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Remote Instruction and Student Mental Health: Swedish Evidence from the Pandemic[†]

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When COVID-19 reached Sweden, upper-secondary students (ages 17–19) transitioned to remote instruction, while lower-secondary schools (ages 14–16) remained open. We use this setting as a natural experiment to analyze how modes of instruction affect student mental health. We find a 4.4 percent decrease in mental health care use from remote instruction, primarily due to fewer diagnoses and prescriptions for depression and anxiety. The reduction persists throughout the study period; 21 months after the initial closure and 9 months after schools resumed usual operations. This suggests potential mental health benefits from remote instruction, at least in the medium term. (*JEL* I12, I18, I21, I28, I31)

Schools play a crucial role in society by providing essential academic and social skills. While such skills are necessary, the educational process and the school environment can be difficult for individual students. Research has shown an association between school failures and poor mental health (Gustafsson et al. 2010; Currie 2020). Evidence also suggests that mental health tends to deteriorate during school terms in comparison to longer school breaks (Hansen and Lang 2011). Understanding how different modes of schooling impact student mental health is therefore an important question, but answering it is challenging due to nonrandom sources of exposure. In this paper, we address this challenge by using Sweden's partial school closure during the COVID-19 pandemic as a source of quasi-experimental variation in exposure to remote instruction. In doing so, we also contribute to the understanding of the repercussions of one of the most widely used nonpharmaceutical interventions (NPIs) during the pandemic.[1]

Unlike all other OECD countries, Sweden only moved upper-secondary students to remote instruction at the beginning of the pandemic, while schools for younger students remained open (OECD 2021a). This allows us to compare adolescents who

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[1] School closures disrupted the education for billions of students during the pandemic, raising concerns regarding the consequences for learning and the mental health of children and adolescents (UNESCO 2021).

were exposed to remote instruction with those who otherwise experienced similar conditions but had different modes of schooling. Using population-wide register data, we employ a difference-in-differences (DID) strategy to study the change in the use of mental health care services among upper-secondary (age 17–19) relative to lower-secondary (age 14–16) students. We define mental health care use as either being prescribed a psychiatric drug or receiving a psychiatric diagnosis from hospitals or specialist psychiatric care facilities.

Relative to lower-secondary students, we find that the use of mental health care among upper-secondary students decreased by 3.7 cases per 1,000 during the initial phase of the pandemic (April–June 2020), largely due to a reduction in diagnoses and prescriptions related to depression and anxiety. This corresponds to a 4.4 percent decrease compared to the pre-pandemic level. The reduction is most pronounced among the groups of students who were also most exposed to remote instruction, in particular those at academic programs and students without prior contact with psychiatric care.

While the research design holds constant a host of factors, there remains the possibility that remote instruction resulted in an uneven decrease in health care accessibility for upper-secondary students. For instance, access through school health care facilities may have been adversely affected. If so, the observed reduction in mental health care use might not reflect a genuine decrease in health care needs. Several results speak against this interpretation. First, we find no corresponding decrease in the use of health care for symptoms unrelated to mental health or COVID-19. Thus, there is no indication of a reduction in general health care use specific to upper-secondary students. Second, if the channels that normally bring upper-secondary students in contact with mental health care were disrupted, we would expect a substitution toward unplanned and emergency care visits. Instead, we find an even larger decrease among these types of care contacts.

Third, we conduct a survey of Swedish health care regions revealing that schools overwhelmingly refer cases related to Attention Deficit Hyperactivity Disorder (ADHD), but the initial decline in health care use was more pronounced for depression and anxiety. As the pandemic progressed, we find similar declines for both these conditions and for ADHD.[2] Qualitatively, none of the surveyed regions reported concerns regarding mental health care access during the pandemic.[3] Finally, and most importantly, we find no rebound in mental health care use up until 21 months after the initial closure, when schools had been operating as normal for 9 months.

The digital infrastructure of Swedish schools is well developed and at the beginning of the pandemic, conditions for remote instruction were among the best in the world (OECD 2021b). Reports also suggest that the transition to remote instruction worked well (Swedish National Agency for Education (SNAE) 2020). Closing the schools thus meant a change in the school environment and mode of instruction

[2]Freedman, Salcedo, and Wing (2023) find that cases of ADHD declined among 6 to 11 year olds in the United States and that this decline was smaller in areas with more in-person schooling.

[3]This finding is consistent with other reports that specialized psychiatric care in Sweden managed well during the pandemic by moving consultations online (Swedish National Board of Health and Welfare 2021; Ohlis et al. 2021). To the extent that problems were reported they concerned absenteeism due to illness. This is unlikely to be systematically related to the age of the care seeker.

rather than a break from schoolwork. The main exception is that national tests were canceled, which may have reduced stress (Heissel et al. 2021). However, tests were also canceled at the lower-secondary level, and patterns across school grades are inconsistent with this being a driving force behind the results.

A plausible explanation for our findings lies in the school environment. The seemingly poorer mental health of Swedish youths compared to their counterparts in similar countries has been discussed for years (Public Health Agency of Sweden (PHAS) 2018). While there is no consensus on the causes, the school environment is frequently implicated, though the specific mechanisms remain undefined. School's behavioral demands could manifest in behavioral disorders such as ADHD, potentially tied to in-school disturbances (Leache et al. 2021). Remote instruction could amplify or mitigate the effects of ADHD on individual learning, but it undoubtedly reduces the disruptive impact on peers.

The school setting can be a source of considerable academic and social stress. In 2018, nearly half of all Swedish upper-secondary students, and two-thirds of those in academic programs, felt stressed by academic demands (SNAE 2019). More than half of students in academic programs reported stress linked to their own ambitions, while 21 percent of all students felt pressures to conform socially. US evidence indicates that pandemic-induced school closures reduced bullying among high school students which possibly contributed to a reduction in suicides among teens (Bacher-Hicks et al. 2022; Hansen, Sabia, and Schaller 2022). Bullying is not very prevalent in Swedish upper-secondary schools, making it a less likely explanation of our results, but we cannot dismiss reduced social pressures as a factor.[4] Regarding academic stress, remote instruction may reduce peer pressures and alleviate time constraints,[5] but also brings about challenges when adapting to new learning formats and potentially less teacher support. While reduced stress could explain our findings, our data is not conclusive about the exact mechanisms.

This study contributes to the literature on the pros and cons of remote instruction. Most of this research has focused on postsecondary education and tends to find negative effects on academic achievement, especially for less prepared students (Escueta et al. 2020). Similar results are reported for upper-secondary students (Heppen et al. 2017; Fitzpatrick et al. 2020). Evidence from the pandemic affirms these findings by documenting substantial learning losses from remote and hybrid instruction, especially among younger and disadvantaged students (Goldhaber et al. 2023; Jack et al. 2023).[6] Our results, together with studies on bullying and suicide, suggest that remote instruction for older students may have some important benefits.

[4] In 2019, 20 percent of US high-school students reported being bullied in school and 16 percent being cyberbullied (Bacher-Hicks et al. 2022). According to SNAE (2019), six percent of all Swedish upper-secondary students reported being bullied (four percent at academic programs).

[5] Remote instruction allows for a more flexible schedule and less commuting. Apart from leaving room for more sleep, a later school starting time has been shown to improve student achievement (see e.g., Carrell, Maghakian and West 2011). We are not aware of any data that allow us to directly address this mechanism in our setting.

[6] See Betthäuser, Bach-Mortensen, and Engzell (2023) for a review of the literature on learning losses. Evaluating learning in Sweden during the pandemic is challenging due to the lack of objective measures of academic achievement when the national tests were canceled. Government surveys directed to the principals suggest some learning loss in both lower- and upper-secondary school due to student absenteeism and remote instruction. This is however not reflected in the grades, which, in fact, increased slightly (SNAE 2022a,b).

A caveat is that we only study medium-term effects. To the extent that valuable academic and social skills are lost, the long-term consequences may differ.

More directly, we contribute to the research on the consequences of school closures during the COVID-19 pandemic. Isolating the impact of school closures on mental health or the use of mental health care services is often challenging. Our approach effectively holds constant factors such as health care capacity, the impact of other NPIs, and various effects of the pandemic. Our findings align with Hansen, Sabia, and Schaller (2022), who find reduced suicide rates, suggesting that school closures have a positive impact on vulnerable students. Conversely, Felfe et al. (2023) report a negative impact on survey responses concerning wellbeing and mental health among younger German students, while older ones were unaffected. Compared to these studies, we focus on less extreme outcomes than suicide but likely more severe than survey answers on wellbeing and mental health.

Further, the results are relevant to the literature on the accuracy of mental health diagnoses. We find the reduction in mental health care use to be concentrated among students without prior diagnoses or prescriptions. As severe psychiatric problems are likely identified by the time students enter upper-secondary education, this suggests a reduction mainly among marginal cases. Considering that treatment for such patients often yields minimal or even negative impacts on health and well-being (Bos, Hertzberg, and Liberman 2021; Currie and Zwiers 2021), the lack of a rebound effect is consistent with reduced overdiagnosis. However, further research needs to confirm this interpretation.

I. Institutional Background and Pandemic Containment

To assess the effects of moving upper-secondary students to remote instruction on mental health, it is important to understand the extent of the Swedish school closures, changes to the learning environment, and the functioning of mental health care services during the pandemic.

A. *School Closures and Containment Measures*

As a response to the rapid increase in COVID-19 infections, upper-secondary schools were instructed to move to remote instruction on March 18, 2020, until the summer break which begins in mid-June. Schools for younger students remained open during this period. After the summer break, which ends in mid-August, upper-secondary schools were instructed to reopen for in-person schooling but had the option of reverting to remote learning if local COVID-19 conditions so demanded. While most schools relied on in-person instruction, several had students alternating between remote and in-person classes to reduce congestion.

As infection rates rose in late October 2020, the use of remote instruction increased. On December 7, 2020, upper-secondary schools were again advised to close, and beginning on January 24, 2021, they were advised to offer each student between 20 and 80 percent of their classes in person. Throughout the spring and fall of 2020, lower-secondary schools mostly remained open, although some closures occurred due to staff shortages. Beginning on January 24, 2021, lower-secondary schools were

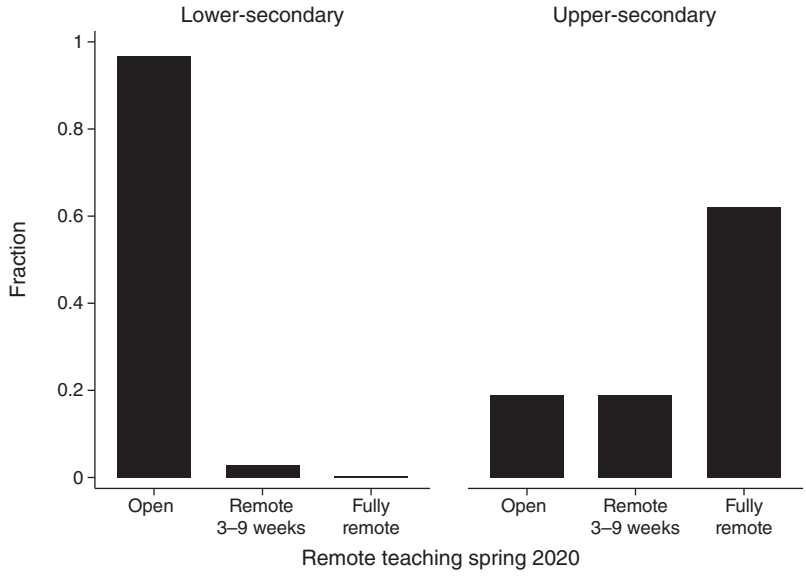

FIGURE 1. REMOTE INSTRUCTION DURING THE SPRING OF 2020

Notes: The figure shows the fraction of students in lower- and upper-secondary school with different degrees of remote instruction based on a survey of school principals by Statistics Sweden (2022). Schools are classified as fully remote if they had more than nine weeks of remote instruction during the spring of 2020.

allowed to use remote instruction if the conditions so required. On April 2, 2021, authorities lifted the recommendations for remote instruction and schools generally resumed normal operations. However, the option to use remote instruction remained until April 2022.

During the pandemic, the Swedish authorities mainly relied on recommendations rather than legislation to implement public health measures, including school closures. This gave schools discretion to adapt their response according to local needs and conditions. Schools were advised to consider exemptions from remote learning for students who would benefit significantly from in-person instruction (Kossack and Sauli 2022). According to the guidelines, this included students enrolled in preparatory programs, those who required on-site facilities for exams and certain vocational training, and those with specific educational, psychological, or physical needs. To provide a more comprehensive picture of remote instruction during the spring of 2020, fall of 2020, and spring of 2021, Statistics Sweden (2022) carried out a survey in the fall of 2021. School principals were asked to estimate the duration of remote instruction for each grade level and type of upper-secondary program. Responses were linked to individual students using personal and school identifiers along with information from the student register.[7]

Using data from this survey, Figure 1 shows the fraction of lower- and upper-secondary students who attended schools that we classify as open, partially

[7] The survey contains information for 43 percent of upper-secondary and 51 percent of lower-secondary students.

Table 1—Remote Instruction during the Pandemic

	Spring 2020	Fall 2020	Spring 2021
Lower-secondary students	6.8	32.4	77.3
	(0.0)	(0.0)	(3.0)
Upper-secondary students	82.5	73.9	70.0
	(11.0)	(2.0)	(5.5)
- Academic programs (61%)	91.4	82.6	81.8
	(12.0)	(3.0)	(6.7)
- Vocational programs (28%)	73.6	68.4	58.7
	(8.0)	(2.0)	(3.0)
- Preparatory programs (11%)	56.0	35.8	29.4
	(4.0)	(0.0)	(0.0)

Notes: The table shows the percentage of students with any remote instruction and the median number of weeks with remote instruction (in parentheses). The left column indicates the fraction of students included in the survey in each upper-secondary program type, reflecting the program distribution within the population.

remote, or fully remote during the spring of 2020.[8] As expected, essentially all lower-secondary students attended schools that remained open, whereas around 20 percent of upper-secondary students did so.

There were substantial differences across upper-secondary programs. Table 1 presents the proportion of students who engaged in any form of remote learning, and the median number of weeks with remote instruction, in lower- and upper-secondary schools during various phases of the pandemic. The data are also broken down by the type of upper-secondary program. Students in academic programs were more likely to participate in remote learning than students in vocational programs, and notably more so than those in preparatory programs. This suggests that schools largely adhered to the general guidelines. As the pandemic progressed, the amount of remote instruction across school levels and programs converged. Academic programs consistently had a higher degree of remote instruction, but in the spring of 2021, lower-secondary students received more remote instruction than those in vocational and preparatory programs.

A more detailed school-level analysis in online Appendix Table A1 reveals that schools with a large fraction of students with mental health issues just before the pandemic had a lower degree of remote instruction. This remains valid even after adjusting for socioeconomic characteristics and school fixed effects. Schools thus appear to have adjusted their response to the perceived vulnerability of their students, in line with the general recommendations.

In an international comparison, the preventive measures in schools that remained open were mild (Guthrie et al. 2020). There were no mandates or recommendations promoting the use of face masks, no reduction in class size, and no targeted testing or quarantining of students. However, compulsory national tests at all levels of education were canceled during the spring terms of 2020 and 2021.

