ORIGINAL CONTRIBUTION

Longitudinal impact of psychosocial status on children's mental health in the context of COVID-19 pandemic restrictions

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Abstract

Emerging research suggests that the prevalence of child and adolescent mental health problems has increased considerably during the COVID-19 crisis. However, there have been few longitudinal studies on children's mental health issues according to their social determinants in this context, especially in Europe. Our aim was to investigate the association between family socioeconomic status (SES) and children' mental health during the period of school closure due to COVID-19. Longitudinal data came from 4575 children aged 8–9 years old in 2020 and participating in the ELFE population-based birth cohort that focuses on children's health, development and socialization. Parents completed the Strengths and Difficulties Questionnaire (SDQ) when children were (a) 5 years of age and (b) 9 years of age, which corresponded to the period of school closure due to the COVID-19 pandemic in France. We retrieved data from the ELFE cohort collected on children from birth to age 5 years (birth, 1 year, 2 years, 3,5 years and 5 years). Socioeconomic status (SES) was measured based on information obtained when the child was 5 years old. Data were analyzed using multinomial logistic regression models. Children's elevated levels of symptoms of Attention-deficit/Hyperactivity disorder (ADHD) during the period of school closure were significantly associated with prior low family SES (aOR 1.26, 95% CI 1.08–1.48). Children's elevated symptoms of hyperactivity/inattention and of emotional symptoms were associated with decline in income during the COVID crisis (respectively, aOR 1.38, 95% CI 1.16–1.63 and aOR 1.23, 95% CI 1.01–1.51). Moreover, when testing interactions, a low prior SES was significantly associated with a higher risk of emotional symptoms aOR 1.54 (1.07–2.21), only for children whose families experienced a decline in income, while gender, parental separation and prior mental health difficulties were not associated. This study underlines the impact of the financial crisis related to the COVID-19 epidemic on children's mental health. Both pre-existing family SES before lockdown and more proximal financial difficulties during the COVID crisis were negatively associated with children's psychological difficulties during the period of school closure. The pandemic appears to exacerbate mental health problems in deprived children whose families suffer from financial difficulties.

Keywords Child mental health · Epidemiology · COVID-19 · Socioeconomic inequality · France

Introduction

Since the beginning of the COVID-19 crisis, there has been a dramatic increase in mental health issues worldwide [1]. This burden has disproportionately impacted vulnerable populations, notably children and adolescents [2–12]. As is commonly observed, the epidemic has led to major socio-economic disparities in mental health, the poorest and less educated populations being the most exposed to a range of deleterious risk factors [13–15]. Recent studies emphasize this negative impact of social inequalities on children's mental health [13, 16]. Of note, the pandemic has caused an unprecedented financial crisis worldwide and pushed millions of families below the poverty line [17], exposing children and adolescents to high levels of psychological distress [13–15]. As found in a US study [15], further risk factors for

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mental health difficulties in children are hardship during the crisis, including caregiving burden, and parents' job loss and income reduction. Even in countries where the welfare state has intensively attempted to mitigate the economic impact of the COVID crisis (e.g. France, Germany), financial difficulties during the lockdown occurred and were related to worsened mental health in children [3, 18]. Moreover, protection measures such as lockdown, curfews and school closures have disproportionally affected families with prior low SES [17].

Despite the well-known association between low SES and children's mental health problems during [1–3] and outside [14, 19] the pandemic context, some issues remain elusive. Some studies showed the impact on children mental health of other risk factors such as parental separation, and the sex of the child [20]. First, most studies are cross-sectional and the impact of a pre-existing socioeconomic disadvantage on children's mental health during the COVID-19 has hardly been studied within a longitudinal framework [21]. Second, interactions between socioeconomic difficulties and risk factors, including sex of the child and parental separation, which have been shown to be linked with SES before the pandemic [14, 22] have not been considered. Understanding the consequences of the COVID-19 crisis on those vulnerable children already at risk of mental health problems is essential for rapidly developing policies and interventions to mitigate the mental health problems of vulnerable groups of children already living in a deprived socioeconomic environment [23].

