COVID-19 vaccination efforts in Brazil played a pivotal role in preventing an additional one million deaths between December 8, 2020 and December 8, 2021 [12,13]. As of September 2023, Brazil ranks third in the world for confirmed COVID-19 cases, with 37,717,062 cases, and has the second-highest death toll, with 704,659 reported fatalities, behind only the United States and India in terms of both confirmed cases and deaths related to the pandemic [12].

Participants and procedure

The 2004 Pelotas Birth Cohort is a prospective, population-based birth cohort from Brazil. More information about the cohort and procedures was published elsewhere [14–16]. Concisely, all children born in 2004 in Pelotas were invited to participate in the cohort, including 4,231 participants (nonresponse rate at recruitment $< 1\%$). In addition to the perinatal interview, there were follow-ups at mean ages (standard deviation) of 3.0 (0.1), 11.9 (0.2), 23.9 (0.4), 49.5 (1.7) months, 6.8 (0.3), and 11.0 (0.3) years. The follow-up at a mean age of 15.7 years (0.2) occurred between November 2019 and March 2020, when the fieldwork had to be interrupted due to the pandemic. At that point, 1,949 adolescents were interviewed (47.8% of the original cohort). The peripandemic wave aimed to interview this same subsample, allowing the study of the mental health impacts of the COVID-19 pandemic in the same individuals by providing data from immediately before and during the pandemic. The peripandemic assessment occurred between August and December of 2021 and 1,826 adolescents (mean age, standard deviation = 17.4, 0.2) were interviewed in person (89.3% of the target population). Figure S1 in the supplementary material displays the flowchart of the included sample.

Measures

Adolescent's mental health indicators. Adolescent's mental health was assessed using the parent version of the Strengths and Difficulties Questionnaire (SDQ) [17]. The instrument was validated for use in the Brazilian population by Fleitlich et al. (2000) [18]. The SDQ is a widely used assessment tool for evaluating the emotional and behavioural wellbeing of children and adolescents [17]. Comprising 25 items organized into five subscales—Emotional Symptoms (five items, e.g., "Often unhappy, downhearted or tearful", and "Many worries, often seems worried", Conduct Problems (five items, e.g., "Often has temper tantrums or hot tempers", and "Often lies or cheats"), Hyperactivity/Inattention (five items, e.g., Restless, overactive, cannot stay still for long", and "Easily distracted, concentration wanders"), Peer Relationship Problems (e.g., Picked on or bullied by other children, and "Rather solitary, tends to play alone"), and Prosocial Behaviour (five items, e.g., "Considerate of other people's feelings", and "Often volunteers to help others [parents, teachers, other children]")—the SDQ is designed to provide a comprehensive overview of an individual's psychological functioning. More details about the SDQ items can be found on the SDQ website [19]. The main caregiver rated each item on a three-point scale ("Not true", "Somewhat true", or "Certainly true"). The scores from each subscale are then combined to generate subscale scores and an overall total difficulties score is derived by summing the 20 items from all subscales, except the prosocial behaviour subscale (score range: 0–40). Cronbach's alpha was calculated to assess the internal consistency of each subscale and the total difficulties score at T1 and T2 (Supplementary Material Table S1). Overall, all scales demonstrated an acceptable internal consistency (Cronbach's alpha values varying from 0.819 to 0.611) [20], except for peer problems in T1 and conduct problems in T2, which presented a marginal acceptable Cronbach's alpha value of 0.597 and 0.599, respectively (Table S1).

Sociodemographic at birth and prepandemic (T1) covariates. Demographic variables were assessed at birth and included monthly family income in the month prior to delivery (presented as quintiles in descriptive statistics), maternal education (number of completed years of formal education, categorized as 0–4 years, 5–8 years, and $\geq$ 9 years in descriptive statistics), maternal self-reported skin colour (White, mixed, and Black; Black and mixed were grouped into the same category), marital status (mothers were asked if they were living with a partner; yes/no), and adolescent's birth-assigned sex (female or male).

Maternal depressive symptoms at both prepandemic and peripandemic waves were measured using the Edinburgh Postnatal Depression Scale (EPDS) [21]. The EPDS is a self-report scale (e.g., "I have blamed myself unnecessarily when things went wrong", "I have felt scared or panicky for no very good reason", and "I have been so unhappy that I have had difficulty sleeping") that assesses the intensity of depressive symptoms over the previous seven days. It consists of 10 items, each with a four-point scale ("0: As much as I always could; 1: Not quite so much now; 2: Definitely not so much now; 3: Not at all"), with a score range of 0–30. The EPDS demonstrated good internal consistency in both waves (Cronbach's alpha T1 = 0.858, Cronbach's alpha T2 = 0.867) (Table S1).

