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ABSTRACT

Two Pandemic Years Greatly Reduced Young People's Life Satisfaction: Evidence from a Comparison with Pre-COVID-19 Panel Data*

How much did young people suffer from the COVID-19 pandemic? A growing number of studies address this question, but they often lack a comparison group that was unaffected by the pandemic, and the observation window is usually short. Here, we compared the 2-year development of life satisfaction of German high school students during COVID-19 (N = 2,698) with the development in prepandemic cohorts (N = 4,834) with a difference-in-differences design. We found a decline in life satisfaction in winter 2020/2021 (Cohen's d = -0.40) that was approximately three times stronger than that in the general population and persisted until winter 2021/2022. Young people found some restrictions particularly burdensome, especially travel restrictions, bans on cultural events, and the closure of bars/clubs.

JEL Classification: I31, I18, J24

Keywords: COVID-19, well-being, causal analysis, pandemic, adolescents, Germany

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Introduction

The COVID-19 pandemic and the restrictions implemented to prevent its spread turned young peoples' lives upside down. When schools and leisure facilities were shut down, adolescents and young adults were faced not only with social isolation (e.g., Elmer et al., 2020) and erosion of their daily structure (e.g., Grewenig et al., 2021) but also with skill deficits (e.g., Betthäuser et al., 2023) and insecurity concerning their educational and occupational futures (e.g., Aucejo et al., 2020). While the pandemic affected all age groups, young people are in a particularly sensitive life stage, which has led to concerns about their well-being (Kowal et al., 2020; OECD, 2022).

A rapidly emerging body of literature has examined the well-being of adolescents and young adults during COVID-19 (e.g., Jensen & Reimer, 2021; Magson et al., 2021; Ravens-Sieberer et al., 2022; Sandner et al., 2023; Thorisdottir et al., 2021) and indicated an overall negative impact of the pandemic. However, these important contributions are typically faced with several challenges. First, they draw on survey data collected during COVID-19 and often lack a control group that was unaffected by the pandemic. Without a control group, the estimation of causal effects is notoriously difficult. Even longitudinal studies without a control group cannot separate the effects of the pandemic from aging effects that may have occurred independently of the pandemic. Second, the bulk of research describes merely immediate changes in well-being during the initial lockdown in spring 2020, and it remains unclear whether the pandemic triggered longer-lasting consequences for the well-being of adolescents or if they recovered. Third, compelling research is lacking whether the pandemic, in the sense of a 'great leveler', had equal effects for all young people, or if traditionally disadvantaged groups suffered particularly negative consequences (Bambra et al., 2021). Fourth, nearly all studies measure only one single overall effect of the pandemic on well-being. However, "the pandemic" encompassed a wide variety of containment measures, such as mask wearing and school closures, which may entail very different psychological consequences. Knowledge of the extent to which individual measures affected the stress experience of young individuals is important for policy, but little is known about this empirically.

The aim of this paper is to contribute to the literature by addressing these issues. We focus on life satisfaction, a central indicator for subjective well-being and the most common measure of an individual's cognitive evaluation of life as a whole (Alderson & Katz-Gerro, 2016).[1] To identify causal effects, we compared trends in the life satisfaction of high school students (M_{age} = 16.62, standard deviation (SD) = 0.75 in wave 1) affected by the pandemic with those of two prepandemic cohorts of high school students with a difference-in-differences design. Data from the 'treatment' cohort came from a panel study that repeatedly surveyed high school students in Germany just before the onset of the pandemic in fall/winter 2019 and two years into the pandemic (winter 2020/2021 and winter 2021/2022).

[1] In contrast to an eudaimonic view on well-being that "… focuses on meaning and self-realization and defines well-being in terms of the degree to which a person is fully functioning." (Ryan & Deci, 2001, p. 141), the employed life satisfaction measure constitutes the cognitive (evaluative) component of hedonic well-being. The broader concept of hedonic well-being also encompasses affective (emotional) components (Diener et al., 1999), which we do not address in the present article.

The students graduated in the summer of 2021, and we observed them during their last two years of high school and 6 months after finishing their degree. Unlike students in lower grades, who were eventually able to return to normal schooling, this was not possible for our sample as they graduated. Thus, we focus on a particularly important group of students who could not finish high school under normal conditions and had to transition to postsecondary schooling or the labor market under very challenging circumstances. We contrasted their development in life satisfaction with that of two prepandemic cohorts that we observed over the same developmental period but who graduated in 2018 and 2014. The data allow us to address possible causal effects of the pandemic on life satisfaction two years into the pandemic. They also allow us to investigate whether the impact of the pandemic differed by gender, migration status, and parental education. In addition, since the last wave of the survey included questions on the stress experience regarding various containment measures, we descriptively show which measures were perceived as particularly burdensome.

To preview the results, we detected a substantial decline in life satisfaction over the course of the pandemic. Compared with previous cohorts, life satisfaction was reduced by Cohen's $d = 0.40$ after one pandemic year, which was approximately three times stronger than comparative estimates from the general German population (Entringer & Kröger, 2021, p. 16). Two years after the onset of the pandemic, adolescents in our sample had not recovered from the initial shock and still had substantially lower average life satisfaction (Cohen's $d = 0.44$) compared to previous cohorts. The magnitude of the decline in life satisfaction does not vary across gender, migrant status, and parental education. In terms of containment measures in winter 2021/2022 (our last measurement point), approximately half of respondents felt strongly or very strongly about travel restrictions, bans of cultural events, and the closure of bars and clubs, while less than one-third of respondents perceived mask wearing and bans of sporting events as a strong burden.

Background and hypotheses

Young people at the end of high school could have been particularly hard hit by the pandemic

Adolescents are in a particularly sensitive developmental stage with respect to biological changes, identity development, and transitions to new environments (e.g., Sawyer et al., 2012). In an already challenging phase of life, 2020, 2021, and the first half of 2022 represented an extraordinary additional burden marked by repeated episodes of quarantine, social isolation, obligations to wear a mask, and suspensions of regular school and extracurricular activities (Mathieu et al., 2022). These measures were put in place to contain the spread of COVID-19, but in combination with actual illnesses and fear of infection, they may have led to immediate and longer-term well-being challenges for adolescents (e.g., Gruber et al., 2021; The Lancet, 2022; Panchal et al., 2023). These challenges may have been particularly strong for adolescents close to graduating high school because the important transition to postsecondary schooling or the labor market took place under very uncertain conditions. At first, it was unclear whether final school exams would be possible at all (Deutsche Welle, 2020). After exams could take place, it was still unclear whether and how well learning could take place under pandemic conditions at universities, vocational schools or the workplace, as was the question of whether new friendships could develop in such a setting (e.g., Egger & Huber,

2022; Larivière-Bastien et al., 2022). This uncertainty and stressful situation could also be detrimental in the longer term. Prior research suggests that students' decline in well-being is related to dissatisfaction with a chosen educational path and to an increased risk of educational failure (Cornaglia et al., 2015; Sandner et al., 2023).

The causal effect of the pandemic

In response to growing concerns about young peoples' well-being, the scientific community was eager to quickly provide answers when the pandemic began in early 2020. To this end, they typically relied on convenience samples and/or on cross-sectional studies that measured well-being without clear prepandemic comparisons (e.g., Al Omari et al., 2020; Gubler et al., 2021; Zhou et al., 2020; review: Nearchou et al., 2020). While these contributions were important in raising awareness of the presumed negative consequences of the pandemic, their estimates are likely to be biased because individuals who volunteer in a convenience study may not be representative of the population. In addition, cross-sectional studies do not allow us to estimate whether there has been a *change* in well-being.

More recently, probability-based longitudinal studies with a prepandemic measurement point emerged, which were better suited than one-time assessments to understand the impact of the pandemic. Zolopa et al. (2022), in a literature review, reported that of seven longitudinal studies that investigated mental health and well-being among young people under the age of 25, six indicated a statistically significant worsening during the pandemic compared to a prepandemic period. For instance, Magson et al. (2021) found that life satisfaction and other indicators of subjective well-being decreased for a sample of Australian adolescents between 2019 and May 2020, approximately two months after the Australian government imposed stay-at-home orders. Another example is Preetz et al. (2021), who followed a sample of German university students until July 2020 to detect a decline in life satisfaction and mental health compared to prepandemic levels.