[8] There is some uncertainty regarding how principals counted weeks of remote instructions as there are some shorter breaks during the terms and not all schools open/close for the term at the same date. For the spring of 2020, we classify more than nine weeks of remote instruction as fully remote, three to nine weeks as partially remote, and less than three weeks as open.

For students in the ninth and final year of lower-secondary school, this resulted in the cancellation of national tests in five subjects. Students in academic tracks have a total of three compulsory national tests, typically held in the final two years.[9] Vocational students had one test canceled, a test that typically takes place in their first year. There are no national tests at preparatory programs. Most schools did have tests during the periods of remote instruction, even if the national tests were canceled.[10]

Around the same date as upper-secondary schools transitioned to remote instruction, the public health authorities introduced nationwide containment measures that affected everyone. These included a ban on large public gatherings, directives for restaurants and bars to increase spacing, recommendations to stay at home if ill, work from home if feasible, socialize in small groups, and avoid nonessential travel. As individual discretion was permitted, socializing with friends remained possible even at the peak of the pandemic. Despite the reliance on voluntary action, mobility in Sweden decreased substantially during the initial phase of the pandemic and the decrease was of similar magnitude in areas with different socioeconomic and demographic characteristics (Dahlberg et al. 2020).

B. *Mental Health Care Services*

Swedish health care services experienced disruptions due to the high number of COVID-19 cases and recommendations to limit nonessential health care visits.[11] Mental health care was, however, relatively unaffected. In the Stockholm region—home to 25 percent of the Swedish population—the number of individuals receiving mental health care even increased somewhat from March to September 2020, compared to the same period in 2019 (Ohlis et al. 2021). This was made possible by shifting to remote consultations, a transition that worked well except for the elderly (70+), among whom visits declined. At the national level, there were slightly fewer new consultations in child and adolescent psychiatric care in the spring of 2020 compared to 2019, likely due to cancellations or rescheduling out of COVID-19 concerns. However, the number of in-depth investigations increased during the March to December 2020 period, in accordance with the previous trend (Swedish National Board of Health and Welfare (NBHW) 2021a).

The move to remote instruction and other problems related to the pandemic had implications for school health care services. These facilities have a general mission to promote the physical, mental, and social health of students in schools (SNAE 2016). Among other things, they conduct health consultations and collaborate with

[9] Students in academic tracks typically take between 25 and 30 courses, with compulsory national tests for three of these. National tests in various subjects and courses are held at the same time across schools. However, upper-secondary schools can structure their programs differently, and some take the tests during the fall (fall tests were not canceled). It is therefore not possible to know exactly how many canceled tests a student faced in a specific year.

[10] According to the survey by Statistics Sweden (2022), 61 percent of lower- and 76 percent of upper-secondary schools replaced the canceled national tests with old national tests, their own tests, or both (online Appendix Table A2). Schools were also free have other tests, as they normally do.

[11] By mid-June 2020, Sweden was among the most affected countries, with 51 COVID-19 deaths per 100,000 inhabitants (Vlachos, Hertegård, and Svaleryd 2021). In the Stockholm region, this number was 93.

outside health and social services. It is difficult to quantify the disruptions to these services caused by the pandemic, but the SNAE (2022c) assesses that they "to some extent" had been hindered in providing the required services. Disruptions were more severe in upper-secondary but also nontrivial in lower-secondary schools, mainly due to absenteeism. According to reports, preventive work and identifying students in need was seen as challenging when students were remote, whereas consultations could be conducted digitally and over the phone. This said, surveys of school principals do not indicate a general reduction in the number of case investigations opened by school health care services (SNAE 2022d).

To better understand the relationship between specialized adolescent psychiatric care and school health services before and during the pandemic, we reached out to all 21 health care regions in the country. Representatives from 15 regions agreed to be interviewed (see online Appendix B for details). In 14 out of the 15 regions, self-referrals are accepted for specialized psychiatric care, but school referrals are common. None of the regions had precise data on referral patterns. Among the nine regions willing to provide an estimate, 42 percent of referrals are from schools. Self-referrals constitute 34 percent, while other health care providers and social services contribute an average of 33 percent.

Furthermore, no region reported a noticeable change in these patterns during the pandemic. School referrals overwhelmingly concern ADHD and related neuropsychiatric conditions. Several regions reported a short-lived initial decline in contacts due to concerns for virus transmissions. Digital consultations largely replaced group therapy sessions, and the transition to online consultations is generally reported to have worked well. 11 out of 15 regions reported an increase in the number of eating disorders during the pandemic. None of the regions had a sense that access to care had been adversely affected by the pandemic, with the exception of minor delays due to illness among staff or caretakers.

II. Expected Impact of Remote Instruction on Mental Health

A priori, it is not clear how a move to remote teaching would affect mental health. The academic and social demands of the school environment can be challenging and studying from home offers certain advantages. Less commuting, a more flexible schedule, and, for most students, a calmer study environment, can all alleviate stress and anxiety. Social interactions in school may also cause stress, especially among students who find it difficult to fit in. On the other hand, academic demands are present also when instruction is remote and the home environment may be less conducive to learning. This, and reduced interactions with fellow students and teachers, may increase stress, anxieties, and feelings of isolation.

The impact of remote instruction on mental health may depend on factors such as the home environment and students' ability to self-monitor their studies. We therefore expect potential heterogeneities with respect to expected academic achievement (largely reflecting socioeconomic background), parents' opportunities to work from home, or their belonging to a COVID-19 risk group. Previous mental health issues and student sex can also be meaningful dimensions of heterogeneity.

The extent of remote instruction varied considerably between upper-secondary programs, particularly during the spring of 2020. As exposure to remote instruction differs by program type, we expect the impact on mental health to vary likewise. Differences in remote instruction between programs and between lower- and upper-secondary schools diminished as the pandemic continued, making longer-term expectations less clear. However, we expect the strongest impact on students in academic programs as they were most exposed throughout the pandemic.

Remote instruction may not affect all mental health conditions equally. Stress and loneliness are most likely related to depression and anxiety. In contrast, ADHD can impair a student's capacity to learn in the school environment and a diagnosis requires a pattern of inattention, hyperactivity, or impulsivity. Such behaviors are disruptive and may make schools particularly prone to flag potential ADHD cases. Indeed, the responses from the health care regions to our survey reveal that the vast majority of school referrals to psychiatric care concern ADHD.

Hansen, Sabia, and Schaller (2022) document a reduction in suicides among US teenagers during school closures. In our setting, suicides are too rare to analyze and we instead study care because of self-destructive behavior. Considering that remote instruction may alter social interactions and hence the intake of alcohol and drugs, there might be a change in care due to substance use disorders. Additionally, several health care regions report indications of an increase in eating disorders during the pandemic, perhaps related to schools being closed.

As discussed in the following sections, we analyze the impact on mental health by studying contacts with mental health care services. Such contacts are influenced by both the demand for and the availability of these services. The pandemic caused some disruptions to health care services across all educational tiers, and school closures may have made them more severe at the upper-secondary level. While most health care regions accept self-referrals for psychiatric care, many referrals originate from schools. Since school referrals mainly concern ADHD, disruptions in school health care facilities would largely manifest itself in a reduction of ADHD cases. If normal points of care access were disrupted, we further expect a shift between providers, in particular from planned to unplanned or emergency care visits. Finally, if school closures adversely affected health care access, we expect this also to apply to health care unrelated to mental health or COVID-19.

III. Empirical Strategy

To study the impact of school closures on mental health, we primarily focus on outcomes between April and June of 2020. In this period, upper-secondary schools were largely closed, while lower-secondary schools remained open. Since lower-secondary students attended schools essentially as usual but otherwise faced similar conditions as upper-secondary students, their use of mental health care provides a counterfactual. As there are level differences between upper- and lower-secondary students, we estimate the impact of the school closures using a DID model. In the main analysis, we analyze the change in contacts with mental health care services April–June 2020 compared to the same period in 2019. We also

estimate the corresponding change compared to each year 2016–2018. Thus, we estimate the DID model (1) using linear regression:

$$y_{ist} = \gamma_s + \delta_t + \sum_{\tau=2016,\tau\neq2019}^{2020} \beta_\tau D_{st} + \mathbf{X}_{it} + \varepsilon_{it}, \quad (1)$$

The main outcome $y_{ist}$is an indicator variable equal to one if individual i, belonging to student-group s, was in contact with mental health care services or picked up a prescription drug in period t. γ_s is an indicator for whether individual i attended upper-secondary school, and δ_t are academic year indicators. The estimates of β_τ are the differences between upper- and lower-secondary students for each academic year, compared to the reference year. To adjust for potential compositional changes in the student population, we include a vector $\mathbf{X}$ of detailed individual and parental characteristics. Standard errors are clustered by school.

To track the longer-term outcomes, we follow students who were exposed to the first period of school closures until December 2021. We estimate model (1) for the periods July–December 2020, January–June 2021, and July–December 2021. Mental health in this later period can be influenced by delayed consequences of the initial school closure as well as by the later partial closures. Additionally, upper-secondary students in grade 12 completed schooling in June 2020, while lower-secondary students in grade 9 transitioned to upper-secondary school in the fall of 2020. As a result, final year students at both levels experienced a mixed exposure during the 2020/21 academic year. In the fall of 2021, students who were in grade 8 in the spring of 2020 also transitioned to upper-secondary school, and those who were in grade 11 completed upper-secondary school. Understanding the exact impact of the initial school closures and subsequent partial closures thus becomes more challenging due to these varying exposures and transitions.

Motivated by the discussion in Section II, we conduct a set of analyses for subgroups of students as well as types of diagnoses and care. The aim of this is to better understand the mechanisms behind the results and to analyze the potential impact by changes in access to care. As part of the analysis of mechanisms, we also analyze differences by school-grade by estimating model (2). This is informative to whether other pandemic related factors affected age groups differently, or if the cancellation of standardized national tests affects the results. This model compares the outcome for students in each school grade s (grade 8 being the reference group) before and after schools closed:

$$y_{ist} = \gamma_s + \delta_t + \sum_{\tau=7,\,\tau\neq8}^{12} \beta_\tau D_{st} + \mathbf{X}_{ist} + \varepsilon_{it}, \quad (2)$$

where y_{ist} is the main outcome variable for individual i, t indicates before or after schools closed, and s is the student school grade. The estimate β_τ captures the difference in the outcome variable between school grades s $=$ 7 and 9–12 when compared to the reference school grade 8 during the period of April–June 2020. This difference is compared to the average for the corresponding time frame in 2016–2019.

IV. Study Population and Data

The study population consists of all Swedish upper- and lower-secondary students who attended school in the academic years 2015/16 to 2019/20. Personal identifiers provide links between registries and families. Information on school grade, upper-secondary program, sex, age, and parental characteristics is obtained from registers held by Statistics Sweden (Statistics Sweden, 2020a, b, c, d, e, f). Information on health care use is sourced from registers held by the NBHW (NBHW, 2021b, c).

A. *Definitions of Variables*

To measure mental health, we rely on contacts with mental health care services. We identify all health care visits to hospitals or specialist psychiatric care facilities with diagnoses within chapter F in the ICD10 classification system, which covers mental, behavioral, and neurodevelopmental disorders. This measure includes care by psychiatrists and psychologists. We also include drug prescriptions for insomnia (ATC code N05), ADHD (ATC codes N06B and C02AC02), and antidepressants (ATC code N06A). Although the data do not provide information on diagnoses from primary health care, the prescription register includes all drugs prescribed in Sweden, including those from primary care. The main outcome variable is an indicator equal to one if the student is given a diagnosis or is prescribed a drug as per above during each respective analysis period. Motivated in Section II, we also present results separately for diagnoses or prescriptions related to depression and anxiety, ADHD, self-destructive behavior, substance abuse, and eating disorders.[12]

To study general health care access, we use visits to health care due to non-mental health and non-COVID related health issues.[13] Furthermore, disruptions in conventional pathways to care might lead to shifts in care-seeking behavior. We study whether school closures induced a shift of upper-secondary students from scheduled visits to unplanned or emergency ones. Finally, as we lack information on primary care visits, a shift by upper-secondary students to primary care might manifest as a reduction in visits to mental health care services. Since information on prescriptions is comprehensive, this is not an issue for drug prescriptions. We therefore also study diagnoses and prescriptions separately.

Section II argues that the impact of school closures may differ between groups of students. To analyze such heterogeneities, we use indicators of type of upper-secondary program (academic, vocational, and preparatory), mental health care contacts earlier in the academic year, student sex, and expected academic achievement. The latter is derived using the predicted grade point average (GPA) from the ninth and final year of compulsory school. To the prediction, we use a set

[12] Depression and anxiety include diagnoses codes ICD10 F32–F34 and F40–F43, and prescriptions for antidepressants (ATC code N06A); ADHD include diagnoses for hyperkinetic disorder (ICD10 F90) and prescriptions for ADHD drugs (ATC codes N06B and C02AC02); Self-destructive behavior include diagnoses ICD10 X6, X7, X80-X84, Y1, Y2, Y30-Y34; Substance abuse include diagnoses ICD10 F10, and eating-disorder ICD10 F50.

[13] This includes all diagnoses related to neoplasm (ICD10 C, D0–D4); skin and subcutaneous tissue diseases (ICD10 L); endocrine, nutritional, and metabolic diseases (ICD10 E); and circulatory system diseases (ICD10 I).

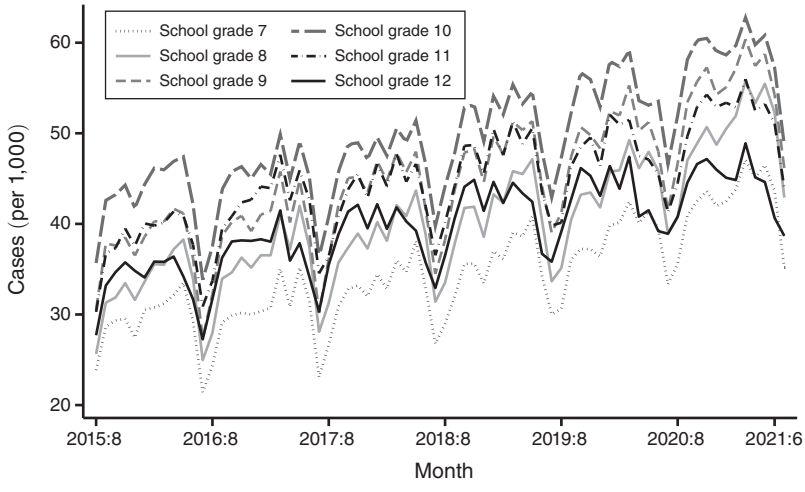

Figure 2. Share of Students Receiving Psychiatric Care by School Grade

Notes: The figure shows the fraction of students with care or prescription drugs related to any mental health diagnoses, as defined in the text, categorized by school grade and calendar year and month. Periods with different remote teaching regimes are as follows (see discussion in Section IA): April–June 2020, most upper-secondary students had remote teaching and lower-secondary students had teaching in school; August–November 2020 some, mainly upper-secondary students were exposed to some remote teaching; December 2020–January 2020 large share of mainly upper-secondary students were exposed to remote teaching; February–March 2021 some students in both upper- and lower-secondary schools had remote teaching.

of student and parental characteristics such as immigration status, parental education, and other indicators of social background. We split students into three equally sized groups based on their predicted GPA rank. Parental opportunity to work from home can be an important source of heterogeneity. We follow Dingel and Neiman (2020) and Hensvik, Le Barbanchon, and Rathelot (2020) to construct an indicator that assesses if occupations are compatible with telework. To capture parental health risk from exposure to COVID-19, we use an indicator based on preexisting medical conditions. Details on data sources and derived variables are provided in online Appendix C.

