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Abstract

Adolescence is an important developmental period when teens begin spending less time with their parents and more time with friends and others outside their households as they transition into adulthood. Using the 2017–2021 American Time Use Surveys and the 2012, 2013, and 2021 Well-being Modules, we examine how the time teens spent alone and with parents, friends, and others changed during the COVID-19 pandemic, shedding light on how the social isolation of the pandemic disrupted this crucial development period. We also examine how time spent on various activities and where those activities took place changed during the pandemic, including the large shift to online schooling and reduction in overall time spent in class. We find that teens spent more time alone during the pandemic than before and spent more of their leisure time alone, with large increases in time spent playing computer games, on social media, and watching TV. We also find that socializing and communicating with others improves teens' well-being over other activities. These results together suggest that teens' well-being was severely impacted by the pandemic.

JEL codes: J13, J22

Keywords: teens, adolescents, COVID-19, well-being, time use, gaming

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1. Introduction

Adolescence is an important developmental period when teens begin spending less time with their parents and more time with their friends and others outside their households as they transition into adulthood (Hamilton et al., 2022). Using the 2017–2021 American Time Use Surveys (ATUS) and the 2012, 2013, and 2021 Well-being Modules of the ATUS, we examine how much time teens spent alone and interacting with parents, friends, and others both before and during the COVID-19 pandemic to determine how the social isolation of the pandemic disrupted this natural process of learning to be independent. We also examine how the time teens spent in various activities changed during the pandemic and explore how these changes in time with others and changes in time in activities might affect teens' well-being.

A first look at teens' well-being suggests that the COVID-19 pandemic may have reduced teens' life satisfaction. Fig. 1 shows that teens' reported life satisfaction, measured on a scale from 0 to 10, was lower in 2021 than in 2012–2013.[1] This corresponds to other reports that teenagers may be in crisis. Using U.S. health-care data, Yard et al. (2021) find a 31 percent increase in the proportion of mental-health-related emergency department visits for teens in 2020 compared with 2019. Emergency department visits for suspected suicide attempts were also higher in 2020 and 2021 compared with 2019. Using data on death certificates from 14 U.S. state health departments over the 2015–2020 period, Charpignon et al. (2022) document that the number of deaths by suicide for youths ages 10–19 also increased in 2020.

One possible explanation for reduced life satisfaction is the increase in the amount of time teens spent alone because of physical-distancing practices during the pandemic. Fig. 2 shows that teens' share of time spent alone increased during the pandemic, for both girls and

[1] Well-being Module data were not available any later in the pre-pandemic period.

boys, with larger increases for boys, who were already spending more time alone than girls prior to the pandemic. Girls spent 42 percent of their awake time alone (up 9 percentage points from 33 percent in 2017–2019) and boys spent 58 percent of their awake time alone (up 18 percentage points from 40 percent in 2017–2019) during the pandemic.[2]

Fig. 3a shows that during the pandemic, teen girls were less happy and more stressed during activities when they were alone than with someone else. They also found less meaning in their activities when they were alone. Fig. 3b shows teen boys were sadder during activities when alone versus with someone else.

Two activities that play a major role in many teens' lives are gaming and using the computer for leisure. Fig. 4 shows that teen boys spent statistically significantly more time gaming on the average day during COVID-19 (135 minutes) than before COVID-19 (87 minutes). Fig. 5 shows that both boys and girls spent statistically significantly more time using computers for leisure, which includes time using social media applications such as TikTok and Instagram, during COVID-19 than before COVID-19 (35 minutes versus 19 minutes for girls and 51 minutes versus 18 minutes for boys on the average day).

These are just descriptive statistics, however. In this paper, in order to shed light on how the pandemic impacted U.S. teen time use, togetherness, and well-being, we use regression analysis on our time-diary data to control for various other individual and household characteristics that may explain the differences above. In addition, in well-being regressions, we examine point-in-time well-being measures and control for person fixed effects, which allows us to account for average differences in well-being across people, as well as controls for different types of activities and the timing and location of activities. Together with our results on changes

[2] The denominator of this share excludes time spent sleeping, grooming, refused, can't remember, and taking high school classes.

in time use during the pandemic, our well-being results suggest a negative effect of the pandemic on teens' well-being.

We examine heterogeneous effects by sex given long-standing differences in teen time use and differences in mental health outcomes by sex (Adams-Prassl et al., 2022; Blanchflower & Bryson, 2022; Livingston, 2019). As a sensitivity analysis, we also examine effects by parental education because parents with a bachelor's degree were more likely to be able to work remotely during the pandemic, changing parents' potential proximity to their teenagers (Pabilonia & Vernon, 2023). Their college-educated parents also may have been less likely to lose their jobs (Daly et al., 2020). In addition, college-educated parents spend more time investing in their children in general, and especially more time on educational activities, even while working longer hours (Doepke et al., 2019). Thus, with many teens participating in online schooling during the 2020–21 school year, college-educated parents may have increased their supervision. College-educated parents also may have been more concerned about their teens' mental well-being or less distracted by other pressing household matters because of their socioeconomic advantage (Cobb-Clark et al., 2019; Conti et al., 2022). Another contribution of this study is that we use data on any interaction with others, both in-person and online, that is available only in the ATUS Well-being Modules to highlight how often teens are interacting with others even when they are not in the same room as others.

Our key findings suggest that teens spent a lot more time alone in 2021 compared with 2017–2019, with girls spending less time with parents, boys spending less time with friends outside of school, and both boys and girls spending less time with others and their peers. Teen girls were less happy and more stressed when they were alone. Teen boys experienced more sadness when they were alone. Although teens had large increases in leisure time, it was mostly

in time spent alone, with large increases in gaming for boys, large increases in TV watching for girls, and large increases in computer use for both sexes. Girls in particular experienced more sadness when gaming and using computers and less meaning when watching TV and using computers relative to socializing and communicating with others. Teen boys experienced less meaning when watching TV, playing games, using computers, and engaging in non-screen relaxing relative to socializing and communicating with others. These results suggest that teens' mental health suffered as a result of this pandemic. In addition, we find that teens decreased their daily educational activities by about a half hour. A good portion of this decrease came from a reduction in class time. Teens also spent considerably more time taking classes at home and at other locations away from their peers.

2. Literature Review

There is a burgeoning literature that examines how teens have been affected by the COVID-19 pandemic. Hamilton et al. (2022) discuss whether social media generally helps or harms teens and whether the pandemic exacerbated its effects. On the one hand, social media could have been helpful during COVID-19, because it allowed socialization in the face of physical-distancing practices as well as access to COVID-19 resources. On the other hand, the dramatically increased use of social media during COVID-19 could have been harmful, because the use of social media by teens has been linked in other studies to reductions in teen safety, self-esteem, body image, anxiety, mood, sleep, and time spent on homework. For example, Braghieri et al. (2022) provide causal evidence of a negative impact of social media on college students' mental health using the staggered introduction of Facebook across U.S. colleges. They also show that there was an increased likelihood of poor academic performance as a result. Similarly,

Arenas-Arroyo et al. (2023) find that the staggered deployment of optic fiber in Spain between 2007 and 2019 led to more mental health diagnoses (taken from hospital records) among girls. They also show that girls spent more time on the internet and less time on sleep, homework, and socializing with family and friends, suggesting that changes in their time allocation are a potential mechanism for their finding. Golin (2022) finds that broadband Internet led to a decline in mental health for young German women.

Using a long panel of internet search data from Google Trends, Bacher-Hicks et al. (2022) conduct an event-study analysis to estimate how school bullying and cyberbullying changed during the pandemic. They show that pre-pandemic internet searches contained useful information about actual bullying behavior, that such searches dropped when schools shifted to remote learning, and that they increased again with the gradual return to in-person instruction. This suggests that bullying was reduced during the pandemic, which could potentially have a positive effect on children's life satisfaction measures. On the other hand, Agostinelli et al. (2022) argue that schools expose students to those from different backgrounds, providing important peer interactions; in addition, online schooling is not as productive as in-person learning as it requires a lot of self-regulated learning (Grewenig et al., 2021). Grewenig et al. (2021) found that in June 2020, during COVID-19-related school closures, German school children reduced their daily learning time by half compared with before COVID-19. This was especially the case for low-achieving students who replaced their learning time with screen time activities, especially for boys who increased their time playing computer games. Werner & Woessman (2023), examining the time use of German students during school lockdowns in early 2021, find that students' learning time was still substantially below their pre-COVID-19 learning time. In addition, these students' parents reported that the school closures were a psychological

burden for their children, with 55 percent saying the closures harmed their children's social skills; however, they also reported a reduction in bullying.

Racine et al. (2021) perform a random-effects meta-analysis to examine teens' mental illness and find that COVID-19 increased the global prevalence of teen mental illness to more than double pre-pandemic estimates. In another pandemic literature review, Samji (2022) finds a high prevalence of COVID-19-related fear among adolescents as well as more depressive and anxious symptoms compared with pre-pandemic estimates. Older adolescents, girls, and those living with neuro-diversities and/or chronic physical conditions were more likely to experience negative mental health outcomes. However, physical exercise, access to entertainment, positive family relationships, and social support were associated with better mental-health outcomes.

McGuine et al. (2021) examine data on over 13,000 U.S. teens who were student athletes and find that females, athletes in grade 12, team-sports participants, and athletes from higher-poverty areas reported increased mental-health symptoms, engaged less in physical activity, and had lower quality-of-life scores during COVID-19. Houghton et al. (2022) examine the impact of school closures on the mental health and loneliness of Western Australian teens and find increases in depression symptoms and a decrease in positive mental well-being because of the COVID-19 pandemic. Looking at teenagers in Italy, Guazzini et al. (2022) find that the pandemic greatly exacerbated their loneliness, especially for teen girls.

Sandner et al. (2023) studies the effects of school closures in Germany on high school students' well-being (mental health, life satisfaction, overall health). They find positive effects early on that they attribute to students experiencing the closures as they would experience holidays but negative effects during the fall/winter 2020/21 closures that they attribute to the burden of distancing measures, less enjoyment in learning, and greater worries about their future

careers because of distancing policies. Kung et al. (2022) examine data on teens and young adults in the UK and find that the loneliness of this group tracked the lockdown restrictions but had returned to baseline levels by September 2021. In addition, these effects were more pronounced for girls than boys, and socioeconomic background did not play a role. Through a phone survey of over 1,500 high school students living in Ecuador, Asanov et al. (2021) find that school closures and social isolation were two problems identified by students during the pandemic and that 16 percent of students had mental health scores that indicated depression. Anders et al. (2022) find that COVID-19 educational restrictions in England reduced adolescent mental well-being, especially for students from poorer familes and for girls.

Using U.S. data from the January–June 2021 Adolescent Behaviors and Experiences Survey, Jones et al. (2022) find that during the 12 months prior to the survey, 44 percent of high-school students experienced persistent feelings of sadness or hopelessness compared with 37 percent in 2019 (Centers for Disease Control and Prevention, 2021), and the effects were larger for girls than boys. Students also experienced difficulty completing schoolwork during the pandemic and emotional abuse by a parent or other adult in their home. However, students who reported feeling close to persons at school or virtually connected with others had a lower prevalence of poor mental health. Christ & Gray (2022) find that U.S. teens who had higher levels of social support from family and friends and were less concerned about COVID-19 also had lower levels of loneliness, COVID-19 stress, and academic worries than those teens who had lower levels of social support or who were more concerned about COVID-19.

More positively, using Swedish population register data and employing a difference-in-difference strategy for teens subject to school closures versus those who were not, Svaleryd et al. (2022) find that school closures during the initial phase of the pandemic (April–June 2020) did

not lead to worse mental health among those students who faced school closures. However, this analysis covered only the very beginning of the pandemic.

