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CLINICAL RESEARCH ARTICLE

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A longitudinal investigation of psychological distress in children during COVID-19: the role of socio-emotional vulnerability

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ABSTRACT

Background: Although the COVID-19 pandemic has increased the incidence of distress in youth, some children show increased resilience, emphasizing the need to better understand the predictors of distress in youth.

Objective: This longitudinal study aimed to assess the combined impact of known socio-emotional predictors of stress-related psychopathology, namely anxiety sensitivity, anxiety trait, intolerance to uncertainty, and rumination, on COVID-related distress in healthy youth.

Method: A total of 92 parent-child dyads that previously participated in a laboratory-based experiment assessing observational fear learning in families between 2017 and 2019 (T0) were recontacted. Of them, 84 children aged between 9 and 14 agreed to participate. They completed online questionnaires in June 2020 (T1), September 2020 (T2), December 2020 (T3), and March 2021 (T4). Participants were free of mental illness at T0 and T1. To create a socio-emotional composite score (SECS), we measured anxiety sensitivity (Childhood Anxiety Sensitivity Index) at T0, trait anxiety (Trait subscale of the State-Trait Anxiety Inventory for Children (STAI-C)), intolerance to uncertainty (Intolerance of Uncertainty Scale for Children), and trait rumination (Children's Response Style Scale) at T1 and created a weighted z-score. To assess symptoms of anxiety, post-traumatic stress (PTS), and depression in reaction to COVID-19, participants completed the State subscale of the STAI-C, the Children's Revised Impact of Event Scale, and the Children's Depression Inventory at T1–T4. Three general linear models were run with sex, age group (9–11 and 12+ years old), and SECS as predictors.

Results: Analyses revealed a SECS*Time interaction, with higher SECS predicting elevated anxiety symptoms at T1 and T4, and elevated PTS symptoms at T1 and T2.

Conclusion: These results suggest that healthy youth endorsing high levels of socio-emotional vulnerability to psychopathology have a higher risk of suffering from anxiety and PTS, but not depressive symptoms, in the year following a major stressor.

Una investigación longitudinal de la angustia psicológica en los niños durante el COVID-19: El rol de la vulnerabilidad socioemocional

Antecedentes: Aunque la pandemia de COVID-19 ha aumentado la incidencia de angustia en jóvenes, algunos niños muestran una mayor resiliencia, relevando la necesidad de comprender mejor los predictores de la angustia en los jóvenes.

Objetivo: Este estudio longitudinal tuvo como objetivo evaluar el impacto combinado de los predictores socioemocionales conocidos de la psicopatología relacionada con el estrés, como son la sensibilidad a la ansiedad, rasgos ansiosos, intolerancia a la incertidumbre y rumiación, en la angustia relacionada con COVID en jóvenes sanos.

Método: 92 díadas de padres e hijos que participaron previamente en un experimento de laboratorio que evaluó el aprendizaje del miedo observacional en familias entre 2017 y 2019 (T0) fueron contactados nuevamente. Participaron 84 niños de entre 9 y 14 años. Completaron cuestionarios en línea en junio de 2020 (T1), septiembre de 2020 (T2), diciembre de 2020 (T3) y marzo de 2021 (T4). Los participantes estaban libres de enfermedad mental en T0 y T1. Para crear una puntuación socioemocional compuesta (SECS), medimos la sensibilidad a la ansiedad (Índice de sensibilidad a la ansiedad infantil) en T0, rasgo de ansiedad (subescala de rasgo del Inventario de ansiedad estado-rasgo para niños (STAI-C)), intolerancia a la incertidumbre (escala de intolerancia a la incertidumbre para niños) y rasgo de rumiación (Escala de estilo de respuesta en niños) en T1 y se creó una puntuación z ponderada. Para evaluar los síntomas de ansiedad, estrés postraumático (PTS) y depresión en reacción al COVID-19, los participantes completaron la subescala de estado de STAI-C, la escala de impacto de eventos para niños revisada, y el inventario de depresión infantil en T1–T4. Se ejecutaron tres modelos lineales generales con sexo, grupo de edad (9–11 y 12+ años) y SECS como predictores.

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关键词

COVID-19; 青年; 焦虑; 创伤后应激; 抑郁; 社会情感脆弱性

HIGHLIGHTS

- This longitudinal study conducted in Quebec, Canada shows that healthy youth endorsing elevated socio-emotional vulnerability, as assessed by a composite score, report greater post-traumatic stress and anxiety symptoms, but not depressive symptoms in response to the COVID-19 pandemic.
- The study also reveals that girls and adolescents present greater symptomatology as opposed to boys and younger children.

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Supplemental data for this article can be accessed here.

Resultados: Los análisis revelaron una interacción entre el tiempo y la puntuación socioemocional compuesta (SECS), donde un SECS más alto predice síntomas de ansiedad elevados en T1 y T4, y síntomas elevados de PTS (Estrés post traumático) en T1 y T2.
Conclusión: Estos resultados sugieren que la juventud sana que presenten altos niveles de vulnerabilidad socioemocional a la psicopatología, tiene un mayor riesgo desufrir de ansiedad y síndrome de estrés postraumático, pero no síntomas depresivos, en el año siguiente a un evento estresante mayor.

一项COVID-19 期间儿童心理困扰的纵向调查:社会情感脆弱性的作用

背景: 尽管 COVID-19 疫情增加了青年精神痛苦的发生率, 一些儿童表现出更强的心理韧性, 这强调需要更好地了解青年精神痛苦的预测因素。
目的: 本纵向研究旨在评估已知的应激相关精神病理学的社会情绪预测因素, 即焦虑敏感性, 焦虑特征, 对不确定性的不容忍和反刍, 对健康青年COVID 相关困扰的综合影响。
方法: 重新联系了 92 对之前参加过 2017 年至 2019 年 (T0) 期间家庭中观察性恐惧学习评估实验室实验的亲子二人组。 84 名 9 至 14 岁的儿童同意参加。他们在2020年6月 (T1), 2020年9月 (T2), 2020年12月 (T3) 和2021年3月 (T4) 完成了在线问卷调查。参与者在 T0 和 T1 时没有精神疾病。为了创建一个社会情绪综合评分 (SECS), 我们测量了 T0 时的焦虑敏感性 (儿童焦虑敏感性指数), 特质焦虑 (儿童状态-特质焦虑量表 (STAI-C) 特质分量表), 对不确定性的不容忍 (儿童不确定性不容忍量表) 和 T1 的特质反刍 (儿童反应风格量表), 并创建了一个加权 z 分数。为了评估对 COVID-19 的焦虑, 创伤后应激 (PTS) 和抑郁症状, 参与者在T1–T4时完成了 STAI-C 状态分量表, 儿童修订版事件影响量表和时的儿童抑郁量表。以性别, 年龄组 (9–11 岁和 12 岁以上) 和 SECS 作为预测变量运行了三个一般线性模型。
结果: 分析揭示了 SECS*Time 相互作用, 较高的 SECS 预测 T1 和 T4 时焦虑症状升高, 以及 T1 和 T2 时 PTS 症状升高。
结论: 这些结果表明, 在主要应激源后一年内, 患有对精神病高度社会情感脆弱性, 患焦虑和 PTS 的风险更高, 但没有抑郁症状的风险。