B. *Descriptive Patterns and Statistics*

Figure 2 depicts the variation in the main outcome variable by school grade from 2015 to 2021. Mental health care contacts fluctuate throughout the year and exhibits an upward trend across all school grades. The incidence increases with grade in lower-secondary but decreases in upper-secondary school. Time-series by school grade and lower- and upper-secondary school with monthly effects removed indicate a slight drop in contacts in April–June 2020 in all school grades, but the decline seems to be larger in the upper-secondary school grades (Figures D1 and D2 in online Appendix D). This difference persists and even increases in the following months. By separately examining depression and anxiety, and ADHD, we find ADHD to be more prevalent in lower-secondary school and in grade 10 (Figure D3).

Table 2—Summary Statistics

	Lower secondary		Upper secondary		Academic		Vocational	
	2018/19	2019/20	2018/19	2019/20	2018/19	2019/20	2018/19	2019/20
Mental health care, April–June	75.00	78.49	85.21	84.87	68.65	67.11	102.81	102.18
Depression/anxiety, April–June	26.11	27.03	45.25	43.88	41.18	38.84	47.95	46.83
ADHD, April–June	43.75	46.14	34.65	36.34	21.10	22.21	51.60	52.82
Mental health care, July–March	92.28	97.21	120.87	123.38	93.49	94.79	150.75	152.20
Male	0.51	0.51	0.53	0.53	0.48	0.47	0.60	0.61
Foreign background	0.25	0.25	0.30	0.30	0.25	0.26	0.21	0.22
University	0.49	0.51	0.43	0.45	0.56	0.57	0.30	0.31
Income percentile	50.58	50.67	46.48	46.82	53.92	54.19	43.57	43.26
	(31.51)	(31.44)	(32.96)	(33.00)	(32.57)	(32.61)	(29.12)	(29.51)
GPA high	0.33	0.33	0.33	0.33	0.47	0.47	0.16	0.16
GPA low	0.33	0.33	0.33	0.33	0.19	0.19	0.42	0.42
Teleworkable	0.46	0.46	0.43	0.44	0.52	0.53	0.30	0.32
Risk group	0.36	0.34	0.42	0.40	0.41	0.39	0.44	0.41
Observations	338,433	346,840	337,436	347,897	199,044	205,801	96,914	100,830

Notes: The table shows mean values, and standard deviations are in parentheses where relevant. Mental health is indicated per 1,000 students. University refers to maternal level of education while income percentile refers to the father. GPA high/low refers to the predicted tercile of student achievement. The average for "Teleworkable" refers to parents for whom information on occupation is available, and Risk group if any parent has a heightened medical higher risk from COVID-19.

Depression and anxiety are more prevalent in upper-secondary school and occurs to a similar extent across grades 10–12 (Figure D4).

To understand how mental health relates to the school environment, we separately analyze how depression and anxiety, ADHD, and self-destructive behavior evolve throughout the school year. Both ADHD and depression/anxiety are more prevalent during the school year than during the summer and winter breaks (Figures D5 and D6). Students are more likely to get an ADHD diagnosis at the beginning of the academic year, while the first episode of depression and anxiety is more likely to occur during the winter. These patterns lead us to conclude that both types of diagnoses can be related to the school environment, albeit in somewhat different ways. That new cases of ADHD are relatively common early in the academic year suggests that schools tend to flag these conditions. This is consistent with survey responses from the health care regions, stating that an overwhelming majority of school referrals concern ADHD. As is the case for suicide in the United States (Hansen and Lang 2011), there is a higher incidence of self-destructive behavior during the school year across all grades, although the pattern is not as pronounced as for depression and anxiety (Figure D7).

Table 2 presents summary statistics for the main outcome variables and some background characteristics of lower- and upper-secondary students for school years 2018/19 and 2019/20. We also show separate statistics for upper-secondary academic and vocational programs. Mental health care contacts among upper-secondary students remained at around 85 per 1,000 between years, while they increased from 75 to 78.49 among lower-secondary students. The same pattern is observed for depression and anxiety, whereas the pattern for ADHD shows an increase among both upper- and lower-secondary students.

The table reveals that upper-secondary students are slightly more likely to be male, have a foreign background, and have parents without a university education and with a lower income. These patterns can primarily be attributed to students without a complete school-leaving certificate from lower-secondary school. They enter preparatory programs in upper-secondary school (41,266 students in 2019/20) to fulfill the necessary requirements before entering an academic or vocational program. As a result, they remain in grade 10 for more than one year.

The survey on remote instruction by Statistics Sweden discussed in Section IA shows that students in academic programs were more likely to have remote instruction in the spring of 2020 than those in vocational or preparatory programs. Table 1 shows that there is less use of mental health care among students in academic programs, particularly for ADHD. Additionally, there is a larger reduction in mental health care contacts among students in academic programs. Further, vocational programs are male dominated, and their students have parents with lower socioeconomic status. There are no dramatic changes in the composition of students between academic years. The measure of medical risk group is constructed for the year 2020, meaning that the share of students with a parent in a medical risk groups increases by year as we move back in time. As age is a risk factor, the share of students with a parent in the medical risk group is higher in upper-secondary school as the parents are, on average, three years older.

V. Results

We begin by presenting the results for the first period of school closures, spanning from April to June 2020. Based on the discussion in Section II, an analysis of heterogeneities follows in Section VB, and a deeper look into the mechanisms in Section VC. Results for the longer run are presented in Section VD. Tables corresponding to the results shown in figures are in online Appendix D.

A. *Short-Term Outcomes: April to June* 2020

Mental health care contacts in the form of diagnoses or prescription drugs among adolescents have increased for several years in Sweden (NBHW 2019). These trends are illustrated in the left panel of Figure 3 for the April–June period among upper- and lower-secondary students. The panel displays estimates from a linear regression of mental health care contacts on year fixed effects for upper- and lower-secondary students. Before the pandemic, both groups saw a rise in mental health care contacts by about five cases per 1,000 annually. In 2020, with upper-secondary schools closed, lower-secondary students continued on this upward trend, while upper-secondary students remained at the 2019 level. That lower-secondary students continued on the pre-pandemic trend suggests that there was no general drop in mental health care contacts.

To formally test whether upper-secondary students reduced their use of mental health care services, we estimate the DID model (1) with and without control variables. Estimates, rescaled to differences in percent, are shown in the right panel of Figure 3. In the April–June 2020 period, upper-secondary students reduced their

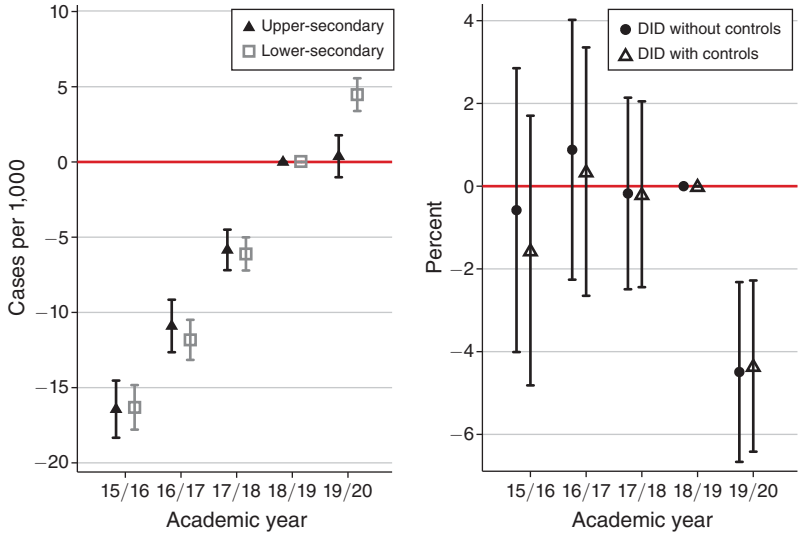

FIGURE 3. MENTAL HEALTH CARE CONTACTS, APRIL TO JUNE

Notes: The figure shows mental health care contacts (diagnoses or prescription drugs) per 1,000 students during April–June each respective academic year, with 2018/19 used as the reference year. The left panel shows estimates from separate linear regressions for upper- and lower-secondary students using year fixed effects. The right panel shows DID estimates from model (1) rescaled to percent, with and without control variables. The controls are sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size, and if the biological parents live in the same household. Unscaled estimates are presented in online Appendix Table D1. Standard errors are clustered at the school level, and 95 percent confidence intervals are indicated.

mental health care contacts with 3.71 cases per 1,000 relative to the expected rate. This corresponds to a 4.35 percent decrease relative to the mean for upper-secondary students in 2019. As shown, mental health care contacts followed a similar trend for the two groups in the years preceding the pandemic. Diverging trends are therefore unlikely to account for the difference estimated for 2020. Adjusting for background characteristics does not affect the result, suggesting that it is not due to compositional changes in the student population.

The impact of remote instruction may vary across symptoms and, as stressed in Section I, school referrals predominantly concern ADHD. Table 3 therefore shows DID estimates for separate categories of mental health. We first consider the two most prevalent categories of mental health concerns: depression/anxiety and ADHD.[14] Column 1 displays a 5.02 percent decrease in depression/anxiety, whereas the decline in ADHD (column 2) is considerably smaller (−1.74 percent) and lacks statistical significance. This implies that a decrease in school referrals is unlikely to be the driving force behind the observed reduction.

Cases in the remaining categories are relatively rare and the estimates have large standard errors. Column 3 shows a decrease in substance use disorders that is not

[14] Trends in depression and anxiety, and ADHD are shown in online Appendix Figure D8.

Table 3— Subcategories of Mental Health care Contacts, April–June

	Depression and anxiety	ADHD	Substance use disorder	Self-destructive	Eating disorder
	(1)	(2)	(3)	(4)	(5)
Upper secondary × 2016	−2.59	0.51	0.17	−0.10	0.21
	(0.77)	(0.82)	(0.16)	(0.12)	(0.18)
Upper secondary × 2017	−0.80	0.98	0.38	−0.15	0.36
	(0.75)	(0.74)	(0.15)	(0.11)	(0.17)
Upper secondary × 2018	−0.94	0.49	0.29	−0.09	0.04
	(0.60)	(0.58)	(0.14)	(0.11)	(0.16)
2019 (reference)	Ref	Ref	Ref	Ref	Ref
Upper secondary × 2020	−2.27	−0.60	−0.09	−0.12	0.10
	(0.61)	(0.63)	(0.15)	(0.11)	(0.16)
Mean dependent variable	45.25	34.65	2.56	1.33	2.45
Effect 2020 (%)	−5.02	−1.74	−3.67	−9.29	4.10
R^2	0.018	0.021	0.001	0.001	0.003
Observations	3,276,398	3,276,398	3,276,398	3,276,398	3,276,398

Notes: The table shows DID estimates from regression model (1). Outcomes per 1,000 students refer to April–June each respective academic year. Years included are 2016–2020, and the estimates are relative to the reference year 2019. Outcomes are categorized as follows: Depression and anxiety (diagnoses ICD10 F40–F42, F32–F34, and antidepressants ATC N06A); ADHD (diagnoses ICD10 F90, prescription ATC N06B and C02AC02); substance abuse (diagnoses ICD10 F1); self-destructive behavior (diagnoses ICD10 X6, X7, X80–X84, Y1, Y2, Y30–Y34); eating disorder (diagnoses ICD10 F50). The model adjusts for sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size, and if the biological parents live in the same household. The mean of the dependent variables refers to upper-secondary students in 2019. Standard errors in parentheses are clustered at school level.

statistically significant. Column 4 displays decrease in self-destructive behavior that is large in percent (9.29 percent), but not statistically significant. Qualitatively, this is in line with US evidence on a reduction in suicides (Hansen, Sabia, and Schaller 2022). Eating disorders (column 5) is the only category that shows an increase, which corresponds with survey responses from the health care regions. However, the estimate is far from statistically significant and does not allow any firm conclusions. When breaking down the results in categories, some pre-period estimates are statistically significant but there are no clear pre-trends in any of the outcomes.

B. *Heterogeneous Effects*

As discussed in Section II, there are reasons to expect that groups of students were differently affected by the period of school closure. Figure 4 therefore shows DID estimates for subpopulations, scaled to changes in percentage relative to 2019.

The percentage decrease is larger for males, −6.28 percent, than for females, −3.07 percent. As shown in online Appendix Table D2, this largely reflects a higher baseline for females and the decrease is of similar magnitude when considering cases per 1000 (−4.25 for males, −3.22 for females).

Students at different upper-secondary programs experienced varying degrees of remote instruction. Academic program students predominantly received remote instruction, while about three-fourths of vocational program students and about half of the students in preparatory programs were subject to at least some remote

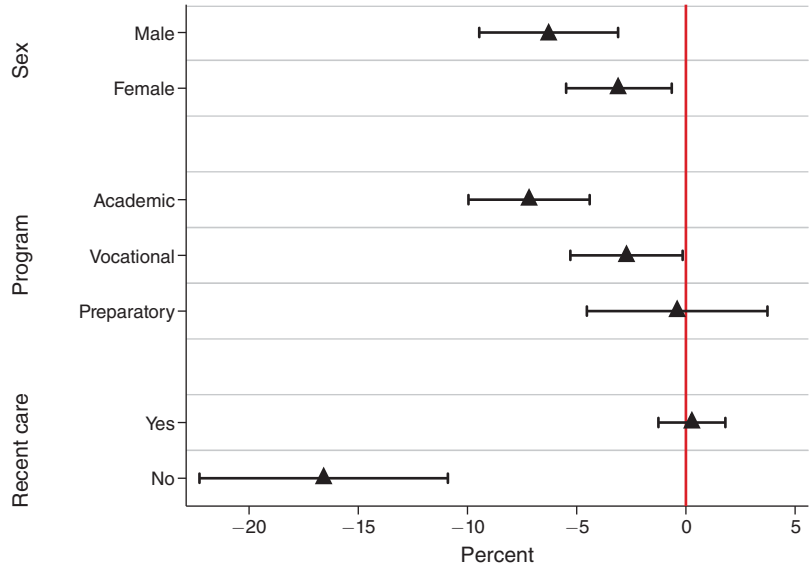

FIGURE 4. RESULTS BY STUDENT AND PROGRAM CHARACTERISTICS

Notes: The figure shows DID estimates by sex, upper-secondary program type, and prior mental health care status. The outcome is mental health care contacts (diagnoses or prescription drugs) per 1,000 students, measured April–June. Estimates from separate linear regressions are rescaled to percent. Unscaled estimates are presented in online Appendix Table D2. The model adjusts for sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size, and if the biological parents live in the same household. Standard errors are clustered at the school level. 95 percent confidence intervals are indicated.

instruction. When splitting the sample by program type, the patterns aligns with exposure: The reduction is substantially larger for academic programs, −7.18 percent, than for vocational programs, −2.72 percent. For preparatory programs, the estimate is small in magnitude, −0.40 percent, and not statistically significant.