While the above-mentioned studies do not use U.S. data from the ATUS to examine changes in teens' time spent alone, time spent with others, time spent in various activities, or teens' mental well-being during the pandemic, a few papers use the ATUS to look at adults' changes in time use and togetherness pre-and post-pandemic.[3] These include studies by Atalay (2023), Frazis (2023), Hamermesh (2020), and Gimenez-Nadal et al. (2023). Atalay (2023) shows that adults have spent increasingly more of their free time alone since 2003, that they have lower life satisfaction when they spend a greater amount of their free time alone, and that they are less happy when doing a non-work activity alone. Frazis (2023) finds that as a result of the COVID-19 pandemic, adults spent substantially more time alone and that this was primarily driven by increases in working from home. He also finds that adults reallocated some of their leisure time away from social activities, although sometimes the reallocation was toward gaming that may substitute (imperfectly) for in-person interaction. Using the 2010 and 2012–2013 ATUS Well-being Modules, Hamermesh (2020) finds that life satisfaction and time spent alone are negatively correlated and uses a simulation exercise to predict that single people were worse off during the pandemic while married couples were better off. Also using the 2010 and 2012–2013 ATUS Well-being Modules, but focusing on point-in-time well-being measures, Gimenez-Nadal et al. (2023) find that workers prefer joint leisure to solo leisure. This paper uses the ATUS and its associated Well-being Modules to examine how teens' time alone and their well-being changed because of the pandemic.

[3] Pabilonia (2017) examines teen' time use and togetherness during the Great Recession, when many parents were out of work, and finds that teen boys spent less time with their mothers as the unemployment rate rose.

3. Data and Methods

Using time diaries from the ATUS, we compare the total minutes that teens spent on various activities and the total time teens spent alone and with various groups of people on the average day across the following two periods: before COVID-19 (2017–2019) and during COVID-19 (May 10, 2020–May 9, 2021).[4] The COVID-19 period that we examine covers only one year to avoid seasonality issues (data are released annually) and roughly corresponds to the time prior to when vaccines became widely available, when large portions of the population were still practicing physical distancing, and many students were attending school virtually or in a hybrid format.[5] Our analysis focuses on unmarried teenagers aged 15–17 living with their parents, excluding those who have children, for a sample size of 909 in the before-COVID-19 period and 306 in the pandemic period.[6]

The ATUS selects one person per household from a subset of households that have recently completed their interviews in the Current Population Survey. For each respondent, ATUS collects a single-day retrospective diary. Respondents report the start and stop times of their primary activities beginning at 4 a.m. on the day before their interview. For most activities, they report the location of the activity and who was in the room with them (if they were at home) or who accompanied them (if they were away from home), also referred to as "who with."[7]

[4] ATUS data are available at https://www.bls.gov/tus/data.htm (U.S. Bureau of Labor Statistics, 2022).
[5] Twenty percent of schools were fully remote for most of the 2020–2021 school year (Kaufman & Diliberti, 2021). Sixty percent of schools had a hybrid format and the remaining 20 percent were fully in-person. All U.S. states had lifted restrictions on business activity and group gatherings by July 1, 2021 (The New York Times, 2021).
[6] See Appendix Table A1 for details of the sample construction.
[7] It is important to note that these are teens' reports. In other work, researchers have found differences in teenagers' and parents' perceptions of time spent together (Milkie et al., 2021; Kalenkoski & Pabilonia, 2023).

"Who with" information was not collected for the following activities: sleeping, grooming, personal activities, refused, can't remember, and taking classes (if enrolled in high school). Location information was not collected for the following activities: sleeping, grooming, personal activities, refused, and can't remember. Because many teens attended school virtually during the first year of the pandemic, it is possible that the time eligible to be classified by alone status changed; however, in our regression analyses, we find similar qualitative results whether we examine "who with" minutes or the share of eligible minutes spent alone and with others.

We begin by examining time alone and time with others by sex. We use two main classifications for time with others. The first classification includes two categories: time with household members and time with non-household members. The second classification includes three categories: time with parents (including non-resident parents), time with friends, and time with others (including siblings, aunts and uncles, grandparents, neighbors, co-workers, etc.). Within each classification, the subgroups are not mutually exclusive. For example, a respondent can spend time with a parent and grandparent (or a friend and a sibling) at the same time. We also consider a separate group of "other," "time with peers," which includes both the time teens report being with friends and the time teens spend in class in-person in a school (this accounts for the fact that teens are with other teens during in-class time). Note that this does not include time spent with teens attending class online, even though they may be interacting with them via Zoom or another video conferencing platform. We estimate linear regression models to assess the impact of COVID-19 on time spent alone and with others, controlling for the number of household members (excluding self and parents), and indicators for sex, age, nonwhite, Hispanic, lives with single mother, lives with single father, parent has a bachelor's degree, enrolled in

school, household income, lives in metropolitan statistical area, state, and month.[8] Summary statistics for our control variables are presented in Appendix Table A2.

Using the 2021 ATUS Well-Being Module, we also examine how teens' well-being varies depending on whether the teen is alone or with others during the pandemic. The data provide information on perceived general life satisfaction and point-in-time well-being (happy, sad, pain, stressed, and tired) for three randomly chosen activities on the diary day as well as whether the activity was meaningful. The following activities were not eligible for selection: sleeping, grooming, personal activities, refused, and can't remember. We have well-being measures for 440 activity episodes (420 of which were eligible for the "who with" question). These point-in-time well-being and meaning measures were rated on a scale of 0 to 6, while general life satisfaction was rated on a scale of 0 to 10. There are four caveats to this analysis. First, there are well-known issues with comparing values of ordinal variables across people and time (Bloem, 2021; Bond & Lang, 2019). Second, economists disagree over how to interpret these subjective well-being measures (MacKerron, 2012; National Research Council, 2013). Third, the reference period for the Well-Being Module and our time-use estimates are not identical. The 2021 Well-Being Module was fielded from March through December of 2021, while our time-use estimates are based on diaries collected for May 10, 2020 through May 9, 2021. Fourth, the sample of teen respondents is quite small (N = 149) (Appendix Table A3).

In regression analyses where our unit of observation is a person-activity, we control for person fixed effects to account for the average difference in well-being measures across people

[8] If nonparticipation occurs because teens never participate in an activity, then tobit models estimated via maximum likelihood are preferred. However, if teens participate on some days but not on the randomly chosen diary day, linear models estimated by OLS are preferred (Kalenkoski & Pabilonia, 2012). We assume the latter here. Estimates using tobit models when convergence could be achieved lead to similar qualitative results.

as suggested in Ferrer-i-Carbonell & Frijters (2004). Thus, we estimate within-person differences in well-being for the point-in-time well-being measures across different groups of activities. In these regressions, we also control for the activity category (education, work, household production, socializing and communicating with others, relaxing leisure, sports, and eating and drinking, with all other activities as the reference category), the natural logarithm of the duration of the activity, the four-hour time band in which the activity began, and an indicator variable for whether the activity was done at home.[9] Respondents to the Well-Being Module also were asked if they were interacting with others during an activity, which captures a different concept of "togetherness" than captured by the "who with" questions. This allows us to examine whether teens might be alone in a room but socializing virtually with others.

We then estimate linear regression models to examine changes in several major time-use categories—schooling, work, sleep, and leisure—as well as select subcategories of education and leisure. Subcategories of education include class time, class time in school, and class time at other locations (primarily from home). Subcategories of leisure include socializing and communicating with others, relaxing and watching sports (with special breakouts for TV, playing games, and using computers for leisure), playing sports and exercise, and eating and drinking. Time spent on social media is included in using computers for leisure. We note that the ATUS does not distinguish between board games and online gaming. For details on the activity codes included in these categories, see Appendix Table A4. In exploratory analyses, we also looked at the time that teens spent using a telephone (which included video chats beginning in the 2020 ATUS); however, few report this activity, and the average time spent on the telephone was small

[9] Well-being measures by activity vary over the course of the day, with respondents recording higher levels of emotional well-being in the middle of the day than in the morning or evening for the same activity (Atalay, 2023). We include the following four-hour indicator bands capturing when the episode began: midnight–4 a.m.; 4 a.m.–8 a.m.; 8 a.m.–noon; noon–4 p.m.; 4 p.m.–8 p.m.; and 8 p.m.–midnight.

in comparison to other activities. We also do not present estimates for time spent doing household chores or care activities, because there are no statistically significant differences between time periods, even though teens were at home more during COVID-19 and thus potentially more available to help around the house or care for siblings.[10]

Finally, we use the 2021 Well-Being Module to compare point-in-time well-being during different activities relative to point-in-time well-being while socializing and communicating with others, a presumably enjoyable activity, and then infer changes in teen well-being resulting from changes in their time allocation during the pandemic. In these well-being models, we separate relaxing time into TV, games, computers, and non-screen relaxing time in order to assess whether people experience similar point-in-time well-being when using screens and when socializing with others. We also interact education with home to test whether teens find online classes and homework done at home as less enjoyable than educational activities done at school among their peers. We do not control for time alone or time with others given that our reference category is socializing and communicating with others. We run linear regressions separately for girls and boys rather than interacting a binary indicator for girl with each activity, and we control for person fixed effects.

4. Results

4.1 Summary Statistics

[10] On the average day in 2017–2021, girls and boys spent about 60 and 41 minutes on household chores and about ten and five minutes on care activities, respectively (authors' calculations from ATUS data). These gender differences in chores and care among teenagers are long standing and may help to explain gender norms in these activities in adulthood (Lundberg et al., 2017; Kalenkoski & Pabilonia, 2023; Schultz, 2021).

Table 1 provides summary statistics on the time teens spent alone and with others, by sex, both before and during COVID-19. Before COVID-19, boys spent more time alone than did girls (260 minutes versus 212 minutes), and they increased their time alone more than girls did during COVID-19. Time spent alone by girls was about 70 minutes more during COVID-19 than before COVID-19. For boys, the increase was 128 minutes. These statistics suggest that boys became more socially isolated during the pandemic than girls.

Examining time spent with parents, we find a substantial difference in the time teen girls and boys spent with their parents before COVID-19. Boys spent only 139 minutes with parents, while girls spent 213 minutes. However, while girls' time with parents decreased by 45 minutes during the pandemic, there was no statistically significant difference for boys between the two time periods. Thus, separation from parents as a normal stage of development seems to have been hurried for girls.

Time spent with non-household members was similar for boys and girls prior to the pandemic, but it decreased by 33 minutes for girls and 78 minutes for boys during the pandemic, again suggesting that boys became more socially isolated than girls during the pandemic with respect to socializing with others outside one's own household. Looking at our second classification of time (parents, friends, and others), we find that boys spent 37 fewer minutes with friends outside of school during the pandemic and 87 fewer minutes with others. Girls' time spent with friends outside of school and others was unchanged. Looking at all time with peers, we find that girls spent 97 fewer minutes with their peers and boys spent 154 fewer minutes with their peers. These results also are consistent with the idea that COVID-19 caused increased social isolation, especially for boys.

Table 2 shows the various activities teen girls engage in and how time spent in these activities changed during COVID-19. We see no statistically significant difference in educational time or class time for girls. However, the percentage of girls attending classes on the average day dropped from 43 percent before COVID-19 to 37 percent during COVID. We also observe a large reallocation of class time from schools to other locations. On the average day during COVID-19, only 11 percent of teen girls attended class in a school, whereas before COVID-19, 40 percent of girls attended school in-person. Girls' time spent on all leisure activities jumped by 52 minutes. They spent more time watching TV (28 minutes more) and more time using computers for leisure/social media (17 minutes more) than before COVID-19.