The aim of our study was: (a) to assess the impact of prior low socioeconomic status (SES) on children's emotional and Attention-Deficit/Hyperactivity Disorder (ADHD) symptoms during the COVID-19 lockdown, taking into account current financial and prior mental health problems 4 years before, and (b) to investigate, in a subgroup of vulnerable children with pre-existing socioeconomic difficulties, which other social factors such as parental separation, sex or decline in income during the lockdown could exacerbate these mental health difficulties. (c) We also assessed the impact of pre-existing mental health disorders before the lockdown on the mental health during the lockdown, as well as the impact of financial insecurity.

Methods

Setting and study design

The SAPRIS ("SAnté, Perception, pratiques, Relations et Inégalités Sociales en population générale pendant la crise COVID-19") survey was set up to study the main epidemiological, social and behavioral challenges of the COVID-19 epidemic in France. More details on this project are available

elsewhere [24]. Briefly, SAPRIS is based on questionnaires sent to five large French cohorts, three of adults (Constances, E3N-E4N and NutriNet-Santé) and two of children (ELFE/EPIPAGE-2).

Sample

The ELFE study is an ongoing multidisciplinary [23–26], nationally representative birth cohort study, which originally included 18,329 infants (18,040 mothers) born in France in 2011. For this study, 4904 parents answered the questionnaires related to their children. This large loss of participants was probably due to the context of the COVID19 crisis. Among them, 329 children were excluded because of missing data. In total, we used data collected on 4575 children (Supplementary Fig. 1).

Data were reported by parents during school closures (from April 16 to May 4, 2020, and/or from May 5 to June 21, 2020) [24]. To study the link between social inequalities and children's mental health prior to the COVID-19 crisis, we retrieved data from the ELFE cohort collected on the child from birth to age 5 (birth, 1 year, 2 years, 3.5 years and 5.5 years).

Measures

Emotional and hyperactivity/inattention symptoms

Symptoms of hyperactivity/inattention and emotional symptoms were ascertained by two subscales of the Strengths and Difficulties Questionnaire (SDQ) [27, 28], a widely used measure of children's mental health which has satisfactory psychometric properties [29, 30]. These symptoms were collected at two key times. First, when the children were 5 years old. Second, during the first school closure in France, when the children were 8 to 9 years old. These symptoms were reported by parents on a 3-point scale (not true, somewhat true, and certainly true; ranges from 0 to 2) to indicate the extent to which each item applied to their children [18, 28]. The following items were used to assess symptoms of hyperactivity/inattention: "Restless, overactive, cannot stay still for long"; "Constantly fidgeting or squirming"; "Easily distracted, concentration wanders"; "Thinks things out before acting"; and "Sees tasks through to the end, good attention span". The five items used to assess the emotional symptoms were: "Complains of headache/stomachache"; "Many worries, often seems worried"; "Often unhappy, down-hearted or tearful"; "Nervous or clingy in new situations, easily loses confidence"; and "Many fears, easily scared". From the parents' responses to the five items of each subscale, we calculated scores that ranged from 0 to 10 with cut-offs of the French version of the SDQ [31]. Concerning hyperactivity/inattention, a score ≤ 5 is considered normal, equal to 6 as borderline state, and > 6 as abnormal. For

emotional symptoms, a score ≤3 is considered normal, equal to 4 as borderline state, and >4 as abnormal.

Socioeconomic characteristics

We were interested in two aspects of families' socioeconomic characteristics: prior socioeconomic status (SES) and decline in parental income during the COVID 19 school closure.

(a) Prior SES (very low and low vs. high and very high) was built from three sub-dimensions [31]:

- *The level of education* of each parent at 5 years old (0. Secondary education ≤ high school level, 1. First-cycle higher education (Grade 12 + 2), 2. Higher education (> Grade 12 + 2)). We retrieved the information from previous questionnaires (questionnaire at 3 years, 2 years, 1 year, 2 months, at birth) in the event of missing data.
- *Occupational grade* of parents at 5 years old (6. Executive, 5. Intermediate executive, 4. Self-employed worker, 3. Employee, 2. Laborer, 1.Unemployed)
- *Household income* at 5 years old.