Emotion regulation was measured by the self-report version of the Emotional Regulation Index for Children and Adolescents (ERICA) [22]. ERICA is a 16-item scale with a score range of 16–80 points. Examples of items are "I have trouble waiting for something I want" and "When others are upset, I become sad or concerned for them", 10 of the 16 items were reverse-scored, such that higher scores reflect more adaptive or functional emotion regulation. Self-esteem was measured by the self-report Rosenberg Self-esteem Scale [23,24]. The measure evaluates an individual's global self-esteem, including six items referring to a positive self-evaluation (e.g., "Overall, I am satisfied with myself") and four items related to a self-deprecating view (e.g., "I feel I do not have much to be proud of"). The self-deprecating items were reverse-scored. The score range is 10–40, with higher scores indicating higher levels of self-esteem. More information about ERICA and self-esteem items is available elsewhere [25]. Locus of control was assessed using the Nowick-Strickland Internal-External Scale [26]. The measure consists of a 12-item test using a "Yes-No" response format and higher scores indicating a more external locus of control (score range: 0–12). An internal locus of control indicates that the person's perception of events is under their control and choices. A person with a more external locus of control perceives that the outcome of the events is the result of luck or random factors not under his/her power [27]. Examples of items are "Do you believe that your success in schoolwork is solely a matter of luck?" and "Do you think that when good or nice things occur in your life, it is primarily due to you being 'lucky'?". The scale was translated into Portuguese and its psychometric properties were positively evaluated by Barros et al. (1992) [28]. All measures (emotion regulation, locus of control, and self-esteem at T1 and T2) showed an acceptable internal consistency with Cronbach's alpha $\geq$ 0.60 (Table S1).

Peripandemic (T2) covariates. Harsh parenting was measured using the parent report of the Parent-Child Conflict Tactics Scale (CTSPC) [29]. We used a 14-item CTSPC version consisting of (1) psychological aggression, related to emotional maltreatment, for example, "How many times did you shout, yell, or scream at him/her" (five items) and (2) physical aggression (nine items) subscales, encompassing items related to physical punishment (six items) and physical maltreatment (three items) (e.g., "How many times did you hit him/her with a fist or kick him/her hard?"). Each item was rated on a Likert scale ranging from 0 ("Never in the past year"), 1 ("Once in the past year"), and 2 ("More than once in the past year"). The harsh parenting score range is 0–28, with higher scores indicating more frequent episodes of harsh parenting during the preceding year. The internal consistency of CTSPC in our sample was Cronbach's alpha = 0.811 in T1 and Cronbach's alpha = 0.821 in T2 (Table S1).

At T2, specific questions related to the COVID-19 pandemic were asked. The questions included items to assess: adopted social distancing levels (categorized as "strict social distancing restrictions", "Moderated social distancing restrictions", and "low/no social distancing restrictions"), perceived impact of the pandemic ("How much have you been affected by the pandemic and/or social distancing measures?", with possible answers "Not affected at all", "Affected a little", "Moderately affected", and "Affected a lot"), fear of food shortage ("Did you feel concerned/afraid of not having food during the pandemic?", yes/no), and fear of getting sick (yes/no).

Statistical analysis. We used multivariate latent change score (LCS) models to examine changes in adolescent's mental health

from before (T1) to during the pandemic (T2). We used LCS for a number of reasons: first, modeling mental health change as a latent variable offers all the advantages associated with Structural Equation Modeling, for example, the incorporation of measurement errors. Second, LCS also allows for the adjustment of initial levels of mental health when calculating the change that occurred during the pandemic. In other words, we can assess whether changes during the pandemic are dependent on the initial levels of mental health. Finally, LCS handles missing values more robustly than traditional methods and enables us to assess the model's adequacy using different model fit indices. The LCS model is a powerful and flexible class of Structural Equation Modeling that allows the investigation of changes in indicators over time by defining the differences between T_1 and T_2 as a latent variable (i.e., an LCS factor) [30,31]. In an LCS model with two time points, the intercept represents the initial level of the latent variable at the first measurement occasion (T1) and the slope represents the rate or magnitude of change in the latent variable between T1 and T2. A positive slope suggests an increase in the construct over time, while a negative slope suggests a decrease [30,31]. The mean (or slope, in case of an LCS with two time points) of the LCS factor represents a robust estimator of the