1. Introduction

Sanitary crises such as the coronavirus disease 2019 (COVID-19) can cause increased levels of distress in the entire community, including youth. Like many other countries, Canada implemented strict sanitary measures to control for the transmission of the virus. Consequently, in March 2020, the province of Quebec was put into generalized quarantine, where children and adolescents were home schooled until the end of the school year (June 2020),[1] when sanitary restrictions had been lessened. In September 2020, children went back to school and a second COVID-19 wave hit the province of Quebec at the end of the month. The latter persisted over time, preventing families from gathering during the holiday period in December 2020. From January until May 2021, a strict curfew was imposed. In March 2021, the third wave began and lasted until the end of April 2021. During this prolonged period that lasted over a year, children's routines have been greatly disrupted, not only at the school level but also in terms of extracurricular, physical, and social activities (Courtney, Watson, Battaglia, Mulsant, & Szatmari, 2020). Children and adolescents were in stable class groups (i.e. always with the same classmates) and had to remain 2 metres apart from teachers and children that were not in their class group. From the age of 10, children were required to wear a procedural mask at all times at school. Although effective at controlling the spread of the disease, increased levels of distress in children and adolescents were reported following this major life event in Western countries (Brown, Doom, Lechuga-Peña, Watamura, & Koppels, 2020; Cost et al., 2021; Courtney et al., 2020; Fitzpatrick, Harris, & Drawve, 2020; Marques de Miranda, da Silva Athanasio, Sena Oliveira, & Simoes-e-Silva, 2020), Europe (Orgilés et al., 2021; Orgilés, Morales, Delvecchio, Mazzeschi, & Espada, 2020; Orsini et al., 2021), and China (Duan et al., 2020; Guo et al., 2020; Hou, Mao, Dong, Cai, & Deng, 2020; Xie et al., 2020). Notably, when compared to pre-pandemic statistics, increased levels of self-reported anxiety, depressive (Cost et al., 2021; Courtney et al., 2020; Duan et al., 2020; Marques de Miranda et al., 2020; Xie et al., 2020), and post-traumatic stress (PTS) symptoms (Orgilés et al., 2020, 2021; Orsini et al., 2021) were found. One Chinese study also reported an increase in the prevalence of clinical anxiety and major depression in children and adolescents in the aftermath of the pandemic (Xie et al., 2020). Still, socio-demographic factors such as sex and age seem to moderate the effects of the pandemic on distress, with adolescent girls being at an increased risk of suffering from clinical anxiety and major depression as opposed to adolescent boys and younger children (for a meta-analysis, see Ma et al., 2021). This finding is consistent with pre-pandemic studies demonstrating that adolescent girls are highly vulnerable to develop a mental health disorder following exposition to chronic stress and/or traumatic events (for a review, see Beesdo, Knappe, & Pine, 2009).

Still, according to a large cross-sectional study that assessed the effect of the pandemic on six mental health domains (depression, anxiety, irritability, attention, hyperactivity, and obsessions/compulsions) in youth, the effects of COVID-19 on mental health are quite variable (Cost et al., 2021). Indeed, while around 70% of

their sample showed a decline in at least one mental health domain, 19 to 31% of youth showed an *improvement* in at least one domain (Cost et al., 2021). Such variability in terms of the impact of COVID-19 on youth's mental health emphasizes the need to better understand the vulnerability and protective factors contributing to one's symptomatology when facing adversity.

Among the risk factors for psychological distress that have been studied in the past decades, four personality traits have received particular scientific attention. First is anxiety sensitivity, which is defined as the fear that anxious symptoms (somatic, cognitive, and social) will have adverse consequences such as causing illness or increasing anxiety (Naragon-Gainey, 2010). Second is trait anxiety, which refers to the general tendency to anticipate stressful situations as well as their potentially harmful impact (Hishinuma et al., 2001). Third is intolerance to uncertainty, which is a tendency to find it unacceptable that the possibility of a negative, stressful, or aversive event may occur, regardless of its probability (Boswell, Thompson-Hollands, Farchione, & Barlow, 2013). Finally, there is the tendency to ruminate characterized by intrusive and recurrent thoughts related to negative events (Sorg, Vögele, Furka, & Meyer, 2012). Cross-sectional studies have shown that, taken individually, these four socio-emotional predictors play a role in the development, chronicity, and/or severity of clinical anxiety (Aktar, Nikolić, & Bögels, 2017; Alkozei, Cooper, & Creswell, 2014; Allan, Capron, Raines, & Schmidt, 2014; Cowie, Clementi, & Alfano, 2018; Hishinuma et al., 2001; McLaughlin, Stewart, & Taylor, 2007; Read, Comer, & Kendall, 2013), post-traumatic stress disorder (PTSD; Hensley & Varela, 2008; Kılıç, Kılıç, & Yılmaz, 2008; Moulds, Bisby, Wild, & Bryant, 2020) and major depressive disorder (Allan et al., 2014; Cox, Enns, & Taylor, 2001; Hong, Lee, Tsai, & Tan, 2017; Taylor, Koch, Woody, & McLean, 1996; Weems, Hammond-Laurence, Silverman, & Ferguson, 1997) in children and adolescents in clinical samples. Additionally, these manifestations could serve to inform about the mechanisms that confer a greater vulnerability to women for stress-related disorders, as studies have shown that they are expressed more strongly in adult women compared to adult men. However, no studies have assessed this question in youth samples (Asher, Asnaani, & Aderka, 2017; Carleton et al., 2012; Johnson & Whisman, 2013; Kelly, Tyrka, Price, & Carpenter, 2008). Although studies tend to assess the individual predictive value of these four socio-emotional factors on distress, research shows that they may cumulate in the prediction of distress in children and adolescents (Boelen, Vrinssen, & van Tulder, 2010; Cox et al., 2001; Hensley & Varela, 2008; Muris, Schmidt, Merckelbach, & Schouten, 2001). The integration of these predictors could be informative about the overall contribution of socio-emotional vulnerability that might prompt the emergence of distress in youth in times of adversity. Importantly, the temporality of the association between these four socio-emotional vulnerability factors and distress remains unclear given the lack of longitudinal studies.