If information concerning both the mother's and the father's education level was available, these were averaged. Otherwise, only the mother's or father's education level was considered. Next, the scores on the three dimensions were centered and reduced. A global score of SES was calculated, as in another national longitudinal survey [31]. This was defined as the average of the scores of the three centered and reduced sub-dimensions. If information for one of the dimensions was missing, it was not considered in the calculation of the global SES score, and we imputed by the mean of the available dimension. This overall SES score was centered and then reduced. Finally, we built the categorical variable SES with four modalities: very low ($x <$ 1st quartile), low (1st quartile $< = x <$ Median), high (median $< = x <$ 3rd quartile) and very high ($x \geq$ 3rd quartile).

(b) We also gathered data on the financial situation during COVID-19 school closure (declining vs constant income) as perceived by the parents during the first lockdown in France.

Covariates

Several covariates measured during the period of school closure were taken into account such as children's sex (female vs. male), family structure (child living with both parents: yes vs no), children's sleeping difficulties (yes vs no). We also adjusted on children's emotional or hyperactivity/inattention symptoms (abnormal vs normal) at 5 years old.

Procedure

Ethical approval and informed consent were obtained from each participant before enrolment in the ELFE cohort. The SAPRIS survey was approved by the Inserm ethics committee (approval #20-672 dated March 30, 2020) [24].

Statistical analyses

First, observations with missing data on both study outcomes (symptoms of hyperactivity/inattention and emotional difficulties) and for our main variable of interest, SES at 5 years old, were removed.

Then, we described children's and family's sociodemographic characteristics, (i.e., frequency with percentages for categorical variables and means and standard deviation for quantitative variables).

We used Classification and Regression Tree methods (CART, imputation method for mixed data: both Continuous and Categorical) to account for missing data [32].

In addition, we tested the association between variables such as prior SES, declining income during COVID-19 and children's mental health (i.e., hyperactivity/inattention and emotional symptoms during school closure) using binary logistic regressions unadjusted and adjusted to estimate odds ratios (OR) and 95% confidence intervals (CI). We also compared participants and non-participants (Supplementary Table 3).

Statistical models were controlled on the child's sex, symptoms of hyperactivity/inattention and emotional difficulties at 5 years old, sleeping difficulties and family structure of the child. Several interactions (e.g. prior SES*financial situation during school closure) were tested in simple models with "hyperactivity/inattention symptoms" or "emotional symptoms" measured during school closure as dependent variable and "prior socioeconomic status" as independent variable. Second, these same models and interactions were estimated by adding the adjustment on the hyperactivity/inattention symptoms at 5 years, the emotional symptoms at 5 years, the child's sex and some variables measured during school closure: if the child lived with both parents, the child's sleeping difficulties and hyperactivity/inattention or emotional symptoms. If there was significant interaction of interest in these more complex models, we presented the analyses by stratifying on the interaction variable. (Supplementary Table 1 and 2).

Data were analyzed using the *stat* package in *R (version 3.6.1)* with binary logistic regressions specified using the

glm function. The *mice* package and its *cart* method were used to perform multiple imputations.

Results

Sample characteristics (Tables 1 and 2)

Sample characteristics are described in Table 1. In total, 4575 children were included. At 5 years of age, 696 (15.8%) children had signs of hyperactivity/inattention symptoms and 880 (19.9%) showed emotional symptoms. During school closure at 9 years of age, 944 (20.6%) children had hyperactivity/inattention symptoms, whereas 569 (12.4%) presented emotional symptoms. 2571 (56.4%) of mothers had higher education, whereas 2013 (44.5%) of fathers had higher education.