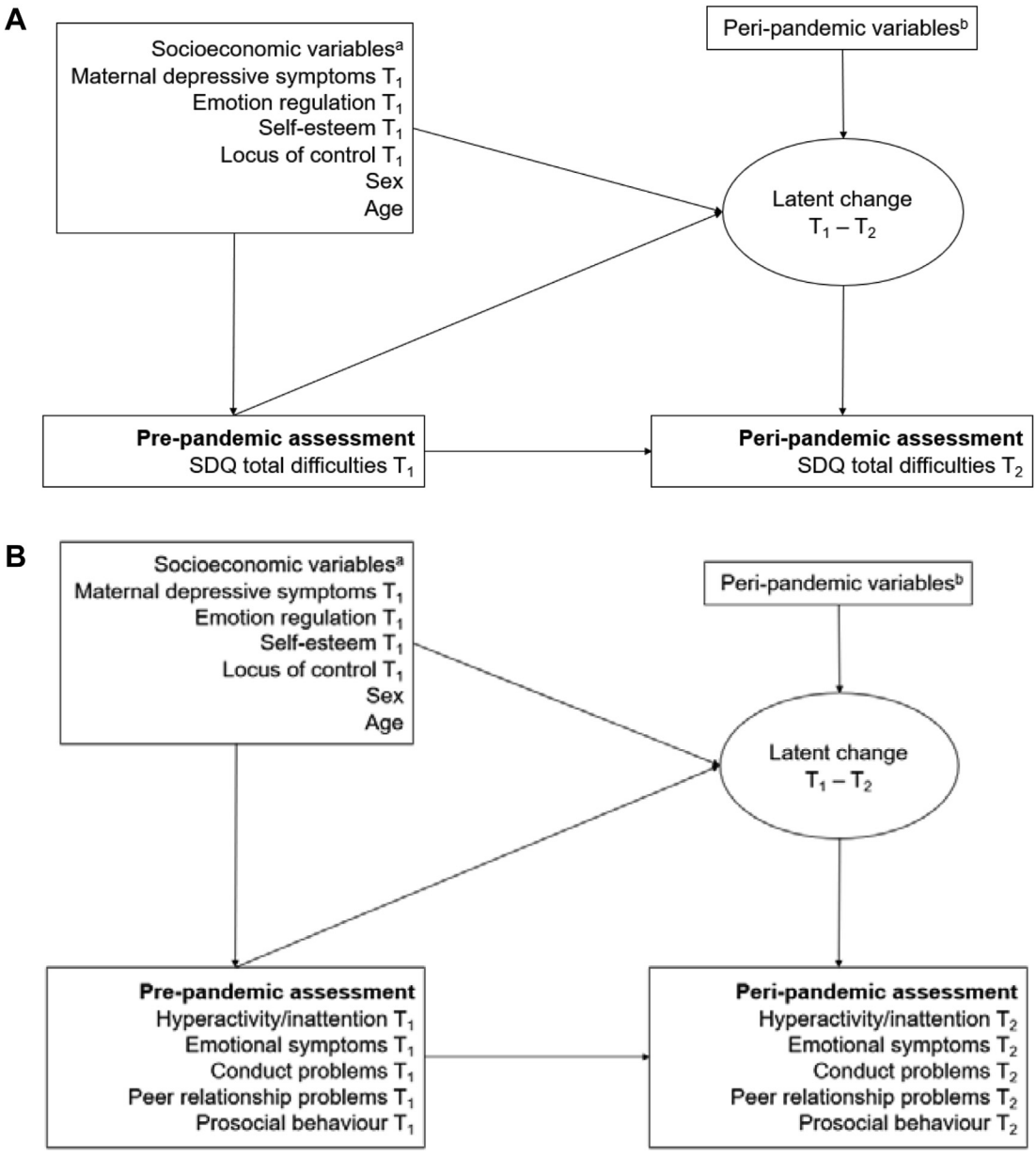

Figure 1. Latent change score model for (A) SDQ total difficulties and (B) hyperactivity/inattention, emotional symptoms, conduct problems, peer relationship problems, and prosocial behaviour subscales from the prepandemic (T_1; from November 2019 to March 2020) to the peripandemic assessments (T_2; from August to December of 2021). [a]Socioeconomic variables at birth are maternal schooling, family income, maternal skin colour, and marital status; [b]Peripandemic variables are maternal depressive symptoms at T_2, harsh parenting, adopted social distancing levels, perceived impact of the pandemic, fear of food shortage, and fear of getting sick.