With such longitudinal studies, changes in well-being can be better linked to the pandemic. However, these studies cannot separate the effects of the pandemic from aging effects that may have occurred independently of the pandemic. Several studies suggest that well-being changes during adolescence and emerging adulthood due to various influences, such as transitions to new environments, psychological and social challenges, or an increase in autonomy (Herke et al., 2019; Proctor et al., 2009; Reuter et al., 2022; Salmela-Aro & Tuominen-Soini, 2010; Siembab & Stawarz, 2019). A more compelling causal design would need to compare trends in well-being between a cohort affected by the pandemic and a control cohort not affected by the pandemic.

Our first contribution to the literature is that we provide such a design. While we expect only minor fluctuations in the well-being of adolescents not affected by the pandemic, we expect a pronounced decline for those affected by the pandemic (*Hypothesis 1*).

The development of well-being over two pandemic years

A marked feature of the previous literature is its focus on the early phase of the pandemic in the spring of 2020. Studies with a longer time horizon are rare, but they are important to gauge whether the pandemic caused only a short-term shock or actually had longer-term consequences for adolescents' well-being. On the one hand, young people may have adapted

to their 'pandemic lives', or the loosening of lockdown measures in the course of the pandemic may have led to an increase in well-being to prepandemic levels (Henseke et al., 2022). On the other hand, the spread of COVID-19, as well as the removal or reimplementation of lockdown measures, were highly dynamic, and uncertainty about the end of the pandemic may have damaged well-being in the longer term.

We are aware of only a few studies that observed the development of young people's well-being for more than a few weeks or months into the pandemic. Thorisdottir et al. (2021) and von Soest et al. (2022) used repeated cross-sectional data to map the development of mental health for adolescents from Iceland and Norway until October 2020 and March 2021, respectively. Their findings showed that several indicators of well-being were lower for survey participants during the pandemic compared to prepandemic survey participants. Using longitudinal data from 18- to 23-year-old residents of Washington state, USA, Graupensperger et al. (2022) reported that COVID-19-related stressors, especially social/relational stressors, were associated with mental health and well-being up until August 2021. Henseke et al. (2022) used panel data of 16- to 25-year-old UK residents to investigate the development of life satisfaction between February 2021 and May 2022. They found that life satisfaction improved since its low point in February 2021. Finally, Sandner et al. (2023) analyzed how the well-being of high school students in Germany developed until fall 2020. They found that the pandemic had a positive effect on students' well-being until spring 2020, presumably because students felt the initial lockdown was like a vacation or a welcome health protection measure. A few months later, however, well-being had strongly declined. Whether this negative trend continued into 2021 or whether students recovered as in the Henseke et al. (2022) study is an open empirical question.

Our second contribution is, therefore, that we extend the observation window until the winter of 2021/2022 to assess whether high school graduates in Germany recovered in the course of the pandemic or whether they continued to struggle. In winter 2021/2022, case numbers in Germany and other European countries rose to unprecedented heights, and concerns about new, more contagious viral mutations were widespread (see German Federal Ministry of Health, 2023, and more detailed explanations below). This may have led to continued lower life satisfaction (*Hypothesis 2*).

Heterogeneity in the development of well-being

With the outbreak of the COVID-19 pandemic, discussions on its equalizing effect on existing societal inequalities emerged (e.g., Bernardi, 2020). Most social scientist were skeptical towards the 'leveler' hypothesis, and subsequent COVID-19 research on morbidity, mortality, well-being, and many other inequality dimensions indicated that the COVID-19 pandemic hit disadvantaged groups to a greater extent (e.g., Bambra et al., 2021; Mamelund & Dimka, 2021). Our third contribution is to expand this research to high school graduates. In terms of health and well-being, the stress process model (Pearlin et al., 1981) offers a conceptual tool to theorize about effect heterogeneity. According to this model, critical life events induce stressors (e.g., economic strain or uncertainty about future), which have a negative impact on individuals mental health and therefore well-being (Ormel et al., 1999). Whether a life event impairs an individuals' well-being depends on social (e.g., support) and personal (e.g., self-efficacy) resources that can have a buffering function. As sociological research indicates that

exposure to stressors as well as buffering resources are socially stratified (Pearlin et al., 2005), we can expect heterogeneous effects of the COVID-19 pandemic on well-being.

In the case of high school students, one might assume that cramped living conditions, a higher risk of parental unemployment, or higher infection rates could lead students with less educated parents or a migration background to suffer more from the pandemic compared to their more privileged peers. In line with this conjecture, first descriptive evidence points to a slightly more pronounced increase in worries about the future among migrants and students from lower social backgrounds (Anger et al., 2021). Regarding gender, the expectations are less straightforward. Research on gendered COVID-19 effects indicates that declines in well-being were primarily observed among women with caregiving responsibilities (Patzina et al., 2023; Zoch et al., 2022), an argument that appears to be less applicable to high school students. However, Zoch et al. (2022) also demonstrated that women were more concerned about the various threats posed by the crisis and, furthermore, experienced higher levels of loneliness compared to men. A similar pattern could also be expected for younger women. In sum, we expect that the decline in life satisfaction may be more pronounced among women, students with a migration background, and students with less educated parents (*Hypothesis 3*).

Some restrictions may have been more burdensome than others

In the course of the pandemic, various things could be experienced as stressful and reduce well-being. These included the disease itself, but also the various measures taken to contain the spread of the virus. Surprisingly, little is known, however, about which facets of the pandemic were perceived as particularly stressful or burdensome. Szczepańska and Pietrzyka (2023) reported that students in Poland found the closure of restaurants or parks more 'inconvenient' than the closure of churches or railway stations. Buffel et al. (2022) reported that school closures, workplace closures and stay-at-home restrictions were related to depressive symptoms among university students worldwide. Mækelæ et al. (2020) found that respondents aged 18–81 from 6 countries were severely affected by school (including kindergarten and university) closures, while social distancing, cancellation of sport and cultural events and reductions in transportation were not rated as severely affecting daily life. All three studies referred to the first wave in spring 2020. Finally, Henseke et al. (2022) showed that reduced social contact and worries about career prospects and job skill learning were related to life satisfaction during the pandemic in the UK, whereas a COVID-19 diagnosis among the respondents or among their family members and friends was not. While they did not assess different types of restrictions directly, their study indicates that stressors related to the restrictions may have been more important for life satisfaction than stressors related to the disease itself.

In our fourth contribution, we add to this research by describing how a large sample of German high school graduates perceived the burden of the various containment measures in winter 2021/2022, i.e., after two pandemic years. Given the paucity of research, this fourth contribution is exploratory, and we do not develop explicit hypotheses. Moreover, this contribution is purely descriptive but of great policy relevance: it allows policy-makers to take into account the psychological consequences of containment measures in future pandemic situations in addition to their medical effectiveness.

In sum, our four contributions are: first, offering a difference-in-differences design to establish the causal effect of the pandemic on life satisfaction for high school graduates;

second, extending the observation window to winter 2021/22 to investigate longer-term consequences; third, examining effect heterogeneity for this age group; and fourth, providing insights into which policy measures were perceived as particularly stressful.

The pandemic situation in Germany

Before reporting the methods and results, we provide some context on the COVID-19 situation in Germany during our observation window.

The Robert Koch Institute (2022) retrospectively categorized the coronavirus pandemic into multiple waves: The first wave (03/2020 – 05/2020) was followed by a summer plateau and then the second wave (10/2020 – 02/2021). The third wave (03/2021 – 05/2021) followed immediately after. Another summer plateau was followed by the fourth wave (08/2021 – 12/2021) and the fifth wave (12/2021 – 05/2022). Figure 1 shows the waves along with the 7-day moving average of new COVID-19 cases over time (it also contains information on the data, which we explain below). COVID-19 cases peaked at approximately 5,200 new cases per day during the first wave in April 2020 and increased to 160,000 new cases per day by the end of January 2022, during the fifth wave.