Association between parental SES and children's symptoms of hyperactivity/inattention and emotional difficulties (Tables 2 and 3)

Tables 2 and 3 show the associations between children's hyperactivity/inattention and emotional difficulties during lockdown and prior SES, as well as declining income.

Symptoms of hyperactivity/inattention

Adjusted logistic regression analyses (Table 2) showed that the likelihood of having high levels of symptoms of hyperactivity inattention was elevated among children whose parents had low or very low SES (OR 1.26, 95% CI 1.08–1.48), and whose parents suffered a decline in income during the COVID-19 lockdown (OR 1.38 95% CI 1.16–1.63). Results showed that the probability of an increase in the score was associated with SES.

Emotional symptoms

Adjusted logistic regression analyses (Table 3) showed that the risk of having abnormal emotional symptoms was higher among children whose parents suffered a decline in income during the COVID-19 lockdown (OR 1.23, 95% CI 1.01–1.51). However, a prior low or very low SES was not significantly associated with emotional symptoms during school closure (OR 1.12, 95% CI 0.92–1.36).

Additional interaction analyses (Table 4) showed that emotional symptoms were higher in children with a low prior SES and whose parents suffered a decline in income during the COVID-19 crisis. Other interaction analyses were not statistically significant.

Overall, non-participants were more frequently male, had more hyperactivity/inattention symptoms, lived less frequently with both parents and have worst prior SES (Supplementary Table 3).

Discussion

Main findings

Overall, and as expected, children from disadvantaged socio-economic backgrounds (i.e. with a low family SES 4 years before) displayed higher levels of ADHD and emotional symptoms during lockdown than those from more advantaged families. After accounting for pre-existing mental health difficulties, while prior parental low SES was still associated with ADHD symptoms during school closure, we found an interactive effect between family SES at 5 years and financial decline during the COVID crisis with regard to children's emotional symptoms. Only children from families with both a low SES at 5 years and suffering a decline in income during the COVID crisis presented significantly high levels of emotional symptoms.

Interpretation of findings

To our knowledge, this is the first study in France to describe children's mental health during the school closure due to COVID-19 according to pre-existing family SES.

Our findings confirm the concern that the COVID-19 crisis, and particularly the lockdown period, was significantly associated with a deterioration in the mental health of children of lower SES. While a decline in income during the COVID-19 crisis was directly linked to both ADHD and emotional symptoms, only emotional symptoms were impacted by the combination of a prior low SES and a decline in income during the crisis.

Irrespective of the COVID-19 context, Reiss et al. [14] already showed that indicators of low SES, including household income, parental education and parental unemployment, as well as a high number of stressful life situations, were associated with more mental health problems in children and adolescents, and that parental education was the strongest predictor. In our study, low parental education and occupation and low income 4 years before contributed to higher hyperactivity inattention symptoms in children during lockdown. The importance of parental education in children's mental health was also determined by other studies. McLaughlin et al. [15] reported in a nationally representative US sample of 5692 adults that low parental education significantly predicted disorder persistence and severity, whereas financial hardship predicted the onset of disorders at every life-course stage.

Concerning maternal education, findings are in line with a previous study [33] investigating trajectories of mental

Table 1 Characteristics of children and household in French SAPRIS-ELFE cohort study (*n* = 4575)