Table 1
Demographic characteristics of study participants

Variables	Not included in the study N = 2,210	Prepandemic assessment (T1) N = 2,021	Peripandemic assessment (T2) N = 1,805
		N (%)	N (%)
Family income (quintiles)			
First quintile (poorest)	497 (22.51)*	374 (18.51)	327 (18.12)
Second to fifth quintile	1,713 (77.49)	1,647 (81.49)	1,478 (81.88)
Maternal schooling (years)			
0–4	373 (17.11)*	281 (14.01)	254 (14.18)
5–8	915 (41.97)	816 (40.68)	719 (40.15)
≥ 9	892 (40.92)	909 (45.31)	818 (45.67)
Maternal skin color			
White	1,599 (72.42)	1,489 (73.68)	1,325 (73.41)
Non-White	609 (27.58)	532 (26.32)	480 (26.59)
Living with a partner at child birth			
Yes	1,818 (82.34)*	1,718 (85.01)	1,533 (84.93)
No	390 (17.66)	303 (14.99)	272 (15.07)
Adolescent's sex			
Male	1,161 (52.53)	1,034 (51.16)	917 (50.80)
Female	1,049 (47.47)	987 (48.12)	888 (49.20)
Adolescents' age			
Mean (SD)	-	15.69 (0.19)	17.41 (0.26)
Range		15.01–16.15	16.7–17.9

*$p < .05$ for the difference between the prepandemic sample (T_1; N = 2,021) and the sample not included in the present study (N = 2,210). There were no statistically differences in socioeconomic variables between the prepandemic (T_1) and peripandemic samples (T_2).

average change between T1 and T2, the variance of the change factor (σ^2) captures the extent to which the individuals differ in the change they manifest over time, and the proportional change refers to how much the change is dependent to the T1 scores (autoregressive path from T1 to LCS factor) [30,31]. Figure 1 shows the latent change models for SDQ total difficulties (Figure 1A) and SDQ subscales (Figure 1B). Changes in SDQ subscales were modeled as five parallel processes, which means that the five latent variables were combined into one model to examine if changes in the SDQ subscales are intercorrelated (Figure 1B). Next, we included the demographic, prepandemic (for the initial levels), and peripandemic covariates (for the LCSs) to investigate the predictors of the initial levels of adolescent's mental health indicators and the LCSs. Adolescent age was also included in all models. The analyses were conducted in Mplus 8.4 [32]. Maximum likelihood estimation with robust standard errors is used for all models. Missingness is accounted for with full information maximum likelihood estimation assuming responses are missing at random, including a final sample of 1,949 adolescents. In addition to the $\chi 2$ value, which is sensitive to sample size [33], the model fit was evaluated by the Comparative Fit Index, the Tucker-Lewis Index, the Root Mean Square Error of Approximation, and the Standardized Root Mean Square Residual. Specifically, Comparative Fit Index/Tucker-Lewis Index $\geq$ 0.90 Root Mean Square Error of Approximation $<$ 0.08 Standardized Root Mean Square Residual $<$ 0.08 are considered a good fit [34,35].

Results

Descriptive statistics

The sociodemographic characteristics of the participants included in the present study versus those not included are shown in Table 1. Compared to the original cohort, the included sample comprised a slightly higher proportion of wealthier families and more educated and no single mothers. There were no statistically significant differences between the prepandemic and peripandemic samples regarding socioeconomic factors.

Table S1 shows the mean, standard deviation, and correlations between the SDQ subscales at T1 and T2. All correlations were significant and varied from very weak to moderate (−0.097 to 0.558). Hyperactivity/inattention, conduct problems, emotional problems, and prosocial behaviour at T1 are moderately correlated with their respective measures at T2. Peer problems at T1 are weakly correlated with peer problems at T2.

Latent change scores modeling

The mean of the latent change factor was positive and significant for the SDQ total difficulties (M_{slope} = 1.071, S.E. = 0.140, $p < .001$), hyperactivity/inattention (M_{slope} = 0.208, S.E. = 0.057, $p < .001$), emotional symptoms (M_{slope} = 0.409, S.E. = 0.060, $p < .001$), and peer problems (M_{slope} = 0.434, S.E. = 0.047, $p = .001$) subscales. As the SDQ subscales have the same score range and they were modeled in the same way, the mean of latent variable can be directly compared. It means that the greater changes were observed for peer problems subscale. This indicates that there was a significant mean increase in the mental health difficulties from the prepandemic to the midpandemic waves. The mean of the latent change factor for conduct problems (M_{slope} = 0.006, S.E. = 0.038, $p = .882$) and for prosocial behaviour (M_{slope} = −0.019, S.E. = 0.040, $p = .626$) were not significant, suggesting that these measures did not change during the study period. The variances for all LCSs were significant, meaning that there were significant interindividual differences in the extent of mental health changes experienced by adolescents in the study (Table 2). Furthermore, all coefficients of the proportional change for SDQ total difficulties, hyperactivity/inattention, conduct problems, emotional symptoms, and peer problems are significant and negative, showing that lower baseline scores of these measures were associated with greater latent change from T1 to T2. In other words, adolescents with lower baseline symptoms showed greater changes in SDQ scores during the pandemic. For prosocial behaviour, the coefficient of