Table 3 shows that teen boys' time use changed even more dramatically during COVID-19. Similar to girls, boys spent more time attending classes online than in-person during COVID-19. However, they were just as likely to attend a class during COVID-19 as before COVID-19 on the average day. Also like girls, boys' leisure time jumped substantially (71 minutes). Boys spent more time playing games (48 minutes more) and more time using computers for leisure/social media (33 minutes more). Unlike girls, they did not adjust their TV viewing. Also unlike girls, they reduced their time spent working (by 25 minutes), socializing and communicating with others (by 18 minutes), and eating and drinking (by 9 minutes).

4.2 Time spent alone and with others

In Table 4, we present linear regression results for how time spent alone and with various groups of people changed during COVID-19 while controlling for various household, demographic, and economic characteristics.[11] Boys spent 128 minutes more alone and girls

[11] As a robustness check for our Table 4 results, we present results from linear regressions in Appendix Table A5 which examine the share of eligible daily minutes spent alone and with others as outcomes and find qualitatively similar results.

spent 95 minutes more alone during COVID-19 than before COVID-19, although this difference between boys and girls is not statistically significant. Boys spent 84 fewer minutes with non-household members during COVID-19 than before COVID-19, while girls spent 39 fewer minutes. This difference is statistically significant. Boys spent 44 fewer minutes with friends and 79 fewer minutes with others during COVID-19 than before COVID-19. Girls did not reduce their time with friends outside of school. Their difference in time with others was not statistically significantly different from boys, suggesting girls also spent fewer minutes with others. Looking at time with all peers (friends plus time in school in-person), we find that boys spent 171 fewer minutes with peers and girls spent 104 fewer minutes with peers, with this difference in the reduction between girls and boys being statistically significant. All these results suggest that in-person socialization declined for teens during COVID-19, especially for boys.

Table 4 also shows a substantial decline in the time girls spent with parents during COVID-19 (47 fewer minutes). To try to understand how girls' time with parents declined even while people spent more time at home during the pandemic, we examine differences in time spent at different locations and time spent with parents at different locations. Overall, Table 5 shows that boys and girls spent more time at home during COVID than before (215 and 185 more minutes, respectively). They also spent less time on school grounds (143 and 133 fewer minutes, respectively). Girls spent 15 fewer minutes as a passenger in a car, while boys spent 12 fewer minutes. Boys also spent 24 fewer minutes in the workplace. Turning to results from linear regressions of time with parents by location on COVID-19, Table 6 shows that girls' time with parents in someone's else home was statistically significantly lower by 12 minutes during COVID (Table 6). The rest of the difference in total time spent with parents was spread out across locations.

Table 7 shows results from a linear probability model (LPM) estimated by OLS for whether teens spent any time with friends or peers. Boys had a 0.29 lower probability of spending any time with friends on the average day during COVID-19 compared with before COVID-19. Girls' probability of spending any time with friends was 0.13 lower, and the difference in the reduction between boys and girls is statistically significant. Combined with our results from Table 4, this implies that some girls were spending a greater amount of time with their friends outside of school when they did get the opportunity to see them. Looking at any time with peers, boys had a 0.40 lower probability of spending any time with peers, while girls had a 0.24 lower probability of spending any time with peers, and the difference in the reduction is statistically significant. This again highlights how boys' in-person socialization was diminished during COVID-19.

4.3 The relationships between time alone, time with others, and well-being

To assess how the increase in time alone affects teen well-being, we turn to results for well-being when doing activities with someone else versus doing them alone (Table 8). We find that girls are less happy and find less meaning in their activities when they spend time alone compared with when they spend time with someone else. They are also more stressed; boys also may be more stressed when alone because the difference between boys and girls is not statistically significant. However, girls feel less pain when they are alone than when they are with someone else. Boys experience more sadness when alone than when with someone else; girls may also be sadder when alone as the difference between boys and girls is not statistically significant.

If we further break down our results and compare time spent separately with parents, friends, and others to time spent alone, we find that spending time with parents does not affect

girls' happiness, but it does make them less stressed (Table 9). Spending time with parents compared with being alone also makes boys less stressed. Thus, spending time with parents appears to be a protective factor for teens. Boys are less happy when they spend time with others (various others who are not parents or friends) relative to spending time alone. However, boys also are less sad when they are with others than when they are alone, perhaps suggesting an ambivalent attitude toward spending time with others. Girls, on the other hand, are happier when they spend time with others and also find more meaning in their activities done with others than in those they do alone. Although the coefficient estimates are not statistically significant at conventional levels, girls are happier and less sad when spending time with friends than when alone. They also find this time to be more meaningful.

4.4 Time spent alone and with others by parental education

In Table 10, we examine whether the associations of COVID-19 with time spent with others and time spent alone differed by whether the teen lives with at least one parent who has a bachelor's degree, in separate regressions for girls and boys for ease of interpretation. We find that the association of COVID-19 with teen alone time did not vary by parental education. However, teen boys living with parents who did not have a bachelor's degree spent 76 fewer minutes with their friends during COVID-19, while those living with more-educated parents did not experience a decrease in time with friends. Perhaps these less-educated parents, who were more likely to be working outside the home, did not have as much time to help their teens stay socially connected. We also find that boys living with parents who did not have a bachelor's degree spent 206 fewer minutes with peers while boys living with less-educated parents spent 132 fewer minutes with peers, although the difference in the reduction is not statistically significant at conventional levels.

4.5 Time spent on activities

Turning to the relationship between COVID-19 and time spent on specific activities in Table 11, we find that boys were less likely to be socializing and communicating with others, while girls were less likely to be working on the average day. Otherwise, we find no other statistically significant differences in daily activities before and during COVID-19 on the extensive margin. However, we do find differences in the average time spent on specific activities, the intensive margin (Table 12). Boys and girls spent a lot less time on educational activities (34 and 30 fewer minutes for boys and girls, respectively). Boys also spent 24 fewer minutes working on the average day during COVID-19 than before COVID-19. These reductions may have long-lasting effects on teen skill development. Early estimates of the impacts of educational disruptions during the pandemic on test scores are not promising (Bertoletti et al., 2023; Goldhaber et al., 2023; Jack et al., 2023; Jakubowski et al., 2023; Kofoed et al., 2021).[12] Boys had substantially more leisure time on the average day during COVID-19 than before COVID-19 (81 minutes more), which consisted mostly of an increase in time spent gaming (51 minutes more) and time spent using computers for leisure/social media (34 minutes more). They experienced a small reduction in time spent socializing and communicating with others (20 fewer minutes). Girls also spent more time on leisure activities (66 minutes more). Girls did not increase their gaming time but spent more time using computers for leisure/social media (19 minutes more) and more time watching TV (32 minutes more).

4.6 Time spent on leisure activities with friends

Table 13 shows how leisure time with friends changed during COVID-19. Boys spent 41 fewer minutes in total on leisure activities with friends, including 15 fewer minutes socializing

[12] Prior studies have documented a negative impact of schooling disruptions on student achievement (Harmey & Moss, 2021; Lamb et al., 2013; Pane et al., 2008).

and communicating with others, 13 fewer minutes relaxing, and 5 fewer minutes eating and drinking. Looking at subcategoires of relaxing time, we find that boys spent less time watching TV (6 fewer minutes) and playing games (6 fewer minutes) together in the same room as their friends. However, boys may have been interacting with their friends more online (though some may argue that this is not a perfect substitute for time together in-person). Looking at gaming episodes in the 2021 Well-being Module, we find that teens reported interacting with others during 68 percent of their gaming sessions without others in close physical proximity (Fig. 6).[13] Thus, the increase in gaming time among boys may have been a protective factor during the pandemic. Indeed, prior research (Algan & Fortin, 2018) finds that computer gaming is associated with higher test scores for boys, potentially through positive effects on cognitive skills and social networks, so skill development for boys during this period may not have decreased as much as it would have in the absence of gaming. More broadly, looking at all activity episodes when teens reported being alone (excluding time in class episodes), teens reported that they were interacting with someone about 49 percent of the time, which includes interacting over the telephone.[14] Thus, it may be that we are understating teens' social interactions when we only look at the ATUS time diaries and not the well-being modules.

4.7 Well-being during activities

Finally, using the 2021 ATUS Well-being Module, Tables 14 (girls) and 15 (boys) show the associations of specific activities and point-in-time well-being measures. Compared with socializing and communicating with others, girls experience lower levels of happiness doing

[13] Barr & Copeland-Stewart (2022) document that people increased time on multiplayer games in order to socialize with others during the pandemic to combat loneliness. They also reported reduced anxiety and stress while playing games.

[14] When not alone in the room, in other words, when with parents, friends or others, some teens also claimed that they were not interacting with anyone (14–17 percent of the time). Thus, the other person may have simply been present in the room.

educational activities at home, working, and doing household production. Other activities provide similar happiness levels to socializing and communicating with others. Girls experience greater sadness when playing games and using computers compared with socializing and communicating with others. They also find that working, household production, watching TV, and using computers are less meaningful than socializing and communicating with others. These findings suggest that online interactions are not perfect substitutes for in-person interactions for girls. Teen girls are less stressed while using computers but more stressed while doing educational activities at home and while gaming relative to socializing and communicating with others. The latter finding is consistent with gaming culture being toxic for girls (Algan and Fortin 2018). Girls, however, experience less pain while working, doing household production, watching TV, and playing games than when socializing and communicating with others. Perhaps these activities kept one's mind off the pandemic and thus reduced mental pain. Finally, they are more tired when working than socializing and communicating with others.

Compared with socializing and communicating with others, boys also experience lower levels of happiness while working and doing educational activities, although the location of their educational activities does not matter as it does for girls. However, they experience greater sadness during educational activities done at home and less sadness during work activities than when socializing and communicating with others. Perhaps they miss the time that they spent in school with others. They do not experience differences in happiness or sadness while playing games or using computers compared with socializing and communicating with others (although these activities and most others are less meaningful). This suggests that boys experience online interactions relative to in-person interactions differently from girls. Boys are more stressed while working and less tired when relaxing without media usage.

All these results suggest that socializing and communicating with others improves teens' well-being over other activities. Given that teens have been spending more time alone, and more time in activities other than socializing and communication, these results suggest a decline in teens' well-being because of the pandemic.

5. Conclusion

Using the 2017–2021 ATUS time diaries and the 2012–2013 and 2021 Well-being Modules of the ATUS, we examined how teens' time use changed during the pandemic and how this affected their well-being. We examined changes in time use on multiple dimensions, including the activities they spent time on, who they were with during activities, if they were interacting with someone online or on the telephone, and where they were while doing those activities.

We find that teens experienced greater aloneness because of the COVID-19 pandemic. Teen girls were less happy and more stressed when doing activities alone than with others during this time, while teen boys were more sad. Teens spent less time on educational activites (about 30 fewer minutes), and teen boys reduced their work activities (24 fewer minutes), while increasing their leisure activities (67–81 minutes more). Teen boys spent less of their leisure time in-person with friends and others, although they increased time gaming by 51 minutes on the average day, which may have helped them to maintain their social connections. Teen girls, on the other hand, spent less time with their parents and less time with others, but experienced no change in their time with friends outside of class, although they spent 34 more minutes using computers for leisure/social media, which also may have allowed girls to maintain social connections. However, girls reported lower levels of happiness and increased sadness when

using computers compared with socializing and communicating with others, suggesting that the use of computers was not as helpful in reducing the negative impacts of physical distancing. In addition, both boys and girls found watching TV and using computers to be less meaningful compared with socializing and communicating with others, and boys found gaming less meaningful. Teens also spent over 100 fewer minutes with peers in-person in part because of the shift to remote/hybrid schooling during the 2020–2021 academic year. These changes in time use potentially have far-reaching consequences given the importance of building cognitive and social skills for later educational and employment outcomes (Deming, 2017; Attanasio et al., 2020).