As discussed in Section I, schools were recommended to exempt vulnerable students from remote instruction, and those with mental health care contacts earlier in the academic year were less exposed to remote instruction. Splitting the sample shows that students without prior mental health care contact account for the entire reduction. The reduction in this group is −16.58 percent, whereas there is no change among students with prior health care contact. It remains unclear whether this reflects that students who received recent care experienced less remote instruction, or if they responded differently during the period of school closure.

The impact of remote instruction may be related to students' preparedness and home environment. Figure 5 presents estimates by student background and parental characteristics. When splitting the sample by the index based on predicted student achievement (GPA), we find the decrease to be small and not statistically significant among relatively disadvantaged students, −1.49 percent. Among students with medium and high predicted GPA, the reduction is around 6 percent.

Having a parent working from home might relieve the potential strain from remote instruction. When splitting the sample by parental occupation, the decrease

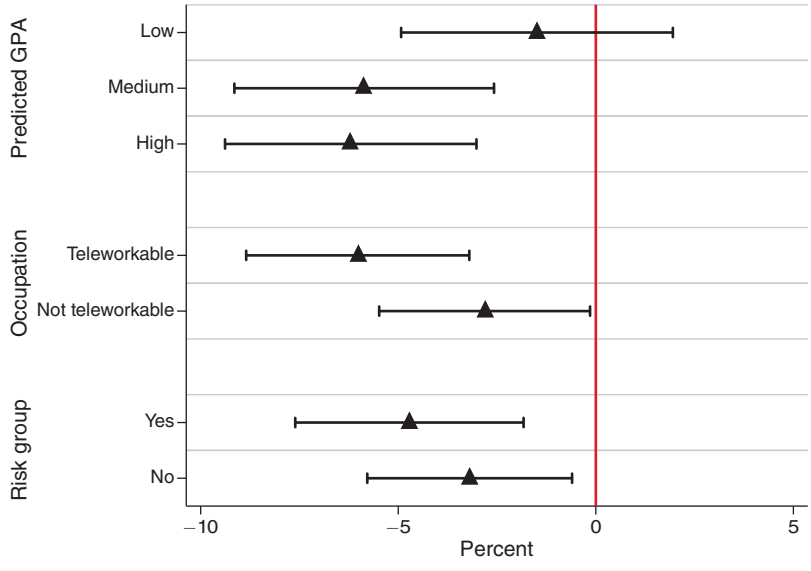

Figure 5. Results by Student Background and Parental Characteristics

Notes: The figure shows DID estimates by predicted GPA, parental opportunities to work from home, and parental risk group. The outcome is mental health care contacts (diagnoses or prescription drugs) per 1,000 students, measured April–June. Estimates from separate linear regressions are rescaled to percent. Unscaled estimates are presented in online Appendix Table D4. The model adjusts for sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size, and if the biological parents live in the same household. Standard errors are clustered at the school level. 95 percent confidence intervals are indicated.

is larger among students whose parents have occupations allowing them to work from home more easily (−6.02 versus −2.81 percent). Finally, we divide the sample based on parental health risk as this might induce stress among students experiencing in-person schooling. The decrease is similar in the two groups, indicating that this factor is not important.

Related to these findings, it is important to consider that predicted GPA or having a teleworkable occupation are linked to socioeconomic conditions.[15] Consequently, a smaller fraction of students with a low predicted GPA, or whose parents do not have occupations allowing them to work from home, attend academic programs. They are hence less exposed to remote instruction. In online Appendix Tables D5 and D6, we present subgroup analyses exclusively for students in academic programs. The findings remain consistent: the reduction is more pronounced among relatively advantaged students and among students whose parents have the option to work from home. In a relative sense, this corresponds to the expectation that these students are better equipped to handle remote instruction. Yet there is a reduction in mental health care contacts for all groups, except those with a low predicted GPA.

[15] As seen in Table 1, 53 percent of students in academic programs had parents with teleworkable occupations. The corresponding fraction in vocational programs is 32 percent. See online Appendix Table D3 for a breakdown of having a parent with a teleworkable occupation and predicted GPA.

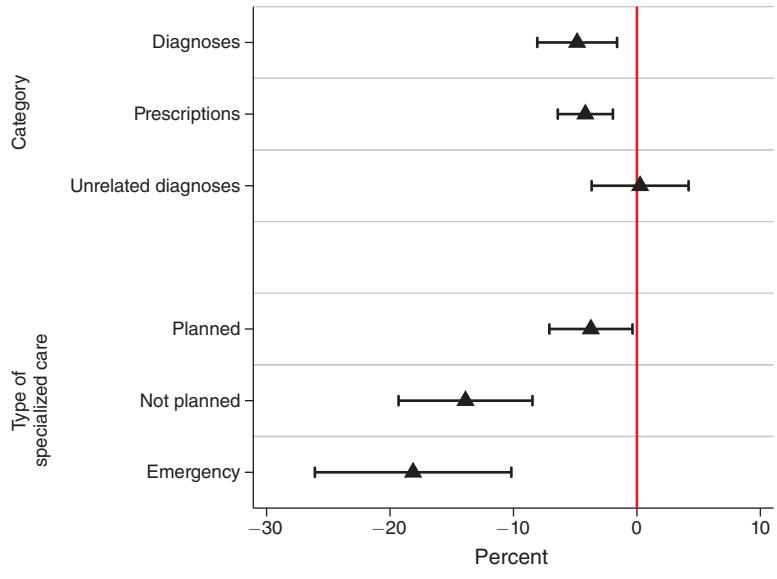

FIGURE 6. RESULTS BY TYPES OF CARE

Notes: The figure shows DID estimates by type of mental health care diagnoses and type of care visit as well as time period. Outcomes are per 1,000 students, measured April–June, and estimates from separate linear regressions are rescaled to percent. "Diagnoses" refers to any mental health diagnoses from specialized psychiatric care; "Prescriptions" to any prescription drug related to mental health issues; "Unrelated diagnoses" to any diagnoses unrelated to mental health or COVID-19; "Planned"/"Not planned"/"Emergency" refers to type of care visit. Unscaled estimates are presented in online Appendix Table D7. The model adjusts for sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size, and if the biological parents live in the same household. Standard errors are clustered at the school level. 95 percent confidence intervals are indicated.

Also for this group, the estimate indicates a reduction, albeit small and not statistically significant.

C. *Mechanisms*

A central question is if the decline in mental health care contacts signify better health among upper-secondary students. An alternative explanation is that reduced access to care or other pandemic-related factors had differential effects on upper- and lower-secondary students. One concern is that we lack data on primary care visits. If upper-secondary students to a larger extent shifted to seeking care from primary care centers, we may underestimate their use of mental health care services. However, data on prescribed psychiatric drugs cover all providers, including primary care. If the reduction is similar when only studying prescriptions, such shifts are unlikely to be a concern. Figure 6 shows a reduction of similar magnitude for health care diagnoses (-4.84 percent) and prescription drugs (-4.18 percent).

The main result may reflect a reduction in health care access specific to upper-secondary students, perhaps due to reduced access through schools' health care facilities. As a first test of this, we estimate the DID model for diagnoses

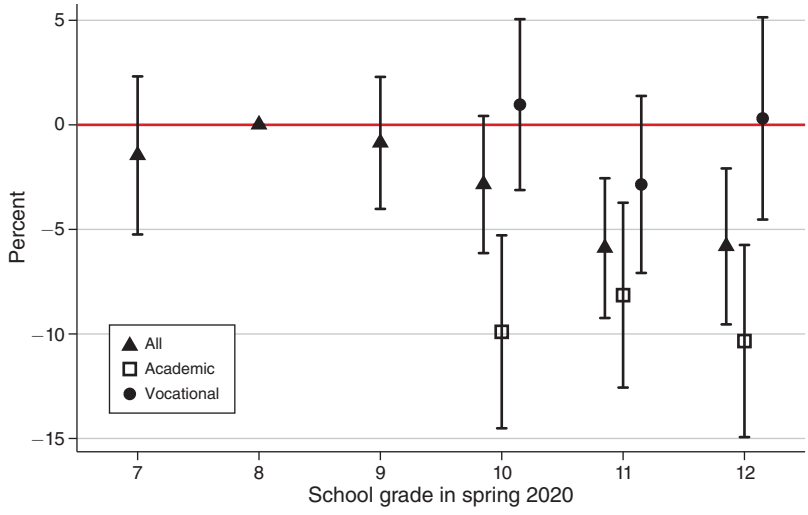

Figure 7. Results by School-Grade and Program

Notes: The figure shows DID estimates from the linear regression of model (2), rescaled to percent. The outcome is mental health care contacts (diagnoses or prescription drugs) per 1,000 students, measured April–June, and estimates show the 2019/20 academic year relative to the period mean before the pandemic. Unscaled estimates are presented in online Appendix Table D8. School grade 8 is the reference category. The model adjusts for sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size, and if the biological parents live in the same household. Standard errors are clustered at the school level. 95 percent confidence intervals are indicated.

unlikely to be related to mental health and COVID-19. As shown in Figure 6, we find a small and statistically insignificant estimate, 0.26 percent, for this outcome. This indicates that there is no reduction in the general access to health care, specific to upper-secondary students. As a second test, we consider different providers. If access through normal channels is reduced, this plausibly shifts upper-secondary students (relative to lower-secondary students) with psychiatric needs toward unplanned care and emergency care facilities. However, the estimates show that the decrease among upper-secondary students is substantially larger for unplanned, −13.88 percent, than for planned care, −3.73 percent. In particular, there is a large decrease in contacts with psychiatric emergency care units, −18.13 percent. This is inconsistent with the patterns of substitution that we would expect if the main results were attributable to reduced access through normal facilities.

Another possibility is that the pandemic in general or other NPIs had differential effects across age groups. If so, we expect the impact to differ across upper-secondary school grades. Figure 7 presents results by school-grade and program type, estimated using the DID model (2). The analysis compares changes in mental health care contacts between the average for the periods 2016–2019 and 2020 for each school grade, relative to grade 8. The results show that contacts with mental health care services follows a similar trend across all lower-secondary grades, as expected since all students remained in school. When pooling all upper-secondary programs, there is a statistically significant reduction in mental health care contacts only for

grades 11 (5.90 percent) and 12 (5.81 percent). However, this result is due to there being only a negative impact among students in academic programs. As academic program students constitute a larger fraction of the student population in grades 11 and 12, the overall effect turns negative. When considering only students in academic programs, the reduction is of similar magnitude across grades: 9.90 percent in grade 10, 8.15 percent in grade 11, and 10.34 percent in grade 12.

Another approach to address the issue of differential age effects is to narrow the sample to only include students in school grades 9 and 10 when estimating the DID model (1). This yields similar results; there is a negative impact when considering all upper-secondary programs, although not statistically significant. Among students in academic programs, however, we find a statistically significant reduction of 6.37 percent. When dividing by diagnoses category, the reduction in depression/anxiety is 5.21 percent for all students, 8.26 for those in academic programs, and 5.01 for those in vocational tracks. For ADHD, the change is not statistically significant for any group (results in online Appendix Table D9).

Heissel et al. (2021) show that testing is stressful and the cancelation of compulsory national testing is a potential mechanism behind the reduction in depression and anxiety. The results in Figure 7 speaks against this. Students in grade 9 had the largest number of tests canceled and we find no reduction in this group relative to students in grades 7 or 8. Upper-secondary students may respond differently to testing, but the results are inconsistent with this as well. Vocational students had one test canceled, typically in grade 10. Among these students, there is no significant decrease in mental health care contacts for any grade. Students in academic programs have three compulsory tests, typically in grades 11 and 12, and none in grade 10, but the reduction is of similar magnitude across grades.

It is important not to overstate the reduced test burden for academic students in grades 11 and 12. Generally, they take between 15 and 20 courses over their final two years, of which three have compulsory tests. The national tests were also largely replaced by other tests. While tests can be stressful, pre-pandemic data on diagnoses for self-destructive behavior or depression and anxiety do not indicate higher levels for school grades which take standardized tests compared to other grades during the usual testing period from March to May (online Appendix Figures D2 and D3). Overall, there is little indication that the cancellation of tests influenced mental health outcomes.

D. *Longer-Run Impact*

Having established that the move to remote instruction led to an immediate reduction in mental health care contacts, particularly related to depression and anxiety, we now turn to the longer-term consequences. In the longer run, the exposure to remote instruction becomes less distinct than in the short run. Students in the final year of lower-secondary school transition to upper-secondary school in the fall of 2020, and a greater exposure to remote instruction thus follows. Final year upper-secondary students move on to post-secondary education or enter the labor market, both of which were affected by the pandemic. As shown in Section I, there was also some convergence in the amount of remote instruction between lower- and

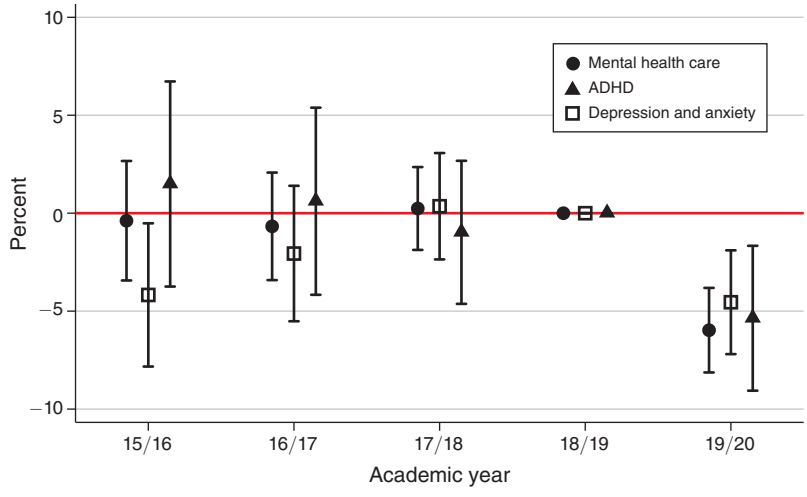

Figure 8. Estimates for July to December, Grades 7-8 and 10-11

Notes: The figure shows DID estimates from the linear regression of model (1) for students who were in grades 7–8 and 10–11 in the spring of 2020. The outcome is mental health care contacts (diagnoses or prescription drugs) per 1,000 students, measured July–December, rescaled to percent. Estimates refer to any mental health care contact, contacts related to depression/anxiety, and contacts related to ADHD. Unscaled estimates are presented in online Appendix Table D10. The model adjusts for sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size, and if the biological parents live in the same household. Standard errors are clustered at the school level. Ninety-five percent confidence intervals are indicated.

upper-secondary schools as the pandemic progressed. These aspects must be kept in mind as we track students over time.

We start by considering the period from July to December 2020. To avoid the problem of students moving between school settings, we restrict our focus to students who were in grades 7–8 or grades 10–11 during the spring of 2020. These students were affected both by the initial period of school closures, largely confined to the upper-secondary level, and by remote instruction during the fall of 2020. Figure 8 presents DID estimates for any type of mental health care contacts as well as separately for treatment related to depression and anxiety and ADHD. The main difference from the results for the spring of 2020 is that there is a reduction in the incidence of both depression/anxiety (4.55 percent) and ADHD (5.36 percent) among upper-secondary students. There is thus no indication of a rebound when schools were relatively open.