Table 2
Latent change scores, individual variability, and proportional change on SDQ subscales from prepandemic wave (T_1) to peripandemic wave (T_2)

	Latent change scores (LCS; T_1–T_2)		Individual variance		Proportional change	
	M_{slope} (S.E.)	*p* value	σ^2	*p* value	*b*	*p* value
SDQ total difficulties	1.071 (0.140)	< .001	22.842	< .001	−0.548	< .001
Hyperactivity/Inattention	0.208 (0.057)	< .001	5.648	< .001	−4.175	< .001
Conduct problems	0.006 (0.038)	.882	2.520	< .001	−1.857	< .001
Emotional problems	0.409 (0.060)	< .001	6.468	< .001	−3.298	< .001
Peer problems	0.434 (0.047)	< .001	3.903	< .001	−1.914	< .001
Prosocial behaviour	−0.019 (0.040)	.626	2.859	< .001	−1.531	< .001

Unstandardized coefficients are shown. Maximum likelihood robust estimator was used, with full maximum information likelihood for handling missing data.
Latent change scores show the mean increase or decrease of SDQ subscales scores between prepandemic and peripandemic waves, modeled as a latent variable; Individual variance (σ^2) captures the extent to which individuals differ in the change they manifest over time; Proportional change shows the extent to which the LCS are related to prepandemic scores.
The multivariate latent change model for SDQ total difficulties yielded an acceptable model fit: $\chi 2 = 434.302$, df = 49, CFI/TLI = 0.752/0.843, RMSEA (90% CI) = 0.043 (0.040 0.047), SRMR = 0.063. For the SDQ subscales, the model fit was good: $\chi 2 = 689.840$, df = 85, CFI/TLI = 0.910/0.805, RMSEA (90%CI) = 0.060 (0.055, 0.064), SRMR = 0.054.
S.E. = standard error.

proportional change is significant and negative. It indicates that adolescents with higher levels of prosocial behaviour before the pandemic showed smaller increases in this measure during the pandemic (Table 2). The correlations between the various LCS factors for each SDQ score are all significant but vary from very weak to weak values (−0.084 to 0.373, Table S2), meaning that mean changes in the mental health indicators are weakly correlated with each other.

Table 3 shows the sociodemographic and prepandemic predictors of the baseline levels of the SDQ total difficulties and the five subscales. Female adolescents presented lower SDQ total difficulties, hyperactivity/inattention, higher emotional problems, and higher prosocial behaviour than male adolescents at the baseline. Higher maternal schooling was associated with lower levels of peer problems. Single motherhood was associated with SDQ total difficulties, hyperactivity/inattention, emotional problems, peer problems, and higher prosocial behaviour. Maternal depressive symptoms at T1 are associated with poorer adolescent mental health regarding SDQ total difficulties and all subscales, except for conduct problems. In contrast, higher adolescent emotion regulation was associated with lower SDQ total difficulties, hyperactivity/inattention, conduct problems, peer problems, and higher prosocial behaviour. Higher self-esteem is associated with lower SDQ total difficulties, emotional, and peer problems. Finally, an external locus of control was associated with SDQ total difficulties, hyperactivity/inattention, emotional, and peer problems (Table 3).

Table 4 shows predictors of the LCSs, categorized into sociodemographic prepandemic and midpandemic predictors. Predictors with positive coefficients are associated with a greater change in that construct. Conversely, predictors with negative coefficients are associated with smaller changes in that construct. In other words, in the case of mental health problems as the outcome, predictors with positive coefficients represent variables that led to an increase in difficulties, while predictors with negative coefficients prevented the increase of difficulties during the pandemic. Being female was associated with greater increases in SDQ total difficulties and hyperactivity/inattention. Single motherhood was a positive predictor of change for emotional problems. Higher self-esteem at T1 was a positive predictor of change for emotional and peer problems. These results indicate that female sex, single motherhood, and higher self-esteem were associated with an increase in mental health difficulties during the pandemic. Higher maternal schooling negatively predicted change in SDQ total difficulties and peer problems. Higher adolescent emotion regulation was a negative