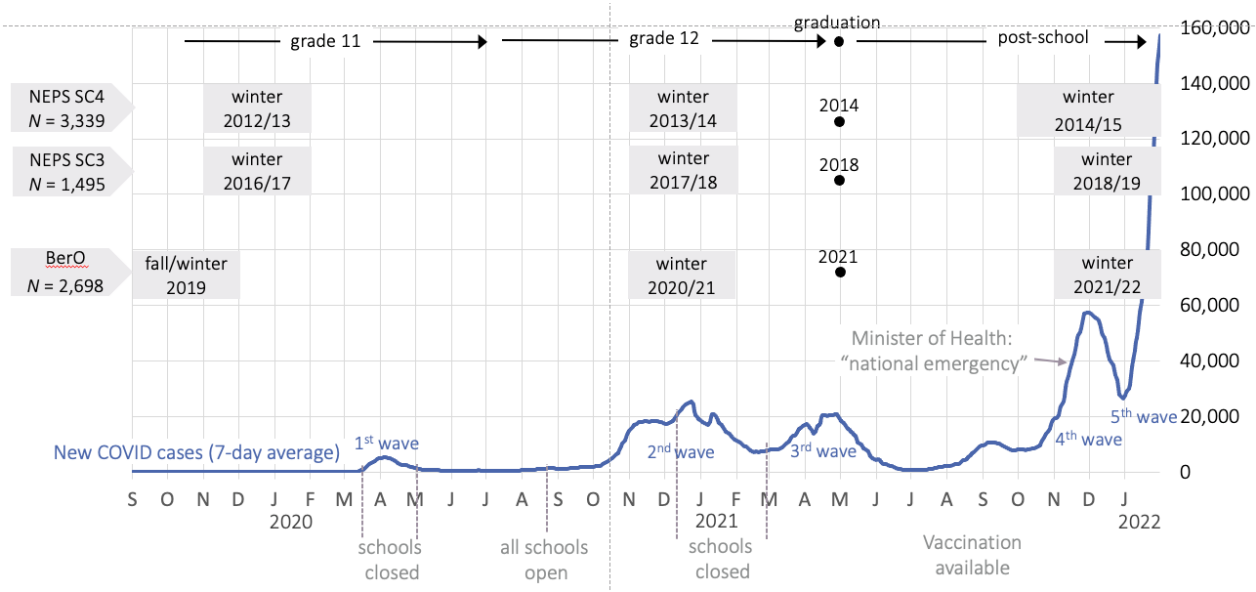

Fig. 1 Timeline of data collection and COVID-19 infections in Germany.

Sources: https://covid19.who.int/data, Robert Koch Institute (2022), German Federal Ministry of Health (2023).

To contain the COVID-19 pandemic, the federal government adopted and periodically re-evaluated various containment measures (for details: German Federal Ministry of Health, 2023). Between March 2020 and May 2020, as well as between October 2020 and March 2021, there were so called lockdowns, during which only systemically important facilities (food stores, pharmacies, etc.) were open. In addition, educational institutions were closed from March 2020 to April 2020. These opened successively from May 2020, but hybrid forms of instruction or rotating classes were used. Educational institutions were then closed once again from December 2020 to February 2021. During the school closures, classes continued online as best as possible. There were also restrictions on leisure activities. During the lockdowns, restaurants, bars, clubs, and cultural and sports facilities were closed, and public

sports and cultural events were postponed until further notice. Contact restrictions were also imposed, each of which was adjusted to the incidence of infection. As of mid-2020, wearing (medical) masks was mandatory in most public spaces.

In fall and winter 2021, every person older than 18 years had the opportunity to be vaccinated. Therefore, many policies at the end of 2021 depended on the vaccination status of individuals. Gatherings among vaccinated individuals were therefore possible again. Despite many vaccination offers in 2021, vaccination rates in Germany did not reach desired levels that may have led to herd immunity or at least prevented an excess of severe disease processes and associated hospitalizations. Given the rapid increase in infections, the German Ministry of Health at the end of 2021 proclaimed that Germany was in a state of "national emergency" and that the COVID-19 situation had never been so dramatic. In addition, during the fourth wave, travel restrictions were in place (irrespective of vaccination status) to reduce the risk of the spread of new virus variants such as B.1.1.529, which was dominant in South Africa at the end of 2021. In addition, major events such as Christmas markets were cancelled, and it was strongly recommended to follow strict distancing rules. Thus, at the end of 2021, individuals faced a great deal of uncertainty regarding new virus variants, as well as strong restrictions to contain the spread of the virus.

Method

Data

To investigate the impact of the COVID-19 pandemic on the development of adolescents' well-being in the transition from high school to postsecondary education, we employed German panel data from three different cohorts: the 2021 high school graduation cohort, which was affected by the COVID-19 pandemic (henceforth the treatment group, TG) and the 2014 and 2018 graduation cohorts, which were not affected during the observation window (henceforth the control group, CG). As depicted in Figure 1, all three cohorts were observed during their last two years of high school and 6 months after finishing their degree with three measurement points (M_{age} = 16.62, standard deviation (SD) = 0.75 in wave 1).

Data on the treatment group stem from the BerO Study carried out by the Institute for Employment Research in Germany. BerO followed individuals in their final two years before graduation from the highest track of secondary school ('Gymnasium') in 2019. The German educational system comprises two to four secondary school tracks, and only 43 % of all students transfer to a 'Gymnasium' after primary school (Autor:innengruppe Bildungsberichterstattung, 2022, p. 127), so we focus on a subset of all secondary school students. While graduation from the lower and intermediate track takes place after grade 9 or 10 and provides individuals access to the vocational part of the German postsecondary education system, graduating from the highest track provides access to both university and vocational training. Graduation from the highest track takes place after grade 12.[2] Graduation from high school in Germany mainly takes place between April and May, and adolescents typically start postsecondary education in the fall of the graduation year.

[2] Some federal states offer academic tracks with nine years of schooling. These nine-year-track high schools have not been part of the BerO study sample frame.

The central aim of the BerO study was the evaluation of a job counseling intervention at German high schools; however, the study also constitutes an excellent data source for the evaluation of the effects of the COVID-19 pandemic on adolescents.[3] The baseline paper-and-pencil survey of the BerO study was conducted in 214 schools from 42 counties (*Arbeitsagenturbezirke*) in eight of 16 German federal states between September and December 2019, i.e., before the pandemic hit. The research project sampled federal states and counties in which the job counseling intervention was implemented most intensively. Within the counties all schools with an academic secondary track were invited to participate in the study. Within participating schools, all students in grades 11 and 12 were invited to complete questionnaires, with a professional data collection team managing the overall fieldwork. In addition to this baseline survey, our study uses data from the first and third follow-up surveys, which took place from November to January 2020/2021 and November to January 2021/2022, respectively.

Data for the control group come from the National Educational Panel Study (NEPS, see Blossfeld & Roßbach, 2019). Adopting a multi-cohort design, NEPS provides high-quality, nationally representative panel data which has become a standard data sources for social scientists concerned with education-related research questions (see, for instance, the over 130 publications based on NEPS data in only 2022: https://www.neps-data.de/Project-Overview/Publications). We use data from the NEPS starting cohorts (SC) 3 (NEPS Network, 2022) and 4 (NEPS Network, 2021). SC3 is a longitudinal study of N = 5,208 students who attended fifth grade in the 2010/2011 school year, while SC4 is a longitudinal study of N = 15,017 students who attended ninth grade in the 2010/2011 school year (in wave 3 of the SC3 a refreshment sample increase the number of students to 6,211 in grade 7). The SC3 and SC4 are an ideal control group because individuals from SC3 graduated in 2018 and individuals from SC4 graduated in 2014 without any COVID-19 restrictions and in the absence of any major labor market crises. SC3 and SC4 were built upon a stratified multistage sampling design in which all students in randomly sampled classes within randomly sampled schools were invited to participate in the study (details: Aßmann et al., 2011).

