The effect of COVID-19related school closures on students' well-being: Evidence from Danish nationwide panel data

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# The effect of COVID-19-related school closures on students' well-being: Evidence from Danish nationwide panel data

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## Abstract

We study the effect of the temporary closure of Danish schools as a result of the COVID-19 pandemic in spring 2020 on students' reported levels of well-being and test whether the effect varies among students of different socioeconomic status. To this end, we draw on panel data from the mandatory annual nationwide Danish Student Well-being Survey (DSWS) and exploit random variation across and within schools in whether students answered the 2020 survey before or during the spring lockdown period. This enables us to compare reported levels of student well-being for selected measures - whether students "like school" and whether they "feel lonely" - among students in grades 6-9 to their responses from previous years. We use an event-study design with individual as well as year and month fixed effects. Our results indicate, firstly, that students' well-being with respect to liking school improved during the lockdown, even if students who answered during vs. before the lockdown were not on parallel trends in terms of previous levels of reported well-being. Secondly, school closures seemed to have no effect on students' reported levels of loneliness. Thirdly, the spring lockdown seemed to have a more positive impact among students of lower socioeconomic status.

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## Ethics approval statement

The data was anonymized and de-identified by Statistics Denmark before it was made available to the researchers. Under Danish law the data can be used for research purposes by individuals affiliated with a Danish research institution, without the need for ethical approval of the specific study.

## 1. Introduction

Few events in recent history have shaped education as profoundly as the COVID-19 pandemic. According to statistics from the United Nations, school closures have affected virtually all (94 percent) the world's students at all levels of education (United Nations, 2020), meaning that extended periods of online teaching or homeschooling have become regular occurrences in the lives of students across the globe. These COVID-19 induced lockdowns have led to serious concerns regarding students' academic progress and their well-being. At the same time, the COVID-19 pandemic can exacerbate existing patterns of social inequalities in education (Grasso et al., 2021, p. 7). Initial studies of the effects of the spring 2020 lockdown in the Netherlands demonstrated that the learning loss due to closed schools is more pronounced among students of lower socioeconomic status (SES) (Engzell et al., 2021; Nationaal Cohortonderzoek Onderwijs, 2021). Furthermore, studies across multiple countries have shown that children from lower SES backgrounds receive less support from their parents and spend less time on homeschooling activities compared to their more privileged peers (Bol, 2020; Dietrich et al., 2020; Jæger & Blaabæk, 2020; Reimer et al., 2021). While most scholars would agree that students will learn less if they are taught remotely, predictions regarding the effects of school closures on students' well-being are less straightforward given that not having to attend school physically can potentially lead to both positive and negative student reactions. For example, in a qualitative study of children's well-being during the lockdown in Spain, Mondragon et al. (2021) found that students had mixed feelings concerning the lockdown as they enjoyed the additional time spent with their parents, but also felt lonely and missed their friends. At the same time, prolonged levels of social isolation can be linked to increased levels of loneliness and worse mental health outcomes for school students and young adults (Bu et al., 2020; Loades et al., 2020). Most existing studies on students' well-being during the initial lockdowns have been based on cross-sectional designs without baseline measurements of students' well-being prior to the lockdown, which makes it difficult to gauge the impact of school closures on students' well-being (Racine et al., 2020).

Against this background, we study the effect of the temporary closure of Danish schools in the spring of 2020 (subsequently labelled "spring lockdown")<sup>1</sup> on students' reported levels of well-being and test whether the effect varies for students of different SES. To this end, we draw on panel data from the mandatory annual nationwide Danish Student Well-being Survey (DSWS) and exploit random variation across and within schools in whether students answered the survey before or during the spring 2020 lockdown period. This enables us to compare reported levels of student well-being for selected measures – whether students "like school" and whether they "feel lonely" – among students in grades 6-9 to their responses from previous years. We use an event-study design with individual as well as year and month fixed effects.

<sup>&</sup>lt;sup>1</sup> We provide a more detailed overview of the timing and length of school closures in Figure 1.

## 2. Schools and student well-being

Schools have the potential to influence students' well-being positively, as they provide an important context for students' friendships and create opportunities for success and self-fulfillment (Graham et al., 2016; Holfve-Sabel, 2014; Kaplan & Maehr, 1999; Konu et al., 2002). Furthermore, attending school provides students with daily routines and structure, which might be particularly supportive for students with mental health issues (J. Lee, 2020). However, schools can also be the cause of burnout, distress and depression due to academic pressure and bullying (Hoferichter et al., 2021; Rigby, 2003; Steinmayr et al., 2016; Upadyaya & Salmela-Aro, 2013). At the negative extreme, school attendance has even been associated with increased rates of suicide, with suicide rates among students dropping during school holidays (Hansen & Lang, 2011; Plemmons et al., 2018).

Since schools can have divergent effects on student well-being, it is unclear how school closures might be expected to impact student well-being, with previous studies addressing well-being during the initials lockdowns showing mixed results. In a Danish survey-based study, for example, students reported that they missed their friends and felt lonely during the spring 2020 lockdown (Wistoft et al., 2020), while the aforementioned qualitative Spanish study indicated that students had mixed experiences, happy to spend time with their families, but also missing their peers, feeling lonely and deprived of fresh air (Mondragon et al., 2021). One British study suggested there had been an increase in depression symptoms among children aged 8-12 (Bignardi et al., 2020), while a Dutch study did not find any effect on children's (10-13 years old) externalizing or internalizing behavior (Achterberg et al., 2021). However, these studies have various methodological limitations, such as a reliance on cross-sectional data (Mondragon et al., 2021; Wistoft et al., 2020), limited longitudinal designs that did not adequately account for how student well-being develops with students' age and varies during the school year (Bignardi et al., 2020), or small sample size (Achterberg et al., 2021). These limitations make it difficult to evaluate the impact of the initial lockdowns on students' well-being.

Studies addressing the impact of the initial lockdowns on the well-being of the adult population have used research designs with a stronger foundation for drawing causal conclusions. Nevertheless, these studies' findings echo those of studies addressing the impact on student's well-being. Some studies found that the initial lockdowns led to reduced levels of well-being in the adult population (Ettman et al., 2020; Huebener et al., 2021; Peretti-Watel et al., 2020), while others found an improvement in well-being (Andersen et al., 2021; Recchi et al., 2020; Sachser et al., 2021). As noted by Andersen et al. (2020), a possible explanation for these differences can be related to the severity of the COVID-19 pandemic in different countries, with Denmark being at the lower end of the scale.<sup>2</sup>

Given the divergent effects of schooling on students' well-being and the mixed results of previous research on the effect of the initial lockdowns on well-being among both students and adults, our first research question (R1) is: *Did the spring lockdown increase or decrease students' well-being?* 

<sup>&</sup>lt;sup>2</sup> As of May 21<sup>st</sup> 2021, the reported cumulative death toll due to COVID-19 in Denmark was 2.505 (World Health Organization, 2021) – with a population size of ~ 5,800,000

#### 2.1. Heterogeneous impact of lockdowns according to students' SES

Previous research has established that students from more highly educated and higher-income families not only perform better in school (Jackson, 2013), they also experience "greater satisfaction with school, and higher social and psychological well-being" (Loft & Waldfogel, 2020, p. 1). Similarly, Erikson and Jonsson, (1996, p. 22) argue that the consumption value of schooling is higher for high-SES children because "... they like being in school better". Multiple factors can contribute to SES gradients in school-related well-being. It can be assumed that SES differentials in academic performance will, to some degree, translate into SES differentials in well-being at school. The quality of the teacher-student relationship is, for example, strongly associated with academic outcomes (Baker, 2006; OECD, 2015). Consequently, high-SES students tend to have more positive relationships with their teachers (Xuan et al., 2019); they are also less often the victims of bullying at school (Jansen et al., 2012; Tippett & Wolke, 2014).

Sociological research applying a so called "seasonal" or "summer-learning" perspective has established that inequalities in student learning tend to increase when students are not in school due to the fact that attending school offers low-SES students a more favorable learning environment compared to staying at home (Alexander et al., 2001; Downey et al., 2004; Downey, Quinn, et al., 2019). Following this perspective, one can assume that differences in student well-being will be larger during the lockdown compared to when the students are in school. This assumption is based on the fact that high-SES parents are typically in a position to both offer more parental support and provide better at-home school facilities, such as the child having their own computer during the lockdown (Bol, 2020), and thus will be able to create a superior homeschooling environment that will allow their children to thrive. Parents from lower-SES strata, meanwhile, are less likely to have employment that allows for remote work from home and might therefore not have been present to provide care while schools were closed. Furthermore, one can assume that the negative financial impact of the shutdown affected low-SES families to a greater degree. For example, there was a surge in unemployment due to the pandemic in March 2020 in Denmark (Styrelsen for Arbejdsmarked og Rekruttering, 2020), which low-SES families were likely more exposed to - potentially leading to negative effects for children from these families (Brand, 2015; Weiland & Yoshikawa, 2012).

A contrasting perspective can be formulated based on findings from literature on the examining the development of students' *non-cognitive skills* during the school holidays. Downey, Workman, et al. (2019) found, for example, that SES-related gaps in social and behavioral skills at the start of kindergarten did not increase during schools holidays. Potentially, the factors discussed above leading to an SES gradient in well-being, such as more frequent experiences of academic failure or negative interactions with teachers, might be absent or reduced when students stay at home. Furthermore, given that high-SES students spend more time on homeschooling activities than their lower-SES peers (Dietrich et al., 2020), the latter group might have more time to pursue leisure activities, which might increase their well-being. Finally, the spring lockdown did not only cause a shutdown of schools, but also of all after-

school activities, such as participation in organized sports or music programs.<sup>3</sup> Numerous studies have established that high-SES children are more likely to participate in these types of activities (Coulangeon, 2018; Lareau, 2011; Mikus et al., 2020). The everyday lives of students from high-SES backgrounds might therefore have been more affected by the cancellation of these activities compared to low-SES students, who were less likely to participate in the first place. In summary, these arguments lead to the following research question (*R2*): *Will existing SES-based differences in student well-being be magnified or reduced during the spring lockdown*?