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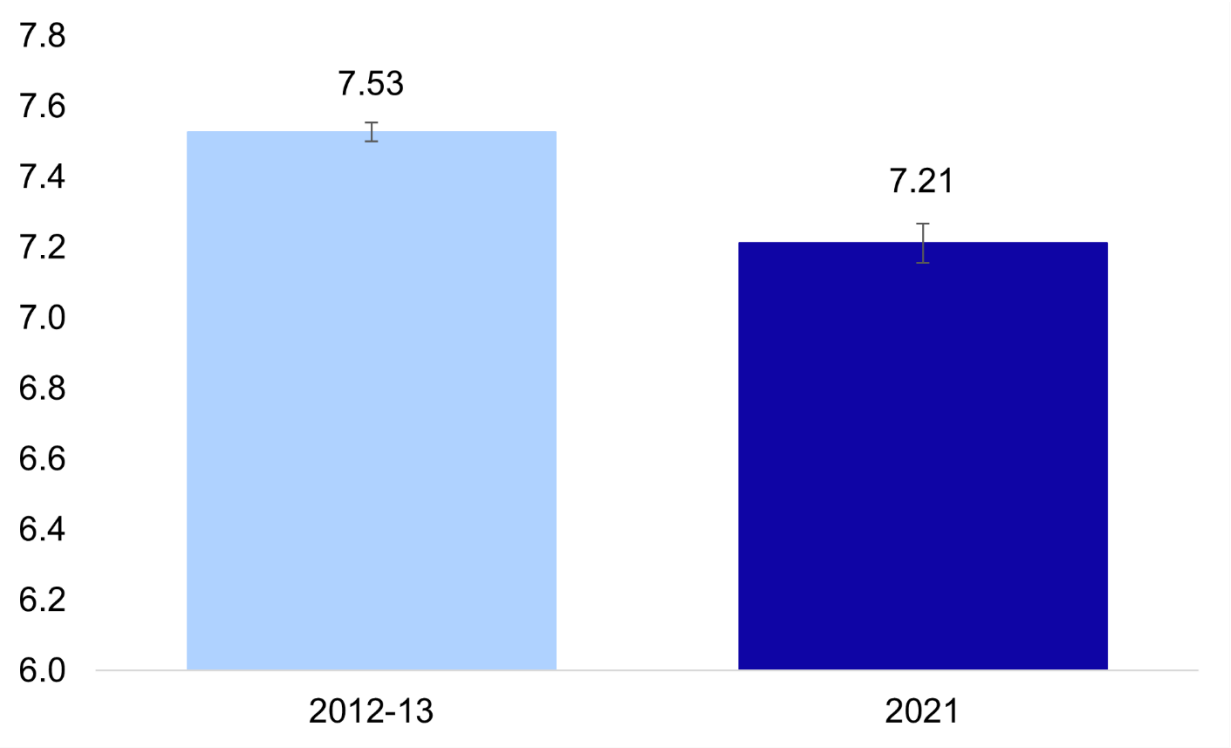
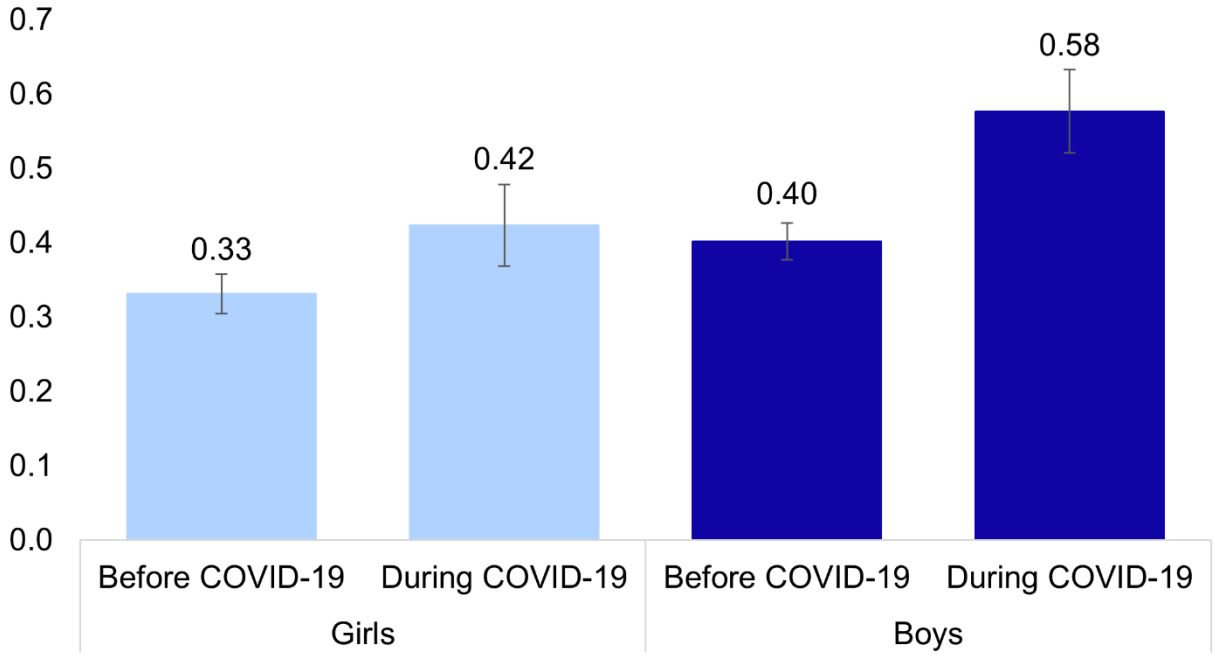
Fig. 1 Teens' general life satisfaction



Note: N = 814 in 2012–13 and 149 in March through December of 2021. Life satisfaction is measured on a 11-point scale. Error bars represent 90% confidence intervals. ATUS Well-being Module respondent weights used. Standard errors are generated using replicate weights. The difference in life satisfaction over time is statistically significant at the 5% level. Source: 2012–2013 and 2021 American Time Use Survey Well-being Modules