As a final exercise, we analyze how mental health care contacts develop through December 2021. Figure 9 shows estimates for students who were in upper-secondary school in the spring of 2020 compared to the lower-secondary students, relative to the difference between the groups in 2018. We estimate the model for the periods (i) April–June 2020, (ii) July–December 2020, (iii) January–June 2021, and (iv) July–December 2021. Since the lower-secondary cohort in 2019 was exposed to the pandemic in periods 3 and 4, we drop 2019 from the estimation and use 2018 as the baseline year. We have already discussed the estimates for periods 1 (Figure 3) and 2 (Figure 8) but show them since the sample differs slightly.

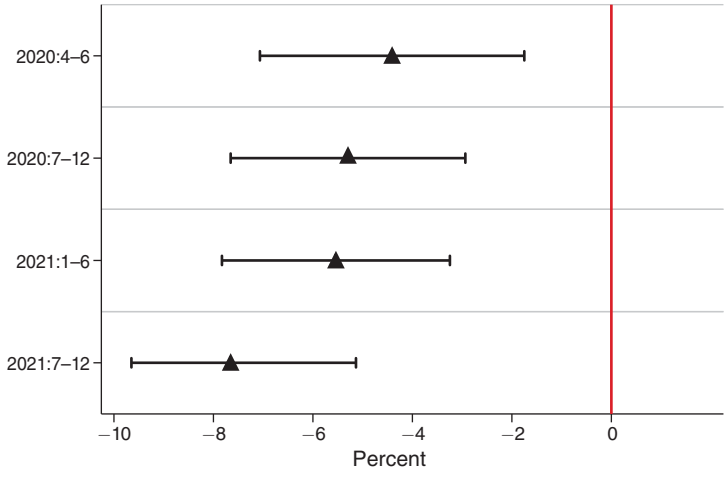

FIGURE 9. MENTAL HEALTH CARE CONTACTS THROUGH DECEMBER 2021

Notes: The figure shows DID estimates for any type of mental health care contact (diagnoses or prescription drugs) per 1,000 students from the linear regression of model (1), for the indicated time-periods. Estimates are rescaled to percent, relative to the corresponding period two years earlier. Unscaled estimates are presented in online Appendix Table D11. The model adjusts for sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size, and if the biological parents live in the same household. Standard errors are clustered at the school level. Ninety-five percent confidence intervals are indicated.

The results consistently show a decrease in mental health care contacts across all periods, with somewhat larger estimates in later periods. There is a decrease of 5.5 percent in January–July 2021 and 7.4 percent in July–December 2021. The full results presented in online Appendix Table D11 show no statistically significant pre-trends. As mentioned above, interpreting the estimates is challenging due to various factors. One factor is that older upper-secondary students finished school and the older lower-secondary students transferred to upper-secondary school. This transition implies changes in school form within the groups. Furthermore, in the later periods (3 and 4), the amount of remote teaching experienced by upper- and lower-secondary students became more similar. However, there is no indication of a rebound in care use up until 19 months after the initial closure.

VI. Conclusions

To reduce the impact of COVID-19, Swedish upper-secondary schools moved to remote instruction on March 18, 2020 and remained closed until the summer break in mid-June. As opposed to other OECD countries, schools serving younger students remained open. We exploit this partial school closure to identify the impact of remote instruction on mental health by comparing health care contacts among upper- (ages 17–19) and lower-secondary (ages 14–16) students, before, during, and after the school closure. The estimates show that upper-secondary students reduced their contacts with mental health care services by 4.4 percent relative to

lower-secondary students during the initial phase of the pandemic. After the summer break, schools were largely open, but the amount of remote instruction increased with infection rates in the latter haft of the term. From December 2020 to January 2021, upper-secondary schools were mainly closed, and instruction continued to be partially remote until early April 2021. With local and temporary exceptions, schools thereafter essentially operated as usual.

In the periods following the initial closure, lower-secondary students also had some amount of remote instruction, but to a lesser extent than upper-secondary students. While this introduces some challenges in identifying the effects, the analysis shows that a reduction in mental health care use persists at least up until the end of the study period in December 2021. The lack of a rebound in health care use in later periods, as well as other results, indicate that the results signify genuine improvements in mental health. This is in contrast to the view that school closures had negative consequences for student's mental health, but is in line with evidence from the United States (Hansen, Sabia, and Schaller 2022).

The recommendation to move to remote instruction left discretion to schools regarding the exact implementation. Schools were instructed to consider the needs of vulnerable students, and the analysis shows that this instruction was followed, at least to some degree. Particularly in the initial phase of school closures, students at academic upper-secondary programs were exposed to substantially more remote instruction than those at vocational and preparatory programs. We also find the largest reduction in mental health care use among academic students. Similarly, students without prior contacts with mental health care were subject to more remote instruction, and the drop in health care use is concentrated to this group. As there are clear socioeconomic patterns in the choice of programs and prior health care contacts, and thus in the exposure to remote instruction, we cannot draw firm conclusions regarding heterogeneous effects between groups. However, while the results show a larger reduction among relatively advantaged groups, there is no indication of an increase for any group of students.

As mentioned in the introduction, the mental health status of Swedish adolescents is a concern and trends in diagnoses and prescription drugs diverge from neighboring countries (Sørensen et al. 2022). Trends in mortality among young adults, mainly due to suicide and drug use, also diverge from Western Europe and are more similar to those in the United States, although the levels are lower (Ågren and Bremberg 2022). The underlying reasons for these trends remains an open question, but our findings support the view that the school environment is a contributing factor. While we cannot specify why remote instruction appears to alleviate these problems, reduced stress is a plausible explanation. Relaxed time constraints and a more flexible work schedule may contribute to this. Outside the realm of schooling, there is evidence that employees tend to value the option to partly work from home highly and perceive their productivity to increase thereby (Barrero, Bloom, and Davis 2021). It is possible that this also applies to upper-secondary students. Other potential channels are reduced social pressures, and that academic standards may have been perceived as less strict under remote instruction.

This study has some additional limitations. Ideally, it would include self-reported mental health surveys for validation, but such information is not available. While

we provide evidence to the contrary, we cannot entirely rule out the possibility that disruptions to school health care facilities limited referrals to specialized care. We are also restricted to a medium-term perspective and remote instruction may have detrimental long-term implications. Finally, the capacity for remote instruction was well-developed in Sweden when the pandemic hit and the NPIs imposed were relatively mild, allowing students to socialize. This may make the results more relevant to normal settings of remote instruction, but perhaps less so regarding the implications for school closures in other countries during the pandemic.

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Online appendix

Remote Instruction and Student Mental Health. Swedish Evidence from the Pandemic.

EVELINA BJÖRKEGREN, HELENA SVALERYD AND JONAS VLACHOS

Appendix A. Survey by Statistics Sweden of remote instruction

In the fall of 2021, Statistics Sweden conducted a survey of school principals on the extent of remote instruction during three phases of the pandemic: the spring of 2020, the fall of 2020, and the spring of 2021. Respondents gave an estimate on the number of weeks of remote instruction by grade level and upper-secondary program type. Using school and personal identifiers, their responses are linked to individual students, based on information in the school register. Since students could be exempted from remote instruction for personal reasons, the survey does not provide an individual measure of the amount of remote instruction. Instead, the responses measure the extent of remote instruction for a typical student at a certain school, program, and grade level. Matching the survey to the individual-level data, we have information for 43 percent of the upper-secondary and 51 percent of the lower-secondary students.

Using these survey data, this appendix presents an analysis of whether the mental health of the school's student population is correlated with the probability of moving to remote instruction. We do this by constructing an indicator of whether or not the student had been in contact with mental healthcare services before the pandemic, more precisely between July 2019 and March 2020. We estimate the relationship between this indicator (Previous care) and the probability that the student received remote instruction in the spring of 2020 and the fall of 2020 (Remote). Thus, we estimate the following model for student i in an upper-secondary school in 2020:

$$Remote_i = \beta Previous\ care_i + \boldsymbol{X}_i + \alpha\ Program_i + \varepsilon_i,$$

where $\boldsymbol{X}$ includes indicators for sex, birth month, if newly arrived in Sweden or arrived less than eight years ago in Sweden, foreign background, parents' education level, any unemployment, welfare, sick leave, pension payments, income percentile by age and sex, if the parents live together, and the total number of children in the household. Program refers to indicators for academic, vocational, and preparatory programs.

We also estimate a model using the population of upper-secondary school students in 2019 and 2020 to control for school fixed effects (γ_s) and cohort fixed effects (δ_t):

$$Remote_{it} = \gamma_s + \delta_t + \beta Previous\ care_{it} + \boldsymbol{X}_{it} + \alpha\ Program_{it} + \varepsilon_{it}.$$

Finally, we estimate these models for the probability to be remotely taught in the fall of 2020, for students who attended grades 10 and 11 in the spring of 2020.

Table A1, columns 1–4 present the estimated effect of prior care on remote teaching in the spring of 2020 and show it is negative and statistically significant. The effect remains significant even after including an extensive battery of variables and controlling for school fixed effects. Including indicators for program reduces the estimate, and it is no longer statistically significant (column 4). However, as discussed in the main text, most of the variation in remote instruction in the spring of 2020 was between programs, meaning there is little variation left in the specification. For students who continue in upper-secondary school in the fall of 2020, that is, students in grades 10 and 11, there is a statistically significant effect of the previous use of mental healthcare services on the probability of remote teaching in the fall, even when controlling for program type (column 6). Given that the well-being of children and students was of the utmost importance during the pandemic—which was why schools for those below age 16 were kept open—this result is not surprising. Rather, it suggests that principals used their discretion to keep schools open in the way intended.

TABLE A1. ANY REMOTE TEACHING

	(1) Spring 2020	(2) Spring 2020	(3) Spring 2020	(4) Spring 2020	(5) Fall 2020	(6) Fall 2020
Previous care	-0.052	-0.054	-0.014	-0.003	-0.114	-0.023
	(0.012)	(0.010)	(0.003)	(0.002)	(0.014)	(0.002)
Controls	No	Yes	Yes	Yes	No	Yes
School & cohort FE	No	No	Yes	Yes	No	Yes
Program FE	No	No	No	Yes	No	Yes
Population year	2020	2020	2019-20	2019-20	2020	2019-20
N	149,187	149,187	288,428	288,428	105,376	204,015
R2	0.002	0.040	0.807	0.812	0.006	0.676

Note: Controls include sex, birth month, indicators for if newly arrived in Sweden or living in Sweden for less than eight years, foreign background, indicators for parents' education level, any unemployment, welfare, sick leave, pension payments, income percentile by age and sex, indicators of if the parents live together, and the total number of children in the household. Standard errors clustered by school are in parentheses.

The survey also contains information on how schools handled the canceled national tests. Principals were asked if and how they replaced the tests, and the responses are shown in Table A2. Schools could replace the tests by several different ways, so the responses are not mutually exclusive.

TABLE A2. REPLACEMENT OF NATIONAL TESTS

	2019/20		2020/21	
	Grade 9	Upper secondary	Grade 9	Upper secondary
Old test	0.55	0.58	0.55	0.58
Own test	0.30	0.61	0.30	0.62
Any test	0.61	0.76	0.61	0.76
N	58,473	146,506	59,836	153,202

Note: The table shows principals' most common responses when asked if and how schools replaced the canceled national tests. The responses are not mutually exclusive.

Appendix B. Survey of healthcare regions

In March and April 2023, we reached out to all 21 healthcare regions in Sweden, asking to interview a representative responsible for adolescent (up until age 18) psychiatric care. Ultimately, we got responses from 15 regions, including the three largest (Stockholm, Västra Götaland, and Skåne). The six nonresponses (Halland, Jönköping, Kronoberg, Norrbotten, Värmland, and Västernorrland) are evenly distributed over the country. Semi-structured interviews were conducted over the phone, but a few representatives responded by email. The interviews covered the following questions:

1) What are the pathways to specialized psychiatric care for lower- and upper-secondary students? Was this pathway affected by the pandemic, and was there a change in referral patterns?

2) Are there systematic patterns in the type of referrals from different sources (schools, families, other sources), and were these affected by the pandemic?

3) Are you aware of systematic health screenings by school healthcare services, and if so, have you received indications that these were affected by the pandemic?

4) Was there a change in the type of diagnoses and treatment during the pandemic, and did you perceive any changes between lower- and upper-secondary students?

5) Are you aware if access to psychiatric care was affected by the pandemic and if so, in what ways, and did it differ between lower- and upper-secondary students?

The interviews ended with an open-ended question regarding other noticeable changes during the pandemic. Interviewees generally did not have access to hard data regarding referrals, diagnoses, or treatments and were then asked to give a rough estimate where applicable. Not all representatives were willing to answer the questions in ways that allow for easy coding. We therefore summarize the responses in Table B1.

TABLE B1. SURVEY OF HEALTHCARE REGIONS

Question	Answer	Comment
Self-referrals possible	Yes=14, No=1	As of April 2021, yes=15
Fraction school referrals (approx.)	Mean=42% (min=20, max=75)	9 responses
Fraction self-referrals (approx.)	Mean=34% (min=20, max=50)	9 responses
Fraction other referrals (approx.)	Mean=33% (min=20, max=40)	9 responses
Referral type from schools	ADHD/ neuropsychiatric	10 responses; all stating ADHD was by far the most common
Changes in referral patterns during the pandemic	No=12, All down=1 Emergency up=1	
Awareness of school health screenings	Yes=3	No noted change among the few aware of screenings
Changes in patterns of diagnoses	Eating disorders up=12, No pattern=3	
Changes in type of care	Group treatment down, digital sessions up	15 responses
Changes between lower- and upper-secondary students	No=15	Vague answers to questions regarding this
Sense of changes in access	No=15	
Problems due to sickleave	Yes=4	Not seen as severe in any region

Appendix C. Data

The database we use in this paper is part of the research program "COVID-19 in Sweden: Infection Tracing, Control and Effects on Individuals and Society" at Stockholm University. Ethical approval for the study was obtained from the Swedish Ethical Review Authority, application 2020-06492. The estimation sample is constructed using the Student Register held by Statistics Sweden and consists of all students in upper- and lower-secondary school during the academic years 2015–2016 to 2020–2021 (Statistics Sweden, 2020a, c). Each student has a personal identifier and is connected to their biological or adoptive parents using the Multi-Generational Register (Statistics Sweden, 2020f). Information on parents' demographic and socioeconomic variables are taken from the Swedish Longitudinal Integrated Database for Health Insurance and Labor Market Studies (LISA) maintained by Statistics Sweden (2020e). Data on contacts with doctors in specialized psychiatric care and hospital visits are available in the patient register, and drug prescriptions are available in the drug register. Both these registers are held by the National Board of Health and Welfare (2021b, c).

Definitions of outcome variables are described in the main text. The control variables are self-explanatory except for the income measure. The measure of parental income is based on individual disposable income and is constructed as follows. We use the average income for the years 2015–2019 and percentile rank each individual by birth cohort and sex. Note that the rank measure is constructed using all individuals in Sweden. For newly immigrated individuals, we only use the income after immigration. When dividing the sample by income, a student is coded as "high income" if any of their parents has an income rank in the fourth quartile.