	n (%) or mean (SD)
Child sex	4539 (99.2)
Male	2268 (50.0)
Female	2271 (50.0)
Children mental health	
Hyperactivity/inattention symptoms (at 5 years old)	4414 (96.5)
Abnormal and boundary state	696 (15.8)
Normal	3718 (84.2)
Hyperactivity/inattention symptoms (during school closure)	4575 (100.0)
Abnormal and boundary state	944 (20.6)
Normal	3631 (79.4)
Emotional symptoms (at 5 years old)	4414 (96.5)
Abnormal and boundary state	880 (19.9)
Normal	3534 (80.1)
Emotional symptoms (during school closure)	4575 (100.0)
Abnormal and boundary state	569 (12.4)
Normal	4006 (87.6)
During school closure	
Child lived with both parents	4575 (100.0)
Yes	3994 (87.3)
No	581 (12.7)
Child sleeping difficulties	4570 (99.9)
Yes	1778 (38.9)
No	2792 (61.1)
Perceived financial situation	4546 (99.4)
Declining income	1209 (26.6)
Constant income	3337 (73.4)
Household socioeconomic characteristics	
Mother's education level	4556 (99.6)
Secondary school completed or less	903 (19.8)
Fist cycle program of higher education	1082 (23.7)
Second or more cycle program of higher education	2571 (56.4)
Father's education level	4528 (99.0)
Secondary school completed or less	1599 (35.3)
Fist cycle program of higher education	916 (20.2)
Second or more cycle program of higher education	2013 (44.5)
Parents' occupational category	4308 (94.2)
Executive	1316 (30.5)
Intermediate and executive	1162 (27.0)
Intermediate and employee	1161 (26.9)
Independent	121 (2.8)
Laborer	278 (6.5)
Both inactive or only one employee/laborer	270 (6.3)
Household income by month	4220 (92.2)
Mean (SD) in euros	4567.88 (3786.77)
Prior socioeconomic status	4575 (100.0)
Low and very low	2289 (50.0)
High and very high	2286 (50.0)

Table 2 Association between children's hyperactivity/inattention symptoms (abnormal and boundary state vs normal) during school closure and family characteristics including parents' prior socioeconomic status: unadjusted and adjusted binary logistic regressions (*n* = 4575)

	OR (95% CI)[a]	aOR (95% CI)[b]
SES characteristics		
Prior socioeconomic status (High and very high: ref. group)		
Low and very low	1.47 [1.27–1.70]	1.26 [1.08–1.48]
Financial situation during school closure (Constant income: ref. group)		
Declining income	1.46 [1.25–1.71]	1.38 [1.16–1.63]
Mental health		
Hyperactivity/inattention at 5 years (Normal: ref. group)		
Abnormal and boundary state	3.92 [3.30–4.66]	3.53 [2.93–4.24]
Emotional symptoms at 5 years (Normal: ref. group)		
Abnormal and boundary state	1.60 [1.35–1.90]	1.15 [0.95–1.39]
Covariates during COVID-19 school closure		
Child sex (Male: ref. group)		
Female	0.54 [0.47–0.63]	0.49 [0.42–0.58]
Child living with both parents (Yes: ref. group)		
No	1.43 [1.17–1.75]	1.23 [0.99–1.54]
Child has sleeping difficulties (No: ref. group)		
Yes	2.45 [2.12–2.84]	2.14 [1.82–2.50]
Emotional symptoms (Normal: ref. group)		
Abnormal and boundary state	3.27 [2.72–3.94]	2.60 [2.11–3.20]

[a]Unadjusted odds ratios and confidence interval

[b]Adjusted odds ratios and confidence interval

Table 3 Association between children's emotional symptoms (abnormal and boundary state vs normal) during school closure and family characteristics including parents' prior socioeconomic status: unadjusted and adjusted binary logistic regressions (*n* = 4575)

	OR (95% CI)[a]	aOR (95% CI)[b]
SES characteristics		
Prior socioeconomic status (High and very high: ref. group)		
Low and very low	1.25 [1.04–1.49]	1.12 [0.92–1.36]
Financial situation during school closure (Constant income: ref. group)		
Declining income	1.38 [1.14–1.67]	1.23 [1.01–1.51]
Mental health		
Hyperactivity/inattention at 5 years (Normal: ref. group)		
Abnormal and boundary state	1.61 [1.29–2.01]	1.07 [0.83–1.36]
Emotional symptoms at 5 years (Normal: ref. group)		
Abnormal and boundary state	2.63 [2.17–3.19]	2.21 [1.80–2.71]
Covariates during COVID-19 school closure		
Child sex (Male: ref. group)		
Female	1.43 [1.20–1.71]	1.64 [1.35–1.99]
Child lived with both parents (Yes: ref. group)		
No	1.22 [0.95–1.57]	0.99 [0.75–1.30]
Child has sleeping difficulties (No: ref. group)		
Yes	4.51 [3.72–5.46]	3.70 [3.04–4.51]
Hyperactivity/inattention symptoms (Normal: ref. group)		
Abnormal and boundary state	3.27 [2.72–3.94]	2.64 [2.14–3.25]