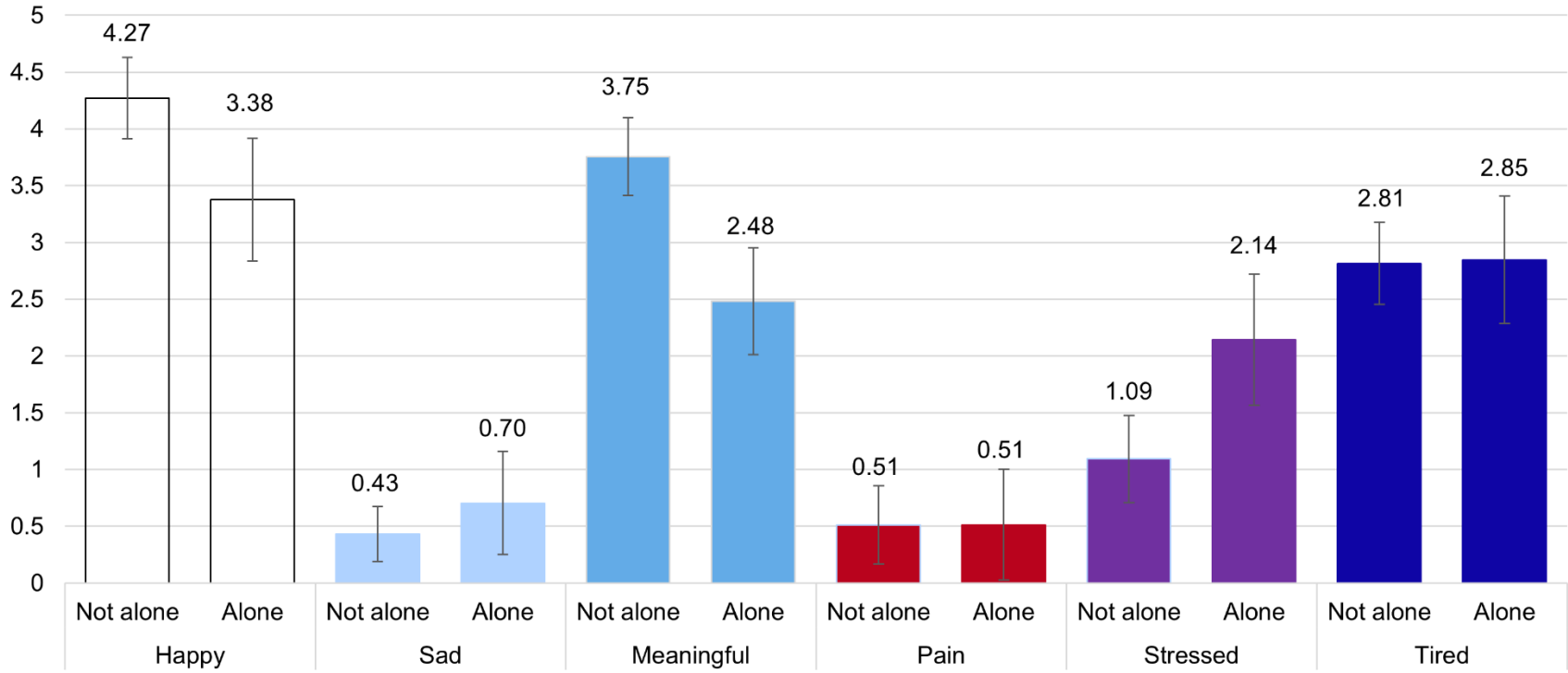
Fig. 2 Teens' share of time spent alone



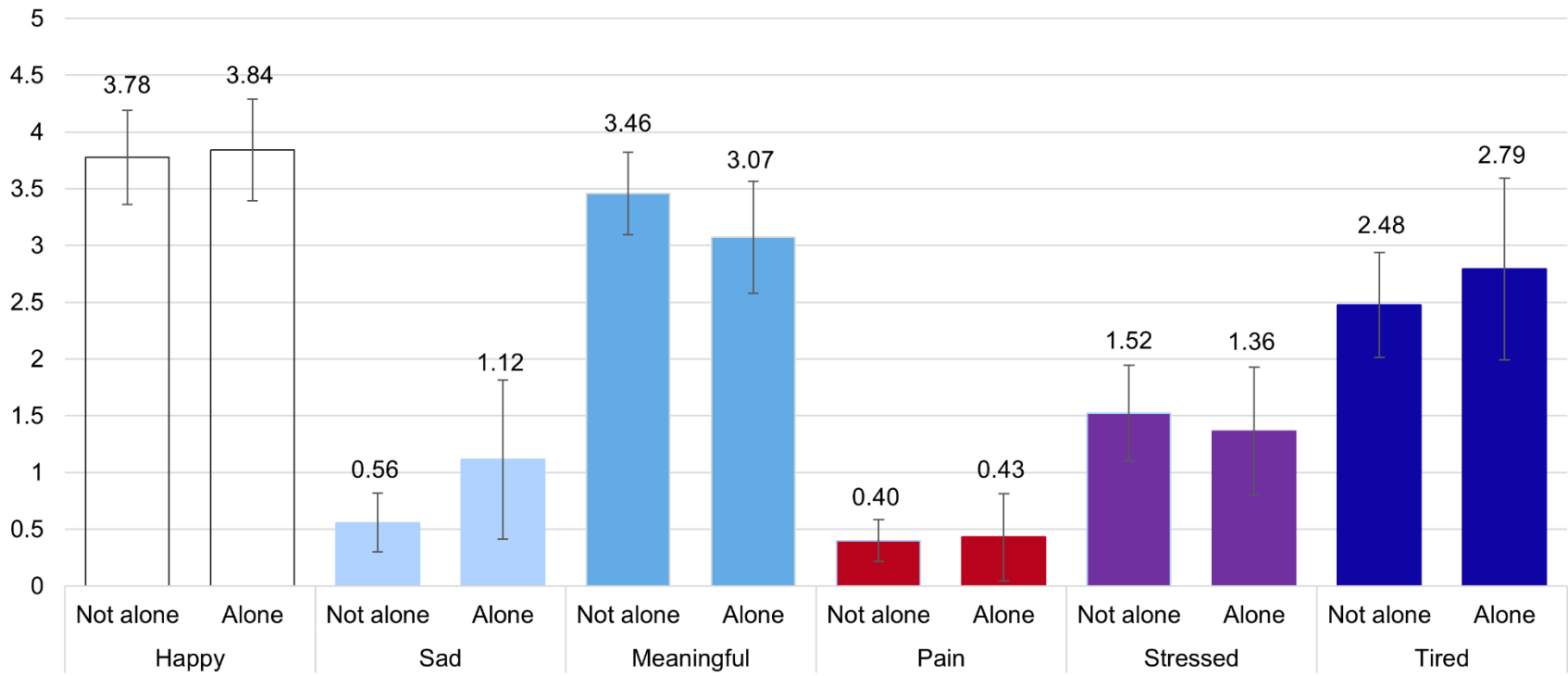
Note: Before COVID-19 is based on time diaries from the 2017–2019 period, while during COVID-19 is based on time diaries from May 10, 2020 to May 9, 2021. Sample sizes: Before COVID-19 = 441, 468 and During COVID-19 = 146, 160 for girls and boys respectively. Error bars represent 90% confidence intervals. ATUS final weights used. Standard errors are generated using replicate weights. Share of time spent alone refers to time on activities when the respondent was asked who was present, which excludes the following activities: sleep, grooming, personal activities, refused, can't remember, and taking high school classes. Differences over time are statistically significant at the 5% level. Source: 2017–2021 American Time Use Surveys

Fig. 3 Teen well-being measures during activities by alone status

a. Girls

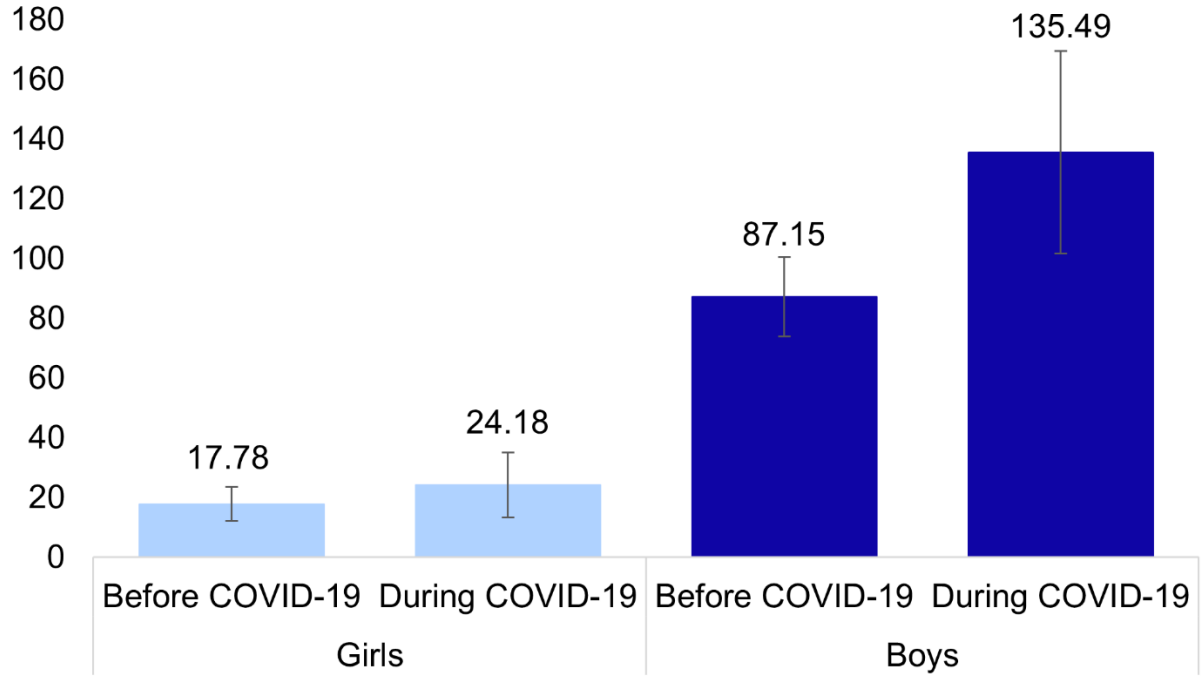


b. Boys



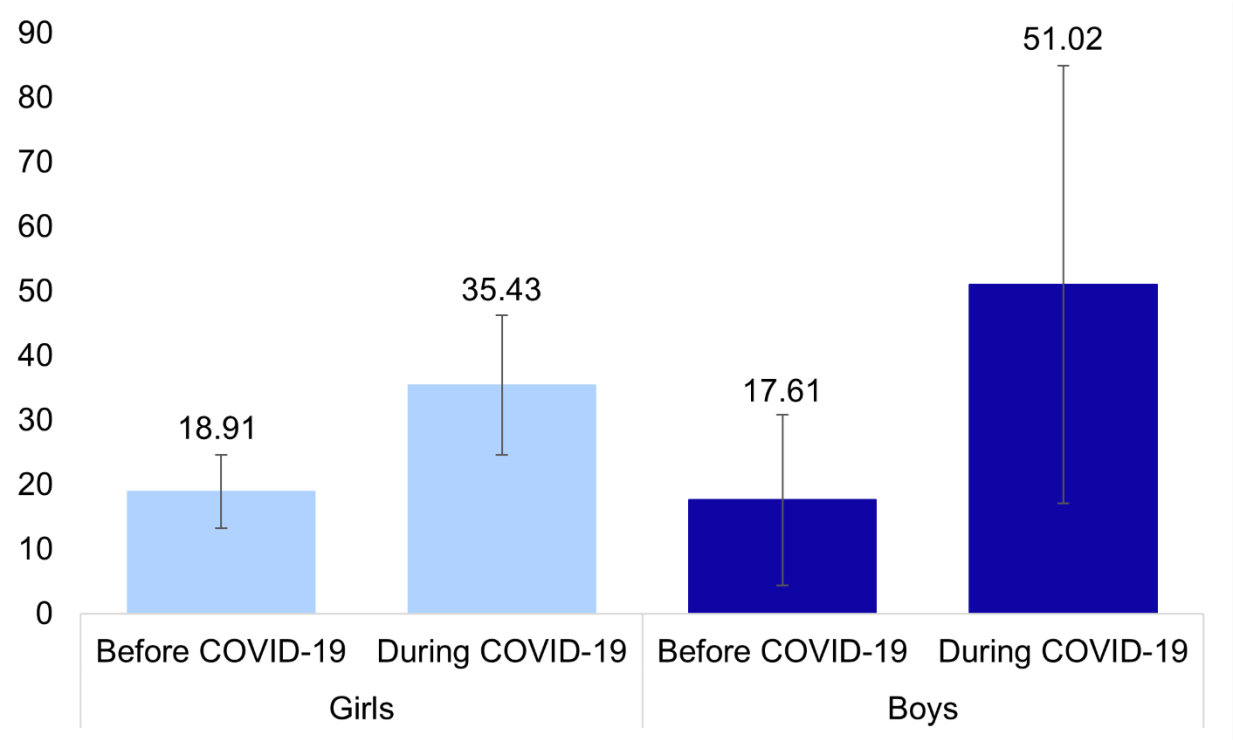
Note: N = 215 for girls and 225 for boys. Interviews were conducted from March through December 2021. The following activities were not eligible for selection: sleeping, grooming, personal activities, refused, and can't remember. Well-being measures are on a 7-point scale. Error bars represent 90% confidence intervals. ATUS Well-being Module time-based weights used. Standard errors are generated using replicate weights. For girls only, the differences in feeling happy and stressed during activities by alone status and the difference in meaningfulness of activities by alone status are statistically significant at the 5% level. For boys, the difference in feeling sad during activities by alone status are statistically significant at the 10% level. Source: 2021 ATUS Well-being Module.

Fig. 4 Teens' minutes spent gaming



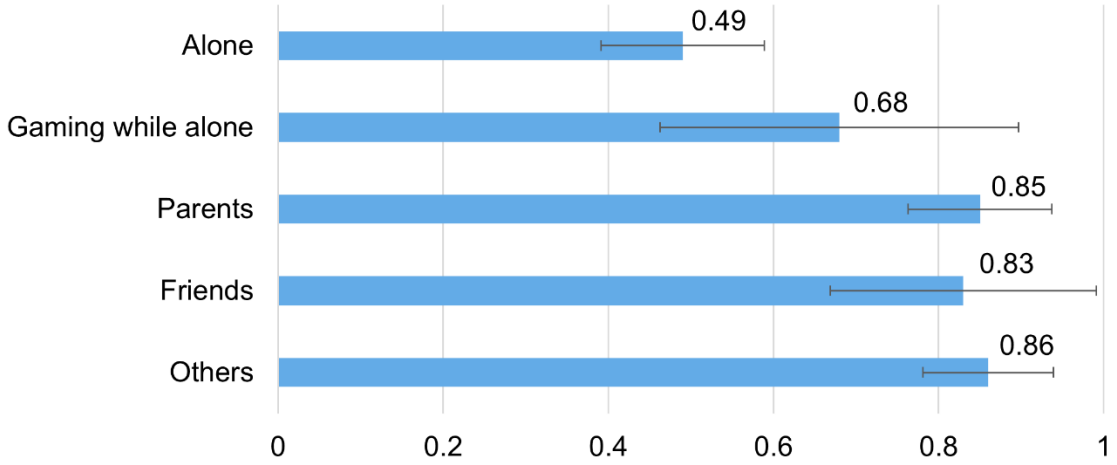
Note: Before COVID-19 is based on time diaries from the 2017–2019 period, while during COVID-19 is based on time diaries from May 10, 2020 to May 9, 2021. Sample sizes: Before COVID-19 = 441, 468 and During COVID-19 = 146, 160 for girls and boys respectively. Error bars represent 90% confidence intervals. ATUS final weights used. Standard errors are generated using replicate weights. Differences over time are statistically significant at the 5% level for boys only. Source: 2017–2021 American Time Use Surveys

Fig. 5 Teens' minutes spent on computers for leisure including using social media



Note: Estimates are based on reports of time spent on primary activities. Before COVID-19 is based on time diaries from the 2017–2019 period, while during COVID-19 is based on time diaries from May 10, 2020 to May 9, 2021. Sample sizes: Before COVID-19 = 441, 468 and During COVID-19 = 146, 160 for girls and boys respectively. Error bars represent 90% confidence intervals. ATUS final weights used. Standard errors are generated using replicate weights. Differences over time are statistically significant at the 5% level. Source: 2017–2021 American Time Use Surveys