This study aimed to better understand the effects of socio-emotional vulnerability (assessed via personality traits measured before the pandemic or at its early stage), sex and age on anxiety, PTS and depressive symptomatology in healthy youth over a one-year period. As anxiety sensitivity, trait anxiety, intolerance to uncertainty, and rumination are known to affect anxiety, PTS, and depressive symptoms, we aimed to better understand their combined impact on distress by calculating a socio-emotional vulnerability index that incorporates these four trait measures.

2. Material and methods

2.1. Participants

Participants were recruited for this study subsequent to their participation in one of our laboratory-based experiments that occurred between 2017 and 2019, and that aimed to study observational fear learning within families (for further details on the purpose of the study, methods used, and obtained results, see Marin et al., 2020). For this laboratory-based experiment, parent–child dyads were recruited through announcements on social media and posters in the surroundings of the research centre. Amongst the parents of the 92 children that were contacted, 84 (91.3%) agreed to participate in this longitudinal follow-up. Eighty-four healthy children (42 girls) aged between 9 and 14 accepted to take part in this longitudinal study. Table 1 shows the repartition of the participants across the four timepoints of the study. Written informed consent was obtained from the primary caregiver in June 2020. In September 2020, 30 children were in elementary school (9–11 years old) and 46 were in high school (12+ years old). Participants were free of physical and mental health conditions at T0 (between 2017 and 2019) and T1. Two children reported being exposed to a potentially traumatic event apart from COVID-19 between T0 and T1, although none of them received a PTSD diagnosis. Given that the exclusion of these two participants from the analyses did not change the results, they were included in the final analyses.

Table 1. Number of participants as a function of sex (for each timepoint) and age group.

	Boys	Girls	Total	% from original study
T0	46	46	92	100
T1	42	42	84	91.3
T2	38	38	76	82.6
T3	28	34	62	67.4
T4	36	39	75	81.5
Age group				
9–11 y/o	19	21	30	
12+ y/o	24	21	46	

Y/O: years old.

2.2. Measures

2.2.1. Childhood Anxiety Sensitivity Index (CASI)

In order to obtain a self-report measure of anxiety sensitivity, the French version of the CASI (Stassart & Etienne, 2014) was completed by the child. This validated questionnaire for children includes 18 items answered on a 3-point scale. The total scores range from 18 to 54. The validated French version of the CASI has an internal consistency of 0.82 (Stassart & Etienne, 2014).

2.2.2. State-Trait Anxiety Inventory for Children (STAIC)

The French version of the STAIC (Turgeon & Chartrand, 2003) is a self-report inventory used to assess anxiety in children. Based on the adult form of the instrument (STAI; Spielberger, 1983), the STAI-C consists of two scales of 20 items each: a State scale (STAIC-S), which measures transient anxiety reactions to particular situations, and a Trait scale (STAIC-T), which measures a stable predisposition to react anxiously to any situation. These two scales of the questionnaire allowed for the assessment of children's trait anxiety (STAIC-T) and anxiety symptomatology in reaction to COVID-19 (STAIC-S). Each item is answered on a 3-point scale. The total scores on each scale range from 20 to 60. STAIC-S scores are commonly classified as 'no or low anxiety' (20–37), 'moderate anxiety' (38–44), and 'high anxiety' (45–60). The validated French version of the STAIC showed good internal consistency, i.e. 0.77 for the state scale and 0.82 for the trait scale (Turgeon & Chartrand, 2003).

2.2.3. Intolerance of Uncertainty Scale for Children (IUSC)

The IUSC (Comer et al., 2009) assesses children's tendency to react negatively emotionally, cognitively, and behaviourally to uncertain situations and events. For each item, children were asked to indicate how well the 27 statements described them on a scale of 1 to 5. The overall scores range from 27 to 135. The psychometric indices for the original version demonstrate good validity of the IUSC (internal consistency of 0.92). The original IUSC was translated into French using a double-blind translation technique by members of our team.

2.2.4. Children's Response Styles Scale (CRSS)

The CRSS (Ziegert & Kistner, 2002) is a 20-item self-report questionnaire that measures the tendency to ruminate and the tendency to seek distraction in response to feelings of sadness in children. For the purpose of these analyses, the rumination subscale was used. The rumination subscale (10 items) represents thoughts and behaviours that maintain a focus on emotions. Items are rated on a five-point Likert scale and scores range from 10 to 50. The validated French version showed excellent internal consistency for each of the factors, ranging from 0.78 to 0.85 (Le Van et al., 2021).

2.2.5. Children's Revised Impact of Event Scale (CRIES)

The Children's Revised Impact of Event Scale (CRIES; Perrin, Meiser-Stedman, & Smith, 2005) has 13 items answered on a 4-point Likert scale. It was developed from the adult version of the Impact of Event Scale – Revised. The items measure the frequency of post-traumatic stress symptoms () following a potentially traumatic event. The total scores range from 0 to 65. The validity indices are good ($\alpha = 0.80$; (Perrin et al., 2005). Using a cut-off score of 30, the scale has been found to be effective at discriminating PTSD cases from groups of trauma exposed children (Perrin et al., 2005). The original version of the questionnaire which was translated into French using a double-blind translation technique by members of the Quebec National Institute of Public Health was administered to the participants.

2.2.6. Children's Depression Inventory (CDI)

The French version of the CDI (Saint-Laurent, 1990) is a 27-item questionnaire examining depression symptomatology. Each item has three response options indicating either 0 (no symptomatology), 1 (mild symptomatology), or 2 (severe symptomatology). Half of the items begin with the option that reflects higher symptom severity, and for the remaining items, the presentation sequence is reversed. The total scores range from 0 to 54 points. The cut-off scores for the CDI are 15 for mild, 20 for moderate, and 25 for severe depression. The validated French version of the CDI has an internal consistency of 0.92 (Saint-Laurent, 1990).