[a]Unadjusted odds ratios and its confidence interval

[b]Adjusted odds ratios and its confidence interval

Table 4 Association between children's emotional symptoms (abnormal and boundary state vs normal) during school closure and socioeconomic characteristics of families whose income declined vs. remained constant during school closure: unadjusted and adjusted binary logistic regressions ($n=4546$)

	Declining income ($n=1209$)		Constant income ($n=3337$)	
	OR (95% CI)[a]	aOR (95% CI)[b]	OR (95% CI)[a]	aOR (95% CI)[b]
Prior socioeconomic status (High and very high: ref. group)				
Low and very low	1.60 [1.14–2.24]	1.54 [1.07–2.21]	1.08 [0.87–1.33]	0.98 [0.77–1.22]

[a]Unadjusted odds ratios and its confidence interval

[b]Adjusted odds ratios and its confidence interval. Results are adjusted on hyperactivity/inattention symptoms at 5 years, emotional symptoms at 5 years, the child sex and some variables measured during school closure: if child lived with both parents, hyperactivity/inattention symptoms and child's sleeping difficulties

health problems by maternal education. Children of mothers with a low educational level had significantly more mental health problems during childhood and adolescence than children of mothers with a high level.

A recent population-based and cross-sectional Chinese study [34] demonstrated socioeconomic inequality in children's mental health during the pandemic. Interestingly, thanks to our longitudinal design, we also found that the pandemic also exacerbated socioeconomic inequalities in children's mental health, especially in vulnerable children already suffering from hyperactivity inattention. In line with this result, a British study [23] showed that a higher proportion of families living in poverty in pre-lockdown reported experiencing financial stress during the lockdown, demonstrating the adverse economic effects of the lockdown on already poor families.

There is a lot of evidence that SES is associated with ADHD [35] but few about his link with emotional symptoms. While a decline in income during the COVID crisis was a significant factor contributing to a concurrent higher risk of both ADHD and emotional symptoms, this was particularly true with regard to emotional symptoms in the subgroup of children displaying prior socioeconomic vulnerability, as suggested by the interaction we found. This finding has important consequences. While UNICEF [16, 17] warned in 2020 that the number of children living below their respective national poverty lines could soar over the coming years, and called for the urgent transfer of cash to low-income countries, the need for governmental financial assistance measures for poor families in developed countries also seems to be a priority in terms of mental health.

The stability of family income during the COVID-19 lockdown has already been found to affect the mental health of young people significantly during the COVID-19 crisis, due to the psychological and economic pressure they face [18, 36–44]. Parental mental health difficulties may also be an intermediate factor. Indeed, in accordance to previous research [37, 38, 45], parents' symptoms of anxiety or depression during lockdown as well as their pre-existing mental health difficulties were associated with a higher level of children's emotional difficulties and symptoms of hyperactivity/inattention.

Interestingly, other factors like parental separation or sex of the child did not increase the risk.

Unsurprisingly, children with high levels of ADHD symptoms and emotional symptoms before the lockdown experienced higher levels of ADHD and emotional symptoms during the school closure, respectively, taking in account SES and other covariates. Of note, having high levels of emotional symptoms 4 years before did not increase the risk of having high levels of ADHD symptoms during the lockdown. Similarly, having high levels of ADHD symptoms 4 years before did not increase the risk of having high levels of emotional symptoms during the lockdown. These findings highlight the importance of longitudinal analyses, because mental health problems in children are a critical issue in this phase of development from childhood to adolescence. This strong continuity of symptoms suggests the adverse mental health effects of the lockdown on already deprived families [23].