As a composite measure of student background characteristic envisaging school performance, we create an index by predicting grade point average (GPA) in grade 9 from an OLS regression for the period 2015–2019. GPA data is from Statistics Sweden (2020b). The explanatory variables used to predict GPA are student indicators for birth month, if the student arrived in Sweden less than four years ago or arrived four to eight years ago, if the student is born in a foreign country, if both or one of the parents are born in a foreign country, if the parents live together, and the number of children in the family. For respective parents, we include 98 indicators of educational level by field, income percentile (linear), indicators of receiving social assistance, unemployment benefit, sickness pay (spells exceeding two weeks) or old age pension, and indicators of parent civil status (unmarried, married, divorced, widowed, or other). The indicator for receiving unemployment insurance and the indicator for social assistance are interacted with an indicator of being foreign born. We also include indicators of not being in the register, which means that the parent does not live in Sweden or is deceased. The model

explains 0.3 of the variance in GPA. The predicted values are used to percentile rank students by year and school grade. Based on the ranking, we divide the students into three equally sized groups.

To determine which occupational groups are more likely to work from home, we use the classification of the feasibility of working remotely developed by Dingel and Neiman (2020). The original classification at the Standard Occupational Classification (SOC) 12-digit level is aggregated to SOC10. SOC10 is then translated to the Swedish classification system SSYK2012 via the International Standard Classification of Occupations 8-digit level using the cross-table in Hensvik et al. (2020). At each step, we use the average value of feasibility of working remotely. From Hensvik et al. (2020), we also collect the variable Share of work conducted at home defined according to the American Time Use Survey at the four-digit SSYK2012 level.

Using these classifications, we create the variable Teleworkable occupation. A parent is categorized as having a teleworkable occupation if the Dingle and Neiwork classification "teleworkable" takes a value in the range of 0.5–1 and is not teleworkable if it takes a lower value. We adjust categories by coding the occupation as teleworkable if more than 35 percent of the work could be conducted from home according to Hensvik et al. (2020). The occupation is coded as not teleworkable if less than 10 percent of the work could be conducted at home. Finally, we make some manual changes and categorize the following as not being teleworkable occupations: school and preschool personnel below upper-secondary school (SSYK2012 1411–1492, 2341–2359, 4116, 5311–5312), military personnel (110–310), some healthcare occupations (1511–1532), and traffic instructors (3441). Due to the restrictions on public gatherings, artists (2651–2655, 3433–3439) and politicians (1111) are classified as teleworkable occupations, as are priests (3412), a missing occupational category in the original data.

The medical risk group has been constructed based on current and previous lists of conditions that Swedish authorities throughout the pandemic has identified might lead to a higher risk of infection or higher risk of severe COVID-19 if infected. A binary indicator was created that identifies individuals with pre-existing medical conditions. These were identified up to five years prior 2020 in inpatient care or in specialized outpatient care or by purchases of prescribed medications in the year before 2020.

TABLE C1 DEFINITION OF RISK FACTORS

Category	ICD	ATC	KVÅ
Cardiovascular disease	I20 I21 I22 I23 I24 I25 I48 I50 I60 I61 I63 I64 I649 I69 I70	N02BA C01DA B01AC24	
Hypertension	I109 I11 I110 I12 I13 I15	C02 (not including C02AC02) C03 C09 C08CA C07AB02	
Diabetes	E10 E11 E12 E13 E14	A10	
Adrenocortical insufficiency	E271 E274		
Chronic lung disease	J40 J41 J42 J43 J44 J45 J46 J47 J60 J61 J62 J63 J64 J65 J66 J67 J684 J69 J701 J703 J849 J841 J848 J840 J961 J968 J969 E840 E849 E848 E841	R03AK R03AL R03BA R03AC12 R03AC13 R03AC18 R03AC19 R03CC12 R03BB04 R03BB05 R03BB06 R03BB07	
Dementia	F00 F01 F02 F039 G30 F107A	N06D	
Cancer	C Z85		DT107 DT108 DT112 DT116 DT135
Chronic liver disease	K70 K71 K73 K74 K75 K76 K77		
Chronic renal failure	I12 I13 N00 N01 N02 N03 N04 N05 N07 N08 N11 N14 N18 N19 Z992 E102 E112		
Neuromuscular/neurodegenerative diseases	G10 G11 G12 G13 G14 G20 G21 G22 G23 G24 G25 G26 G30 G31 G32 G35 G36 G37 G70 G71 G72 G73 G80 G81 G82 G83		
Immunocompromised	D8 D80 D81 D82 D83 D84 D85 D86 D87 D88 D89		
Alcohol-related diagnoses	F10 E244 G312 G621 G721 I426 K292 K852 K860 Q860 Z714 Z721	N07BB	
Substance addiction	F11 F12 F13 F14 F15 F16 F17 F18 F19	N07BC	
Psychiatric illness	F20 F25 F30 F31	N05AN	

Appendix D. Figures and tables

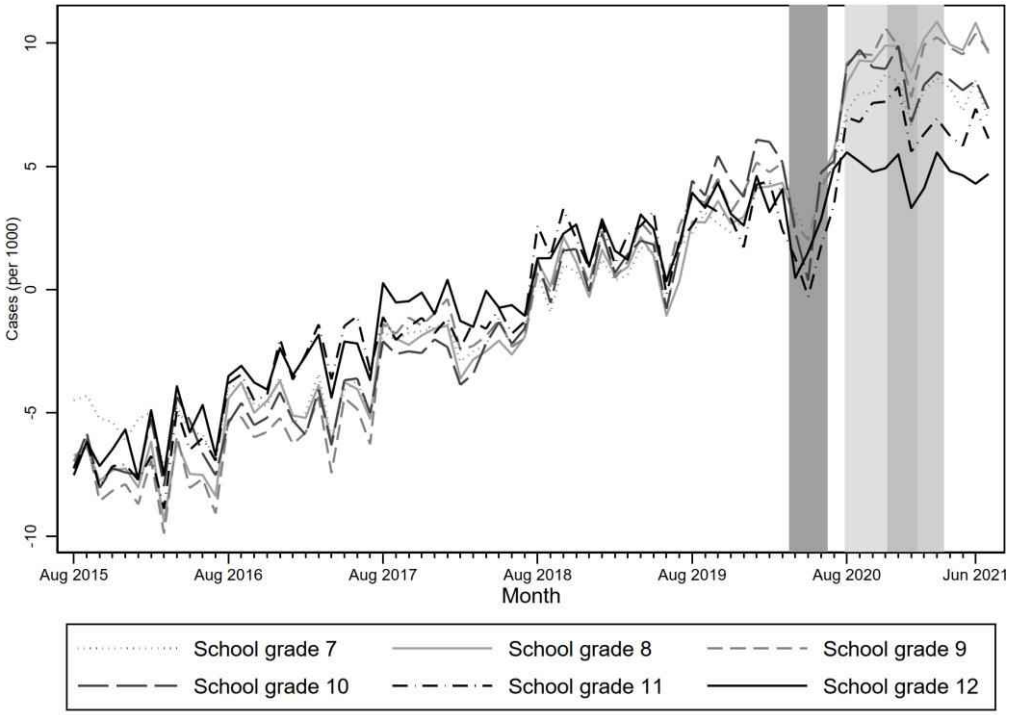

FIGURE D1. TRENDS IN THE SHARE OF STUDENTS RECEIVING PSYCHIATRIC CARE WITH MONTHLY EFFECTS REMOVED BY SCHOOL GRADE

Notes: The table displays the residuals from a regression of the share of students in school years 7-12 receiving psychiatric care (a diagnosis within the ICD10 chapter F or a prescription for drug within ATC-code N05, N06A, N06B, C02AC02) on month fixed effects for the period August 2015-July 2021. The shaded areas indicate periods with different remote teaching regimes. See discussion in main text Section 1.A. From the left: April-June 2020, most upper secondary students had remote teaching and lower secondary students had teaching in school; August-November 2020 some, mainly upper-secondary students were exposed to some remote teaching; December 2020- January 2020 large share of both lower- and upper secondary students were exposed to remote teaching; February-March 2021 some students in both upper-and lower secondary schools had remote teaching.

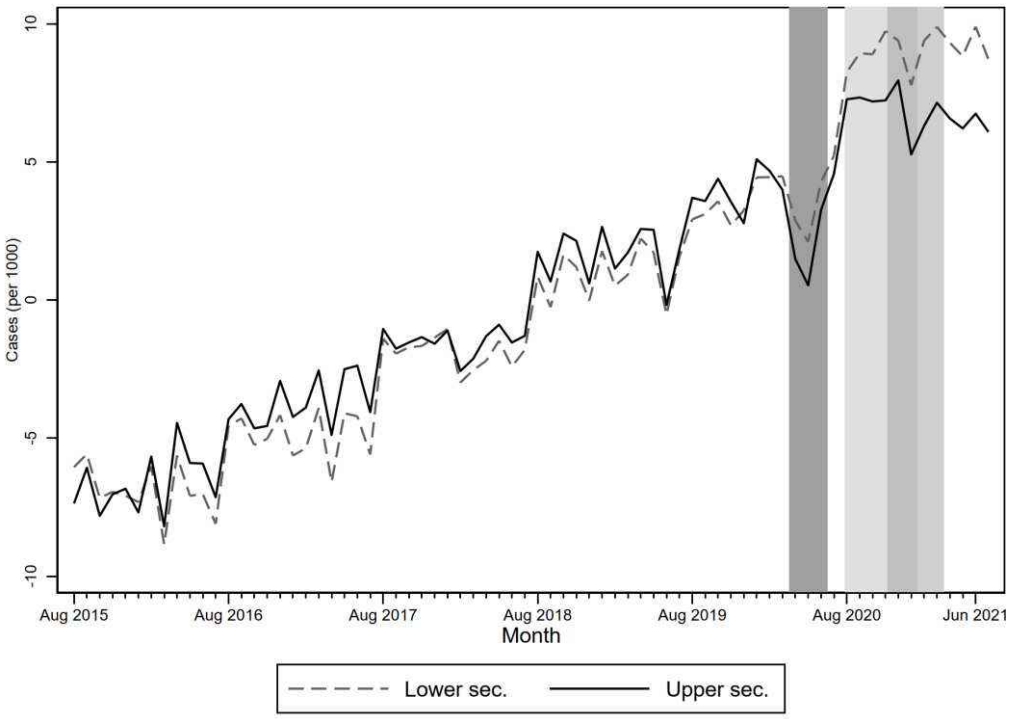

FIGURE D2. TRENDS IN THE SHARE OF STUDENTS RECEIVING PSYCHIATRIC CARE WITH MONTHLY EFFECTS REMOVED BY UPPER-AND LOWER SECONDARY LEVEL

Notes: The table displays the residuals from a regression of the share of students in upper-and lower secondary school receiving psychiatric care (a diagnosis within the ICD10 chapter F or a prescription for drug within ATC-code N05, N06A, N06B, C02AC02) on month fixed effects for the period August 2015-July 2021. The shaded areas indicate periods with different remote teaching regimes. See discussion in main text Section 1.A. From the left: April-June 2020, most upper secondary students had remote teaching and lower secondary students had teaching in school; August-November 2020 some, mainly upper-secondary students were exposed to some remote teaching; December 2020-January 2020 large share of both lower- and upper secondary students were exposed to remote teaching; February-March 2021 some students in both upper-and lower secondary schools had remote teaching

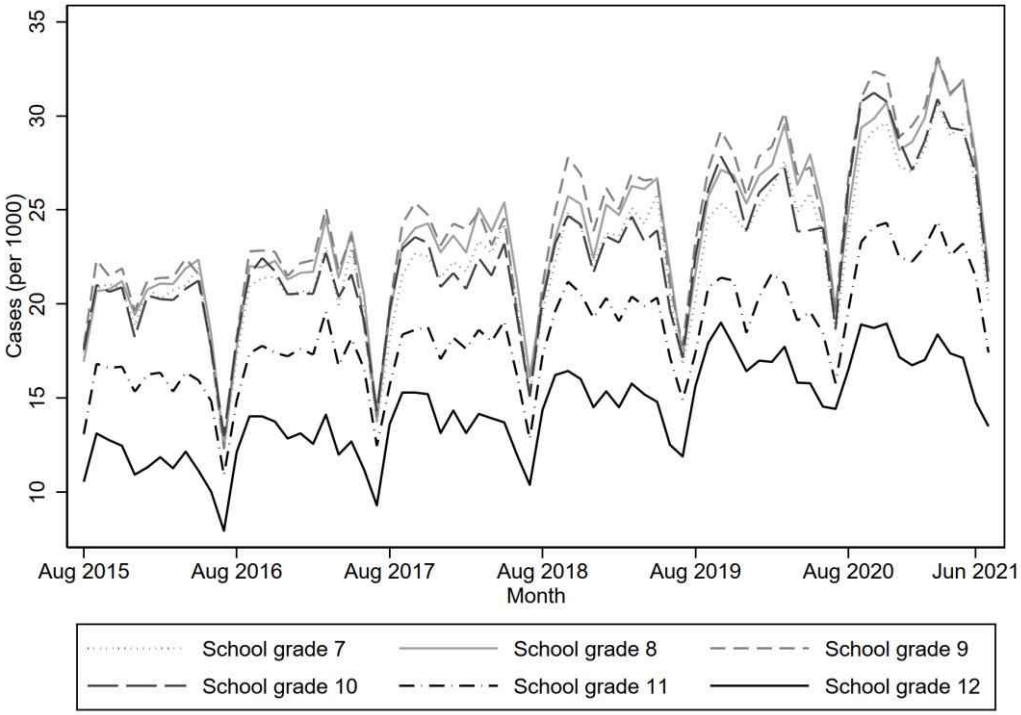

FIGURE D3. SHARE OF STUDENTS RECEIVING CARE OR PRESCRIPTION DRUGS FOR ADHD BY SCHOOL GRADE

Notes: The table displays the share of students in school years 7-12 receiving care related to ADHD (a diagnosis within the ICD10 chapter F90 or a prescription for drug within ATC-code N06A or C02AC02), per month August 2015-June 2021. The shaded areas indicate periods with different remote teaching regimes. See discussion in main text Section 1.A. From the left: April-June 2020, most upper secondary students had remote teaching and lower secondary students had teaching in school; August-November 2020 some, mainly upper-secondary students were exposed to some remote teaching; December 2020- January 2020 2020 large share of mainly upper secondary students were exposed to remote teaching; February-March 2021 some students in both upper-and lower secondary schools had remote teaching.