2.3. Questionnaire completion

Participants completed the French versions of these questionnaires via Qualtrics, an online based and highly secure platform. To access the platform, a personalized URL link was sent to each participant via email at each study timepoint.

2.4. General protocol

Participants were recruited for this study subsequent to their participation in one of our laboratory-based experiments that occurred between 2017 and 2019 (T0). Subsequent to the confinement measures implemented in response to COVID-19 in March 2020 in Quebec, participants were contacted to take part in this longitudinal study. The latter assessed distress symptoms at four 3-month interval timepoints: June 2020 (T1), September 2020, (T2), December 2020 (T3), and March 2021 (T4); (see Figure 1 for timeline overview). At T0, children completed the CASI. At T1, they completed the STAIC-T, IUSC, and CRSS to assess

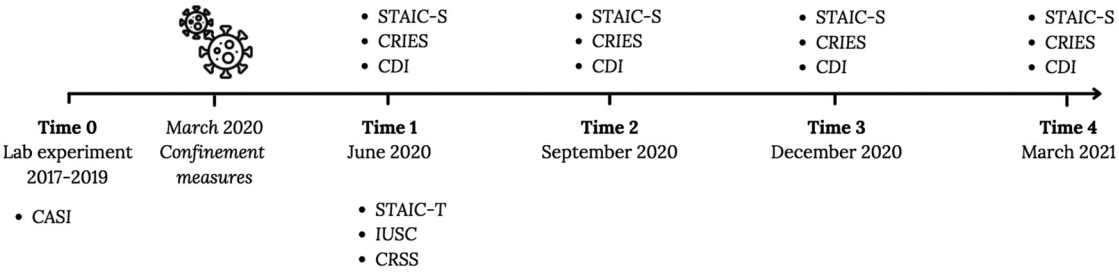

Figure 1. Timeline overview. CASI: Childhood Anxiety Sensitivity Index; CDI: Children's Depression Inventory; CRIES: Children's Revised Impact of Event Scale; CRSS: Children's Response Styles Scale; IUSC: Intolerance of Uncertainty Scale for Children; STAI-C: State-Trait Anxiety Inventory for Children (S: State; T: Trait).

socio-emotional factors. The STAIC-S, CRIES, and CDI were completed four times by the children in the sample (T1 through T4).

2.5. Statistical analyses

Analyses were run using IBM SPSS Statistics, version 26. Data were examined and standardized data (Z scores) below −3.29 or above 3.29 (thresholds based on Tabachnick & Fidell, 2007) were considered outliers and thus, winsorized. The winsorization process allows to minimize the influence of outliers by replacing the extreme values by the maximum and/or minimum values at the established thresholds (Tabachnick & Fidell, 2007). Only one participant exhibited an extreme score on the STAIC-S. This participant scored above average at T3. Two participants had extreme (above average) scores on the CDI, one at T1 and one at T3. In line with ethical considerations, these participants as well as the ones who had a score of 19 or more on the CDI (criteria for mild depression; Bang, Park, & Kim, 2015) were contacted by a study staff member and provided with psychological resources. Finally, two participants exhibited extreme (above average) scores on the CRIES, one at T1 and the other at T4. Winsorized data can be found in Table 2, Table 3. Analyses were run twice: once including the winsorized values and once excluding them. As no difference was found between the two sets of analyses, winsorized data were included in the final analyses.

The distribution of our variables was also assessed for skewness and kurtosis prior to conducting the statistical analyses. Using indices for acceptable limits of ±2, data were found to be normally distributed. Therefore, no transformation was applied to the raw values.

In order to determine if a systematic bias might have caused the attrition between T0 and T1, we verified whether participants who agreed to participate to this COVID follow-up (N = 84) and those who did not (N = 8) differed on their CASI scores, age at T0 and sex. We found no statistical difference on CASI scores [$t(90) = 1.099$, $p = .596$], age [$t(90) = 1.720$, $p = .971$] or sex [X^2 (1, N = 92) = 4.577, $p = .101$].

2.5.1. Initial treatment of the data

2.5.1.1. Socio-emotional composite score. In order to create a socio-emotional composite score (as used by Marin, Hammoud, Klumpp, Simon, & Milad, 2020), z-scores were generated for each of the following questionnaires: CASI, STAIC-T, IUSC, and CRSS and were then averaged for each participant, providing a weighted score, and is referred to as the *socio-emotional composite score* (SECS).

2.5.1.2. Age group. We categorized children as a function of their age at T2 in order to create a categorical variable: '9–11' versus '12+ years old'. We made this decision given that it also allowed us to consider each child's pubertal status (where puberty occurs at around 12 years old; Rosenfield et al., 2000), as well as whether or not they transitioned from elementary (Grade 1 to 6; 7 to 11 years old) to high school (Grade 7 to 11; 12 to 17 years) during the pandemic, which may have affected their distress levels (Goldstein, Boxer, & Rudolph, 2015). At T2, children in the 9–11 year old age group were in elementary school and all 12+ years old children were in high school.

2.5.2. Main analyses

Thereafter, we conducted three linear mixed models in order to predict changes in the STAIC-S, CRIES, and CDI. One advantage of linear mixed models over repeated measurements ANOVAs it that they allow dealing with missing data by using all available data through the different timepoints using maximum likelihood estimation. Restricted maximum likelihood (REML) was applied as it allows for robust analysis with skewed variables (Banks et al., 1985). 'Subjects' were considered as a random effect. Time (four levels: T1–T4), sex (two levels: boys, girls), age (two levels: 9–11 years old, 12+ years old), the SECS as well as the interaction terms between Time*Sex, Time*Age, and Time*SECS were entered as predictors. Between-subjects and within-subjects post-hoc comparisons were performed using Sidak's multiple comparisons test.

Table 2. Correlation matrix of the socio-emotional predictors.

	Anxiety sensitivity	Trait anxiety	Intolerance to uncertainty	Rumination
Anxiety sensitivity	-	-	-	-
Trait anxiety	.214 (.053)	-	-	-
Intolerance to uncertainty	.161 (.148)	.586 (<.001)*	-	-
Rumination	.196 (.088)	.339 (.003)*	.259 (.023)*	-

The table describes the correlations among the different socio-emotional predictors included in the weighted SECS. r (*p* values). *Indicates statistical significance set at $p < .05$.