Table 1 shows which survey waves of which dataset we used. To cover the same observation period as in the treatment group, we followed students from grade 11 onwards, which corresponds to waves 8 – 10 in SC3 and waves 5 – 8 in SC4. To match the treatment group, we also excluded respondents who did not attend the general academic track ('Gymnasium') in grade 11. These were primarily individuals who had attended a lower school track and were now pursuing postsecondary vocational education and training. Furthermore, academic track schools with nine years of schooling instead of the standard eight years of schooling had to be excluded because the treatment group only included individuals from academic tracks with eight years of schooling. Because we were interested in analyzing changes over time, another important restriction is that we excluded all individuals with only one observation. Additionally, we dropped observations with missing values for the

[3] We checked whether the job counseling intervention influenced the outcome under study. The results from two-tailed t tests reveal no significant differences in the development of life satisfaction across treatment (recipients of job counseling) and control group.

outcome variable. After employing all data restrictions, we relied on information from 7,532 individuals.[4]

In each wave, primary fieldwork was conducted in fall and winter. As the outcome under study may suffer from seasonal fluctuations (e.g., Kuehnle & Wunder, 2016), using data from the same seasons is important.

Table 1 Overview of surveys, sample restrictions and case numbers

Data source	**NEPS-SC3**	**NEPS-SC4**	**BerO study**	**Total**
Survey waves	W8,9,10	W5,7,8	W1,3,5	
Interview timing[a]	Sep. to Feb.	Sep. to Feb.	Sep. to Dec. (W1); Nov. to Jan. (W3,5)	
N grade 5/9 across all tracks	5,208	15,017	-	-
N grade 11 'Gymnasium' track[b]	1,845	4,780	4,131	10,756
Loss due to nine-year 'Gymnasium' (G9)	-45	-522	-	-567
Loss due to grade retention	-187	-671	-305	-1,163
Loss due to missing outcome	0	-1	-111	-112
Loss due to at least two observations	-118	-247	-1,017	-1,382
***N* analytic sample**	**1,495**	**3,339**	**2,698**	**7,532**

[a] Some NEPS interviews took place outside this observation period. However, case numbers were very low. In the NEPS-SC3 cohort, over 95% of interviews were always conducted in this period. In the NEPS-SC4 cohort, over 91% of interviews were always conducted in this period. [b] net of grade skippers.

Measures

Outcome variable: Life satisfaction is a key indicator of subjective well-being (Alderson & Katz-Gerro, 2016) and the most common measure of an individual's cognitive overall appraisal of the quality of his or her own life (e.g., Diener et al., 2006; Headey et al., 2010; Lucas, 2007). Among young people, decreased life satisfaction is correlated with a broad spectrum of negative social and psychological outcomes, including academic failure, emotional disturbance, violent behavior, substance abuse, and suicide (Borrello, 2005; Proctor et al., 2017). Empirically, we relied on answers to the following question: "How satisfied are you currently with your life in general?" Respondents answered on a scale ranging from 0 ("totally dissatisfied") to 10 ("totally satisfied"). Life satisfaction was assessed with the same instrument in all waves and datasets. While multi-item scales are generally preferred for their greater reliability, validity, and ability to capture nuances within a construct, research on adolescents suggests that the single item measure of life satisfaction highly correlates with the multi-item 'Satisfaction With Life Scale' and has, for instance, the same predictive power for school grades (Jovanović, 2016).

Treatment and control group: Individuals who graduated high school in 2021, i.e., during the COVID-19 pandemic, constituted the treatment group. Individuals who graduated high school in 2014 or 2018, i.e., prior to the COVID-19 pandemic, constituted the control group.

[4] Since BerO data was only collected in 8 out of 16 federal states, while NEPS data is available for all 16 federal states, we conducted a sensitivity analysis in which we limited the NEPS data to the 8 federal states covered by BerO. The substantive findings remained unchanged (see Figure S3 in the Supplementary Material).

Time: Our main objective was to investigate the development of life satisfaction over time. Thus, we created a variable indicating the time of measurement: grade 11, grade 12, or postschool (i.e., 6 months after finishing school).

Effect heterogeneity: We explored treatment effect heterogeneity by gender (male/female), migration background (student or at least one parent born abroad; yes/no), and parental education (at least one parent has a university degree; yes/no).

Further control variables: In addition to the effect heterogeneity variables, our balancing equation (see next section for details) relied on a linear age term indicating age in years in grade 11. Moreover, we employed a school performance measure that constituted an average of the final grade point average of German and Math (1 indicated the best grade and 5 the worst grade) from grade 10. In all analytical steps, we furthermore used a dummy variable that indicated whether an individual switched from a paper or online survey to a telephone interview situation.

Stress experience regarding containment measures: In the last wave (winter 2021/2022), the treatment group was asked to indicate on a 5-point scale (1 = very little, 5 = very strong) how much of a burden different hygiene and distancing rules placed on them. We used this information in the last part of the Results section to explore what was perceived as particularly stressful.

Analytical strategy

We employed a difference-in-differences (DiD) design to estimate the effect of the pandemic on the life satisfaction development of adolescents in the transition from school to postsecondary education. Thus, we aim to answer the following question: "How would the well-being of the treatment group (i.e., COVID-19 graduation cohort) have developed without the COVID-19 pandemic?". This research question describes an average treatment effect on the treated (ATT) (Morgan & Winship, 2014). We were able to observe the within-individual change in life satisfaction in a state with and without the COVID-19 pandemic—the needed potential outcome.

Empirically, we estimated the following equation:

$$Y_{it} = \beta_1 TG_i + \beta_2 Time_{it} + \beta_3 (TG_i Time_{it}) + \beta_4 X + \varepsilon_{it}$$

In this equation, Y_{it} represents the life satisfaction of individual i at time t. β_1 captures level differences in the outcome between the treatment and control group, while β_2 captures the time change in life satisfaction during the final two years of high school and the first year after graduation. β_4 captures mode effects (i.e., switches from paper-pencil or online surveys to telephone surveys). According to the literature, capturing such effects in life satisfaction equations is important because interviewer presence leads to increases in life satisfaction reporting (e.g., Chadi, 2013). β_3 captures the effect of interest, which we retrieved from interacting the treatment group indicator TG_i with the time indicator $Time_{it}$.

Employing this equation should provide causal estimates of the change in life satisfaction between the treatment and control group. However, when graduation cohorts differ in certain characteristics (e.g., the proportion of females), which may affect the development of the outcome under study, estimates of our DiD approach could still be biased. To reduce potential bias in our estimates, we employed entropy balancing (EB) to reweight

our data (Hainmueller, 2012). Our EB approach reweighted the control group at grade 11 so that the means of and variances in all covariates (e.g., demographics or school performance) were identical across the treatment and control group (see Table 2 for marginal distributions before and after balancing). This procedure ensures that baseline conditions are as comparable as possible across data sources. In contrast to more classical matching or weighting techniques, EB is doubly robust, as it leads to perfect balance between groups (Zhao & Percival, 2017). While we prefer EB-DiD over simple DiD regressions, we replicated our findings using unweighted data (see right-hand side of Figure 1 and Supplementary Material Figures S1 to S2).

Table 2. Variable distributions pre- and post-entropy balancing at grade 11

	Control group (2014/18 graduates)		Treatment group (2021 graduates)
	Pre	Post	Treatment
Life satisfaction	7.41	7.42	7.42
	(1.75)	(1.96)	(1.96)
Age	16.46	16.62	16.62
	(0.59)	(0.75)	(0.75)
Females	55%	64%	64%
College-educated parents	54%	62%	62%
Migration background	18%	21%	21%
German/Math GPA	2.50	2.62	2.62
	(0.82)	(0.78)	(0.78)
N	4,834		2,698

Standard deviation in parentheses.

To fill in missing values (ranging from 2.4% for migration background to 8.9% for parental education), we employed multiple imputation with chained equations to create 20 complete datasets using Stata 17.0 (White et al., 2011). While our findings did not change meaningfully when we excluded individuals with missing data, we gained statistical power by incorporating these cases.[5]

Results

Negative long-term development of life satisfaction

Figure 2 presents our main results. Depicted are predicted values of the development of life satisfaction along with 95% confidence intervals from DiD regressions (see Table S1 in the Supplementary Material for corresponding regression tables). The black lines show the control groups (CG, 2014 and 2018 cohorts), and the gray lines mark the development of life satisfaction of the treatment group (TG), i.e., school students who graduated in 2021 during the COVID-19 pandemic.