## 3. The Danish context

Figure 1 presents a timeline and overview of the most important restrictions and events related to the pandemic during spring 2020 in Denmark. On March 11, a nationwide lockdown was announced in Denmark, including the closure of schools and many other public institutions – measures that were in full effect by March 16 (Statsministeriet, 2020). The Danish Government began to ease lockdown restrictions on April 15, with all students from grades 0-5 allowed to return to school by April 20. On May 18, students in grades 6-9 were also allowed back to school.

While students in grades 6-9 ended up having to stay at home for nine weeks, the lockdown was initially announced as only lasting for two weeks. The repeated extensions of the restrictions might have tempered the initial negative impact on well-being, as parents and students believed they only had to stay at home for a short period. Furthermore, the school closures coincided with a general shutting down of society, which likely also influenced students' well-being. Finally, it is important to note that, while schools and many other parts of society were locked down, small social gatherings below 10 persons were still allowed,<sup>4</sup> and there was no curfew or other restrictions in terms of leaving one's residence, unlike in many other countries.

Another factor worthy of mention is that, according to the OECD, 95.4 % of all households in Denmark have access to the internet (8<sup>th</sup> highest worldwide), and 93.1 % of all households have a computer at home (6<sup>th</sup> highest) (OECD, 2021), providing a strong foundation for the necessary switch to online teaching and learning. It is also important to note that Denmark is an educational system with so called "late-tracking" and all students attend compulsory school (*folkeskole*) together from grades 0-9 indicating that students in grade 6-9 are not sorted or streamed in different tracks.<sup>5</sup>

<sup>&</sup>lt;sup>3</sup> Figure 1 reports the dates when some of the lockdown measures were suspended. Organized outdoor sports activities, for example, reopened May 7, 2020. Most lockdown responses were collected before that date.
<sup>4</sup> The generative data activities are then 10 different research.

<sup>&</sup>lt;sup>4</sup> The government recommended not seeing more than 10 different people.

<sup>&</sup>lt;sup>5</sup> However, 18.1% of the student population attended private schools in the 2019/2020 school year (Børne- og Undervisningsministeriet, 2021).



Figure 1. Timeline over corona-restrictions in Denmark

Note. The figure present the most important events during the spring lockdown in Denmark.

## 4. Data

We combine data from the Danish Student Well-being Survey (DSWS) with the Danish administrative registers. Data were merged using unique personal identification numbers. The DSWS is a mandatory survey for all students in public primary and lower secondary school. The survey has been conducted annually since 2014/2015. A more limited survey is used for students in grades 0-3 compared to those attending grades 4-9. We primarily use the survey for students in grades 4-9 and further restrict our sample to students in grades 6-9 as this group was at home for nine weeks while younger students returned to school after five weeks already (in Appendix H, we present additional results for grade 5 students). The survey was conducted during the spring semester, with schools deciding when during the semester the students should answer the survey. The exact timing of the survey has varied over the years. In 2020, the first schools started conducting the survey, with 10 % doing so during the lockdown and the remaining 15 % after returning to school. It is important to note that the Danish Ministry of Education allows schools to decide independently when to distribute the well-being survey among their students within a specified period.

The Danish administrative registers contain detailed background information on students and their parents, providing accurate and reliable measures of parents' SES, which, especially for younger students, is preferable compared to self-reported answers (Engzell, 2019). The combination of the mandatory DSWS survey and population registers provides us with information on everyone in our study population, including students who likely would not participate in a voluntary survey study. In the context of the lockdown, this is important, as systematic nonresponse seems otherwise probable, particularly among students' with lower levels of well-being or engagement with school.

We exclude students attending schools for students with special needs and students who are two or more years above or below the designated age for their grade. We also exclude students who answered the survey after they had returned to school, analyzing responses from this group separately (see appendix G). We also drop 10 students who answered the survey 10 weeks before all other students in 2018, and 26 students who answered a few weeks later in 2017. Furthermore, students with missing values and students who had answered they did not want to answer the specific questions (6.9 %) were also excluded.<sup>6</sup> In total, we include 123,530 students from a total sample of 179,724 students.

#### 4.1. Measures

#### **4.1.1. Dependent variables**

Overall, student well-being is a multidimensional concept that can be conceived of as having psychological, physical, social, material and cognitive dimensions (Borgonovi & Pál, 2016, p. 10). The DSWS was developed to assess multiple dimensions<sup>7</sup> of student well-being *in school* or in relation to school, with questions such as "Are you afraid of being made fun of at school?", "How often do you feel safe at school?" and "Have you been bullied during the current school year?". However, it can be problematic to use many of these survey questions in a situation where students are not physically attending school. Consequently, we selected two items from the DSWS that seem equally applicable in a normal situation vs. enforced homeschooling. These two items are (1) "Do you feel lonely? and (2) "Do you like your school?" We believe these two items capture central aspects of students' psychological (liking school) and social (feeling lonely) well-being. Furthermore, in recent years, loneliness has been identified as a serious public health concern that is associated with multiple negative health outcomes (Cacioppo & Cacioppo, 2018). All of the items used in the analysis are based on a five-point Likert-scale: Liking school is coded so 1 denotes a negative response and 5 a positive response, while loneliness is reverse-coded so 1 denotes not feeling lonely and 5 denotes feeling lonely. All dependent variables are standardized to a mean of zero and a standard deviation of one.

<sup>&</sup>lt;sup>6</sup> This percentage is comparatively low given the panel-nature of the data. Because the proportion of missing values was spread evenly across students who answered before and during the lockdown, we decided against applying a missing imputation procedure.

<sup>&</sup>lt;sup>7</sup> The DSWS includes items with the goal of measuring the following dimensions of students' well-being: Social well-being, academic well-being, support and inspiration, and disciplinary climate (in Danish "ro and orden") (Ministry of Children and Education, 2016).

#### 4.1.2. The lockdown

The DSWS contains timestamps for when the students answered the survey. We assign lockdown status to students who answered the DSWS survey between the first official day of the lockdown, March 16 2020, and the last day of the initial lockdown on May 18 2020.

#### 4.1.3. Socioeconomic status

We use data from the administrative registers concerning the mother's highest formal level of educational attainment and the parents' average disposable income. Mother's highest level of formal education was dummy coded as college degree/no college degree. Parents' disposable income was coded into a dummy for above or below the median, and into quartiles.

#### 4.2. Method

The data presented above provide us with both a control group, comprising students who participated in the well-being survey before the lockdown, and a treatment group, comprising students who responded during the lockdown. Furthermore, the data enable us to compare responses to a baseline measurement, as we also have access to students' DSWS responses from prior years. We examine the change in well-being from previous years for students who answered the survey during the lockdown compared to students who answered before the lockdown. Our event-study approach allows us to assess the change in student's well-being while controlling for fixed differences across individuals and time (Cunningham, 2021). We estimate:

 $Y_{igtm} = \lambda_i + \gamma_t + \tau_m + \upsilon_g + \sum_{r=q}^{2019} \mu_r D_i + \sum_{r=2020}^m \delta_r D_i + \varepsilon_{igtm}$ (1)

where  $Y_{igtm}$  is the outcome for student *i*, in grade *g*, in year *t*, and month *m*. The variable  $D_i$  equals 1 if student *i* answered the survey during the lockdown, and 0 otherwise.  $\delta_r$  measures the effect of the lockdown in 2020.  $\mu_r$  measures leads prior to 2020 when the lockdown took place, and is zero in all years for the students who did not respond during the lockdown. The omitted category is r=2019, the year prior to the lockdown. Therefore, each estimate of  $\mu_r$  indicates the change in well-being relative to 2019. If the well-being among students who answered during the lockdown and prior to the lockdown exhibits similar trends, we expect the estimated coefficients for the previous years to be small and not statistically significant. Significant differences will suggest that the groups were not on parallel trends. The estimates of  $\mu_r$  work as a placebo test, indicating whether treatment vs. control students had different levels of well-being in prior years, which can indicate, but not guarantee, parallel trends (Kahn-Lang & Lang, 2020).

The model also includes individual-level fixed effects  $(\lambda_i)$ , year fixed effects  $(\gamma_t)$ , month fixed effects  $(\tau_m)$ , and controls for the grade the students attend  $(v_g)$ . The individual-level fixed effects account for observed and unobserved time-invariant characteristics of the individual, such as socioeconomic status, gender and ethnicity. The year fixed effects account for timevarying shocks that are common to all students irrespective of whether they answered during the lockdown. The month fixed effects control for common factors in the months that might impact well-being, such as the transition from winter and early spring to late spring.  $\varepsilon_{igtm}$  is the error term. To test the existence of an SES gradient, we introduce an interaction term in the model. We test interactions with the different treatment indicators and the two variables for parental SES (mother obtained a college degree or not and parents' average disposable income is below or above the median).

#### 5. Analysis

#### 5.1. Descriptive analysis

In Table 1, we compare characteristics of students who answered before and during the springlockdown of schools in Denmark. Overall, the groups are very similar across the observed socio-demographic background indicators, suggesting no systematic selection bias.

|                              | Control-Group | Lockdown | Difference |
|------------------------------|---------------|----------|------------|
| Boys                         | 0.51          | 0.50     | 0.01       |
| Immigration-status           |               |          |            |
| Danish                       | 0.89          | 0.90     | 0.01       |
| First generation immigrant   | 0.04          | 0.04     | 0          |
| Second generation            | 0.07          | 0.07     | 0          |
| immigrant                    |               |          |            |
| Income Quartiles             |               |          |            |
| 0-25                         | 0.25          | 0.25     | 0          |
| 25-50                        | 0.25          | 0.26     | 0.01       |
| 50-75                        | 0.25          | 0.26     | 0.01       |
| 75-100                       | 0.25          | 0.23     | 0.02       |
| Mother's highest level of ed | ucation       |          |            |
| Compulsory                   | 0.12          | 0.12     | 0          |
| Upper Secondary              | 0.38          | 0.39     | 0.01       |
| Tertiary                     | 0.36          | 0.37     | 0.01       |
| Higher                       | 0.14          | 0.13     | 0.01       |
| N                            | 108.790       | 14.740   |            |

#### Table 1. Descriptive Statistics

*Note.* The descriptive statistics are based on students, who had valid answers on the two outcomes in 2020. Tertiary education refers to short cycle or BA degrees, higher education refers to MA degrees, PhD or higher.