Table 3. Distress as a function of time.

	Min	Max	Mean	SD	*N* > clinical threshold
Anxiety					
T1	21	44	29.52	.51	4
T2	20	44	28.73	.55	4
T3	20	43	28.64	.65	3
T4	20	48	30.00	.63	4
PTS					
T1	0	36	12.70	1.03	5
T2	0	41	12.73	1.11	5
T3	0	42	11.98	1.15	3
T4	0	51	14.51	1.10	5
Depressive					
T1	0	25	7.77	.59	3
T2	0	21	6.81	.51	1
T3	0	21	7.56	.74	3
T4	0	25	8.68	.75	8

Minimum (min), maximum (max), mean, and standard deviation (SD) values for anxiety, PTS, and depressive symptomatology for the four study timepoints. Maximum values for PTS and depressive symptoms were winsorized. Anxiety symptoms were assessed using the STAIC-S, post-traumatic stress (PTS) symptoms through the CRIES, and depressive symptoms using the CDI. To quantify the number of individuals scoring above the clinical threshold, participants' scores were compared to the clinical threshold score of the respective scale.

3. Results

3.1. Preliminary analyses

Table 2 shows the correlations among the socio-emotional predictors that were assessed: anxiety sensitivity (CASI), trait anxiety (STAIC-T), intolerance to uncertainty (IUSC), and rumination (CRSS).

SECS (mean z-scores) varied between −1.5081 and 1.7391 (M = 0.0085, SD = 0.0739) in our sample. Descriptive statistics for anxiety, PTS, and depressive symptoms as a function of the four study timepoints are presented in Table 3.

Table 4. General linear model results for anxiety symptoms.

	Numerator *df*	Denominator *df*	F	*p*
Main effects				
Time	3	64.41	4.794*	.004
Sex	1	68.96	.823	.367
Age	1	68.85	1.003	.188
SECS	1	68.78	3.772	.056
Interactions				
Time x Sex	3	64.18	1.003	.397
Time x Age	3	64.09	3.960*	.012
Time x SECS	3	64.57	3.570*	.014

SECS: socio-emotional composite score. *Indicates statistical significance set at $p < .05$.

3.2. Main analyses

3.2.1. Anxiety symptoms

For anxiety symptoms (Table 4), the analysis yielded a main effect of Time, but no main effect of SECS or Sex (Figure 2(a)) or Age ($p < .188$). We also found a Time*Age interaction [F(3,64.09) = 3.960; $p = .012$] (Figure 2(b)), explained by a time effect [F(3,62.99) = 5.520; $p = .002$] observed in younger children who showed higher anxiety symptoms at T1 relative to T2 ($p = .003$) and to T3 at a trend level ($p = .06$). No time effect was found for the older children [F(3,64.40) = 1.945; $p = .131$]. Relative to older children, those aged 9 to 11 years old presented significantly lower levels of anxiety at T2 ($p = .07$), T3 ($p = .045$), and T4 ($p = .04$), but not at T1 ($p = .923$). Finally, we found a significant Time*SECS interaction ($p = .014$). Post-hoc tests revealed a time effect for children scoring high on SECS (+1SD) [F(3,63.07) = 7.708; $p < .001$], as they reported higher anxiety symptoms at T1 relative to T2 ($p = .004$) and T3 ($p = .046$), and higher symptoms at T2 compared to T4 ($p = .04$). No time effect was found in children exhibiting

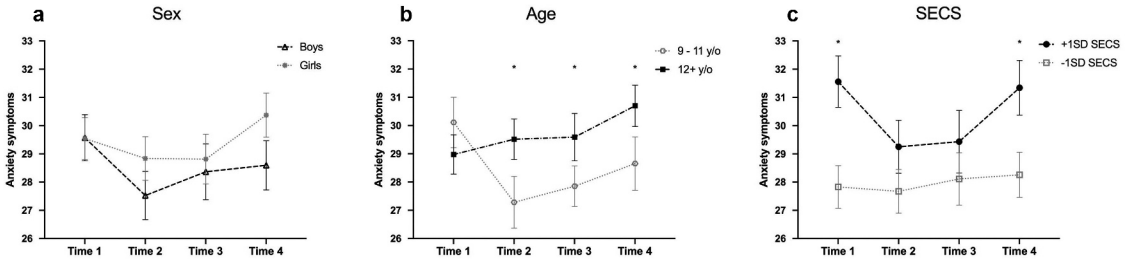

Figure 2. Anxiety symptoms as a function of sex (a), age (b), and SECS (c). Anxiety symptoms as assessed by the STAIC-S. Means are adjusted for sex, age, and SECS. SECS of 1SD below and above the mean are presented on panel C. Error bars represent the standard error of the mean. SECS; socio-emotional composite score. *Indicates statistical significance set at $p < .05$.

lower SECS (−1SD) [F(3,64.97) = .216; p = .885]. Coefficients associated with the SECS were extracted from the model at each timepoint. A β of 2.66 (p = .002) was found at T1, a β of 1.73 (p = .051) at T4, with increased z-scores predicting increased anxiety symptoms. β indices were nonsignificant at T2 (p = .555) and T3 (p = .509; Figure 2(c)).