[5] The imputation model included all model and reweighting variables. To allow for possible interaction effects in the main analysis between these variables and the treatment indicator, we ran the imputation model separately for the treatment and control group.

The left-hand side of Figure 2 shows results based on unbalanced data, with separate estimates for all three cohorts. The development of life satisfaction of the 2014 and 2018 cohorts was almost identical, although they were four years apart. Life satisfaction did not change in the last two years of school, while it increased slightly after leaving high school by approximately 0.2 scale points. The fact that both control groups showed a similar pattern supports the assumption that this is the typical development in a world without a pandemic. In sharp contrast, the life satisfaction of the treatment group decreased significantly between grade 11 (before the pandemic) and grade 12 (during the pandemic) and developed after leaving school analogously to the course of the control group, but at a constantly lower level. Since the two control groups were similar, we combined them in the next analysis step and balanced the composition of the control and treatment groups using entropy balancing (see right-hand side of Figure 2). The central finding, irrespective of the balancing of the data, is that life satisfaction was greatly reduced as a result of the COVID-19 pandemic. Compared to the control group, life satisfaction was reduced by 0.78 scale points in grade 12 (Cohen's d = -0.40). In the further course of the pandemic, life satisfaction did not recover. In the first year after leaving school, life satisfaction was reduced by 0.84 scale points compared to the control group (Cohen's d = -0.44). The sharp drop in life satisfaction in winter 2020/2021 and the continued low level in winter 2021/2022 confirm hypotheses 1 and 2.

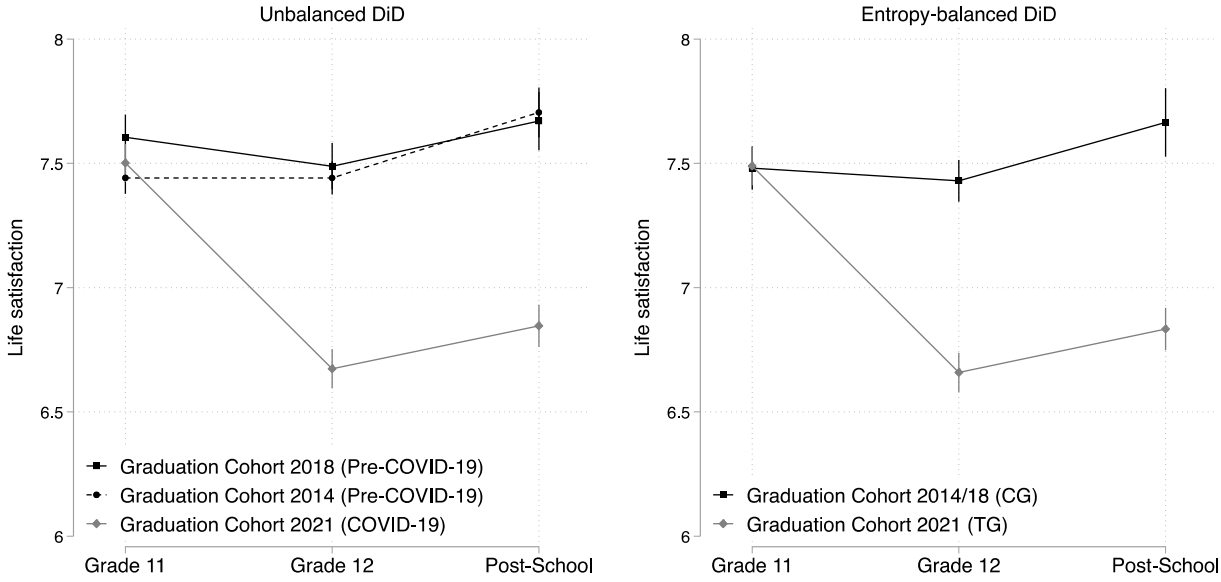

Fig. 2 Development of life satisfaction by cohort

Predicted values from DiD regressions; the left part shows results based on unbalanced data, with separate estimates for all three cohorts. The right part shows the results based on the entropy-balanced (pooled) control and treatment group. *N* observations = 20,478; *N* individuals = 7,532.

Such strong declines in life satisfaction are unusual. To put this into context, descriptive findings for the overall German population showed a drop in life satisfaction in January/February 2021 of only 0.24 scale points compared to pre-pandemic levels in 2019 (measured with the same scale; Entringer & Kröger, 2021, p. 16). Thus, the effect in our cohort is approximately three times as large. Compared to the learning loss of school-aged children during the COVID-19 pandemic (Cohen's d = -0.14 according to a meta-analysis; Betthäuser et al. 2023), the loss in life satisfaction was approximately three times stronger. A

comparably strong drop in life satisfaction can be found for only a few other critical life events, such as unemployment or the death of a spouse (Luhmann et al., 2012).

Little heterogeneity in the effects of the COVID-19 pandemic

We also investigated whether the findings differed for different subgroups. Figure 3 presents the results from our DiD approach based on entropy-balanced data.

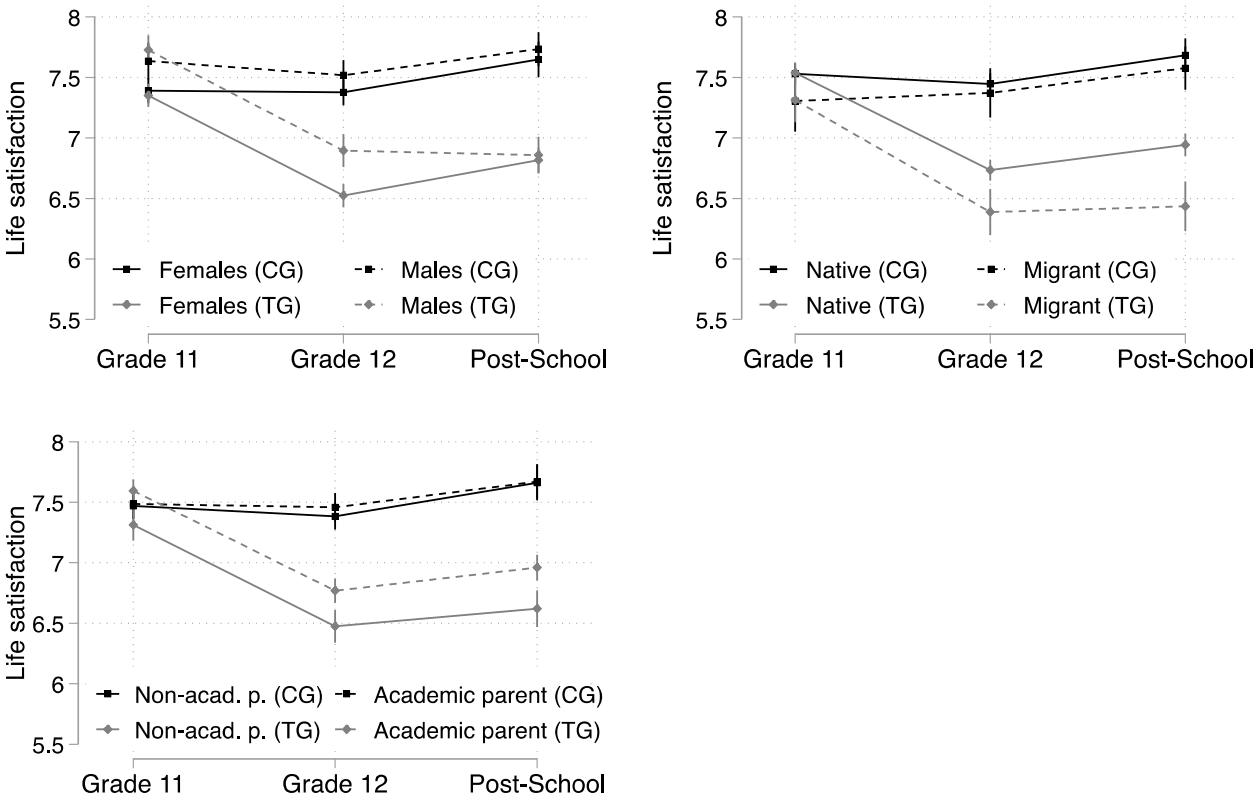

Fig. 3 Development of life satisfaction by cohort and subgroups

Predicted values from DiD regressions based on the entropy-balanced (pooled) control and treatment group. *N* observations = 20,478; *N* individuals = 7,532.