A key identification assumption in our study is that whether students participated in the DSWS before or during the spring lockdown was random. While the students themselves did not decide when to take part in the survey, their schools did. In table 2, we examine the timing of survey participation in previous years for the lockdown and control groups. A slightly larger

percentage of students who answered during the lockdown in 2020 answered during the last month in 2018 and 2019 than was the case for the control group. Overall, these differences seem minor and do not suggest a systematic pattern in the timing of survey participation in previous years. This leads us to believe that the timing of survey participation in 2020 was more or less random. Furthermore, we control for the specific month the student answered the survey.

| 2015     | Control | Lockdown | Difference |
|----------|---------|----------|------------|
| January  | 0.03    | 0.02     | 0.01       |
| February | 0.35    | 0.38     | 0.03       |
| Marts    | 0.62    | 0.60     | 0.02       |
| Ν        | 19.603  | 2.810    |            |
| 2016     |         |          |            |
| January  | 0.13    | 0.14     | 0.01       |
| February | 0.32    | 0.31     | 0.01       |
| Marts    | 0.54    | 0.54     | 0.00       |
| April    | 0.01    | 0.01     | 0.00       |
| Ν        | 45.625  | 6.567    |            |
| 2017     |         |          |            |
| January  | 0.14    | 0.13     | 0.01       |
| February | 0.29    | 0.28     | 0.01       |
| Marts    | 0.57    | 0.59     | 0.02       |
| Ν        | 72.617  | 10.439   |            |
| 2018     |         |          |            |
| Marts    | 0.06    | 0.06     | 0.0        |
| April    | 0.45    | 0.41     | 0.04       |
| May      | 0.48    | 0.53     | 0.05       |
| June     | N/A     | N/A      |            |
| Ν        | 99.347  | 13.464   |            |
| 2019     |         |          |            |
| May      | 0.63    | 0.58     | 0.05       |
| June     | 0.37    | 0.42     | 0.05       |
| Ν        | 108.790 | 14.740   |            |

Table 2. Timing of answers in previous years

Note. A few students answered in June 2018, but the numbers are too small to report for some groups.

Figure 2 illustrates trends for the two outcomes *liking school* and *feeling lonely* over the course of spring 2020. We see that liking school was trending slightly downwards before the spring lockdown. After the lockdown, there was a sharp increase in levels of liking school among student responses, remaining stable during the first three weeks of the lockdown. The fourth week of lockdown corresponded with the 2020 Easter holiday, which could explain the very

low level in this week, with students likely to have been displeased at having to perform a school-related task during their holidays. The much higher levels of liking school among student responses in weeks 5 and 6 may have been 'boosted' by students having enjoyed their holidays, but could also be attributable to statistical noise given the comparatively low N in this period. There was then a return to a level similar to during the first three weeks after the lockdown – a level that remained largely constant even after the students returned to school.



Figure 2. Development of liking school and loneliness in 2020

*Note.* Average values for the two outcomes in 2020. Week 1 is the first week of the lockdown, the students returned to school in week 10. The fourth weeks is the Easter holidays.

There did not seem to be a pronounced change in student responses to the question of feeling lonely following the lockdown, but student responses varied more from week to week during the lockdown than during the pre-lockdown period, which might be related to the relatively low N in some weeks, but might also suggest that the lockdown affected students in heterogeneous ways.

In Figure 3, we present trends for how the two outcomes from 2015 to 2020 for both the lockdown and control groups. It should be noted that figures for 2015 are based solely on students attending grade 9 in 2020, figures for 2016 on students attending grades 8 and 9 in 2020, and so on, meaning that only the 2019 figures are based on all grades (6-9).



Figure 3. Trends in outcomes

For both outcomes, the levels for control group are relatively stable. However, for the lockdown group, a slight downward trend for liking school can be observed from 2017 to 2019.

For 2020, we see a sharp reversal of this trend, with students who answered the survey during the lockdown period reporting higher levels of liking school. The reported levels of loneliness for the lockdown group varied over time, which indicates some noise in the measurement, and the change in 2020 does not exceed swings in some of the previous years. Overall, these trends indicate that the lockdown group and control group were not on parallel trends before 2020. However, these differences may be random fluctuations, which is why we now turn to parametric tests by including leads in the model.

#### 5.2. The effect of the spring lockdown

In Figure 4, the results of the event study are presented, with the figure showing how students' well-being differed compared to the reference year (2019), both in previous years and during the lockdown.

*Note.* The levels in 2015 are only based on students who attended 9<sup>th</sup> grade in 2020, results for 2016 are based on 8<sup>th</sup> and 9<sup>th</sup> grade in 2020 and so forth.



Figure 4. Event study estimates with 95 % confidence intervals

The figure shows that the students reported slightly higher levels of liking school in 2017 and 2018 compared to the 2019 level, suggesting a downward trend consistent with the trends depicted in Figure 3. Concerning student loneliness, the results show a statistically significant lower level in 2017. Overall, the event study indicates that the groups were not on a parallel trend before the school closures, meaning that the estimates of the lockdown's effect on the outcomes are likely biased. Nevertheless, the analysis shows a sharp increase in reported levels of liking school during the lockdown period that far exceeds the observed difference in prior levels. This finding suggests the presence of a causal effect on students liking school – even in light of nonparallel trends. No such causal effect was found for student loneliness.

#### 5.2.1. Robustness checks

We have conducted a number of robustness checks to check the stability of our results. First we repeated our event study using 2017 as the reference year as this is the last year before the downward trend observed in Figure 2, still finding a significant change in students' reported levels of liking school (Appendix C). We also exploited the discontinuities observed in Figure 2 and implement a regression discontinuity design (RDD) based on the 2020 data only (Appendix B). Results are in line with the findings from the event study and indicate a positive effect of the spring lockdown on students' reported levels of liking school and no effects on students' reported levels of loneliness.

Another potential limitation of the presented analysis is that students who answered during the lockdown interpret the question regarding 'liking school' not with reference to the current situation but retrospectively, e.g. with a pre-lockdown situation in mind. Alternatively, students who indicated that they like school during the spring lockdown might simply have missed regular school. We therefore test the effect of the spring lockdown on two indicators of students' somatic complaints that might be less susceptible to retrospective reporting biases:

*Note.* The estimates represent changes in the outcomes compared to the reference year (2019). The coefficient estimate for 2020 represents the lockdown effect. For all coefficient estimates see Appendix A, Table A.1

Students' reports of headaches and stomach pains, both of which might be expected to increase in cases where students feel stressed or unwell (Dooley et al., 2005; Shapiro & Nguyen, 2010). The results are reported in appendix D and suggest a reduction in the frequency of reports concerning both headaches and stomach pains during the spring lockdown. This, in turn, suggests that the positive effect of the spring lockdown on students' reported levels of liking school seems to be a valid finding not affected by students' (mis)understanding of the survey question.

Finally, one might not expect the lockdown to have a negative effect from day one, but that prolonged exposure to the lockdown could have a negative effect on student well-being. In an additional analysis, we therefore also tested whether the length of the lockdown increased or decreased potential effects on well-being by clustering students' survey responses according to every second week into the lockdown (see Appendix E). The analysis shows that positive effect on liking school was largely constant from week 1 to week 9. The analysis also indicates an increase in student loneliness in weeks 7-8, but looking at some of the random fluctuations in students' average reported levels of loneliness in figure 2, it seems likely that this effect was a false positive.

#### 5.3. SES differentials

To assess whether the spring lockdown either magnified or decreased differences in well-being among students of different SES, we introduce an interaction term to the model between the leads and the estimate for the effect of the lockdown, and our two measures of SES: Mother has a college degree or not, and parental income is below or above the median. Figure 5 presents the results from this analysis.



Figure 5. Event study estimates for different socioeconomic status with 95% confidence intervals

*Note.* The estimates represent changes in the outcomes compared to the reference year (2019). The coefficient estimate for 2020 represents the lockdown effect. Coefficient estimates indicate the difference between the high SES group (College educated mother, and parents with above median income) and the low SES group (Non-college educated mother, and parents with below median income Coefficient estimates are presented in Appendix A, Table A.2.

Starting with the mother's highest level of education, the result suggests that students in the lockdown and control groups whose mothers have a college degree were on parallel trends prior to 2020 with respect to whether they reported liking school. For students' reported levels of loneliness, there is an indication that students in the lockdown and control group whose mothers have a college degree were not on parallel trends as the lockdown group had a statistically significant lower level in 2016 compared to their 2019-level. However, the statistically significant difference for loneliness occurs only in 2016, perhaps suggesting that the lockdown and control groups were more similar in the years closer to 2020. While the results suggest parallel trends, the statistical power of the analysis is also reduced as we are looking at smaller groups, and the standard errors for each year are larger. The lower statistical power might leave some differences in pre-trends undetected.

The results in Figure 5 show a lower reported level of liking school and a higher reported level of loneliness in 2020 for students whose mothers have a college degree. To be more precise, the results suggest that the lockdown's overall positive effect on liking school was weaker for students with college-educated mothers than for students with non-college-educated mothers. Furthermore, the results suggest that students with college-educated mothers felt lonelier during the lockdown than they did in previous years, and in comparison to students whose mother did not have a college degree.

For parental income, we found no difference in the lockdown's impact whether above or below the median.

In Appendix F, we replicate the results with more fine-graded definitions of SES; overall, the findings are largely the same. Interestingly, the results show that the differentials reported above for students' mothers' educational attainment are primarily driven by students whose mothers have a master's degree or higher.

Finally, we also examined students' well-being upon returning to school (Appendix G) and found that students still seemed to like school more compared to before the spring lockdown. The results further indicated a slight increase in reported levels of loneliness without signs of any SES gradients (Appendix G). Also, additional results for grade 5 students are very similar to the results for the grade 6-9 students and show elevated levels of liking school and a reduction of loneliness while no significant SES gradients could be found (Appendix H).

## 6. Discussion

In this paper, we have examined 1) whether the temporary lockdown of Danish schools in the spring of 2020 affected students' well-being, measured using indicators for liking school and loneliness, and tested 2) whether the effect varied for students from different socioeconomic status. Our results suggest an increase in students' reported levels of liking school during the spring lockdown despite the fact that those students who answered the survey during the spring lockdown period seem to differ from those who answered before the lockdown in terms of their responses in previous years (violating the "parallel trends" assumption). Surprisingly, this effect was also found for students who responded to the survey after returning to school (Appendix G). No systematic effects emerged in relation to students' reported levels of loneliness. Furthermore, the results indicate that the spring lockdown did not magnify inequalities in students' well-being. We even found a slightly less positive impact for students with more educated mothers compared to students with less educated mothers.