Fig. 6 Share of teens interacting with someone during activity episodes



Note: N = 167 episodes alone, 15 episodes gaming while alone, 142 episodes with parents, 34 episodes with friends, and 166 episodes with others. Episodes alone exclude class-time episodes. Interacting includes interacting over the telephone. Time with parents, friends, and others are not mutually exclusive. Error bars represent 90% confidence intervals. ATUS Well-being Module time-based weights used. Standard errors are generated using replicate weights. Source: 2021 ATUS Well-being Module

Table 1 Summary statistics on who teenagers aged 15-17 spent time with

	During COVID-19			Before COVID-19				
With who category	Proportion of teens with positive minutes	Average minutes per day if positive minutes	Average minutes per day including zeros	Proportion of teens with positive minutes	Average minutes per day if positive minutes	Average minutes per day including zeros	Difference in average minutes including zeros	P-value of difference in average minutes including zeros
Panel A. Girls								
Alone	0.93	301.21	280.84	0.89	237.78	211.65	69.19	0.01
Not alone: Classification 1								
Household members	0.91	265.78	240.93	0.95	288.14	274.80	-33.87	0.19
Non-household members	0.50	246.70	123.95	0.61	256.96	156.76	-32.81	0.09
Not alone: Classification 2								
Parents	0.87	193.90	168.67	0.90	236.06	213.42	-44.74	0.05
Friends	0.26	300.50	78.06	0.41	172.06	69.90	8.15	0.68
Others	0.86	307.62	264.78	0.87	338.19	293.15	-28.37	0.26
Peers (Friends + In-school)	0.31	392.05	122.10	0.53	412.98	219.57	97.47	0.00
Panel B. Boys								
Alone	0.96	403.18	387.97	0.93	278.95	259.99	127.98	0.00
Not alone: Classification								
Household members	0.81	234.31	188.86	0.91	223.75	202.88	-14.03	0.51
Non-household members	0.37	214.44	80.15	0.63	250.74	157.98	-77.82	0.00
Not alone: Classification 2								
Parents	0.75	172.30	129.50	0.82	170.22	139.25	-9.75	0.57
Friends	0.16	261.79	41.04	0.43	182.83	78.52	-37.47	0.000
Others	0.74	246.46	182.10	0.87	309.64	269.26	-87.16	0.00
Peers (Friends + In-school)	0.24	375.03	89.72	0.61	243.77	402.12	154.05	0.00

Notes: N = 441 and 468 before COVID-19 and 146 and 160 during COVID-19 for girls and boys, respectively. ATUS final weights used. Reweighting for equal day-of-the-week representation by year and sex. Standard errors are generated using replicate weights. Before COVID-19 is based on time diaries from the 2017–2019 period, while during COVID-19 is based on time diaries from May 10, 2020 to May 9, 2021. Source: 2017–2021 American Time Use Surveys

Table 2 Summary statistics on time spent by teen girls in different activities

	During COVID-19			Before COVID-19				
Primary activity	Proportion of teens with positive minutes	Average minutes per day if positive minutes	Average minutes per day including zeros	Proportion of teens with positive minutes	Average minutes per day if positive minutes	Average minutes per day including zeros	Difference in average minutes including zeros	P-value of difference in average minutes including zeros
Education	0.60	352.48	210.32	0.60	393.25	236.81	-26.49	0.26
Select subcategories of education:								
Class	0.37	352.79	129.82	0.43	363.46	155.81	-25.99	0.20
Class at school	0.11	411.22	44.04	0.40	375.41	149.67	-105.62	0.00
Class other location	0.27	321.78	85.78	0.05	113.78	6.14	79.63	0.00
Work	0.15	229.87	35.23	0.07	340.37	25.48	9.74	0.28
Sleeping	1.00	582.23	582.23	1.00	585.99	585.99	-3.77	0.79
Leisure	1.00	429.19	429.19	1.00	378.68	377.46	51.73	0.03
Select subcategories of leisure:								
Socializing and communicating with others	0.34	141.73	48.40	0.46	103.66	47.67	0.73	0.95
Relaxing and watching sports	0.90	288.66	258.75	0.89	215.55	192.34	66.40	0.00
Select subcategories of relaxing and watching sports:								
TV	0.72	198.14	143.49	0.69	169.23	115.94	27.55	0.09
Playing games	0.19	130.40	24.18	0.12	145.12	17.78	6.40	0.40
Computer for leisure	0.30	119.57	35.43	0.26	73.77	18.91	16.51	0.05
Playing sports and exercise	0.36	100.48	35.70	0.29	118.55	34.57	1.13	0.88
Eating and drinking	0.98	62.47	60.99	0.96	64.13	61.56	-0.58	0.89

Notes: N = 441 and 468 before COVID-19 and 146 and 160 during COVID-19 for girls and boys, respectively. ATUS final weights used. Reweighting for equal day-of-the-week representation by year and sex. Standard errors are generated using replicate weights. Before COVID-19 is based on time diaries from the 2017–2019 period, while during COVID-19 is based on time diaries from May 10, 2020 to May 9, 2021. Source: 2017–2021 American Time Use Surveys

Table 3 Summary statistics on time spent by teen boys aged 15-17 in different activities

	During COVID-19			Before COVID-19				
Primary activity	Proportion of teens with positive minutes	Average minutes per day if positive minutes	Average minutes per day including zeros	Proportion of teens with positive minutes	Average minutes per day if positive minutes	Average minutes per day including zeros	Difference in average minutes including zeros	P-value of difference in average minutes including zeros
Education	0.64	313.91	200.31	0.58	387.67	224.88	-24.56	0.23
Select subcategories of education:								
Class	0.45	314.71	142.00	0.45	378.26	170.54	-28.54	0.12
Class at school	0.13	368.29	48.67	0.43	385.19	165.25	-116.58	0.00
Class other location	0.34	274.18	93.33	0.03	180.05	5.29	88.04	0.00
Work	0.12	226.24	27.46	0.16	324.75	52.83	-25.37	0.04
Sleeping	1.00	593.08	593.08	1.00	585.55	584.28	8.80	0.57
Leisure	1.00	497.61	497.61	1.00	426.34	426.34	71.27	0.00
Select subcategories of leisure:								
Socializing and communicating with others	0.18	105.95	19.23	0.43	86.27	37.27	-18.05	0.00
Relaxing and watching sports	0.96	358.68	343.87	0.93	265.62	247.21	96.66	0.00
Select subcategories of relaxing and watching sports:								
TV	0.64	205.07	131.15	0.73	163.69	119.31	11.84	0.48
Playing games	0.48	281.81	135.49	0.44	196.28	87.15	48.34	0.03
Computer for leisure	0.25	207.14	51.02	0.20	88.16	17.61	33.41	0.01
Playing sports and exercise	0.37	141.26	52.44	0.38	135.60	51.88	0.56	0.95
Eating and drinking	0.99	53.99	53.30	0.98	63.18	62.23	-8.93	0.08

Notes: N = 441 and 468 before COVID-19 and 146 and 160 during COVID-19 for girls and boys, respectively. ATUS final weights used. Reweighting for equal day-of-the-week representation by year and sex. Standard errors are generated using replicate weights. Before COVID-19 is based on time diaries from the 2017–2019 period, while during COVID-19 is based on time diaries from May 10, 2020 to May 9, 2021. Source: 2017–2021 American Time Use Surveys

Table 4 The relationship between COVID-19 and minutes teens aged 15-17 spent with various groups on the diary day (OLS estimates)

		Not alone: Classification 1		Not alone: Classification 2			
Variables	Alone	Household members	Non-household members	Parents	Friends	Others	Peers
COVID-19	128.24***	-2.44	-84.47***	-5.13	-43.82***	-79.25***	-170.58***
	(27.05)	(18.99)	(19.41)	(17.86)	(15.61)	(21.54)	(28.16)
COVID-19 × Girl	-33.15	-29.52	45.51*	-41.56	57.75**	44.64	66.54*
	(34.83)	(31.62)	(25.28)	(30.80)	(25.73)	(32.96)	(36.20)
R-squared	0.21	0.22	0.15	0.20	0.09	0.19	0.25
Joint hypothesis test:							
COVID-19 + COVID-19 × Girl	95.09**	-31.96	-38.96*	-46.69**	13.94	-34.60	-104.04***
	(24.60)	(24.35)	(20.72)	(23.13)	(19.38)	(24.27)	(24.39)

Notes: N = 1,215. ATUS final weights used. Reweighting for equal day-of-the-week representation by year and sex. Standard errors are computed using replicate weights. Before COVID-19 is based on time diaries from the 2017–2019 period, while during COVID-19 is based on time diaries from May 10, 2020 to May 9, 2021. Controls include number of household members (excluding self and parents), and indicators for sex, age, nonwhite, Hispanic, lives with single mother, lives with single father, parent has bachelor's degree, enrolled in school, household income, lives in MSA, state, and month. Time with parents includes nonresident parents. Time with others includes spending time with people other than parents or friends, including siblings, other relatives, neighbors, coworkers, etc. Time with peers includes time with friends and time spent in school. Significance: *p<0.10, **p<0.05, ***p<0.01. Source: 2017–2021 American Time Use Surveys

Table 5 Summary statistics of time spent by location of activity (Teens aged 15–17)

Location	During COVID-19			Before COVID-19				
	Proportion of teens with positive minutes	Average minutes per day if positive minutes	Average minutes per day including zeros	Proportion of teens with positive minutes	Average minutes per day if positive minutes	Average minutes per day including zeros	Difference in average minutes including zeros	P-value of difference in average minutes including zeros
Panel A. Girls								
Undisclosed location	1.00	631.07	631.07	1.00	646.32	646.32	-15.25	0.29
Home	0.97	562.26	548.20	0.94	383.86	362.74	185.46	0.00
Workplace	0.09	257.09	23.74	0.07	325.14	21.81	1.93	0.81
Someone's home	0.26	223.67	58.62	0.28	196.88	55.62	3.00	0.84
School	0.16	335.98	55.26	0.46	410.28	188.27	-133.00	0.00
Car as driver	0.26	62.84	16.49	0.27	55.32	14.76	1.73	0.68
Car as passenger	0.42	51.06	21.55	0.60	60.69	36.32	-14.77	0.01
Other location	0.55	154.23	85.07	0.69	165.43	114.17	-29.10	0.07
Panel B. Boys								
Undisclosed location	1.00	626.21	626.21	1.00	622.89	622.89	3.32	0.84
Home	0.97	619.88	602.59	0.97	400.22	387.50	215.09	0.00
Workplace	0.07	295.90	20.18	0.13	335.39	43.95	-23.77	0.03
Someone's home	0.14	195.25	27.95	0.23	156.77	36.76	-8.81	0.26
School	0.19	359.79	69.00	0.48	437.44	211.87	-142.87	0.00
Car as driver	0.31	42.98	13.41	0.31	51.17	15.65	-2.24	0.49
Car as passenger	0.27	42.68	11.50	0.45	52.44	23.53	-12.03	0.00
Other location	0.49	140.22	69.16	0.71	138.58	97.86	-28.69	0.02

Notes: N = 441 and 468 before COVID-19 and 146 and 160 during COVID-19 for girls and boys, respectively. ATUS final weights used. Reweighting for equal day-of-the-week representation by year and sex. Standard errors are computed using replicate weights. Undisclosed location is when they do not ask where the activity took place. Location information was not collected for the following activities: sleeping, grooming, personal activities, refused, and can't remember. Before COVID-19 is based on time diaries from 2017–2019 while during COVID-19 is based on time diaries from May 10, 2020–May 9, 2021. Source: 2017–2021 American Time Use Surveys

Table 6 The relationship between COVID-19 and teens' minutes per day with parents by location (OLS estimates)