We assume that children with previous ADHD and emotional disorders are particularly exposed to psychological distress during the pandemic due to loss of daily routines caused by school closures and home confinement. As Jefsen suggests [45], this may be reduced by supporting families to maintain the framework of family life, despite the unusual circumstances that they find themselves in. The evidence clearly suggests that children suffering from previous emotional or ADHD symptoms, and who normally had access to specialized psychiatric care prior COVID-19 pandemic, have had more severe symptoms. In addition, their parents have likely struggled to look after their children in a confined space, since they were not allowed to go out. However, some studies reported opposite results between degradation and improvement of symptoms, unlike the general population [46, 47].

Strengths and limitations

The main strength of this study is that it was based on a community sample, followed participants during the first lockdown period, but started prior to the COVID-19 epidemic, making it possible to include pre-existing risk factors in a longitudinal design. Second, as we assessed children's emotional difficulties and hyperactivity/inattention before the pandemic, we had information concerning pre-existing vulnerabilities. Third, it included a large number of parent respondents during school closures in France at the beginning of the pandemic. It also included pre-term children, a population more at risk of hyperactivity/inattention, so it provides more power for studying risk and protective factors in a lockdown situation. Fourth, we were able to control for a wide range of possible covariates among the sociodemographic and socioeconomic characteristics of children's families. Fifth, we used validated measures of hyperactivity/inattention and emotional symptoms (SDQ) with satisfactory psychometric properties [28, 29].

However, the study also has limitations. First, all measures were based on self-reports, including the SDQ reported by parents, so the emotional state of parents may have influenced their responses [36]. However, parental evaluations are appropriate in this setting, given the young mean age of the children (5–8 years old). It must be acknowledged that the SDQ does not allow a diagnosis. However, the SDQ has satisfactory psychometric properties and the performance and validity of the parent-reported SDQ in French [27] suggests that its performance is similar to that of psychiatric interviews [30], though ADHD is a clinical diagnosis based on symptomatology and associated impairments. Second, only a few parents reported their alcohol and smoking consumption as well as their mental disorders, which prevented us from taking these variables into account in our analyses. Third, although it would have been of interest to assess the peer-relationship, pro-social behavior and conduct problem subscales of the SDQ, it was not feasible in the present study. Fourth, the SES was constructed as a combination of three dimensions. We assumed that each dimension has an equal impact, as it has been used in other birth cohorts such as the Quebec Longitudinal Study of Child Development (QLSCD) cohort [48], and we assumed it was an appropriate proxy of the SES. Finally, we did not assess in this study the impact of lockdown on disruptions of physical activities and excessive use of screen time, but previous studies showed those factors to be highly related to hyperactivity symptoms [18, 49].

Implications for policy and practice

The mental health gap between advantaged and disadvantaged children has not been reduced over the last 20 years, and there is evidence that it may even be increasing [44].

The unprecedented combination of school closures and children having to stay at home very likely creates difficulties and stress for both children and their parents.

In addition, the decline in income during school closure that some families suffered was a strong predictor of children's psychological difficulties in this study. However, it is more appropriate to talk of financial stress in the context of uncertainty, since other studies have subsequently shown that the financial compensation measures that the French authorities implemented functioned well. Therefore, maintaining such state-aided assistance for children from socially deprived backgrounds, even in developed countries, seems a priority in terms of public mental health. Children suffering from ADHD and emotional symptoms and with pre-existing vulnerabilities such as prior low SES and low parental educational level may require special guidance during a pandemic. The potential benefits of closing schools to curb the spread of a virus like COVID-19 need to be weighed against the effects on children's mental health. In addition, while a return to school may be welcomed by many pupils, others might feel anxious or frightened [18], so further longitudinal studies focusing on the return to school and the social interactions engendered are needed.

Declarations

Conflicts of interest The authors declare that they have no conflicts of interest.

Ethics approval Ethical approval and informed consent were obtained from each participant before enrolment in the ELFE cohort. The SAP-RIS survey was approved by the Inserm ethics committee (approval #20-672 dated March 30, 2020).

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