One central concern in relation to the presented analysis is that the selected items might be insufficient or incomplete to capture students' well-being during the period of school closures. However, given that additional analysis based on students' reported somatic complaints follows the same pattern, i.e. pointing towards increased well-being during the spring lockdown, the chosen indicators seem to have sufficient validity. This does not preclude that other aspects of students' well-being were more affected during the lockdown, such as missing their friends (Wistoft et al., 2020).

As noted, the lockdown measures implemented during spring 2020 in Denmark were less restrictive than in many other countries; for example, small social gatherings were still allowed and no curfew was in force. Furthermore, infection and mortality rates, even during the first wave in spring 2020, were relatively moderate in an international comparative perspective. It follows that studies of the effects of the COVID-19 pandemic on students' – or the general population's – well-being need to be situated in their geographical and temporal context. Denmark seems to be a country where the spring 2020 lockdown did not lead to a drastic decrease in students' or adults' well-being. However, since the initial lockdowns, Denmark and many other countries have implemented both a second and third lockdown – lockdowns that have tended to last longer than the initials lockdowns. It is thus quite possible that any initial positive effects have evaporated or been reversed by now.

Foa et al., (2020) made the observation that possible negative effects of the initial lockdowns on well-being can perhaps not be attributed to these lockdowns, but the COVID-19 pandemic more generally. While we are confident, that our research design allowed us to estimate effects of the school-closings on students' well-being, our results still have to be seen in the context of the pandemic. It might very well be that school-closings that are not caused by a threatening global disease might affect students' well-being quite differently.

## 7. Conclusion

Overall, our results show that the spring lockdown of schools in Denmark neither had a general negative effect on students' levels of reported well-being, nor exacerbated existing inequalities in this regard. Rather, the opposite is true. However, it could be that the factors potentially leading to an increase in students' well-being – such as having more free time – are also the factors leading to learning losses, which are more concentrated among lower-SES students (Engzell et al., 2021).

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## Appendix A: Regression tables

|      | Like school | Loneliness |
|------|-------------|------------|
| 2015 | 0.015       | -0.028     |
|      | (0.022)     | (0.021)    |
| 2016 | 0.022       | -0.016     |
|      | (0.015)     | (0.014)    |
| 2017 | 0.026**     | -0.030***  |
|      | (0.012)     | (0.011)    |
| 2018 | 0.021**     | -0.010     |
|      | (0.010)     | (0.009)    |
| 2019 | ref         | ref        |
| 2020 | 0.149***    | 0.002      |
|      | (0.010)     | (0.010)    |
| Ν    | 123.530     | 123.530    |

#### Table A.1. Event study estimates

*Note.* All models are with individual, year and months fixed effects. The model controls for grade-year. Standard errors are clustered at the individual level. p < 0.1, p < 0.05, p < 0.01

|                       | Like School       | Loneliness        |
|-----------------------|-------------------|-------------------|
| 2015 (No college)     | Ref               | Ref               |
| 2015 (College degree) | 0.006 (0.044)     | -0.068 (0.042)    |
| 2016 (No college)     | Ref               | Ref               |
| 2016 (College degree) | -0.041 (0.030)    | -0.101*** (0.028) |
| 2017 (No college)     | Ref               | Ref               |
| 2017 (College degree) | 0.016 (0.024)     | -0.042* (0.023)   |
| 2018 (No college)     | Ref               | Ref               |
| 2018 (College degree) | -0.020 (0.020)    | -0.022 (0.019)    |
| 2019 (College degree) | Ref               | Ref               |
| 2020 (No college)     | Ref               | Ref               |
| 2020 (College degree) | -0.060*** (0.019) | 0.0690*** (0.018) |
| 2015(Below median)    | Ref               | Ref               |
| 2015 (Above median)   | -0.072 (0.044)    | -0.031 (0.042)    |
| 2016 (Below median)   | Ref               | Ref               |
| 2016 (Above median)   | -0.046 (0.030)    | -0.034 (0.028)    |
| 2017 (Below median)   | Ref               | Ref               |
| 2017 (Above median)   | -0.049** (0.024)  | -0.009 (0.023)    |
| 2018 (Below median)   | Ref               | Ref               |
| 2018 (Above median)   | -0.002 (0.020)    | -0.000 (0.020)    |
| 2019 (Above median)   | Ref               | Ref               |
| 2020 (Below median)   | Ref               | Ref               |
| 2020 (Above median)   | -0.027 (0.020)    | -0.018 (0.018)    |
| N                     | 123.530           | 123.530           |

Table A.2. Effects based on socioeconomic status

*Note.* All models are with individual, year and months fixed effects. The model controls for grade-year. Standard errors are clustered at the individual level. p < 0.1, p < 0.05, p < 0.01

## Appendix B: Regression Discontinuity Design

In the Regression Discontinuity Design (RDD) the assignment to a treatment condition based on some observed assignment variable - or running variable - is used to estimate the treatment effect in a non-experimental setting (D. S. Lee & Lemieux, 2010). In the context of the spring lockdown of schools, we exploit that from week to another the schools in Denmark went from being open to closed, and students had to attend online schooling. Our primary identification assumption is that students, who answered one week prior to the lockdown, should not be different from students, who answered one week into the lockdown. Whether a student answered in the two weeks should be arbitrary. A weakness of the RDD is that the longer in time we move from the cutoff, the less valid this assumption becomes, and the RDD can only be expected to provide a local treatment effect, which is valid for the first weeks of the lockdown. However, if only the weeks just prior to and after the lockdown are used in the analysis, the analysis might not have sufficient statistical power to detect an effect (D. S. Lee & Lemieux, 2010). In the context of the spring lockdown, this is of particular importance, as the experience of the lockdown might differ based on whether the lockdown had lasted for one week or eight weeks. A strength for inference in the present context is that the students themselves were not able to manipulate whether they answered during the lockdown.

In the RDD careful consideration must be put into the bin size, here how time is measured, and the bandwidth, here how many days or weeks we include prior to and after the lockdown. We use days and weeks to measures time as they have an intuitive interpretation. In our analysis, we test whether any effects found depends on the number of weeks we include in the analysis. For the RDD we only use data from 2020. We estimate the following model:

$$Y_i = \alpha + \delta Lockdown_i + \beta time_i + \varepsilon_i \quad (B.1)$$

Where Y is the well-being of the student, *i*, Lockdown is an indicator variable equal to one if the students answered after the lockdown was put into effect, time refers to either the weeks or days prior to or after the lockdown that the student answered. In the second model, we include an interaction term between the lockdown variable and the time variable, which allows the slope to take a different shape on either side of the cutoff, otherwise, the observations from before the lockdown would contribute to the estimate for the lockdown (D. S. Lee & Lemieux, 2010). In our initial analysis, time was allowed to have different functional forms, but we did not see any strong trends in our data and for simplicity, we only present results where time is modelled as being linear. Furthermore, to reduce bias from the regression function potentially not being linear, we also estimate the RDD with values closer to the cutoff, which should reduce bias from observations far from the cutoff (D. S. Lee & Lemieux, 2010).

#### Analysis

We present the plots with both weeks and days as the time variable, from the days-plot it became apparent that the announcement of the lockdown might also have had affected student answers. The lockdown was announced on the 11<sup>th</sup> of Marts but was not put into effect before

the 16<sup>th</sup> of Marts. However, families were encouraged to keep their children at from the 12<sup>th</sup> of Marts if it was possible for them (Statsministeriet, 2020); we therefore also present a plot where the days between the announcement and the actual lockdown have been deleted. We do so as it is unclear whether the students answering in those days were already in lockdown, or school. For the days-plot, we only keep a bandwidth with three weeks prior and 18 days after the lockdown, we do so as some 'scatter dots' otherwise would refer to groups that are too small to be investigated following regulations set by Statistics Denmark, no cell values below 3.

In figure B.1, we present plots for the 6<sup>th</sup>-9<sup>th</sup> grade with a linear model fitted. The weeksplot for liking school show that students liking school was downward trending before the lockdown, but also indicate a sharp discontinuation before and after the lockdown, with the lockdown increasing students liking school. Furthermore, the linear line fitted to the data suggests that the initial positive effect decreased in the following weeks. As presented earlier week 4 corresponds with the Easter Holiday, which might also have impacted the following weeks. From the days-plot, we see that the sharp increase in liking school happened after the announcement of the lockdown. However, as mentioned parents were encouraged to keep their children at home from the day after the announcement, which might explain the increase. From the plots, we also see that the linear line fits the data well.

For student loneliness, the plots in figure B.1 suggest that there was no discontinuation in loneliness and that the lockdown did not impact the 6<sup>th</sup>-9<sup>th</sup>-grade students' feelings of loneliness.

The days-plots for both liking school and loneliness reveal that the values vary within the weeks, with positive and negative values in adjacent days.

Table B.1 reports the regression result for the 6<sup>th</sup>-9<sup>th</sup> grade students. In general, the results show a statistically significant positive effect of the lockdown on liking school across the different bandwidth and the two models. When time is modelled as days, and only observation 1 week before and after the lockdown is included the result suggests a negative effect of the lockdown on liking school. However, when days between the announcement and the lockdown are deleted this negative effect disappears, as the negative effect was created by the sharp increase in liking school after the announcement of the lockdown. As noted people were encouraged to keep their children home from school the day after the announcement, which likely caused the increase in students liking school. The results are consistent with the event study and suggest an effect of about 0.15 SD. As noted liking school was downward trending prior to the lockdown, which contributes to the size of the effect. The positive effect of the lockdown should be interpreted in the context of the fact that prior to the lockdown the students were starting to like school less, which could be due to the awareness of the pandemic. The positive local treatment effect on liking school is unlikely to generalize to a context, where homeschooling for all students was not motivated by a pandemic.

Consistent with the plots for loneliness the regression result shows no effect of the lockdown on students feeling of loneliness.