Variables	Home	Workplace	Someone's home	Driving car	Passenger in car	Other location
COVID-19	-0.59	-1.46	0.76	0.39	-0.59	4.51
	(14.36)	(1.02)	(3.98)	(1.27)	(14.36)	(8.46)
COVID-19 × Girl	-11.30	0.77	-13.20*	2.52	-11.30	-13.08
	(20.72)	(1.23)	(6.98)	(3.21)	(20.72)	(14.79)
R-squared	0.12	0.31	0.15	0.07	0.12	0.15
Joint hypothesis test:						
COVID-19 + COVID-19 × Girl	-11.89	-0.07	-12.44**	2.92	-11.89	-8.57
	(13.62)	(0.89)	(5.55)	(3.26)	(13.62)	(11.62)

Notes: N = 441 and 468 before COVID-19 and 146 and 160 during COVID-19 for girls and boys, respectively. ATUS final weights used. Reweighting for equal day-of-the-week representation by year and sex. Standard errors are computed using replicate weights. Standard errors are computed using replicate weights. Before COVID-19 is based on time diaries from the 2017–2019 period, while during COVID-19 is based on time diaries from May 10, 2020 to May 9, 2021. Location information was not collected for the following activities: sleeping, grooming, personal activities, refused, and can't remember. See Table 4 for other control variables. Significance: *p<0.10, **p<0.05, ***p<0.01. Source: 2017–2021 American Time Use Surveys

Table 7 The relationship between COVID-19 and spending any time with friends or spending any time with peers (Linear Probability Model)

Variables	Any Time with Friends (1=Yes)	Any Time with Peers (1=Yes)
COVID-19	-0.29***	-0.40***
	(0.04)	(0.05)
COVID-19 × Girl	0.16**	0.16**
	(0.07)	(0.07)
R-squared	0.19	0.30
Joint hypothesis test:		
COVID-19 + COVID-19 × Girl	-0.13***	-0.24***
	(0.05)	(0.05)

Notes: N = 1,215. ATUS final weights used. Reweighting for equal day-of-the-week representation by year and sex. Standard errors are computed using replicate weights. Before COVID-19 is based on time diaries from the 2017–2019 period, while during COVID-19 is based on time diaries from May 10, 2020 to May 9, 2021. Controls include number of household members (excluding self and parents), and indicators for sex, age, nonwhite, Hispanic, lives with single mother, lives with single father, parent has bachelor's degree, enrolled in school, household income, lives in MSA, state, and month. Significance: *p<0.10, **p<0.05, ***p<0.01. Source: 2017–2021 American Time Use Surveys

Table 8 Teen well-being when spending time alone relative to spending time with someone else (Fixed-Effects Model)

Variables	Happy	Sad	Meaning	Pain	Stressed	Tired
Alone	-0.00	0.22*	-0.08	0.03	0.29	0.38
	(0.29)	(0.12)	(0.31)	(0.09)	(0.35)	(0.24)
Alone × Girl	-0.59	-0.20	-0.76*	-0.30*	0.50	-0.20
	(0.37)	(0.17)	(0.41)	(0.15)	(0.43)	(0.43)
R-squared	0.85	0.92	0.74	0.91	0.81	0.85
Joint hypothesis test:						
Alone + Alone × Girl	-0.59**	0.02	-0.84***	-0.28**	0.79***	0.19
	(0.24)	(0.15)	(0.31)	(0.11)	(0.29)	(0.34)

Notes: N = 420. Well-being measures are measured on a 7-point scale, from 0 to 6. Observations are weighted by the product of the well-being module activity weights and the total time spent in all activities eligible to be selected for the Well-being Module. Standard errors are computed using replicate weights. The following activities were not eligible for selection: sleeping, grooming, personal activities, refused, and can't remember. Controls also include whether the activity type (education, work, household, socializing, relaxing leisure, sports, and eating and drinking, with all other activities as the reference category), the natural logarithm of the duration of the activity, the four-hour time band in which the activity began, an indicator variable for whether the activity occurred at home, and person fixed effects. Significance: *p<0.10, **p<0.05, ***p<0.01. Source: 2021 American Time Use Survey Well-being Module

Table 9 Teen well-being when spending time with friends, parents, and others relative to time spent alone (Fixed-Effects Model)

Variables	Happy	Sad	Meaning	Pain	Stressed	Tired
Parent	0.72***	0.15	-0.25	0.07	-0.67*	0.10
	(0.26)	(0.14)	(0.44)	(0.28)	(0.40)	(0.30)
Parent × Girl	-0.71*	-0.14	0.53	0.04	0.00	-0.07
	(0.37)	(0.17)	(0.51)	(0.32)	(0.41)	(0.39)
Friend	0.59	-0.24	1.01	0.47	0.79	-0.41
	(0.56)	(0.61)	(0.70)	(0.35)	(0.53)	(0.50)
Friend × Girl	0.21	-0.28	0.30	-0.32	-1.49**	-0.34
	(0.75)	(0.71)	(1.19)	(0.41)	(0.71)	(0.75)
Other	-0.56**	-0.35**	0.17	0.05	-0.51	-0.35
	(0.23)	(0.13)	(0.32)	(0.10)	(0.36)	(0.28)
Other × Girl	1.05***	0.40**	0.79	0.24	0.14	0.44
	(0.36)	(0.17)	(0.48)	(0.23)	(0.43)	(0.40)
R-squared	0.86	0.92	0.75	0.92	0.82	0.85
Joint hypothesis tests:						
Parent + Parent × Girl	0.02	0.02	0.29	0.11	-0.67***	0.03
	(0.28)	(0.13)	(0.34)	(0.16)	(0.24)	(0.30)
Friend + Friend × Girl	0.79	-0.53	1.31	0.16	-0.71	-0.75
	(0.53)	(0.36)	(0.99)	(0.21)	(0.52)	(0.53)
Other + Other × Girl	0.49*	0.05	0.96**	0.30	-0.36	0.09
	(0.26)	(0.11)	(0.39)	(0.20)	(0.25)	(0.32)

Notes: N = 420. Well-being measures are measured on a 7-point scale, from 0 to 6. Observations are weighted by the product of the well-being module activity weights and the total time spent in all activities eligible to be selected for the Well-being Module. Standard errors are computed using replicate weights. The following activities were not eligible for selection: sleeping, grooming, personal activities, refused, and can't remember. See Table 8 for other controls. Significance: *p<0.10, **p<0.05, ***p<0.01. Source: 2021 American Time Use Survey Well-being Module

Table 10 The relationship between COVID-19 and minutes spent alone, with parents, with friends, with peers, and with others by parental education for teens aged 15–17 (OLS estimates)

Variables	Alone	Parents	Friends	Others	Peers
Panel A. Girls (N = 587)					
COVID-19	108.51***	-14.92	-8.30	-40.68	-113.67***
	(38.03)	(36.63)	(27.52)	(36.75)	(35.94)
COVID-19 × Parent bachelor's degree	-43.09	-30.28	19.88	8.27	7.98
	(51.35)	(41.21)	(33.27)	(44.23)	(44.78)
R-squared	0.19	0.17	0.18	0.28	0.28
Joint hypothesis test:					
COVID-19 + COVID-19 × Parent bachelor's degree	65.42**	-45.20*	11.58	-32.41	-105.68***
	(31.245)	(25.50)	(23.90)	(29.17)	(29.73)
Panel B. Boys (N = 628)					
COVID-19	147.36***	1.43	-76.22***	-89.10***	-205.65***
	(38.12)	(21.41)	(15.39)	(30.64)	(28.01)
COVID-19 × Parent bachelor's degree	-40.02	-13.58	69.16**	20.40	73.73
	(52.31)	(28.98)	(28.26)	(41.77)	(47.06)
R-squared	0.24	0.24	0.13	0.22	0.29
Joint hypothesis test:					
COVID-19 + COVID-19 × Parent bachelor's degree	107.34***	-12.15	-7.06	-68.70**	-131.92***
	(35.12)	(21.14)	(22.38)	(28.24)	(39.47)

Notes: ATUS final weights used. Reweighting for equal day-of-the-week representation by year and sex. Standard errors are computed using replicate weights. Before COVID-19 is based on time diaries from the 2017–2019 period, while during COVID-19 is based on time diaries from May 10, 2020 to May 9, 2021. See Table 4 for other control variables. Time with parents includes nonresident parents. Time with peers includes time with friends and time spent in school. Time with others includes spending time with people other than parents or friends, including siblings, other relatives, neighbors, coworkers, etc. Significance: *p<0.10, **p<0.05, ***p<0.01. Source: 2017–2021 American Time Use Surveys

Table 11 The relationship between COVID-19 and teens' participation in activities (Linear probability model)

					Select Subcategories of Leisure						
							Select Subcategories of Relaxing				
Variables	Education	Work	Sleep	All Leisure	Socializing	Relaxing	TV	Games	Computers	Sports	Eating and Drinking
COVID-19	0.04	-0.03	0.00	-0.00	-0.27***	0.05	-0.08	0.04	0.05	0.00	-0.00
	(0.04)	(0.04)	(0.00)	(0.00)	(0.05)	(0.03)	(0.06)	(0.06)	(0.05)	(0.06)	(0.01)
COVID-19 × Girl	-0.05	0.12**	-0.00	0.00	0.19**	-0.04	0.14*	0.03	0.01	0.03	0.02
	(0.06)	(0.05)	(0.00)	(0.01)	(0.07)	(0.04)	(0.08)	(0.08)	(0.07)	(0.08)	(0.02)
R-squared	0.37	0.17	0.09	0.01	0.17	0.15	0.15	0.15	0.13	0.15	0.09
Joint hypothesis test:											
COVID-19 + COVID-19 × Girl	-0.02	0.08**	-0.00	0.00	-0.08	0.01	0.06	0.07	0.06	0.03	0.02
	(0.04)	(0.03)	(0.00)	(0.00)	(0.06)	(0.03)	(0.05)	(0.05)	(0.05)	(0.05)	(0.02)

Notes: N = 1,215. ATUS final weights used. Reweighting for equal day-of-the-week representation by year and sex. Standard errors are computed using replicate weights. Before COVID-19 is based on time diaries from the 2017–2019 period, while during COVID-19 is based on time diaries from May 10, 2020 to May 9, 2021. See Table 4 for other control variables. Significance: *p<0.10, **p<0.05, ***p<0.01. Source: 2017–2021 American Time Use Surveys

Table 12 The relationship between COVID-19 and teens' minutes spent on activities (OLS estimates)

					Select Subcategories of Leisure						
							Select Subcategories of Relaxing				
Variables	Education	Work	Sleep	All Leisure	Socializing	Relaxing	TV	Games	Computers	Sports	Eating and Drinking
COVID-19	-33.83*	-24.01**	13.71	80.53***	-19.65***	102.44***	12.36	50.69**	34.39***	1.41	-8.10
	(19.62)	(11.57)	(14.54)	(21.39)	(6.11)	(22.05)	(17.08)	(21.03)	(11.38)	(9.88)	(5.34)
COVID-19 × Girl	3.69	32.06**	-24.29	-13.71	25.13*	-22.42	19.17	-38.87	-15.42	-5.43	7.62
	(30.19)	(14.61)	(18.78)	(30.00)	(13.34)	(27.38)	(23.64)	(25.12)	(13.89)	(11.35)	(6.99)
R-squared	0.32	0.18	0.18	0.23	0.10	0.21	0.12	0.18	0.16	0.17	0.14
Joint hypothesis test:											
COVID-19 + COVID-19 × Girl	-30.13	8.06	-10.58	66.20***	5.48	80.02***	31.53**	11.82	18.96**	-4.02	-0.49
	(21.01)	(9.38)	(13.95)	(20.48)	(11.78)	(19.68)	(15.81)	(14.21)	(8.27)	(8.67)	(4.02)