Table 3
Predictors of initial SDQ scores assessed at the prepandemic assessment

	Initial SDQ scores (T_1)					
	SDQ total difficulties	Hyperactivity inattention	Conduct problems	Emotional problems	Peer problems	Prosocial behaviour
	β (S.E.)	β (S.E.)	β (S.E.)	β (S.E.)	β (S.E.)	β (S.E.)
Maternal schooling	−0.035 (0.024)	−0.018 (0.022)	−0.005 (0.036)	0.002 (0.025)	**−0.057 (0.027)****	−0.039 (0.026)
Family income	−0.001 (0.024)	0.012 (0.021)	0.005 (0.028)	−0.002 (0.025)	−0.006 (0.027)	0.011 (0.025)
Single mother	**−0.093 (0.023)*****	**−0.043 (0.022)****	−0.069 (0.039)*	**−0.079 (0.023)*****	**−0.051 (0.024)****	**0.082 (0.025)****
Black/brown mother	0.004 (0.021)	−0.004 (0.019)	0.003 (0.045)	0.002 (0.023)	−0.009 (0.023)	0.036 (0.023)
Maternal depressive symptoms (T_1)	**0.512 (0.042)*****	**0.051 (0.019)****	0.110 (0.074)	**0.226 (0.021)*****	**0.167 (0.022)*****	**−0.119 (0.023)*****
Female adolescents	**−0.389 (0.168)****	**−0.096 (0.021)*****	−0.012 (0.053)	**0.114 (0.022)*****	−0.014 (0.022)	**0.069 (0.023)*****
Emotion regulation	**−0.275 (0.046)*****	**−0.066 (0.026)****	**−0.212 (0.104)****	−0.037 (0.028)	**−0.059 (0.028)****	**0.170 (0.026)*****
Self-esteem	**−0.281 (0.076)*****	−0.027 (0.024)	0.027 (0.047)	**−0.173 (0.028)*****	**−0.086 (0.027)****	−0.010 (0.031)
Locus of control[a]	**0.242 (0.103)****	**0.114 (0.022)*****	0.018 (0.044)	**0.052 (0.023)****	**0.056 (0.028)****	0.010 (0.026)

Standardized coefficients are shown. Significant coefficients are in bold. Maximum likelihood robust estimator was used, with full maximum information likelihood for handling missing data. All models included adolescent age at the assessment.
*$p < .10$; **$p < .05$; ***$p < .001$.
[a] Higher scores refer to a more external locus of control.

Table 4
Predictors of SDQ latent change scores from the prepandemic to the peripandemic assessments

	Latent change scores ($T_1 - T_2$)					
	SDQ total difficulties	Hyperactivity inattention	Conduct problems	Emotional problems	Peer problems	Prosocial behaviour
	β (S.E.)	β (S.E.)	β (S.E.)	β (S.E.)	β (S.E.)	β (S.E.)
Demographic and prepandemic predictors						
Maternal schooling	**−0.108 (0.023)*****	−0.005 (0.026)	**−0.068 (0.028)****	−0.044 (0.028)	**−0.072 (0.028)****	**0.060 (0.029)****
Family income	−0.027 (0.023)	−0.008 (0.026)	−0.021 (0.027)	−0.011 (0.027)	−0.018 (0.027)	−0.019 (0.027)
Single mother	−0.004 (0.022)	0.012 (0.025)	0.038 (0.026)	**0.058 (0.025)****	0.028 (0.026)	−0.036 (0.027)
Black/brown mother	0.005 (0.022)	−0.004 (0.025)	−0.042 (0.026)*	0.027 (0.025)	0.008 (0.026)	0.016 (0.025)
Female adolescents	**0.027 (0.020)**	**0.055 (0.024)****	0.002 (0.024)	0.004 (0.023)	0.022 (0.024)	0.003 (0.023)
Emotion regulation	**−0.128 (0.021)*****	−0.009 (0.029)	**0.056 (0.028)****	**−0.063 (0.028)****	−0.042 (0.030)	−0.014 (0.032)
Self-esteem	−0.015 (0.035)	0.005 (0.029)	0.006 (0.028)	**0.056 (0.028)****	**0.070 (0.028)****	−0.020 (0.032)
Locus of control[a]	0.055 (0.068)	**−0.076 (0.025)****	−0.015 (0.027)	−0.011 (0.026)	**−0.053 (0.026)****	0.002 (0.028)
Mid-pandemic predictors						
Maternal depressive symptoms (T_2)	**0.207 (0.024)*****	**0.055 (0.016)****	**0.070 (0.024)****	**0.130 (0.023)*****	**0.068 (0.024)****	−0.015 (0.023)
Harsh parenting	**0.236 (0.022)*****	**0.161 (0.032)*****	**0.141 (0.028)*****	**0.084 (0.023)****	**0.057 (0.025)****	**−0.181 (0.025)*****
Social isolation	0.001 (0.021)	**−0.036 (0.014)****	**−0.046 (0.022)****	0.027 (0.020)	**0.071 (0.020)*****	0.018 (0.021)
Perceived impact of the pandemic	**0.067 (0.022)****	−0.007 (0.017)	0.022 (0.021)	**0.076 (0.023)****	0.028 (0.022)	0.003 (0.024)
Fear of food shortage	0.011 (0.024)	−0.001 (0.015)	−0.026 (0.030)	**0.088 (0.023)****	0.020 (0.024)	0.039 (0.024)*
Fear of getting sick	−0.010 (0.022)	−0.023 (0.015)	0.001 (0.026)	−0.001 (0.022)	−0.017 (0.023)	0.012 (0.024)