# References

Lee, D.S., Lemieux, T., 2010. Regression Discontinuity Designs in Economics. J. Econ. Lit. 48, 281–355. https://doi.org/10.1257/jel.48.2.281

Statsministeriet, 2020. Pressemøde om COVID-19 den 11. marts 2020 [WWW Document]. URL https://www.stm.dk/presse/pressemoedearkiv/pressemoede-om-covid-19-den-11-marts-2020/ (accessed 2.12.21).

|                   | Like School    |               | Loneliness |            |             |
|-------------------|----------------|---------------|------------|------------|-------------|
| Bandwidth         | (1)            | (2)           | (3)        | (4)        | Sample size |
| Weeks             |                |               |            |            |             |
| All               | 0.157***       | 0.149***      | -0.015     | -0.008     | 145.592     |
|                   | (0.013)        | (0.013)       | (0.013)    | (0.013)    |             |
| +3 and -3 week    | 0.131***       | 0.138***      | 0.004      | 0.023      | 63.534      |
|                   | (0.021)        | (0.028)       | (0.022)    | (0.029)    |             |
| +2 and -2 week    | 0.148***       | 0.161***      | -0.020     | -0.038     | 42.835      |
|                   | (0.031)        | (0.040)       | (0.031)    | (0.043)    |             |
| +1 and -1 week    | N/A            | N/A           | N/A        | N/A        | 20.214      |
| Days              |                |               |            |            |             |
| All               | 0.148***       | 0.141***      | -0.013     | -0.007     | 145.592     |
|                   | (0.012)        | (0.012)       | (0.012)    | (0.012)    |             |
| +3 and -3 week    | 0.109***       | 0.114***      | 0.007      | 0.016      | 63.534      |
|                   | (0.017)        | (0.018)       | (0.017)    | (0.019)    |             |
| +2 and -2 week    | 0.098***       | 0.106***      | -0.001     | -0.0001    | 42.835      |
|                   | (0.022)        | (0.022)       | (0.022)    | (0.023)    |             |
| +1 and -1 week    | -0.181***      | -0.212***     | 0.031      | 0.024      | 20.214      |
|                   | (0.038)        | (0.038)       | (0.04)     | (0.040)    |             |
| Days – observatio | ons between an | nouncement an | d          |            |             |
| lockdown deleted  | 1              |               |            |            |             |
| All               | 0.166***       | 0.157***      | -0.012     | -0.006     | 143.159     |
|                   | (0.012)        | (0.012)       | (0.012)    | (0.013)    |             |
| +3 and -3 week    | 0.166***       | 0.164***      | 0.012      | 0.02       | 61.101      |
|                   | (0.018)        | (0.019)       | (0.018)    | (0.019)    |             |
| +2 and -2 week    | 0.211***       | 0.208***      | 0.004      | 0.004      | 40.402      |
|                   | (0.025)        | (0.025)       | (0.025)    | (0.025)    |             |
| +1 and -1 week    | 0.084          | 0.0218        | 0.062      | 0.027      | 17.781      |
|                   | (0.056)        | (0.072)       | (0.057)    | (0.071)    |             |
| Controls          | Time           | Time, time    | Time       | Time, time |             |
|                   |                | interacted    |            | interacted |             |
|                   |                | with          |            | with       |             |
|                   |                | lockdown      |            | lockdown   |             |

*Table B.1. RDD estimates for the effect of the lockdown for* 6<sup>th</sup>-9<sup>th</sup>-grade students.

*Note.* Time refers to either weeks or days. Standard errors are clustered at the individual level. \*p < 0.1, \*\* p<0.05, \*\*\* p<0.01



Figure B.1. RDD plots for 6<sup>th</sup>-9<sup>th</sup>-grade students

Note. a) Weeks-plot, b) days-plot, c) days-plot without observations after announcement of lockdown, d) Weeks-plot, e) days-plot, f) days-plot without observations after announcement of lockdown. Positive x-values are after lockdown, negative x-values are prior to lockdown. Days = -5 corresponds to the announcement of the lockdown.

# Appendix C: Investigating non-parallel trends for the lockdown and post-lockdown group

Results using 2017 as the reference-group are presented in Table C.1. For the lockdown-group, we still see non-parallel trends in the period prior to 2020 for the three outcomes. For liking school, we still see a rather large positive estimate for the lockdown but it is reduced from .149 SD to .119 SD, and is now five times larger instead of seven than the pre-trend differences. The results now suggest an effect on the lockdown on loneliness, but it is similar to the fluctuations in prior years.

Table C.1 also reports results for the post-lockdown group with 2017 as the reference-group, and the results are similar to the lockdown-group, and the trends are also still non-parallel for the three outcomes. The estimate for liking school have been reduced. The estimate for loneliness have increased from -0.027 to -0.064.

*Table C.1.* Event study estimates for the lockdown-group and post-lockdown group with 2017 as the reference-year  $6^{th}-9^{th}$  grade

|      | L           | ockdown    | Ро          | st Lockdown |
|------|-------------|------------|-------------|-------------|
|      | Like school | Loneliness | Like school | Loneliness  |
| 2015 | -0.011      | 0.004      | -0.036*     | 0.011       |
|      | (0.021)     | (0.021)    | (0.019)     | (0.018)     |
| 2016 | -0.004      | 0.012      | 0.006       | -0.011      |
|      | (0.014)     | (0.014)    | (0.012)     | (0.012)     |
| 2017 | ref         | ref        | ref         | Ref         |
| 2018 | -0.002      | 0.027**    | -0.030***   | 0.0181*     |
|      | (0.012)     | (0.011)    | (0.010)     | (0.01)      |
| 2019 | 0.027**     | 0.022*     | -0.045***   | 0.025**     |
|      | (0.012)     | (0.012)    | (0.010)     | (0.010)     |
| 2020 | 0.119***    | 0.035**    | 0.110***    | 0.064***    |
|      | (0.014)     | (0.013)    | (0.018)     | (0.017)     |
| Ν    | 88.177      | 88.177     | 92.339      | 92.339      |

*Note.* All models are with individual, year and months fixed effects. The model controls for grade-year. Standard errors are clustered at the individual level. p < 0.1, p < 0.05, p < 0.01

# Appendix D: Headache and stomach ache as outcomes

Both items are coded so lower values indicates better well-being, e.g. less headaches and stomachaches.

|      | Headache       | Stomach ache |
|------|----------------|--------------|
| 2015 | -0.050**       | -0.007       |
|      | (0.020)        | (0.021)      |
| 2016 | -0.020         | -0.004       |
|      | (0.014)        | (0.014)      |
| 2017 | -0.022**       | -0.023**     |
|      | (0.011)        | (0.011)      |
| 2018 | -0.010 (0.009) | -0.007       |
|      |                | (0.009)      |
| 2019 | ref            | ref          |
| 2020 | -0.061***      | -0.106***    |
|      | (0.009)        | (0.010)      |
| Ν    | 123.530        | 123.530      |
|      |                |              |

 Table D.1. Event study estimates

*Note.* All models are with individual, year and months fixed effects. The model controls for grade-year. Standard errors are clustered at the individual level. p < 0.1, p < 0.05, p < 0.01



Figure D.1. Trends in outcomes

*Note.* The levels in 2015 are only based on students who attended 9<sup>th</sup> grade in 2020, results for 2016 are based on 8<sup>th</sup> and 9<sup>th</sup> grade in 2020 and so forth.

## Appendix E: Lockdown length

Here we test whether liking school and feelings of loneliness might have changed depending on how long the students were exposed. While the estimates for how long the students have been exposed also are biased due to the non-parallel trends, the estimates can give us an idea of how the lockdown might have affected this selected group differently based on how long they had been exposed. However, differences in the specific weeks can also be attributed to further school-level selection processes.

In Table E.1, we present how many students answered every second week. As can be seen, fewer students answered the survey, after the first week, which suggests that some schools decided to put the survey on hold. With the 6<sup>th</sup>-9<sup>th</sup> graders, we saw an increase in answers from week 7. An issue in the context of looking at the different weeks is that they coincide with different announcements of prolonging the lockdown, the return to the schools and the Easter-holidays, which might have interacted with the student's well-being.

In Table E.2, we present results on how the amount of exposure to the lockdown has impacted students. Starting with students in 5<sup>th</sup> grade, the table shows that there is a positive impact on the two outcomes *liking school* and *loneliness* in the first two weeks, but the estimate for the remaining weeks are statistically insignificant. As presented in Table E.1 only very few students in 5<sup>th</sup> grade responded after the second week, and the insignificant estimates are likely due to low statistical power.

Table E.2 also reports the results for the 6<sup>th</sup> to 9<sup>th</sup> grade, the week-estimates for this group shows that the higher levels of liking school are consistent throughout all 9 weeks. For student loneliness, there are no statistically significant estimates in the first 6 weeks, but in week 7 and 8 there is a negative estimate, which indicates an increase in student loneliness. For the 9<sup>th</sup> week, there is also a negative estimate, but it is only statistically significant at the 0.10-level. For liking school, there is a much larger estimate in week 5-6, this corresponds with the students returning from the Easter holidays in week 5, and the holidays might have boosted student well-being.

In general, the results of the week-analysis pointed towards the student not being impacted negatively and having a positive at home school experience in the first 6 weeks of the lockdown. From the seventh week, the analysis indicated a lower level of student loneliness. However, the bias from non-parallel trends is still relevant in the context of these week-estimates, and the results do not warrant a causal interpretation. Furthermore, looking at figure 2, it is apparent that there is some random fluctuations in students' average loneliness, and it is possible that the estimate is a false positive.

|       | 5 <sup>th</sup> grade | 6-9 <sup>th</sup> grade |
|-------|-----------------------|-------------------------|
| 1-2   | 1.572                 | 7.412                   |
| 3-4*  | 120                   | 464                     |
| 5-6** | 74                    | 561                     |
| 7-8   | N/A                   | 3.524                   |
| 9     | N/A                   | 2.778                   |

Table E.1. Weeks of spring lockdown and number of student answers

*Note.* Every second week have been clustered together, as some weeks have very few responses. \*The fourth weeks corresponds with the Easter-holidays and have almost no responses. \*\*For 5<sup>th</sup> grade this only refers to week 5

|       | 5th gi        | rade       | 6-9th       | grade      |
|-------|---------------|------------|-------------|------------|
|       | Like School   | Loneliness | Like School | Loneliness |
| 1-2   | 0.126***      | -0.122***  | 0.119***    | 0.001      |
|       | (0.028)       | (0.026)    | (0.011)     | (0.011)    |
| 3-4*  | -0.012        | -0.184*    | 0.151***    | -0.018     |
|       | (0.166)       | (0.109)    | (0.041)     | (0.039)    |
| 5-6** | 0.091 (0.223) | -0.293     | 0.281***    | 0.017      |
|       |               | (0.189)    | (0.039)     | (0.039)    |
| 7-8   | N/A           | N/A        | 0.160***    | 0.064***   |
|       |               |            | (0.020)     | (0.019)    |
| 9     | N/A           | N/A        | 0.146***    | 0.034*     |
|       |               |            | (0.021)     | (0.021)    |
| N     | 30.827        | 30.827     | 123.530     | 123.530    |