In the control group, gender, migration background and parental education had no influence on the development of life satisfaction. There were also only few differences in the treatment group. The upper left part of Figure 3 shows that between grades 11 and 12, life satisfaction dropped for both genders equally. After graduation, life satisfaction for women in the COVID-19 cohort significantly increased by 0.29 scale points, leading to a leveling of differences in life satisfaction after school between men and women. The upper right part of Figure 3 indicates that between grades 11 and 12, life satisfaction dropped equally for individuals with and without a migration background. After individuals had left school, ethnic disadvantages (i.e., level differences in life satisfaction by migration background) in life satisfaction in the COVID-19 cohort slightly increased by 0.16 scale points; however, this increase was not statistically significant. In terms of parental education, the bottom part of Figure 3 indicates no effect heterogeneity. Contrary to our hypothesis, the overall development of life satisfaction was similarly negative across the subgroups considered.

Some COVID-19 containment measures were more burdensome than others

To evaluate the causal impact of certain policy measures on life satisfaction, it is necessary to use some exogenous variation in the implementation of measures, e.g., variation within individuals and across regional levels (Goodman-Bacon & Marcus, 2020). Unfortunately, our data set does not contain sufficient case numbers to provide a rigorous analysis of variations in measure implementations. Nevertheless, we wanted to use the data at hand to provide explorative evidence on the perceived burdens associated with nine different policy measures and their correlations with the outcome under study (i.e., life satisfaction).

Figure 4 presents shares of individuals who stated that in winter 2021/2022 a certain policy measure placed a strong or a very strong burden on them (value of 4 or 5 on a 5-point scale). The figure also shows the correlations between answers to these measures on the 5-point scale and life satisfaction in the winter of 2021/2022. Correlations are based on ordinary least squares (OLS) regressions that adjust for baseline life satisfaction from fall/winter 2019.

As 54% of respondents stated that travel restrictions placed a (very) strong burden on them, this policy domain appeared most stressful for young people, followed by the ban of cultural events and festivals (47%), and the closure of bars and clubs (44%). The ban on sporting events (23%), mask wearing (29%), and the closure of educational institutions (36%) placed the least burden on respondents in our sample.

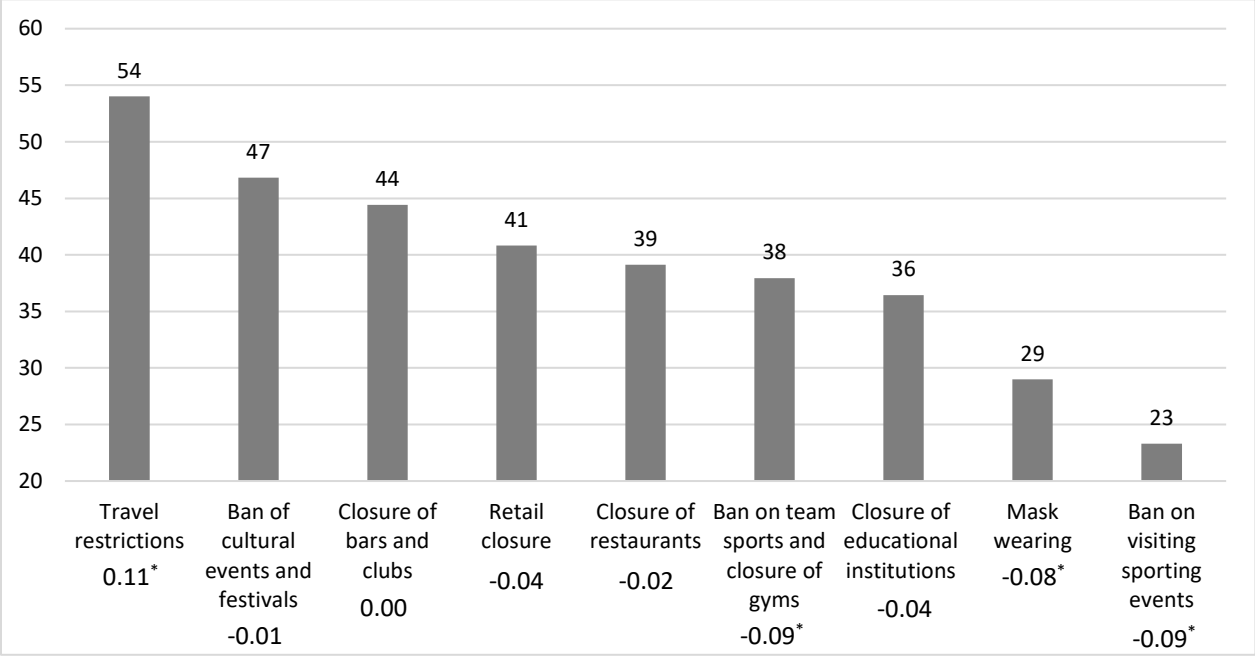

Fig. 4 Share of respondents (in %) who stated that a containment measure placed a (very) strong burden on them in winter 2021/2022

The legend shows different containment measures and the correlation between answers on the 5-point scale and life satisfaction. Correlations are based on OLS regressions to control for baseline life satisfaction from fall/winter 2019.
* $p < 0.05$.

When investigating correlations between the perceived subjective burden of certain policies and life satisfaction, our results indicate weak associations (0.00 to -0.09). For instance, with a one-unit increase in the perceived burden of the ban on team sports and

closure of gyms, life satisfaction decreased by 0.09 scale points. Thus, the life satisfaction levels of individuals who perceived this as a very strong burden compared to individuals who perceived no burden at all were approximately 0.45 scale points lower. This difference corresponds to a Cohen's *d* of 0.23 and therefore constitutes a small but nonnegligible difference. Surprisingly, the burden related to travel restrictions was positively associated with life satisfaction, which appeared implausible because many individuals stated that they were (very) strongly affected by this policy measure. This could be because people who enjoy traveling generally have higher life satisfaction but at the same time feel strongly restricted by travel constraints. Of course, there were other sources of stress that do not appear in Figure 4. We take up this point in the discussion.

Summary and Discussion

The end of schooling and the transition to a postschool career is a challenging developmental period even under "normal" conditions (e.g., Zarrett & Eccles, 2006). The COVID-19 pandemic represented an additional burden that raised great concern that young people's well-being suffered (e.g., OECD, 2022). However, hardly any studies exist to date that a) compare the development of well-being during the pandemic with the development of well-being in a world without the pandemic to better approximate the causal effect; b) take into account later pandemic waves to be able to make statements about the longer-term development; c) investigate effect heterogeneity for this age group, or that d) trace which measures were perceived as particularly stressful by young people. Based on three panel datasets that followed German high school graduation cohorts in 2014, 2018, and 2021 during the last two years of high school until 6 months after graduation, we employed a difference-in-differences design to address these shortcomings.