3.2.2. Post-traumatic stress symptoms

For PTS symptoms (Table 5), the analysis revealed a marginal effect of Sex and a main effect of SECS, but no main effect of Time or Age. We also found a Time*Sex interaction, with the Time effect being significant in girls [F(3,62.11) = 4.311; p = .008], but not in boys [F(3,62.77) = .783; p = .508]. In girls, PTS symptoms were significantly higher at T4 as opposed to T3 (p = .008). Between sex comparisons showed that boys and girls only differed in PTS symptoms at T4 [F(1,69) = 12.288; p = .001] (Figure 3(a)). A Time*Age interaction (p = .004) was found, with the Time effect being significant in older children [F(3,63.29) = 3.678; p = .017], but only trending towards statistical significance in the group of younger children [F(3,61.81) = 3.678; p = .059]. In the '12+ years old' group, post-hoc tests revealed that the PTS symptoms at T4 were significantly higher as opposed to T1 (p = .028) and T2 (p = .040). In the '9–11 years old' group, PTSS at T1 tended to be higher compared to T3 (p = .06). Compared to the older children, children aged 9–11 years old presented higher PTS symptoms at T1 (p = .030). However at T4, they presented significantly lower PTS symptoms compared to 12+ years old children (p = .004; Figure 3(b)). Finally, we found a Time*SECS interaction (p = .035). Post-hoc analyses revealed a time effect for children having higher SECS (+1SD) [F(3,62.1) = 2.611; p = .05], where they showed increased PTS symptoms at T1 as opposed to T3 (p = .046). No effect of Time was found in children scoring low (−1SD) on the SECS [F(3,63.61) = 1.558; p = .208]. Coefficients associated with the SECS were extracted from the model at each timepoint. A β of 6.12 (p < .001) was found at T1, a β of 4.24 (p = .019) at T2, with higher SECS predicting higher PTS symptoms. β indices were nonsignificant at T3 (p = .570) and T4 (p = .305; Figure 3(c)).

Table 5. General linear model results for post-traumatic stress symptoms.

	Numerator *df*	Denominator *df*	F	*p*
Main effects				
Time	3	65.63	1.180*	.017
Sex	1	65.79	3.968	.051
Age	1	65.68	.054	.817
SECS	1	65.60	6.049*	.017
Interactions				
Time x Sex	3	65.30	3.756*	.019
Time x Age	3	65.20	4.850*	.004
Time x SECS	3	65.20	3.030*	.035

SECS: socio-emotional composite score. *Indicates statistical significance set at p < .05.

3.2.3. Depressive symptoms

For depressive symptoms (Table 6, Figure 4), the analyses revealed a main effect of Time and a marginal effect of Age, with older children presenting higher depressive symptoms at T2 (p = .007) and T3 (p = .045) as opposed to children aged 9–11 years old. However, no main effect of Sex or SECS were found. We also found a marginal Time*Sex interaction, with boys [F(3,32.75) = 6.446; p = .001] and girls [F(3,37.02) = 6.446; p = .052] presenting a Time effect. In boys, T2 significantly differed from T3 (p = .022) and T4 (p = .05). However, in girls, post-hoc tests did not reveal any difference between each timepoint (ps > .103). Boys presented significantly greater depressive symptoms at T2 as opposed to girls (p = .007). No Time*Age (p = .090) or Time*SECS (p = .871) interactions were found.

4. Discussion

This longitudinal study, which began before the arrival of COVID-19 in Quebec (Canada) and lasted for a year throughout the pandemic, aimed to assess the combined impact of socio-emotional vulnerability to psychopathology on COVID-associated distress in

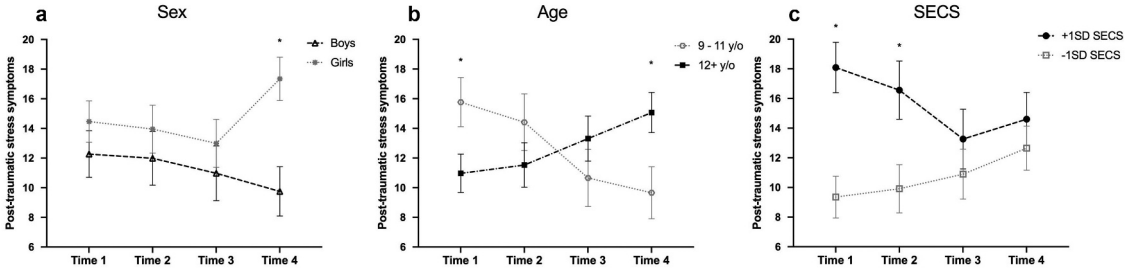

Figure 3. Post-traumatic stress (PTS) symptoms as a function of sex (a), age (b), and SECS (c). PTSS as assessed by the Children's Revised Impact of Event Scale (CRIES). Means are adjusted for sex, age, and SECS. Error bars represent the standard error of the mean. SECS of 1SD below and above the mean are presented on panel C. SECS; socio-emotional composite score; PTSS: post-traumatic stress symptoms. *Indicates statistical significance set at p < .05.

Table 6. General linear model results for depressive symptoms.

	Numerator *df*	Denominator *df*	F	*p*
Main effects				
Time	3	67.23	7.660*	<.001
Sex	1	68.814	1.360	.248
Age	1	68.721	3.811	.055
SECS	1	68.617	1.919	.170
Interactions				
Time × Sex	3	67.06	1.360	.052
Time × Age	3	66.97	2.262	.090
Time × SECS	3	67.37	.235	.871

SECS: socio-emotional composite score. *Indicates statistical significance set at $p < .05$.

healthy youth. It also intended to better understand the effects of sex and age in the prediction of distress.

First, we found that socio-emotional vulnerability, as estimated by a composite score (referred to as SECS), predicted anxiety and post-traumatic stress symptoms (PTSS) evolution in youth. Specifically, in the early phase of the pandemic (T1: June 2020), children scoring high on SECS presented greater anxiety and PTSS. Also, when youth went back to school after staying at home for 6 months (T2: September 2020), children scoring high on SECS presented an increase in PTSS. Given that novel, unpredictable, threatening to the self, and/or uncontrollable situations additively contribute to the stress response (Dickerson & Kemeny, 2004; Mason, 1968), it is possible to believe that youth showing increased socio-emotional vulnerability exhibited greater anxiety at the beginning of the confinement measures. Similarly, in vulnerable children, the stressful nature of the situation may have prompted behavioural (e.g. avoidance, withdrawal), cognitive (e.g. thought suppression), and emotional (e.g. anger, irritability) responses that were assessed by the CRIES. In the same vein, one study showed an increase in anxiety and PTSD diagnoses in youth one month after the confinement measures were applied in January 2020 in China (Duan et al., 2020). In our study, children scoring high on SECS had higher anxiety symptoms not only in the immediate aftermath of the first confinement period (T1), but also one year later (T4; March 2021). Two potential explanations could account for this result. First, at T4, the third COVID-19 wave was affecting the province of Quebec and may have triggered a state of anticipation amongst vulnerable youth as to whether a potential complete reconfinement would occur and in turn, may have prompted anxiety symptoms. Indeed, school attendance can represent an important source of social support for many children (Bokhorst, Sumter, & Westenberg, 2010), not only in terms of relationships with their peers, but also with their teachers and school staff. Second, these results could also be explained by a chronification of anxiety symptoms in youth presenting increased socio-emotional vunerability to psychopathology.