Table E.2. Week effects of the lockdown

Note. All models are with individual, year and months fixed effects. The model controls for grade-year.Standard errors are clustered at the individual level. \*The fourth weeks corresponds with the easter-<br/>holidays and have almost no responses. \*\*For 5th grade this only refers to week 5. \*p < 0.1,<br/>\*\* p<0.05, \*\*\* p<0.01</td>

# Appendix F: Fine graded definition of socioeconomic status

| Mother's highest education | Like School       | Loneliness       |
|----------------------------|-------------------|------------------|
| 2015-2020 (Compulsory)     | Ref               | Ref              |
| 2015 (Upper Secondary)     | 0.082 (0.080)     | -0.11 (0.077)    |
| 2016 (Upper Secondary)     | -0.061 (0.051)    | -0.037 (0.051)   |
| 2017 (Upper Secondary)     | 0.004 (0.042)     | 0.010 (0.041)    |
| 2018 (Upper Secondary)     | 0.017 (0.035)     | 0.076** (0.034)  |
| 2019 (Upper Secondary)     | Ref               | Ref              |
| 2020 (Upper Secondary)     | 0.023 (0.032)     | 0.030 (0.032)    |
| 2015 (Tertiary)            | 0.091 (0.082)     | -0.169** (0.078) |
| 2016 (Tertiary)            | -0.083 (0.053)    | -0.124** (0.052) |
| 2017 (Tertiary)            | 0.018 (0.043)     | -0.030 (0.043)   |
| 2018 (Tertiary)            | 0.007 (0.036)     | 0.039 (0.035)    |
| 2019 (Tertiary)            | Ref               | Ref              |
| 2020 (Tertiary)            | -0.028 (0.034)    | 0.078** (0.033)  |
| 2015 (Higher)              | 0.038 (0.100)     | -0.127 (0.091)   |
| 2016 (Higher)              | -0.096 (0.065)    | -0.125** (0.061) |
| 2017 (Higher)              | 0.037 (0.052)     | -0.029 (0.049)   |
| 2018 (Higher)              | -0.037 (0.043)    | 0.037 (0.041)    |
| 2019 (Higher)              | Ref               | Ref              |
| 2020 (Higher)              | -0.083** (0.039)  | 0.134*** (0.038) |
| Income                     |                   |                  |
| 2015-2020 (0-25)           | Ref               | Ref              |
| 2015 (25-50)               | -0.143** (0.062)  | 0.051 (0.061)    |
| 2016 (25-50)               | -0.042 (0.042)    | -0.059 (0.041)   |
| 2017 (25-50)               | -0.031 (0.034)    | -0.024 (0.033)   |
| 2018 (25-50)               | -0.048* (0.028)   | -0.008 (0.028)   |
| 2019 (25-50)               | Ref               | Ref              |
| 2020 (25-50)               | -0.033 (0.026)    | 0.010 (0.026)    |
| 2015 (50-75)               | -0.200*** (0.064) | 0.027 (0.061)    |
| 2016 (50-75)               | -0.067 (0.043)    | -0.06 (0.042)    |
| 2017 (50-75)               | -0.078** (0.035)  | -0.016 (0.034)   |
| 2018 (50-75)               | -0.037 (0.029)    | -0.022 (0.028)   |
| 2019 (50-75)               | Ref               | Ref              |
| 2020 (50-75)               | -0.053** (0.027)  | -0.026 (0.026)   |
| 2015 (75-100)              | -0.103 (0.066)    | -0.023 (0.062)   |
| 2016 (75-100)              | -0.057 (0.045)    | -0.067 (0.043)   |
| 2017 (75-100)              | -0.058 (0.037)    | -0.032 (0.035)   |
| 2018 (75-100)              | -0.012 (0.030)    | 0.001 (0.030)    |
|                            |                   |                  |

**Table F.1.** Effects based on socioeconomic status for  $6^{th}-9^{th}$  grade – lockdown

Table continues next page

| 2019 (75-100) | Ref              | Ref            |
|---------------|------------------|----------------|
| 2020 (75-100) | -0.029 (0.028)   | -0.015 (0.027) |
| Ν             | 123.530          | 123.530        |
|               | 1 1 6 1 66 7 751 |                |

*Note.* All models are with individual, year and months fixed effects. The model controls for grade-year. Standard errors are clustered at the individual level. Tertiary education refers to short cycle or BA degrees, higher education refers to MA degrees, PhD or higher. \*p < 0.1, \*\* p<0.05, \*\*\* p<0.01

# Appendix G: The effect for the return to school – post lockdown

|                        | Control-Group | Post Lockdown |
|------------------------|---------------|---------------|
| Boys                   | 0.51          | 0.51          |
| Immigration-status     |               |               |
| Danish                 | 0.89          | 0.88          |
| First generation immig | rant 0.04     | 0.04          |
| Second generat         | tion 0.07     | 0.08          |
| immigrant              |               |               |
| Income Quartiles       |               |               |
| 0-25                   | 0.25          | 0.27          |
| 25-50                  | 0.25          | 0.25          |
| 50-75                  | 0.25          | 0.24          |
| 75-100                 | 0.25          | 0.24          |
| Mother's highest level | of education  |               |
| Compulsory             | 0.12          | 0.13          |
| Upper Secondary        | 0.38          | 0.39          |
| Tertiary               | 0.36          | 0.34          |
| Higher                 | 0.14          | 0.14          |
| Ν                      | 108.790       | 21.527        |

Table G.2. Descriptive Statistics

*Note.* The descriptive statistics are based on students, who had valid answers on the three outcomes in 2020. Tertiary education refers to short cycle or BA degrees, higher education refers to MA degrees, PhD or higher.

|      | Like school | Loneliness |
|------|-------------|------------|
| 2015 | 0.012       | -0.016     |
|      | (0.019)     | (0.018)    |
| 2016 | 0.054***    | -0.034***  |
|      | (0.013)     | (0.012)    |
| 2017 | 0.044***    | -0.026***  |
|      | (0.010)     | (0.010)    |
| 2018 | 0.014       | -0.001     |
|      | (0.008)     | (0.008)    |
| 2019 | ref         | ref        |
| 2020 | 0.152***    | 0.027**    |
|      | (0.014)     | (0.013)    |
| Ν    | 130.317     | 130.317    |

**Table G.2.** Event study estimates for the  $6^{th}-9^{th}$  grade

*Note.* All models are with individual, year and months fixed effects. The model controls for grade-year. Standard errors are clustered at the individual level. \*p < 0.1, \*\* p<0.05, \*\*\* p<0.01

| 2015     | Control | Post-lockdown |
|----------|---------|---------------|
| January  | 0.03    | 0.03          |
| February | 0.35    | 0.28          |
| Marts    | 0.62    | 0.69          |
| Ν        | 19.603  | 3.636         |
| 2016     |         |               |
| January  | 0.13    | 0.12          |
| February | 0.32    | 0.31          |
| Marts    | 0.54    | 0.55          |
| April    | 0.01    | 0.01          |
| Ν        | 45.625  | 8.925         |
| 2017     |         |               |
| January  | 0.14    | 0.13          |
| February | 0.29    | 0.26          |
| Marts    | 0.57    | 0.61          |
| Ν        | 72.617  | 14.327        |
| 2018     |         |               |
| Marts    | 0.06    | 0.04          |
| April    | 0.45    | 0.41          |
| May      | 0.48    | 0.54          |
| June     | N/A     | N/A           |
| Ν        | 99.347  | 19.518        |
| 2019     |         |               |
| May      | 0.63    | 0.54          |
| June     | 0.37    | 0.46          |
| Ν        | 108.790 | 21.527        |

Table G.3. Timing of answers in previous years 6<sup>th</sup>-9<sup>th</sup> grade students

*Note*. Table is only based on the 6<sup>th</sup>-9<sup>th</sup> grade. A few students answered in June 2018, but the numbers are too small to report for some groups.

|                       | Like School      | Loneliness        |  |
|-----------------------|------------------|-------------------|--|
| 2015 (No college)     | Ref              | Ref               |  |
| 2015 (College degree) | 0.035 (0.038)    | -0.136*** (0.036) |  |
| 2016 (No college)     | Ref              | Ref               |  |
| 2016 (College degree) | 0.040 (0.025)    | -0.095*** (0.024) |  |
| 2017 (No college)     | Ref              | Ref               |  |
| 2017 (College degree) | 0.032 (0.020)    | -0.048** (0.019)  |  |
| 2018 (No college)     | Ref              | Ref               |  |
| 2018 (College degree) | 0.043** (0.017)  | -0.043*** (0.016) |  |
| 2019 (College degree) | Ref              | Ref               |  |
| 2020 (No college)     | Ref              | Ref               |  |
| 2020 (College degree) | -0.023 (0.016)   | 0.012 (0.015)     |  |
| 2015 (Below median)   | Ref              | Ref               |  |
| 2015 (Above median)   | -0.077** (0.039) | -0.081** (0.037)  |  |
| 2016 (Below median)   | Ref              | Ref               |  |
| 2016 (Above median)   | -0.049* (0.026)  | -0.036 (0.024)    |  |
| 2017 (Below median)   | Ref              | Ref               |  |
| 2017 (Above median)   | -0.041** (0.020) | -0.031 (0.019)    |  |
| 2018 (Below median)   | Ref              | Ref               |  |
| 2018 (Above median)   | -0.027 (0.017)   | -0.020 (0.016)    |  |
| 2019 (Above median)   | Ref              | Ref               |  |
| 2020 (Below median)   | Ref              | Ref               |  |
| 2020 (Above median)   | -0.011 (0.016)   | -0.002 (0.015)    |  |
| N                     | 130.317          | 130.317           |  |

Table G.4. Effects based on socioeconomic status for 6<sup>th</sup>-9<sup>th</sup> grade students