We found a strong decline in life satisfaction over the course of the pandemic. After one year of the pandemic, life satisfaction was Cohen's $d = 0.40$ lower than in previous cohorts, an effect that was approximately three times stronger than estimates from the general German population and approximately three times stronger than the average learning loss students experienced during the pandemic. Two years after the onset of the pandemic, young people in our sample had not recovered from the initial shock and still had substantially lower average life satisfaction compared to previous cohorts ($d = 0.44$). The size of the life satisfaction decline is worrisome. Although young people in Britain (Henseke et al., 2022) also showed a sharp drop in life satisfaction in winter 2020/2021, life satisfaction rose steadily thereafter, whereas in Germany, it remained at a low level in winter 2021/2022. This may have to do with the fact that the German administration imposed severe restrictions on public life in winter 2021/2022 to deal with the sharply rising numbers of infections. Young people were frustrated by the unclear further development after two pandemic years in which they had to cope with these restrictions. The pandemic was not the great equalizer, as traditionally disadvantaged groups experienced higher rates of illness, increased mortality, and suffered more profoundly from the economic consequences (e.g., Bambra et al., 2021). However, the development of life satisfaction was similarly negative for young men and women, and it was also independent of migration background or parental education. One reason for limited differences could be that our sample already consisted of privileged upper secondary track students. Whether effect heterogeneity manifested in lower tracks of the secondary school

system, or if the pandemic has simply affected all young individuals uniformly strongly, should be clarified by future research. In the last step of our analysis, we described which of these constraints were perceived as particularly burdensome by the respondents who had now finished high school. Wearing masks was not perceived as burdensome by 2/3 of the respondents; likewise, the closures of educational institutions (including universities) were well tolerated by many. In contrast, things that limited freedom of movement (travel restrictions) and social and cultural exchange (cultural events, bars, clubs) were particularly burdensome.

These findings are important in several respects. First, because of the causal design of this study, we can now show with greater certainty that the COVID-19 pandemic had a strong negative impact on the well-being of adolescents at the end of high school. Second, our study shows that this impact was longer lasting. For future research, it will be important to map how well-being evolved after the winter of 2021/2022. On the one hand, it is conceivable that young people recover after most of the constraints have been removed because after critical life events, people often return to their original set point of well-being (e.g., Lucas, 2007). On the other hand, it is conceivable that some of the developmental steps impeded by the pandemic (e.g., identity formation, formation of intimate relationships, career choices) cannot be made up for and that the difficulties from this period linger for a long time (Sawyer et al., 2012). Given path dependencies in individuals' life courses (Mayer, 2009) and the importance of health and well-being at earlier life course stages for the socioeconomic attainment process (Haas, 2006), well-being declines during the school-to-work transition may have long-lasting well-being consequences for the cohort under study. Third, the information on the stress experience of individual measures has policy relevance. It allows policy-makers to better consider the psychological consequences of containment measures in the event of possible future pandemic waves. Fourth, findings from this paper can contribute to a deeper understanding of how individuals and societies respond to crises in general. They may also inform strategies for mental health support and intervention during other public health crises or periods of societal stress.

The strengths of this study include the use of large panel datasets and control groups unaffected by the pandemic to estimate causal effects. However, several limitations remain. We analyzed a sample of upper secondary track students around the time of graduation, and the findings cannot be generalized to lower-track students or other age groups. For instance, it is conceivable that lower-track students were less affected by travel restrictions or that younger students who could finish high school again in person were less burdened. The effect of the pandemic on these groups is an important direction for future research. Similarly, findings may differ in low-income countries or in countries such as Sweden where a less restrictive coronavirus policy was applied (Vira & Skoog, 2021). Moreover, although life satisfaction is one of the key measures of well-being, it would have been desirable to analyze additional well-being indicators. Unfortunately, there are no other well-being variables that were measured identically in both the NEPS and BerO data. Finally, we can only draw an incomplete picture of the causes of the decline in well-being. In addition to the hygiene and distancing rules shown, the infections themselves may have influenced well-being, as well as worries about the future (e.g., Aucejo et al., 2020; Henseke et al., 2022). Despite these caveats, this study provides rigorous and novel insights into the causal effects of the pandemic, its development until winter 2021/2022, and the effects of individual containment measures.

In solidarity with elderly and sick individuals, young people drastically restricted their lives in the wake of COVID-19. Our study suggests that these restrictions, which were demanded and implemented by (older) policy-makers, had massive consequences for the well-being of adolescents and young adults. These age groups were likely to be one of the main sufferers during the pandemic (Ellwardt & Präg, 2021). At the same time, they are our future, and it seems essential to take the needs of this generation more into account in future policy decisions.

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Supplementary Material

Part A: Regressions corresponding with figures in main text

Table S1 Development of life satisfaction

	Unbalanced		Entropy Balanced	
	Coef.	*(SE)*	*Coef.*	*(SE)*
Time (ref. grade 12)				
grade 11	0.117*	(0.047)	0.051	(0.043)
post-school	0.182*	(0.079)	0.235**	(0.088)
Graduation cohorts (ref. cohort 2018)				
cohort 2014	-0.047	(0.056)		
cohort 2021	-0.815***	(0.062)		
Interaction terms: time and cohort				
grade 11 X cohort 2014	-0.117*	(0.056)		
grade 11 X cohort 2021	0.711***	(0.064)		
post-school X cohort 2014	0.082	(0.057)		
post-school X cohort 2021	-0.009	(0.094)		
Treatment cohort (ref. pooled cohorts 2014/18)			-0.771***	(0.058)
Interaction terms: time and cohort				
grade 11 X treatment cohort			0.779***	(0.061)
post-school X treatment cohort			-0.061	(0.103)
Constant	7.406***	(0.046)	7.359***	(0.041)
N observations	20,478		20,478	
N individuals	7,532		7,532	

Regressions corresponding with Fig. 2.; robust standard errors in parentheses; models include dummy for switches into CATI interview; estimates based on $M = 20$ imputed datasets.
+ p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001.
Data Sources: NEPS-SC3, NEPS-SC4 and Bero-Study.

Table S2 Effect heterogeneity in the development of life satisfaction

	Gender		Migration background		Parental education	
	Coef.	*(SE)*	*Coef.*	*(SE)*	*Coef.*	*(SE)*
Time (ref. grade 12)						
grade 11	0.012	(0.050)	0.084*	(0.040)	0.087	(0.058)
post-school	0.272**	(0.096)	0.236**	(0.091)	0.278**	(0.093)
Treatment cohort (ref. pooled cohorts 2014/18)	-0.854***	(0.073)	-0.713***	(0.063)	-0.909***	(0.089)
Interaction terms: time and cohort						
grade 11 X treatment cohort	0.815***	(0.073)	0.721***	(0.062)	0.752***	(0.095)
post-school X treatment cohort	0.021	(0.113)	-0.027	(0.110)	-0.133	(0.127)
Dummy for male gender (ref. female)	0.140+	(0.082)				
Interaction terms: time and gender						
grade 11 X male	0.105	(0.094)				
post-school X male	-0.055	(0.077)				
Treatment cohort X male	0.231+	(0.118)				
Triple interaction: time, cohort & gender						
grade 11 X treatment cohort X male	-0.102	(0.129)				
post-school X treatment cohort X male	-0.275*	(0.124)				
Dummy for mig. background (ref. no mig. back.)			-0.074	(0.112)		
Interaction terms: time and mig. back.						
grade 11 X migrant			-0.151	(0.144)		
post-school X migrant			-0.032	(0.102)		
Treatment cohort X migrant			-0.272+	(0.156)		
Triple interaction: time, cohort & mig. back.						
grade 11 X treatment cohort X migrant			0.271	(0.187)		
post-school X treatment cohort X migrant			-0.129	(0.161)		
Dummy for at least 1 parent with uni educ. (ref. no par. w. uni. educ.)					0.074	(0.082)
Interaction terms: time and par. educ.						
grade 11 X uni. educ. par.					-0.058	(0.093)
post-school X uni. educ. par.					-0.065	(0.081)
Treatment cohort X uni. educ. par.					0.220+	(0.120)
Triple interaction: time, cohort & par. educ.						
grade 11 X treatment cohort X uni. educ. par.					0.045	(0.133)
post-school y X treatment cohort X uni. educ. par.					0.111	(0.134)
Constant	7.310***	(0.053)	7.375***	(0.043)	7.314***	(0.056)
N observations	20,478		20,478		20,478	
N individuals	7,532		7,532		7,532	

Regressions corresponding with Fig. 3.; robust standard errors in parentheses; models include dummy for switches into CATI interview; estimates based on $M = 20$ imputed datasets.
+ p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001.
Data Sources: NEPS-SC3, NEPS-SC4 and Bero-Study.