Therefore, our results support the idea that socio-emotional vulnerability influenced the evolution of anxiety and PTS symptomatology among youth during the year that followed the beginning of the confinement measures in Quebec. Importantly, this novel study provides support to the idea that the accumulation of certain personality traits that were present before the pandemic (or at its early stages) are important predictors of consequential outcomes in healthy youth. This study is important as it is, to our knowledge, the first COVID-related mental health longitudinal study that intended to better understand the predictive value of vulnerability factors in healthy youth. Still, the question remains as to *how* socio-emotional vulnerability influences mental health in youth. As such, the biological stress system has received abundant scientific attention (Faravelli et al., 2012; Heim, Newport, Mletzko, Miller, & Nemeroff, 2008; Kempke et al., 2015; McGowan, 2013; Pariante & Lightman, 2008; Raymond, Marin, Juster, & Lupien, 2019). Indeed, one hypothesis is that when faced with adverse life events, children and adolescents presenting increased socio-emotional vulnerability might react by secreting increased cortisol levels (i.e. an important stress hormone in humans) which might contribute to psychiatric symptoms through dysregulation of various cognitive processes (for reviews, see Raymond, Marin, Majeur, & Lupien, 2018; Soliemanifar, Soleymanifar, & Afrisham, 2018). Indeed, cortisol reaches specific receptors located in brain regions that are necessary to regulate negative emotions

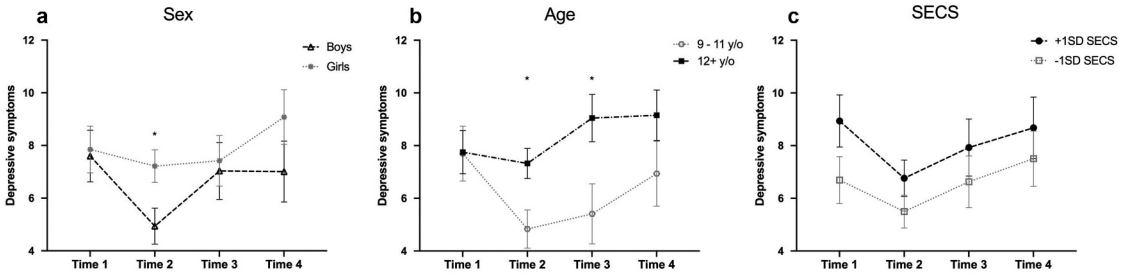

Figure 4. Depressive symptoms as a function of sex (a), age (b), and SECS (c). Depressive symptoms as assessed by the Children's Depression Inventory (CDI). Means are adjusted for sex, age, and SECS. Error bars represent the standard error of the mean. SECS of 1SD below and above the mean are presented on (c). SECS; socio-emotional composite score. *Indicates statistical significance set at $p < .05$.

(such as the prefrontal cortex, the amygdala and the hippocampus; Lupien, McEwen, Gunnar, & Heim, 2009). Of note, one recent study demonstrated that the first wave of the pandemic led to an increase in hair cortisol concentrations (a cumulative measure of cortisol levels) in adult nurses, suggesting that the pandemic affected physiological stress system activity in certain populations (Rajcani, Vytykacova, Solarikova, & Brezina, 2021). It would be important for future studies to assess the biological/hormonal responses in reaction to major events. This would allow for a better understanding of the mechanisms by which socio-emotional vulnerability modulates distress when youth face adverse events.

Interestingly, contrary to our hypotheses, socio-emotional vulnerability did not predict depressive symptoms at any timepoint. With that said, it is possible to believe that this result is attributable to the time-window during which depressive symptoms were assessed. From an evolutionary point of view, shortly after being exposed to a stressful life experience such as COVID-19, the human body mobilizes a significant amount of energy and cognitive resources in order to apprehend the threat (DeMorrow, 2018). In individuals presenting a cognitive, biological, or socio-emotional vulnerability to depression, a subsequent depletion of energy can be noted that is characterized by the onset of a depressive episode (transient or long-lasting; for a review on the subject, see Baldwin, Evans, Hirschfeld, & Kasper, 2002). Perhaps assessing depressive symptoms for a longer period of time would have yielded an effect of SECS on depressive symptoms in the long-run. Also, it is possible to believe that the inclusion of predictors that are more specific to depression (such as negative emotionality and introversion; Klein, Kotov, & Bufferd, 2011) would have revealed a personality effect on depressive symptomatology. Finally, although we could not test this hypothesis due to insufficient statistical power, another possibility is that SECS interacts with other vulnerability factors such as sex and/or age in the prediction of depressive symptoms.

Indeed, in the current study, we found that sex and age predicted the evolution of COVID-related distress in youth. As previously reported in cross-sectional studies investigating the impact of COVID-19 on mental health in youth (for a meta-analysis, see Ma et al., 2021), we found that girls and adolescents (12+ years old) were at an increased risk of suffering from elevated distress. As for biological sex, girls presented increased PTS symtoms one year into the pandemic (T4) and increased depressive symptoms when they went back to school (T2) when compared to boys. In terms of age, for anxiety and depressive symptoms, adolescents presented increased distress as opposed to younger children, a difference that also emerged at T2 when they went back to school and that persisted over time. On the other hand, for PTSS, adolescents presented a gradual increase in symptomatology and reached their highest levels at T4. These findings are consistent with studies published over the past decades showing that adolescence represents a vulnerable time window for the development of stress-related disorders in girls (for a review, see Beesdo et al., 2009). Indeed, in late childhood and early adolescence, there is a drastic increase in the diagnosis of stress-related disorders in young girls, with a median age of onset of 12 to 14 years old, depending on the disorder (for a review, see Beesdo et al., 2009). During adolescence, we also see the emergence of a strong sexual dimorphism where twice as many girls as boys suffer from stress-related disorders (for a review, see Bangasser & Valentino, 2014). Said sexual differences persist throughout development, with certain forms of psychopathologies being diagnosed three times more often in adult women as opposed to men (Bangasser & Valentino, 2014). Many biological (e.g. pubertal status, brain development phases) and social hypotheses have been proposed (Beesdo et al., 2009) in order to better understand the influence of sex and age on the development of exacerbated distress. Still, the lack of longitudinal studies that begin assessing children before they develop a stress-related disorder prevents the identification of a precise mechanism that might prompt the development of distress in teenage girls. In the current study, we suggest that exposition to a chronic stressor during this sensitive timewindow prompts the development of distress in adolescent girls and supports the idea that it is crucial to monitor this population closely in the context of COVID-19.