 N
 130.317
 130.317

 Note. All models are with individual, year and months fixed effects. The model controls for grade-year. Standard errors are clustered at the individual level. \*p < 0.1, \*\* p<0.05, \*\*\* p<0.01</td>

| Mother's        | highest  | Like School               | Loneliness        |  |  |
|-----------------|----------|---------------------------|-------------------|--|--|
| education       |          |                           |                   |  |  |
| 2015-2020 (Com  | pulsory) | Ref                       | Ref               |  |  |
| 2015 (Upper Sec | ondary)  | -0.075 (0.068)            | -0.007 (0.068)    |  |  |
| 2016 (Upper Sec | ondary)  | 0.015 (0.045)             | -0.096** (0.042)  |  |  |
| 2017 (Upper Sec | ondary)  | -0.033 (0.0345)           | -0.073** (0.033)  |  |  |
| 2018 (Upper Sec | ondary)  | -0.018 (0.0292)           | -0.044 (0.028)    |  |  |
| 2019 (Upper Sec | ondary)  | Ref                       | Ref               |  |  |
| 2020 (Upper Sec | ondary)  | 0.023 (0.028)             | 0.005 (0.026)     |  |  |
| 2015 (Tertiary) |          | -0.017 (0.071)            | -0.145** (0.071)  |  |  |
| 2016 (Tertiary) |          | 0.055 (0.047)             | -0.159*** (0.044) |  |  |
| 2017 (Tertiary) |          | 0.001 (0.036)             | -0.102*** (0.035) |  |  |
| 2018 (Tertiary) |          | 0.028 (0.031)             | -0.078*** (0.029) |  |  |
| 2019 (Tertiary) |          | Ref                       | Ref               |  |  |
| 2020 (Tertiary) |          | 0.002 (0.029)             | 0.010 (0.027)     |  |  |
| 2015 (Higher)   |          | -0.041 (0.082)            | -0.078 (0.081)    |  |  |
| 2016 (Higher)   |          | 0.063 (0.055)             | -0.166*** (0.052) |  |  |
| 2017 (Higher)   |          | 0.014 (0.042)             | -0.086** (0.042)  |  |  |
| 2018 (Higher)   |          | 0.024 (0.035)             | -0.063* (0.034)   |  |  |
| 2019 (Higher)   |          | Ref                       | Ref               |  |  |
| 2020 (Higher)   |          | -0.024 (0.033)            | 0.026 (0.032)     |  |  |
| Income          |          |                           |                   |  |  |
| 2015-2020 (0-25 | )        | Ref                       | Ref               |  |  |
| 2015 (25-50)    |          | -0.041 (0.055)            | -0.100* (0.054)   |  |  |
| 2016 (25-50)    |          | -0.072** (0.037)          | -0.042 (0.035)    |  |  |
| 2017 (25-50)    |          | -0.022 (0.029)            | -0.016 (0.028)    |  |  |
| 2018 (25-50)    |          | -0.016 (0.024)            | -0.006 (0.023)    |  |  |
| 2019 (25-50)    |          | Ref                       | Ref               |  |  |
| 2020 (25-50)    |          | -0.021 (0.022)            | 0.017 (0.021)     |  |  |
| 2015 (50-75)    |          | -0.080 (0.058)            | -0.128** (0.055)  |  |  |
| 2016 (50-75)    |          | -0.100*** (0.037)         | -0.011 (0.035)    |  |  |
| 2017 (50-75)    |          | -0.065** (0.029)          | 0.001 (0.028)     |  |  |
| 2018 (50-75)    |          | -0.047* (0.025)           | 0.007 (0.023)     |  |  |
| 2019 (50-75)    |          | Ref                       | Ref               |  |  |
| 2020 (50-75)    |          | -0.031 (0.023)            | 0.005 (0.022)     |  |  |
| 2015 (75-100)   |          | -0.095 (0.058)            | -0.156*** (0.055) |  |  |
| 2016 (75-100)   |          | -0.078** (0.038)          | -0.088** (0.036)  |  |  |
| 2017 (75-100)   |          | -0.035 (0.030)            | -0.072** (0.029)  |  |  |
| 2018 (75-100)   |          | -0.017 (0.025)            | -0.034 (0.024)    |  |  |
| 2019 (75-100)   |          | Ref                       | Ref               |  |  |
|                 |          | Table continues next page |                   |  |  |

**Table G.5.** Effects based on socioeconomic status for  $6^{th}-9^{th}$  grade – post lockdown

| 2020 (75-100) | -0.012 (0.024) | 0.004 (0.023) |
|---------------|----------------|---------------|
| Ν             | 130.317        | 130.317       |
|               |                |               |

*Note.* All models are with individual, year and months fixed effects. The model controls for grade-year. Standard errors are clustered at the individual level. Tertiary education refers to short cycle or BA degrees, higher education refers to MA degrees, PhD or higher. \*p < 0.1, \*\* p<0.05, \*\*\* p<0.01

## Appendix H: Results for grade 5 students

#### Data

We use the same data for the 5<sup>th</sup> grade students, but the analysis for this group differ on to key aspects. First, there is only one premeasure available, the students' answers in 4<sup>th</sup> grade. Secondly, the lockdown for the 5<sup>th</sup> grade students only lasted until April 20<sup>th</sup>.

With respect to when the students answered in 2020, 73 % of all the 5<sup>th</sup> grade student had answered the survey before the lockdown, 4 % answered during the lockdown, and 23 % answered after returning to school.

#### Method

Students in 5<sup>th</sup> grade only have one valid pre-test, in their answers in 4<sup>th</sup> grade, and we can therefore not test whether these students were on a parallel trend. Furthermore, the 5<sup>th</sup>-grade students had a shorter lockdown period; we, therefore, run the analysis separately for this group using their answers in 4<sup>th</sup> grade as a pretest, estimating the following model.

 $Y_{itm} = \lambda_i + \gamma_t + \tau_m + v_g + \delta_{itm} + \varepsilon_{igtm}$ 

Here  $\delta_{itm}$  is the coefficient of interest, and has the value 1 if students answered during the lockdown of schools, and 0 for all other students, and in prior years. The remaining parts of the model are equivalent to model 1.

#### **Descriptive Statistics**

Figure H.1 presents the weekly development in the two outcomes in 2020 for the 5<sup>th</sup> grade students. The figures shows a sharp increase in the first weeks of the lockdown, followed by a return to pre lockdown levels in the subsequent weeks. Upon returning to the school, the level of liking school increases sharply, but in the following weeks, the level decreases to pre lockdown levels. For the 5<sup>th</sup> grade students, there is a very stable level of loneliness before the lockdown, but after the lockdown there is a sharp decrease suggesting a reduction in feelings of loneliness, in the following weeks it is downward trending, and after the return to school students' feelings of loneliness return to pre lockdown levels.

In Table 1, we present descriptive statistics where we compare characteristics of students, who answered before, during and after the lockdown of schools in Denmark. Overall, the groups are very similar across the observed socio-demographic background indicators suggesting no systematic selection bias.

## Effect for 5<sup>th</sup>-graders lockdown and return to school

Table H.4 reports the effect of the lockdown for 5<sup>th</sup> graders on *liking school* and *loneliness*. As mentioned, the spring lockdown was shorter for 5<sup>th</sup> graders and lasted 5 weeks. Our results show that the lockdown had students report liking school more, and feeling less lonely.

Table H.4 also reports the effect of returning to school for 5<sup>th</sup>-grade students, and the results show the return to school did not affect the outcomes. The fact that we only find an effect during the spring lockdown, suggests that the effect can be attributed to the lockdown. However, as was apparent from figure H.1, the results for liking school might have been primarily created by the week of the lockdown. The improvement in loneliness looked to have been more stable, but the descriptive results also indicate that the positive effect was fading over time.

## **SES differentials**

5<sup>th</sup> graders. Table H.3 presents the results for how the lockdown and return to school affected the 5<sup>th</sup>-grade students based on their SES. With respect to the lockdown, there are no statistically significant differences between students of different SES and the impact of the lockdown on two outcomes, suggesting that lockdown, in general, had a similar impact across SES.

#### **Regression discontinuity design**

We also ran the RDD for the 5<sup>th</sup> grade students. For the 5<sup>th</sup> grade students, we also deleted the fourth week, as it had too few observations, furthermore we dropped observations in day -8, -15, and 12 due to small cell values. Figure H.2 presents plots for how the two outcomes developed for the 5<sup>th</sup>-grade students with linear models fitted. For liking school, there is some indication of discontinuation at the cutoff when looking at the weeks-plot, which suggest an increase in students liking school due to the lockdown, but only for the first week, the second and third week is similar to the pre-lockdown levels. The fourth weeks corresponds with the Easter holidays, and have been deleted, but the Easter holidays might have interacted with how students answer in the following weeks, which could explain the high level in the fifth week. In week six, the 5<sup>th</sup>-grade students returned to school, and we see the levels of liking school slowly returning to the pre-lockdown levels. When time is modelled as days, it becomes apparent that there is considerable variation within the weeks, as one day might show an average value of liking school of 0.2 SD, and the next day it is -0.2 SD. The large variation might stem from the days having relatively few observations. Furthermore, the days-plot show that the increase in liking school started when the lockdown was announced, which could be due to parents keeping their children at home from the 12<sup>th</sup> of Marts.

Figure H.2 also reports the plots for students' feelings of loneliness, and the weeks-plot show a sharp discontinuation in student loneliness, which suggest that students felt less lonely in the weeks following the lockdown. The linear model fitted to the data also suggest that this

positive effect faded out over time. When time is included as days, we see that the students start reporting feeling lonelier in the days following the announcement of the lockdown, but when the lockdown was put into effect students reported feeling less lonely. Similar to liking school the days-plot show that there is considerable variation in student report of loneliness from day to day, but to a lesser extent than what we saw with liking school.

Overall, the plots point towards the lockdown having temporarily reduced 5<sup>th</sup>-grade students' feelings of loneliness, but also that this positive effect faded over time. For liking school, there is some indication of an improvement, but it was potentially limited to the first week of the lockdown. Furthermore, the plots indicate that the linearity assumption is reasonable at least with the weeks-plot for both outcomes. We now move on to consider the regression estimates for the effect. Table H.5 reports the results with 4 bandwidths, all observations in 2020, 3 weeks prior to and after the lockdown, 2 weeks and 1 week. We choose 3 weeks, due to the Easter holiday potentially interacting with the results. Furthermore, the results are reported with weeks as time, days as time, and days as time, but with the days between the announcement and the lockdown being in full effect deleted. When time is modelled as weeks, and only one week prior and after the lockdown cannot be estimated.