Standardized coefficients are shown. Significant coefficients at $p < .05$ threshold are in bold. Maximum likelihood robust estimator was used, with full maximum information likelihood for handling missing data. All models included adolescent age at the assessment.
*$p < .10$; **$p < .05$; ***$p < .001$.
[a] Higher scores refer to a more external locus of control.

predictor of SDQ total difficulties and emotional problems (diminished their increase during the pandemic). An external locus of control was a negative predictor of change for hyperactivity/inattention and peer problems. These results indicate that higher maternal schooling, higher levels of emotion regulation, and a more external locus of control exerted protective effects for mental health deterioration during the pandemic.

Regarding family and adolescent factors measured at mid-pandemic, maternal depressive symptoms predicted greater increases in SDQ total difficulties, hyperactivity/inattention, emotional problems, and peer problems. Likewise, harsh parenting emerged as the strongest positive predictor of change for SDQ total difficulties and all SDQ subscales. Restrictive levels of social distancing positively predicted changes in peer problems, but were a negative predictor of changes in hyperactivity/inattention (i.e., a more restricted social distancing prevented the increase in hyperactivity/inattention symptoms during the pandemic). A more negative perception of the impacts of the pandemic was a positive predictor for SDQ total difficulties and emotional problems. In addition, fear of food shortage during the pandemic was a positive predictor of change for emotional problems. Finally, fear of getting sick did not predict any changes in mental health indicators (Table 4).

Discussion

We examined the changes in adolescent mental health during the COVID-19 pandemic in comparison to shortly before the pandemic, using data from a Brazilian birth cohort. We also investigated socioeconomic, prepandemic, and pandemic-related factors that may be associated with the changes during the study period. We found that the adolescents presented an overall deterioration in SDQ total difficulties, hyperactivity/inattention symptoms, emotional symptoms, and peer problems. Conduct problems and prosocial behaviour remained stable over the two-time points. Lower levels of adolescent mental health problems at the prepandemic baseline were associated with larger increases in symptoms during the pandemic. However, there was significant variation in these changes between adolescents in the study. Harsh parenting and maternal depressive symptoms during the pandemic helped explain this variation—which were associated with greater increases in adolescent mental health problems for nearly all indicators examined. Other variables related to sociodemographic characteristics (e.g., maternal schooling and single motherhood at birth) and adolescent socioemotional competences also predicted changes in specific indicators of adolescent mental health problems during the pandemic. For instance, higher adolescent emotion regulation in the prepandemic period presented a protective role against increases in adolescent mental health during the pandemic.

Notably, adolescents with higher self-esteem before the pandemic showed an increase in emotional and peer problems. In addition, a more external locus of control protected against a worsening in hyperactivity/inattention symptoms and peer problems. These results are contrary to our hypothesis that high self-esteem and internal locus of control would buffer the negative impacts of the COVID-19 pandemic on adolescent mental health. Some possible explanations of such findings can be proposed. First, self-esteem is a complex construct shaped by a myriad of factors and social relations have a great impact on a person's perception of self-worth [36]. This heightened influence of interpersonal relationships on self-esteem is especially pronounced during adolescence, when the perception of being accepted and valued by peers is crucial in this life phase [36]. Therefore, it is possible that adolescents with higher self-esteem that was related to daily interactions with their friends prior to the pandemic would present deterioration in their mental health when social distancing measures, including school closures, were imposed. Regarding locus of control, individuals with a strong internal locus of control believe that the events of their lives are a result of their choices and actions. An external locus of control

relates to a belief that life events are controlled by outside factors which the person has no power over [37]. The COVID-19 pandemic was an unprecedented event that profoundly disrupted routines and impacted conceptions of control over life choices. Possibly, individuals with a more internal locus of control would struggle more in the context of total lack of control, as the pandemic imposed for many. Indeed, some evidence shows that in the face of unpredictable stress, a balanced locus of control expectancy (i.e., a mix of internal and external locus of control) may be more favourable for wellbeing [38–40]. Nonetheless, it is important to note that these are initial speculations that may explain part of our findings and more studies replicating them are encouraged.