Importantly, our results suggest that younger children also suffered from the pandemic, especially in terms of PTSS. Indeed, in children aged 9 to 11 years old, we found increased symptoms of PTS at T1 compared with adolescents. However, as opposed to adolescents, PTS symptoms gradually decreased in children to reach their lowest levels at T4. These results could be interpreted with the notion of the parent-child dyadic synchrony theory (for a review, see Davis, West, Bilms, Morelen, & Suveg, 2018). Indeed, it may be that for younger children, parents' PTS symptoms at T1 influenced those of the child and that, conversely, the parents' ability to regulate their symptoms later on during the year helped with the regulation of their child's emotions. According to a recent study, during the early stages of the pandemic, higher rates of psychological distress in parents were associated with greater symptomatology in children (but not in adolescents), an association that was mediated by parent verbal hostility and child emotional problems (Marchetti et al., 2020). Other COVID-related cross-sectional studies also revealed that parent-child psychological distress associations were stronger in younger children as opposed to adolescents (Orgilés et al., 2020, 2021). It would be

interesting to assess whether parent-child synchrony also applies to physiological measures of stress by assessing cortisol concentrations of both parents and children, which would provide insight into the mechanism underlying intergenerational transmission of stress (Bowers & Yehuda, 2016).

Our study contains a number of limitations that should be addressed. First, although we did find that SECS was a significant predictor of distress in reaction to COVID-19 in youth, the clinical importance of these findings remains a lingering question. Indeed, for the most part, children and adolescents mean scores on STAI-C, CRIES, and CDI in our sample did not meet a clinical threshold. Indeed, as presented in the results section of this paper, only between 1 and 5% of our sample (depending on the measurement time) met the established clinical thresholds for the various symptoms of psychological distress that were assessed. Therefore, further studies must be conducted to better understand the factors contributing to the development of psychopathology following exposure to adverse events. Second, some may question whether SECS is an adequate predictor of distress, or whether it is more specific to anxiety as opposed to the other constructs examined in this study, i.e. depression and PTS symptoms. Though, as mentioned above, all constructs included in the SECS variable have been previously shown to be associated with anxiety (Aktar et al., 2017; Alkozei et al., 2014; Allan et al., 2014; Cowie et al., 2018; Hishinuma et al., 2001; McLaughlin et al., 2007; Read et al., 2013), posttraumatic (Hensley & Varela, 2008; Kılıç et al., 2008; Moulds et al., 2020), and depressive (Allan et al., 2014; Cox et al., 2001; Hong et al., 2017; Taylor et al., 1996; Weems et al., 1997) symptoms in children and adolescents. Research has shown that the development of different symptoms (i.e. anxiety, depressions, PTS) is time sensitive. For example, anxiety may develop before the emergence of major depression in adolescents (Beesdo et al., 2009). Taken together with the results of the current study, it would be interesting to further investigate the moderating role of socio-emotional vulnerability on the developmental course of distress. Further studies should investigate this important question. Third, another limitation to consider in these results is that three of the four predictors included in the composite score of socio-emotional vulnerability (anxiety trait, intolerance to uncertainty and rumination) were measured when the pandemic was already active in the province of Quebec. One may therefore wonder if the obtained results are due to a *pre-pandemic* socio-emotional vulnerability, or if the vulnerability score was amplified by the pandemic itself. However, as presented in Supplementary Analyses, anxiety sensitivity, which was measured at T0 (two to three years before the pandemic), alone modulates the evolution of anxiety and PTS symptoms during the pandemic. This further supports the idea that the main findings of the current study are indeed due (at least in part) to a vulnerability that was present before the pandemic. Fourth, our limited sample size did not allow for the verification of whether sex and age moderated the association between socio-emotional vulnerability and distress in youth. Also given our small sample size, we were unable to include potentially important covariates in our statistical models, such as perceived social support, socio-economic status, and employment status of the parent. It would also be interesting for future studies to verify whether the degree to which the pandemic affected the economic situation or family structure modulates the association between socio-emotional vulnerability and distress. Another limitation pertains to the use of self-administered questionnaires as it could bias the data. It would be important for future studies to replicate these results while including parental report of children's distress. To date however, most COVID-related studies have been cross-sectional. Although tremendously informative, these studies cannot inform us about the long-term effects of the pandemic on the mental health of youth. Therefore, the longitudinal nature of the present study represents an important strength. Another considerable strength of this paper is the recruitment of healthy children before the pandemic, making it possible to suggest directionality in the association between socio-emotional vulnerability and distress in young people. Our results also suggest the presence of distress in healthy children at the time of the pandemic and suggest the need to follow them in the long-run to have a better understanding of the factors that promote the development of psychopathologies.

For many children, COVID-19 has involved repeated exposure to adverse life events on multiple levels. Not only has their school environment been turned upside down, but also their socio-affective environments. Emergence of distress in childhood and adolescence is a significant predictor of chronicity and severity of stress-related disorders (Beesdo et al., 2009). Understanding the vulnerability and resiliency factors that promote (or prevent) the development of stress-related disorders in youth in the aftermath of the pandemic is therefore crucial in order to better target at risk children. This study provides insights into the long-term effects of socio-emotional vulnerability on distress in response to a major stressor in youth. Further studies are needed in order to better understand the complex pathway that leads to psychopathology following exposition to such unprecedent stressors.

Note

1. As of mid May 2020, the government of Quebec allowed children and adolescents from certain regions that were less affected by the pandemic to return to their classrooms (every other day for high-school students) on a voluntary basis. This measure excluded

all schools from the Greater Montreal area where the number of positive COVID-19 cases were high. All participants who took part in the current study were from the Greater Montreal area and therefore, did not return to school until September 2020.

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Data availability statement

The data that support the findings of this study are available from the corresponding author, [MFM], upon reasonable request. Data are not deposited in a community-recognized repository as participants had not provided informed consent to do so.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Ethics statement

The ethics committee of the *Research Centre of the Institut universitaire en santé mentale de Montréal* approved this study. Participants gave their assent, and their parents gave written informed consent.

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