Notes: N = 1,215. ATUS final weights used. Reweighting for equal day-of-the-week representation. Standard errors are computed using replicate weights. Before COVID-19 is based on time diaries from the 2017–2019 period, while during COVID-19 is based on time diaries from May 10, 2020 to May 9, 2021. See Table 4 for other control variables. Significance: *p<0.10, **p<0.05, ***p<0.01. Source: 2017–2021 American Time Use Surveys

Table 13 The relationship between COVID-19 and teens' minutes spent on leisure activities with friends (OLS estimates)

				Select Subcategories of Relaxing				
Variables	All Leisure	Socializing	Relaxing	TV	Games	Computers	Sports	Eating and Drinking
COVID-19	-40.54***	-14.79***	-12.59***	-6.40*	-5.86***	-0.04	-2.31	-5.39***
	(11.54)	(4.63)	(4.63)	(3.43)	(1.76)	(0.23)	(5.39)	(1.87)
COVID-19 × Girl	56.75***	29.08**	21.12***	7.95	8.29**	2.17	0.34	2.87
	(19.21)	(11.34)	(7.39)	(5.33)	(3.19)	(1.50)	(6.49)	(2.68)
R-squared	0.07	0.08	0.09	0.09	0.07	0.03	0.09	0.16
Joint hypothesis test:								
COVID-19 + COVID-19 × Girl	16.21	14.29	8.53	1.55	2.43	-2.13	-1.98	-2.52
	(15.10)	(10.19)	(6.33)	(4.57)	(2.63)	(1.49)	(3.03)	(2.52)

Notes: N = 1,215. ATUS final weights used. Reweighting for equal day-of-the-week representation. Standard errors are computed using replicate weights. Before COVID-19 is based on time diaries from the 2017–2019 period, while during COVID-19 is based on time diaries from May 10, 2020 to May 9, 2021. See Table 4 for other control variables. Significance: *p<0.10, **p<0.05, ***p<0.01. Source: 2017–2021 American Time Use Surveys

Table 14 Teen girls' well-being during activities (Fixed-Effects Model)

Variables	Happy	Sad	Meaning	Pain	Stressed	Tired
Education	-0.48	0.44	-1.48	0.40	0.89	-0.61
	(0.63)	(0.33)	(0.96)	(0.89)	(0.92)	(1.18)
Education × home	-2.25***	0.09	1.29	-1.30	1.96**	0.92
	(0.62)	(0.34)	(0.92)	(1.06)	(0.89)	(0.97)
Work	-3.42***	0.07	-3.14***	-2.33**	0.45	1.80*
	(1.31)	(0.34)	(0.72)	(0.97)	(0.93)	(1.00)
Household	-0.81*	0.15	-1.47**	-0.58**	0.07	-0.50
	(0.45)	(0.24)	(0.56)	(0.28)	(0.35)	(0.55)
TV	-0.02	0.21	-2.39***	-0.93**	-0.18	-1.05*
	(0.49)	(0.22)	(0.71)	(0.38)	(0.44)	(0.62)
Games	0.12	0.84**	-0.12	-0.72**	1.57***	-0.34
	(0.78)	(0.36)	(0.83)	(0.36)	(0.57)	(0.85)
Computers	-0.46	0.56**	-2.51***	-0.59	-0.96*	-0.76
	(0.52)	(0.27)	(0.64)	(0.41)	(0.54)	(0.77)
Non-screen relaxing	0.20	0.33	0.49	-0.33	0.02	-0.53
	(0.46)	(0.25)	(0.78)	(0.32)	(0.43)	(0.66)
Sports	0.62	0.19	0.14	0.15	-0.68	-0.63
	(0.52)	(0.26)	(0.89)	(0.69)	(0.72)	(0.75)
Eating and drinking	-0.02	-0.09	-0.47	-0.30	0.22	-0.79
	(0.47)	(0.14)	(0.56)	(0.33)	(0.39)	(0.56)
Other	-0.48	-0.13	-1.44**	-0.47	0.98*	-0.76
	(0.51)	(0.27)	(0.69)	(0.36)	(0.51)	(0.72)
R-squared	0.87	0.90	0.79	0.90	0.88	0.77

Note: N = 215. Well-being measures are measured on a 7-point scale, from 0 to 6. The reference activity is socializing and communicating with others. Observations are weighted by the product of the well-being module activity weights and the total time spent in all activities eligible to be selected for the Well-being Module. Standard errors are computed using replicate weights. The following activities were not eligible for selection: sleeping, grooming, personal activities, refused, and can't remember. Controls also include the natural logarithm of the duration of the activity, the four-hour time band in which the activity began, an indicator variable for whether the activity occurred at home, and person fixed effects. Significance: *p<0.10, **p<0.05, ***p<0.01. Source: 2021 American Time Use Survey Well-being Module

Table 15 Teen boys' well-being during activities (Fixed-Effects Estimates)

Variables	Happy	Sad	Meaning	Pain	Stressed	Tired
Education	-1.19**	0.22	-1.09**	0.18	0.79	-0.27
	(0.59)	(0.38)	(0.53)	(0.16)	(1.05)	(0.69)
Education × home	-0.82	0.64*	-0.70	0.03	-0.42	0.15
	(0.69)	(0.36)	(0.76)	(0.17)	(0.87)	(0.44)
Work	-2.60***	-0.68**	-2.76***	0.16	1.58**	-0.89
	(0.69)	(0.30)	(0.86)	(0.16)	(0.66)	(0.64)
Household	-0.61	0.35	-2.12***	0.05	0.46	-0.36
	(0.40)	(0.29)	(0.47)	(0.11)	(0.81)	(0.59)
TV	0.32	0.10	-1.32**	0.06	0.37	-0.69
	(0.37)	(0.24)	(0.58)	(0.18)	(0.60)	(0.68)
Games	0.40	0.22	-1.55**	-0.27	0.48	-0.91
	(0.58)	(0.32)	(0.72)	(0.21)	(0.66)	(0.66)
Computers	-0.81	0.13	-2.56***	0.12	-0.76	-0.59
	(0.63)	(0.33)	(0.59)	(0.22)	(0.82)	(0.75)
Non-screen relaxing	0.21	-0.07	-1.51***	0.23	-0.14	-0.99*
	(0.42)	(0.30)	(0.47)	(0.35)	(0.74)	(0.59)
Sports	-0.13	-0.33	-0.10	0.29	1.37	-0.55
	(0.60)	(0.34)	(0.72)	(0.43)	(1.47)	(1.71)
Eating and drinking	-0.32	0.15	-1.42***	0.08	0.04	-0.88
	(0.43)	(0.31)	(0.42)	(0.11)	(0.73)	(0.57)
Other	-0.75	0.20	-1.86***	0.12	-0.07	-0.35
	(0.57)	(0.49)	(0.67)	(0.24)	(0.75)	(0.58)
R-squared	0.85	0.93	0.86	0.90	0.78	0.85

Notes: N = 225. Well-being measures are measured on a 7-point scale, from 0 to 6. The reference activity is socializing and communicating with others. Observations are weighted by the product of the well-being module activity weights and the total time spent in all activities eligible to be selected for the Well-being Module. Standard errors are computed using replicate weights. The following activities were not eligible for selection: sleeping, grooming, personal activities, refused, and can't remember. Controls also include the natural logarithm of the duration of the activity, the four-hour time band in which the activity began, an indicator variable for whether the activity occurred at home, and individual fixed effects. Significance: *p<0.10, **p<0.05, ***p<0.01. Source: 2021 American Time Use Survey Well-being Module

Appendix

Table A1 Sample construction for teens aged 15–17 (2017–2019, May 2020–May 2021)

Sample Criteria	Number of Observations
Teens aged 15–17	1,258
- Has a child	1,251
- Is married	1,248
- Not live with a parent	1,215
Sample sizes:	
2017–2019	909
May 2020–May 2021	306

Source: 2017–21 American Time Use Surveys

Table A2 Means of Covariates (2017–2019, May 2020–May 2021)

Covariates	Mean
COVID-19	0.23
Girl	0.12
Age 15	0.26
Age 16	0.39
Age 17	0.35
Enrolled in high school or university	0.83
Nonwhite	0.21
Hispanic	0.27
Single mother household	0.18
Single father household	0.05
Two-parent household	0.77
At least one parent has bachelor's degree	0.50
Household members (excluding self/parents)	1.66
Household income <$30,000	0.15
Household income $30,000-$74,999	0.32
Household income $75,000+	0.53
Lives in MSA	0.87

Notes: N = 1,215. State and month indicators not shown were also included in all regressions.
Source: 2017–21 American Time Use Surveys

Table A3 Sample sizes for well-being modules for teens aged 15–17

	All	Girls	Boys
Well-being respondent modules			
2012–2013	814	389	425
March 2021–December 2021	149	73	76
Well-being activity files (No. of episodes)			
March 2021–December 2021	440	215	225
March 2021–December 2021 (asked with whom)	420	208	212

Source: 2012, 2013, 2021 American Time Use Survey Well-being Modules

Table A4 Activity codes used for time-use activities

Time-use category	ATUS activity Codes
Education (taking a class, extracurricular activities, homework)	06
Taking a class	0601
Work and work-related activities including work-related travel	05, 1805
Sleeping	0101
Leisure (includes telephone calls)	11, 12, 13, 14, 15, 160101, 160102
Select subcategories of leisure:	
Socializing and communicating with others	1201, 1202, 120501, 120502
Relaxing and watching sports	1203, 120503, 1302, 130302, 130402
Select subcategories of relaxing and watching sports:	
TV (religious or not)	120303, 120304
Playing games (computer or not)	120307
Computer for leisure (excluding gaming)	120308
Playing sports and exercise	1301, 130301, 130401
Eating and drinking	11

Source: ATUS Activity Lexicon 2003–2019 (U.S. Bureau of Labor Statistics, 2020a)

Table A5 The relationship between COVID-19 and the share of minutes spent with whom for teens aged 15–17 (OLS estimates)

		Not alone: Classification 1		Not alone: Classification 2		
Variables	Alone	HH members	Non-HH members	Parents	Friends	Others
COVID-19	0.18***	-0.00	-0.13***	-0.00	-0.08***	-0.13***
	(0.04)	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)
COVID-19 × Girl	-0.07	-0.07	0.06*	-0.09**	0.08**	0.06
	(0.05)	(0.04)	(0.03)	(0.04)	(0.04)	(0.05)
R-squared	0.22	0.22	0.17	0.20	0.11	0.21
Joint hypothesis test:						
COVID-19 + COVID-19 × Girl	0.11**	-0.07**	-0.07**	-0.10***	0.010	-0.06
	(0.034)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)

Notes: N = 1,215. ATUS final weights used. Reweighting for equal day-of-the-week representation. Standard errors are computed using replicate weights. Before COVID-19 is based on time diaries from the 2017–2019 period, while during COVID-19 is based on time diaries from May 10, 2020 to May 9, 2021. Share of minutes spent alone or with others refers to time on activities when the respondent was asked who was present, which excludes the following activities: sleep, grooming, refused, can't remember, and taking high school classes. Time with parents includes nonresident parents. Time with others includes spending time with people other than parents or friends, including siblings, other relatives, neighbors, coworkers, etc. See Table 4 for other control variables. Significance: *p<0.10, **p<0.05, ***p<0.01. Source: 2017–21 American Time Use Surveys