Part B: Replication of results using unweighted data

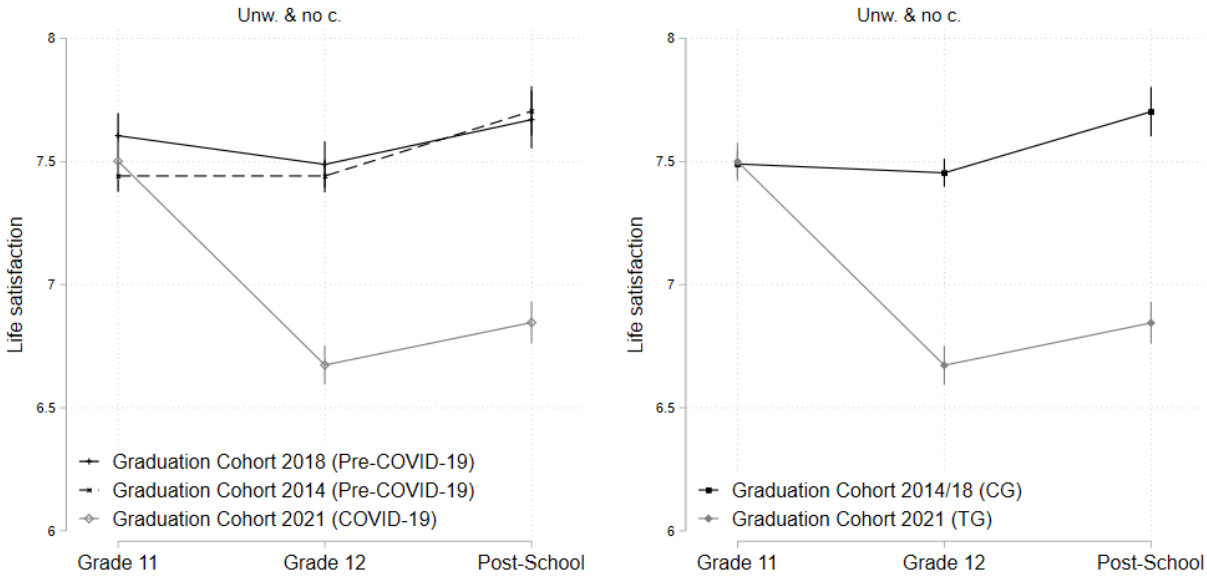

Fig. S1 Development of life satisfaction with unweighted data and no control variables

Predicted values from DiD regressions; the left part shows separate estimates for all three cohorts. The right part shows estimates for a (pooled) control and the treatment group. *N* observations = 20,478; *N* individuals = 7,532.
Data Sources: NEPS-SC3, NEPS-SC4 and Bero-Study.

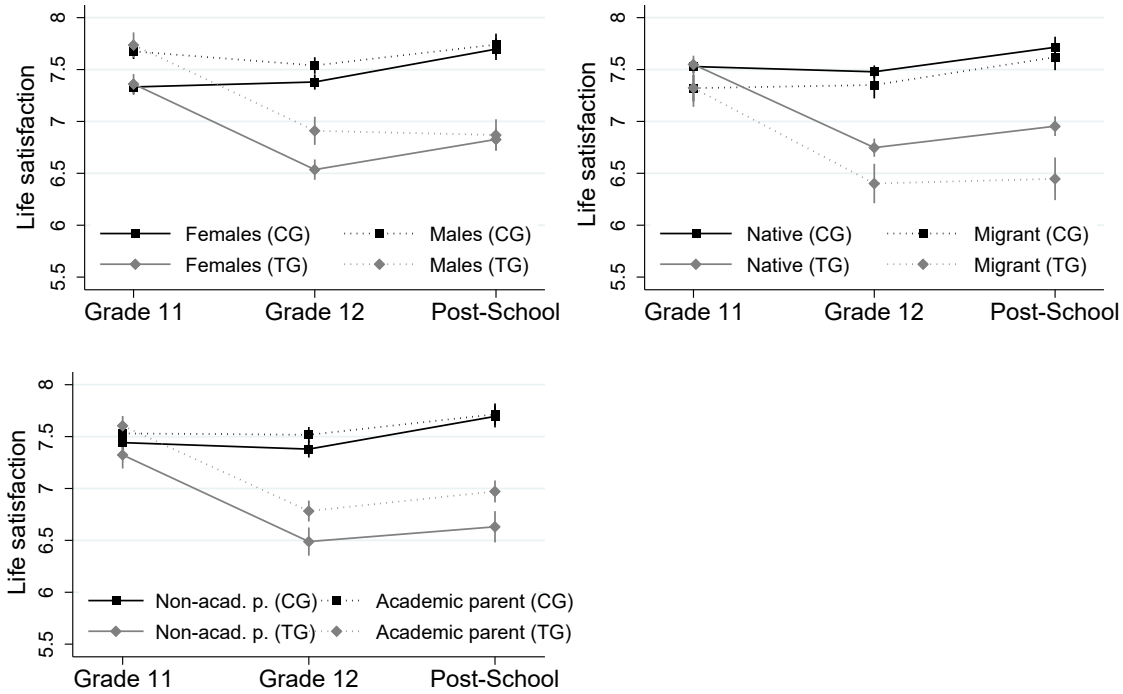

Fig. S2 Development of life satisfaction by cohort and subgroups with unweighted data and no control variables

Predicted values from DiD regressions based on a (pooled) control and the treatment group. *N* observations = 20,478; *N* individuals = 7,532.
Data Sources: NEPS-SC3, NEPS-SC4 and Bero-Study.

Part C: Replication of results with restriction of control group sample to the 8 BerO Länder

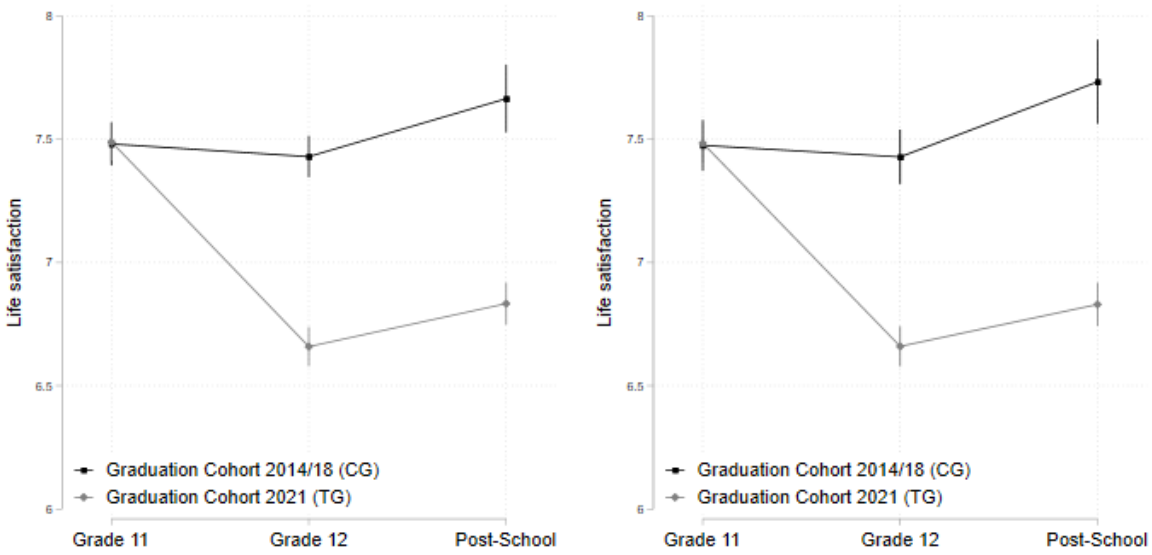

Fig. S3 Development of life satisfaction by cohort and subgroups with restricted control group data

Predicted values from DiD regressions based on a (pooled) control and the treatment group. The left part of the figure shows the results from the manuscript. The right part shows results in which the NEPS data were restricted to federal states that have been included in the BerO study. *N* observations = 16,876; *N* individuals = 6,024.

Data Sources: NEPS-SC3, NEPS-SC4 and Bero-Study.