The results for liking school show that the estimate for the effect is only statistically significant when the 3 weeks or more observations are included, however, the estimates are still positive for the more reduced bandwidth, except for 1 week with the days between the announcement and lockdown deleted. We expect the insignificant estimate to be due to reduced statistical power from the smaller sample size, with the narrower bandwidth. The estimate of the effect is relatively stable in the model both with and without the interaction-term, and suggest an effect of about 0.1 SD, which is consistent with the result of the event study. However, this effect is likely to have been created by the first week of the lockdown.

Table H.5 also reports the results for student loneliness, when time is modelled as weeks; we find a statistically significant effect when 3 weeks or more observations are included. When time is included as days, there is a statistically significant effect even when just one week prior and one week afterwards are included. However, as shown in figure B1, the effect might have been created by lower values of loneliness in the days leading up to the lockdown. When the days between the announcement and the lockdown are deleted there is no longer a statistically significant estimate for 1 week, but the wider bandwidths are still statistically significant and show a positive effect. The insignificant estimate for 1 week with the announcement days excluded is likely due to reduced statistical power, as the standard errors more than doubled in size. Overall, the results for student loneliness consistently show a positive effect of about 0.1 SD across different models and bandwidths. These results are consistent with those found for the event study.

|                                     | Control- | Lockdown | Post     |
|-------------------------------------|----------|----------|----------|
|                                     | Group    |          | Lockdown |
| Boys                                | 0.51     | 0.50     | 0.52     |
| Immigration-status                  |          |          |          |
| Danish                              | 0.89     | 0.90     | 0.89     |
| First generation immigrant          | 0.04     | 0.03     | 0.04     |
| Second generation immigrant         | 0.07     | 0.06     | 0.07     |
| Income Quartiles                    |          |          |          |
| 0-25                                | 0.26     | 0.25     | 0.27     |
| 25-50                               | 0.25     | 0.27     | 0.26     |
| 50-75                               | 0.25     | 0.25     | 0.24     |
| 75-100                              | 0.24     | 0.23     | 0.22     |
| Mother's highest level of education |          |          |          |
| Compulsory                          | 0.12     | 0.11     | 0.13     |
| Upper Secondary                     | 0.36     | 0.34     | 0.38     |
| Tertiary                            | 0.36     | 0.38     | 0.35     |
| Higher                              | 0.16     | 0.17     | 0.12     |
| N                                   | 29.061   | 1.766    | 9.043    |

## Table H.3. Descriptive Statistics 5th grade students

*Note.* The descriptive statistics are based on students, who had valid answers on the three outcomes in 2020. Tertiary education refers to short cycle or BA degrees, higher education refers to MA degrees, PhD or higher.

|                   | Like school      | Loneliness        |
|-------------------|------------------|-------------------|
| Lockdown          | 0.123*** (0.028) | -0.124*** (0.025) |
| Post lockdown     | 0.011 (0.020)    | 0.009 (0.019)     |
| N (Lockdown)      | 30.827           | 30.827            |
| N (Post Lockdown) | 38.104           | 38.104            |

Table H.4. Overall effect of the lockdown and return to school for 5<sup>th</sup> grade

*Note.* All models are with individual, year and months fixed effects. The model controls for grade-year. Standard errors are clustered at the individual level. \*p < 0.1, \*\*p < 0.05, \*\*\*p < 0.01

|                | Lockdown    |            | Post Lo        | ockdown    |
|----------------|-------------|------------|----------------|------------|
|                | Like School | Loneliness | Like school    |            |
|                |             |            |                | Loneliness |
| No college     | Ref         | Ref        | Ref            | Ref        |
|                |             |            |                |            |
| College degree | -0.066      | 0.055      | -0.020 (0.026) | 0.014      |
|                | (0.055)     | (0.048)    |                | (0.025)    |
| Below median   | Ref         | Ref        | Ref            | Ref        |
|                |             |            |                |            |
| Above median   | -0.008      | 0.033      | 0.000          | 0.039      |
|                | (0.052)     | (0.047)    | (0.026)        | (0.024)    |
| N              | 30.827      | 30.827     | 38.104         | 38.104     |

# Table H.3. Effects based on socioeconomic status 5<sup>th</sup> grade

*Note.* All models are with individual, year and months fixed effects. The model controls for grade-year. Standard errors are clustered at the individual level. \*p < 0.1, \*\* p<0.05, \*\*\* p<0.01

|                 | Lockdown 5th |            | Post-lockdow | vn 5th     |
|-----------------|--------------|------------|--------------|------------|
|                 | Like School  | Loneliness | Like school  | Loneliness |
| Compulsory      | Ref          | Ref        | Ref          | Ref        |
| Education       |              |            |              |            |
| Upper Secondary | -0.076       | 0.084      | 0.069        | 0.046      |
|                 | (0.118)      | (0.100)    | (0.047)      | (0.043)    |
| Tertiary        | -0.124       | 0.109      | 0.021        | 0.037      |
|                 | (0.116)      | (0.100)    | (0.048)      | (0.044)    |
| Higher          | -0.141       | 0.123      | 0.048        | 0.107**    |
|                 | (0.126)      | (0.112)    | (0.056)      | (0.052)    |
| Income          |              |            |              |            |
| 0-25            | Ref          | Ref        | Ref          | Ref        |
| 25-50           | -0.002       | 0.132*     | 0.092**      | -0.031     |
|                 | (0.085)      | (0.069)    | (0.036)      | (0.033)    |
| 50-75           | -0.002       | 0.111*     | 0.056        | 0.009      |
|                 | (0.081)      | (0.067)    | (0.038)      | (0.035)    |
| 75-100          | 0.003        | 0.082      | 0.021        | 0.010      |
|                 | (0.085)      | (0.070)    | (0.040)      | (0.036)    |
| N               | 30.827       | 30.827     | 38.104       | 38.104     |

*Table H.4.* Effects based on socioeconomic status  $5^{th}$  grade – fine graded definition of SES.

*Note.* The model is with individual, year and months fixed effects. The model controls for grade-year. Standard errors are clustered at the individual level. Tertiary education refers to short cycle or BA degrees, higher education refers to MA degrees, PhD or higher. \*p < 0.1, \*\* p<0.05, \*\*\* p<0.01

|                  | Like School     | Loneliness   |             |            |             |
|------------------|-----------------|--------------|-------------|------------|-------------|
| Bandwidth        | (1)             | (2)          | (3)         | (4)        | Sample size |
| Weeks            |                 |              |             |            |             |
| All              | 0.189***        | 0.174***     | -0.101***   | -0.111***  | 39.908      |
|                  | (0.026)         | (0.026)      | (0.025)     | (0.026)    |             |
| +3 and -3 week   | 0.099**         | 0.149**      | -0.101**    | -0.117**   | 16.851      |
|                  | (0.043)         | (0.059)      | (0.042)     | (0.057)    |             |
| +2 and -2 week   | 0.085           | 0.172        | -0.108*     | -0.121     | 10.778      |
|                  | (0.063)         | (0.109)      | (0.062)     | (0.097)    |             |
| +1 and -1 week   | N/A             | N/A          | N/A         | N/A        | 5.040       |
| Days             |                 |              |             |            |             |
| All              | 0.173***        | 0.161***     | -0.098***   | -0.106***  | 39.908      |
|                  | (0.024)         | (0.025)      | (0.024)     | (0.024)    |             |
| +3 and -3 week   | 0.083**         | 0.100***     | -0.104***   | -0.109***  | 16.851      |
|                  | (0.035)         | (0.038)      | (0.034)     | (0.037)    |             |
| +2 and -2 week   | 0.080*          | 0.098*       | -0.124***   | -0.124**   | 10.778      |
|                  | (0.047)         | (0.050)      | (0.046)     | (0.048)    |             |
| +1 and -1 week   | 0.069           | 0.063        | -0.205**    | -0.215**   | 5.040       |
|                  | (0.094)         | (0.095)      | (0.092)     | (0.094)    |             |
| Days-observation | ons between ani | nouncement a | nd lockdown |            |             |
| deleted          |                 |              |             |            |             |
| All              | 0.172***        | 0.161***     | -0.096***   | -0.104***  | 39.639      |
|                  | (0.024)         | (0.025)      | (0.024)     | (0.024)    |             |
| +3 and -3 week   | 0.0786**        | 0.096**      | -0.098***   | -0.103***  | 16.582      |
|                  | (0.036)         | (0.039)      | (0.035)     | (0.038)    |             |
| +2 and -2 week   | 0.0693          | 0.087*       | -0.113**    | -0.114**   | 10.509      |
|                  | (0.05)          | (0.053)      | (0.048)     | (0.050)    |             |
| +1 and -1 week   | -0.0141         | -0.091       | -0.182      | -0.217     | 4.771       |
|                  | (0.118)         | (0.138)      | (0.115)     | (0.134)    |             |
| Controls         | Time            | Time, time   | Time        | Time, time |             |
|                  |                 | interacted   |             | interacted |             |
|                  |                 | with         |             | with       |             |
|                  |                 | lockdown     |             | lockdown   |             |

*Table H.5: RDD estimates for the effect of the lockdown for* 5<sup>th</sup>-grade students.

*Note.* Time refers to either weeks or days. Standard errors are clustered at the individual level. \*p < 0.1, \*\* p<0.05, \*\*\* p<0.01



Figure H.1. Development in outcomes in 2020 – weeks plot.

*Note*. Average values for each in 2020. Week 1 is the first week of the lockdown, the 5<sup>th</sup>-grade students return to school in week 6. The fourth weeks is the Easter holidays. The fourth weeks is deleted for the 5<sup>th</sup>-grade students as it had to few observations following regulations for the use of register-data.



Figure H.2. RDD plots for 5<sup>th</sup>-grade students

Note. a) Weeks-plot, b) days-plot, c) days-plot without observations after announcement of lockdown, d) Weeks-plot, e) days-plot, f) days-plot without observations after announcement of lockdown. Positive x-values are after lockdown, negative x-values are prior to lockdown. Days = -5 corresponds to the announcement of the lockdown.