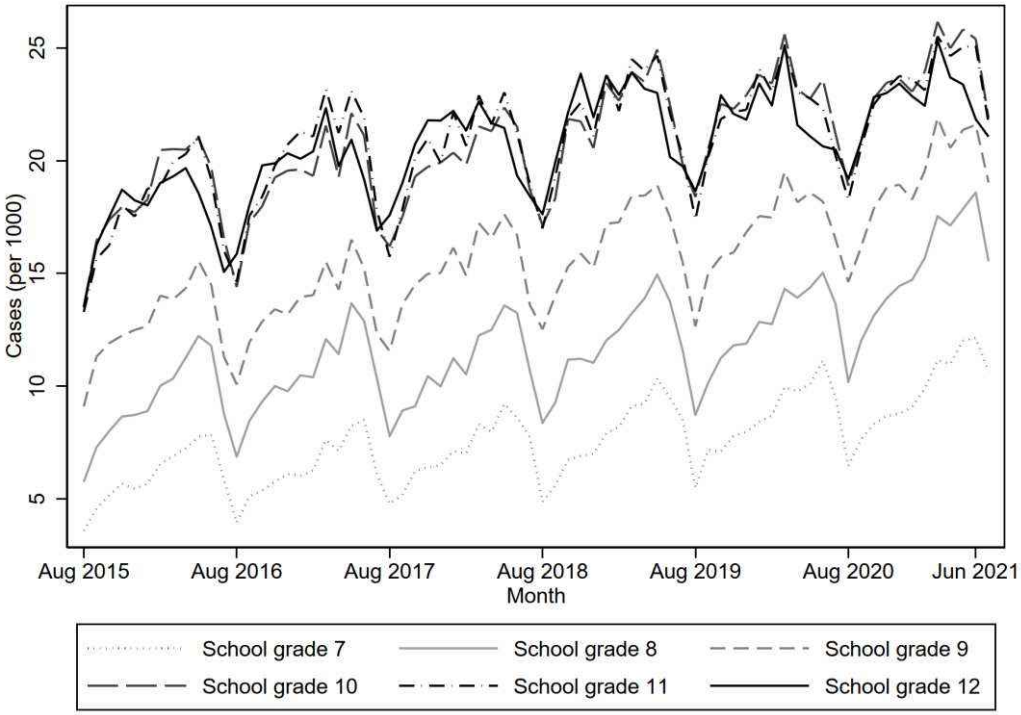

FIGURE D4. SHARE OF STUDENTS RECEIVING CARE OR PRESCRIPTION DRUGS FOR DEPRESSION AND ANXIETY BY SCHOOL GRADE

Notes: The table displays the share of students in school years 7-12 receiving care related to depression or anxiety (a diagnosis within the ICD10 chapter F32-F34, F40-F43 or a prescription for drug within ATC-code N05), per month August 2015-July 2021. The shaded areas indicate periods with different remote teaching regimes. See discussion in main text Section 1.A. From the left: April-June 2020, most upper secondary students had remote teaching and lower secondary students had teaching in school; August-November 2020 some, mainly upper-secondary students were exposed to some remote teaching; December 2020- January 2020 2020 large share of mainly upper secondary students were exposed to remote teaching; February-March 2021 some students in both upper-and lower secondary schools had remote teaching.

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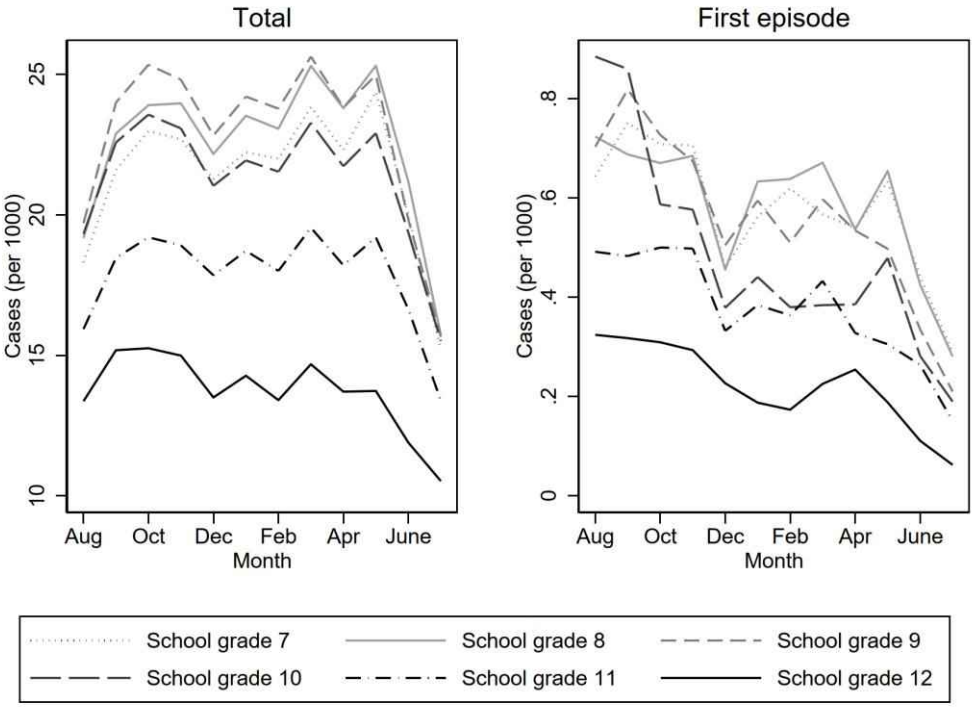

FIGURE D5. ADHD OVER THE SCHOOL YEAR, AVERAGE 2016-2019

Notes: The left panel displays the share of students in school years 7-12 receiving care related to ADHD (a diagnosis within the ICD10 chapter F90 or a prescription for drug within ATC-code N06A or C02AC02), per month, average 2017-2019. The right panel displays the share of student receiving an ADHD diagnoses or prescription since July 2015, average 2017-2019.

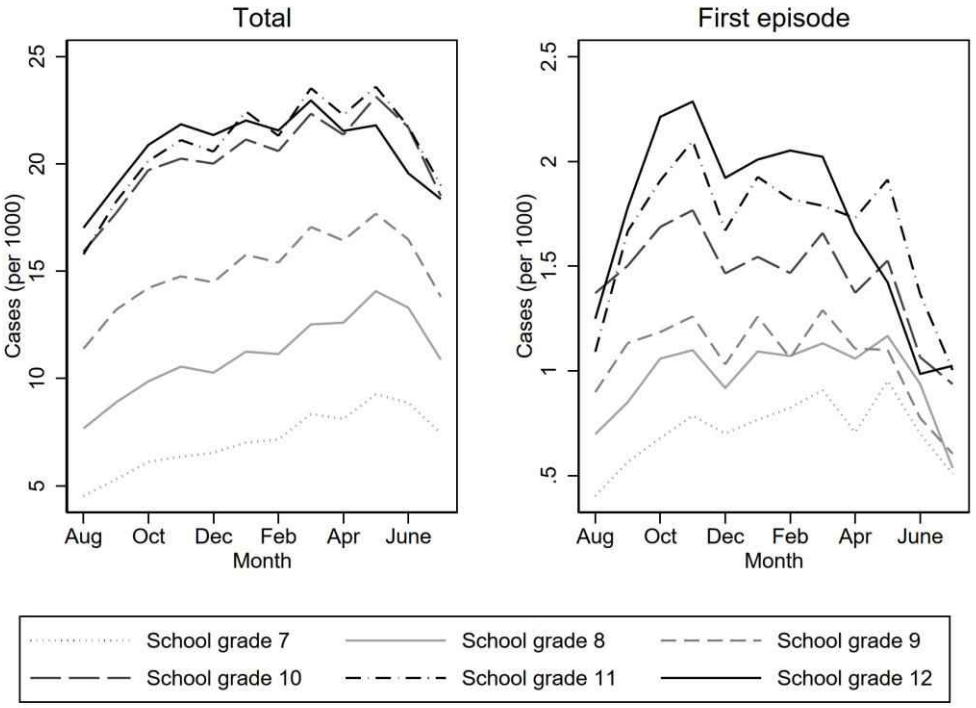

FIGURE D6. DEPRESSION AND ANXIETY OVER THE SCHOOL YEAR, AVERAGE 2016-2019

Notes: The left panel displays the share of students in school years 7-12 receiving care related to depression or anxiety (a diagnosis within the ICD10 chapter F32-F34, F40-F43 or a prescription for drug within ATC-code N05), per month, average 2017-2019. The right panel displays the share of student receiving a diagnoses or prescription since July 2015, average 2017-2019.

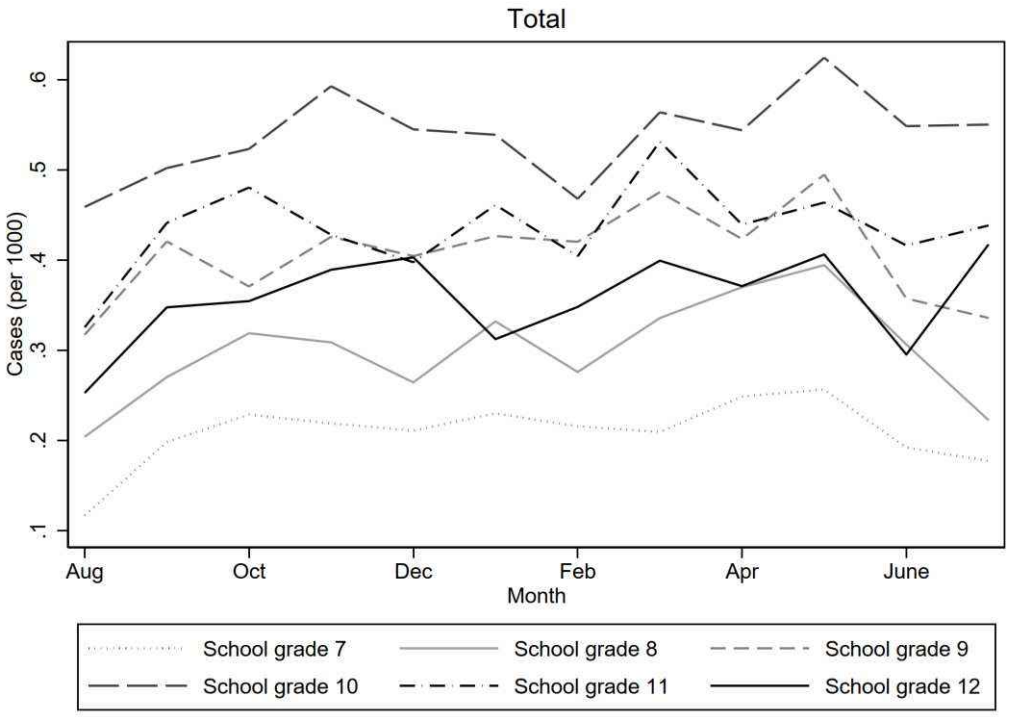

FIGURE D7. SELF-DESTRUCTIVE BEHAVIOR OVER THE SCHOOL YEAR, AVERAGE 2016-2019

Notes: The table displays the share of students in school years 7-12 receiving care related to self-destructive behavior (a diagnosis within the ICD10 chapters X6, X7, X80-X84, Y1, Y2, Y30-Y34 FXXX), per month, average 2017-2019.

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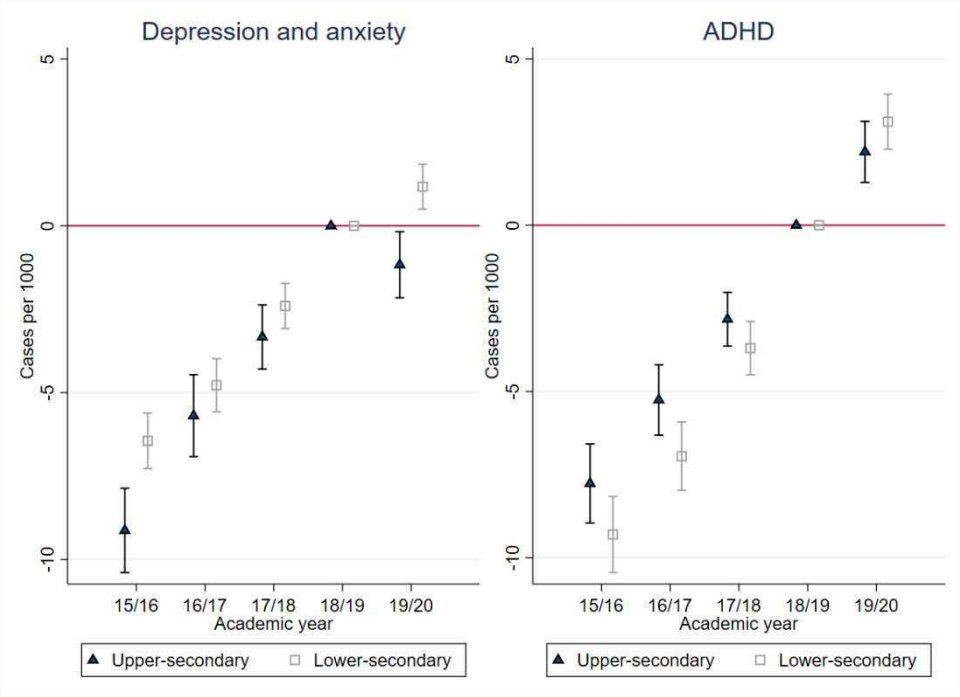

FIGURE D8. TRENDS IN DEPRESSION AND ANXIETY AND ADHD, APRIL–JUNE

Notes: The left panel shows diagnoses or prescriptions for depression and anxiety (diagnoses ICD10 F40-F42, F32-F34, and antidepressants ATC N06A) and the right panel for ADHD (diagnoses ICD10 F90, prescription ATC N06B and C02AC02) during April–June each respective academic year, with 2018/19 used as the reference year. The figures show estimates from separate linear regressions for upper- and lower-secondary students using year fixed effects and control variables: sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size, and if the biological parents live in the same household. Standard errors are clustered at the school level, and 95 percent confidence intervals are indicated.

Tables

TABLE D1. MENTAL HEALTHCARE CONTACTS, APRIL-JUNE

	(1) Without controls	(2) With controls
Upper-sec × 2016	-0.42	-1.13
	(1.27)	(1.21)
Upper-sec × 2017	0.64	0.26
	(1.17)	(1.11)
Upper-sec × 2018	-0.14	-0.15
	(0.91)	(0.88)
2019 (ref)	Ref	Ref
Upper-sec × 2020	-3.83	-3.71
	(0.94)	(0.90)
Mean dep var (2019)	85.21	85.21
Estimate (%)	-4.49	-4.35
R2	0.001	0.025
N	3,276,398	3,276,398

Notes: DID estimates from model (1), corresponding to Figure 3. The dependent variable is mental healthcare contacts (diagnoses or prescription drugs) scaled to represent cases per 1000. The model in column (1) is without covariates. The model in column (2) adjusts for: sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size and if the biological parents live in the same household. Lower-secondary students act as the control group for upper-secondary students. Standard errors in parentheses are clustered at school level.

TABLE D2. RESULTS BY STUDENT AND PROGRAM CHARACTERISTICS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Males	Females	Academic	Vocational	Preparatory	Recent care	No recent care
Upper-sec × 2016	1.83	-4.49	1.24	-6.37	1.14	-7.96	0.47
	(1.43)	(1.67)	(1.37)	(1.81)	(3.16)	(5.49)	(0.44)
Upper-sec × 2017	0.02	0.49	2.19	-3.21	0.92	4.66	0.12
	(1.25)	(1.63)	(1.28)	(1.65)	(2.98)	(5.42)	(0.43)
Upper-sec × 2018	-1.07	0.91	0.92	-1.75	-2.87	2.49	0.61
	(1.04)	(1.31)	(1.02)	(1.38)	(2.29)	(4.91)	(0.41)
2019 (ref)	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Upper-sec × 2020	-4.25	-3.22	-4.93	-2.80	-0.49	1.65	-2.39
	(1.10)	(1.29)	(0.97)	(1.35)	(2.60)	(4.69)	(0.42)
Mean dep var (2019)	67.69	104.90	68.65	102.81	123.51	600.34	14.38
Estimate (%)	-6.28	-3.07	-7.18	-2.72	-0.40	0.27	-16.58
R2	0.025	0.028	0.021	0.026	0.042	0.034	0.003
N	1,706,036	1,570,362	2,600,185	2,111,199	1,829,838	331,399	2,944,999

Notes: DID estimates from model (1), corresponding to Figure 4. The dependent variable is mental healthcare contacts (diagnoses or prescription drugs) scaled to represent cases per 1000. The model in column adjusts for: sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size and if the biological parents live in the same household. Lower-secondary students act as the control group for upper-secondary students. Standard errors in parentheses are clustered at school level.