On the other hand, we found evidence for a protective role of prepandemic emotion regulation on adolescent mental health during the pandemic. This is consistent with previous research reporting that adaptive emotion regulation was associated with maintained psychological wellbeing and predicted higher quality of life in different groups during the pandemic [41–44]. Emotion regulation refers to the processes and strategies individuals use to monitor, evaluate, and reason about their emotions, regulating their intensity, frequency, and duration [45,46]. The development of emotion regulation skills provides individuals with the means to have a better awareness of their feelings and communicate them in a socially appropriate manner [45,46]. Having adaptive emotion regulation skills enabling the individual to understand, manage, and properly express emotions is a valuable ability in a context of great uncertainty and adversities imposed by the pandemic [43,46]. Therefore, our results emphasize that interventions aiming to promote emotion regulation skills are a promising approach to support adolescents in maintaining their mental health in adverse contexts, such as that represented by the COVID-19 pandemic, and should be considered in future studies [47].

Our findings are consistent with a recent umbrella review showing a varying burden of mental health problems among children and adolescents during the COVID-19 pandemic [48]. In addition, we also identified important predictors of adolescent poor mental health during the pandemic, highlighting the role of family-related risk factors (i.e., harsh parenting and poor maternal mental health) in agreement with previous research [5,48]. Our study adds to the literature robust evidence of adolescent mental health during the COVID-19 pandemic using longitudinal data of a representative sample from a country in the global south, a gap in the current knowledge thus far [48]. In accordance with evidence-based recommendations for future research and policy-making listed by Hossain et al. (2022) [48], our study emphasizes: (1) the need for continued research to investigate the persistence of mental health and psychosocial symptoms and their impact on youth development in the long-term. The occurrence of mental health problems during adolescence is associated with adverse outcomes across various aspects of an individual's life, including quality of life, interpersonal relationships, and physical health [7,49,50]. Furthermore, the continuity of psychopathologies and mental health issues from early life into adulthood represents a burden both at the individual and societal levels. When these symptoms persist into adulthood, individuals are more likely to experience financial difficulties and have lower chances of completing their education, thereby contributing to the intergenerational transmission of socioeconomic disadvantages [7,49,50]; (2) the design and implementation of family-based interventions to address risk factors and promote protective factors to support the mental health of children, adolescents, and their caregivers; and (3) finally, the prioritization of social determinants of mental health in the global health agenda [48].

The present study has several limitations. First, our study sample is comprised of 48% of the original cohort given the abrupt finish to ongoing fieldwork at the time when the pandemic started. Although we have included several socioeconomic variables assessed at birth and used full information maximum likelihood estimation, we cannot rule out the possibility of residual bias. Second, adolescent mental health was assessed by maternal report. Self-report or the use of multi-respondent measures is more appropriate to capture the changes that occurred during the pandemic, especially in case of internalizing symptoms. Third, although the study provided a valuable opportunity to examine changes in adolescent mental health with longitudinal data, the time gap between waves was nearly 18 months, representing a relatively long period in adolescent life. Moreover, the prevalence of mental health problems changes over time. Therefore, several time points would have allowed the modeling of trajectories of mental health over the period and the capacity to identify patterns of change. In addition, the midpandemic follow-up occurred when Brazil was facing an easing phase of the pandemic, with widespread vaccination and reduced cases and hospitalizations. It is possible that we would have had very different results if the follow-up had occurred in the acute phase or before the vaccination, so the findings speak more to enduring mental health difficulties experienced by adolescents in a later phase of the pandemic, and key stresses experienced earlier on are not captured in this study. Additionally, regrettably, the absence of critical variables (e.g., gender identity) in our dataset represents a noteworthy limitation of the study, which should be acknowledged. Finally, political and economic factors (e.g., the federal government's omission of a coordinated response to the pandemic and the disinformation crisis) led to a chaotic scenario in Brazil, which partly explains why the impacts of the pandemic were unequally distributed across the country [11], and it is not possible to estimate the extent to which these differences affect the generalization of our results.

Our findings corroborate previous evidence on the high burden of mental health problems among adolescents during the COVID-19 pandemic. Moreover, the sociodemographic factors, parenting practices, and maternal mental health had an essential role in understanding the changes in adolescent mental health problems during this period. Finally, higher levels of emotion regulation in the prepandemic period buffered the adverse impacts of the pandemic on adolescent mental health problems during the pandemic. The importance of interventions to improve emotion regulation skills in adolescents extends beyond the COVID-19 pandemic context and is essential to support youth in the challenges of the postpandemic world.

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Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jadohealth.2023.10.016.

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