TABLE D3. NUMBER OF STUDENTS BY PREDICTED GPA AND PARENTS' OCCUPATION TELEWORKABLE 2020

	Not teleworkable	Teleworkable	No information of occupation	Total
Predicted GPA lowest tercile	139 941	25 058	63 368	229 267
Predicted GPA mid tercile	138 052	90 632	7 524	236 208
Predicted GPA highest tercile	65 482	161 584	2 196	229 262
Total	343 475	278 174	73 088	694 737

Notes: Students split by tercile of predicted grade point average (GPA) tabulated against at least one parent having a teleworkable occupation, and missing information on parents' occupation.

TABLE D4. RESULTS BY STUDENT BACKGROUND AND PARENTAL CHARACTERISTICS

	(1) Low GPA	(2) Medium GPA	(3) High GPA	(4) Tele-workable	(5) Not tele-workable	(6) In risk group	(7) Not risk group
Upper-sec × 2016	3.44	-2.22	-4.14	-2.19	0.36	-0.93	-1.41
	(1.94)	(1.83)	(1.67)	(1.76)	(1.61)	(1.82)	(1.34)
Upper-sec × 2017	3.84	-0.59	-2.01	-0.79	1.32	0.46	0.13
	(1.75)	(1.73)	(1.62)	(1.63)	(1.49)	(1.63)	(1.28)
Upper-sec × 2018	2.61	-0.30	-2.28	-1.51	1.36	0.18	-0.35
	(1.48)	(1.47)	(1.33)	(1.36)	(1.22)	(1.40)	(1.01)
2019 (ref)	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Upper-sec × 2020	-1.28	-5.36	-4.84	-5.37	-2.56	-4.70	-2.48
	(1.51)	(1.53)	(1.27)	(1.28)	(1.24)	(1.47)	(1.03)
Mean dep var (2019)	85.93	91.45	78.05	89.19	90.82	99.59	77.74
Estimate (%)	-1.49	-5.86	-6.20	-6.02	-2.81	-4.72	-3.19
R2	0.049	0.015	0.010	0.015	0.028	0.026	0.024
N	1,081,228	1,113,973	1,081,197	1,239,372	1,624,261	1,313,115	1,893,005

Notes: DID estimates from model (1), corresponding to Figure 5. The dependent variable is mental healthcare contacts (diagnoses or prescription drugs) scaled to represent cases per 1000. Low/Medium/High GPA refers to terciles of predicted grade point average. Definitions of teleworkable parental occupation and parental medical risk group in Online Appendix C. The model in column adjusts for: sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size and if the biological parents live in the same household. Lower-secondary students act as the control group for upper-secondary students. Standard errors in parentheses are clustered at school level.

TABLE D5. RESULTS BY STUDENT CHARACTERISTICS FOR STUDENTS IN ACADEMIC PROGRAMS

	(1) Males	(2) Females	(3) Recent care	(4) No recent care
Upper sec × 2016	2.73	0.11	-7.41	0.42
	(1.56)	(1.87)	(6.96)	(0.50)
Upper sec × 2017	0.92	3.48	8.07	0.36
	(1.35)	(1.82)	(6.73)	(0.50)
Upper sec × 2018	-0.40	2.36	2.03	0.63
	(1.16)	(1.46)	(6.10)	(0.46)
2019 (ref)	Ref	Ref	Ref	Ref
Upper sec × 2020	-4.32	-5.60	-3.61	-2.25
	(1.19)	(1.35)	(5.80)	(0.46)
Mean dep var (2019)	51.73	84.06	613.63	12.45
Estimate (%)	-8.35	-6.66	-0.59	-18.07
R2	0.025	0.020	0.025	0.003
N	1,299,383	1,300,802	228,186	2,371,999

Notes: DID estimates from model (1). Sample consists of lower secondary students and students in academic upper-secondary programs. The dependent variable is mental healthcare contacts (diagnoses or prescription drugs) scaled to represent cases per 1000. The model in column adjusts for: sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size and if the biological parents live in the same household. Lower-secondary students act as the control group for upper-secondary students. Standard errors in parentheses are clustered at school level.

TABLE D6. RESULTS BY STUDENT BACKGROUND AND PARENTAL CHARACTERISTICS FOR STUDENTS IN ACADEMIC PROGRAMS

	(1) Low GPA	(2) Medium GPA	(3) High GPA	(4) Tele-workable	(5) Not tele-workable	(6) In risk group	(7) Not risk group
Upper-sec × 2016	5.53	1.11	-1.82	0.77	5.21	3.33	0.29
	(2.39)	(2.06)	(1.70)	(1.85)	(1.76)	(2.02)	(1.49)
Upper-sec × 2017	8.30	1.55	-0.68	1.58	4.25	3.23	1.88
	(2.30)	(1.93)	(1.66)	(1.73)	(1.62)	(1.80)	(1.42)
Upper-sec × 2018	5.70	-0.41	-1.00	-0.18	2.95	1.87	0.31
	(1.96)	(1.63)	(1.36)	(1.43)	(1.38)	(1.53)	(1.14)
2019 (ref)	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Upper-sec × 2020	-1.22	-6.33	-5.63	-7.03	-3.81	-6.48	-3.99
	(1.96)	(1.63)	(1.30)	(1.32)	(1.32)	(1.54)	(1.11)
Mean dep var (2019)	67.24	71.99	66.82	73.03	66.51	77.94	62.53
Estimate (%)	-1.81	-8.79	-8.43	-9.63	-5.73	-8.31	-6.39
R2	0.046	0.013	0.008	0.012	0.026	0.022	0.020
N	722,887	883,066	994,232	1,097,647	1,248,441	1,028,654	1,552,107

Notes: DID estimates from model (1). Sample consists of lower secondary students and students in academic upper-secondary programs. The dependent variable is mental healthcare contacts (diagnoses or prescription drugs) scaled to represent cases per 1000. Low/Medium/High GPA refers to terciles of predicted grade point average. Definitions of teleworkable parental occupation and parental medical risk group in Online Appendix C. The model in column adjusts for: sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size and if the biological parents live in the same household. Lower-secondary students act as the control group for upper-secondary students. Standard errors in parentheses are clustered at school level.

TABLE D7. TYPES OF CARE

	(1) Diagnoses	(2) Prescriptions	(3) Unrelated diagnoses	(4) Planned	(5) Not planned	(6) Emergency
Upper-sec × 2016	1.18	-1.03	0.31	1.38	0.25	-0.28
	(0.81)	(1.10)	(0.61)	(0.81)	(0.38)	(0.22)
Upper-sec × 2017	2.08	0.13	0.96	1.94	0.56	0.45
	(0.79)	(1.01)	(0.58)	(0.78)	(0.36)	(0.22)
Upper-sec × 2018	0.87	-0.31	0.31	0.69	0.99	0.11
	(0.67)	(0.80)	(0.53)	(0.67)	(0.35)	(0.21)
2019 (ref)	Ref	Ref	Ref	Ref	Ref	Ref
Upper-sec × 2020	-1.98	-3.05	0.07	-1.45	-1.65	-0.89
	(0.67)	(0.83)	(0.51)	(0.67)	(0.33)	(0.20)
Mean dep var (2019)	40.91	72.94	25.61	38.95	11.91	4.92
Estimate (%)	-4.84	-4.18	0.26	-3.73	-13.88	-18.13
R2	0.012	0.023	0.001	0.011	0.002	0.002
N	3,276,398	3,276,398	3,276,398	3,276,398	3,276,398	3,276,398

Notes: DID estimates from model (1), corresponding to Figure 6. The dependent variable is mental healthcare contacts of different types scaled to represent cases per 1000. "Diagnoses" refers to any mental health diagnoses from specialized psychiatric care; "Prescriptions" to any prescription drug related to mental health issues; "Unrelated" diagnoses to any diagnoses unrelated to mental health or COVID-19; "Planned"/"Unplanned"/"Emergency" refers to type of care visit. The model in column adjusts for: sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size and if the biological parents live in the same household. Lower-secondary students act as the control group for upper-secondary students. Standard errors in parentheses are clustered at school level.

TABLE D8. BY SCHOOL GRADE AND PROGRAM

	(1) All	(2) Academic	(3) Vocational
School year 7 × 2020	-0.95	-0.96	-0.97
	(1.25)	(1.25)	(1.25)
School year 8 (ref)	Ref	Ref	Ref
School year 9 × 2020	-0.73	-0.68	-0.71
	(1.36)	(1.36)	(1.36)
School year 10 × 2020	-2.62	-6.58	1.12
	(1.53)	(1.56)	(2.41)
School year 11 × 2020	-5.04	-5.76	-2.98
	(1.46)	(1.59)	(2.26)
School year 12 × 2020	-4.43	-7.12	0.26
	(1.45)	(1.61)	(2.12)
Mean dep var gr 7 2019	64.90	64.90	64.90
Effect (%) gr 7	-1.46	-1.48	-1.49
Mean dep var gr 9 2019	84.21	84.21	84.21
Effect (%) gr 9	-0.86	-0.81	-0.84
Mean dep var gr 10 2019	91.67	66.50	115.61
Effect (%) gr 10	-2.85	-9.90	0.97
Mean dep var gr 11 2019	85.52	70.75	104.62
Effect (%) gr 11	-5.90	-8.15	-2.85
Mean dep var gr 12 2019	76.13	68.90	85.83
Effect (%) gr 12	-5.81	-10.34	0.31
R2	0.026	0.021	0.026
N	3,276,398	2,600,185	2,111,199

Notes: DID estimates from model (2), corresponding to Figure 7. The outcome is mental healthcare contacts (diagnoses or prescription drugs) per 1000 students, measured April–June. The model in column adjusts for: sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size and if the biological parents live in the same household. Lower-secondary students act as the control group for upper-secondary students. Standard errors in parentheses are clustered at school level.

TABLE D9. MENTAL HEALTHCARE CONTACTS SCHOOL GRADES 9 AND 10

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Any contact			Depression/anxiety			ADHD		
	All	Acad	Voc	All	Acad	Voc	All	Acad	Voc
Upper-sec × 2016	0.77	2.46	-3.49	-1.63	1.08	-3.16	1.79	2.90	-2.34
	(1.88)	(2.06)	(2.91)	(1.22)	(1.41)	(1.84)	(1.32)	(1.26)	(2.26)
Upper-sec × 2017	1.46	3.68	-0.94	-0.37	2.32	-1.91	1.57	2.20	-1.91
	(1.85)	(2.02)	(2.99)	(1.24)	(1.42)	(1.97)	(1.31)	(1.29)	(2.22)
Upper-sec × 2018	0.08	1.14	0.81	-1.46	-0.05	-1.39	1.98	2.31	1.25
	(1.69)	(1.88)	(2.77)	(1.14)	(1.32)	(1.82)	(1.17)	(1.18)	(2.10)
2019 (ref)	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref	Ref
Upper-sec × 2020	-1.45	-4.24	1.04	-2.35	-3.02	-2.54	0.09	-1.35	0.82
	(1.76)	(1.82)	(2.92)	(1.14)	(1.27)	(1.88)	(1.31)	(1.27)	(2.19)
Mean dep var (2019)	91.67	66.50	115.61	45.05	36.62	50.69	41.24	22.78	63.05
Estimate (%)	-1.58	-6.37	0.90	-5.21	-8.26	-5.01	0.22	-5.92	1.30
R2	0.032	0.025	0.030	0.021	0.016	0.020	0.024	0.021	0.021
N	1,170,040	877,611	703,538	1,170,040	877,611	703,538	1,170,040	877,611	703,538

Notes: DID estimates from model (1). Including only school grades 9 and 10. The outcome is mental healthcare contacts (diagnoses or prescription drugs) per 1000 students, measured April–June. (1)-(3) refers to any mental healthcare contact, (4)-(6) to contacts related to depression/anxiety, (7)-(9) to contacts related to ADHD. Acad/Voc refers to academic respective vocational programs. The model in column adjusts for: sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size and if the biological parents live in the same household. Lower-secondary students act as the control group for upper-secondary students. Standard errors in parentheses are clustered at school level.

TABLE D10. MENTAL HEALTHCARE CONTACTS JULY TO DECEMBER 2020

	(1)	(2)	(3)
	Any mental health care use	Depression and anxiety	ADHD
Upper-sec × 2016	-0.38	-2.20	0.60
	(1.55)	(0.98)	(1.07)
Upper-sec × 2017	-0.71	-1.15	0.26
	(1.47)	(0.98)	(1.03)
Upper-sec × 2018	0.26	0.21	-0.42
	(1.18)	(0.81)	(0.81)
2019 (ref)	Ref	Ref	Ref
Upper-sec × 2020	-6.76	-2.72	-2.50
	(1.25)	(0.81)	(0.88)
Mean dep var (2019)	113.25	59.76	46.55
Estimate (%)	-5.97	-4.55	-5.36
R2	0.034	0.026	0.026
N	2,256,637	2,256,637	2,256,637

Notes: DID estimates from model (1), corresponding to Figure 8. Population includes students in grades 7-8, and 10-11 in the spring of 2020. The outcome is mental healthcare contacts (diagnoses or prescription drugs) per 1000 students, measured July–December. (1) Refers to any mental healthcare contact, (2) to contacts related to depression/anxiety, and (3) to contacts related to ADHD. The model in column adjusts for: sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size and if the biological parents live in the same household. Lower-secondary students act as the control group for upper-secondary students. Standard errors in parentheses are clustered at school level.

TABLE D11. MENTAL HEALTHCARE CONTACTS THROUGH DECEMBER 2021

	(1) Apr-Jun 20	(2) Jul-Dec 20	(3) Jan-Jun 21	(4) Jul-Dec 21
Upper sec × 2016	-0.98	0.05	1.11	1.46
	(1.04)	(1.21)	(1.22)	(1.22)
Upper sec × 2017	0.41	0.57	0.40	0.30
	(0.89)	(1.02)	(1.05)	(1.03)
2018 (ref)	Ref	Ref	Ref	Ref
Upper sec × 2020	-3.55	-5.50	-6.03	-7.89
	(1.09)	(1.25)	(1.27)	(1.23)
Mean dep var (2018)	80.49	103.81	108.80	106.70
Estimate (%)	-4.41	-5.29	-5.54	-7.39
R2	0.025	0.030	0.031	0.031
N	2,600,531	2,600,531	2,600,531	2,600,531

Notes: DID estimates from model (1), corresponding to Figure 9. The outcome is any type of mental healthcare contact (diagnoses or prescription drugs) per 1000 students for the indicated time-periods. The model in column adjusts for: sex, birth month, newly immigrated to Sweden, parental foreign background, income, education, income from social security systems, family size and if the biological parents live in the same household. Lower-secondary students act as the control group for upper-secondary students. Standard errors in parentheses are clustered at school level.