

Self-injury, suicidality and eating disorder symptoms in young adults following COVID-19 lockdowns in Denmark

Received: 18 March 2022

Accepted: 7 December 2022

Published online: 19 January 2023

 Check for updates

Stine Danielsen¹✉, Andrea Joensen², Per K. Andersen³, Trine Madsen¹
& Katrine Strandberg-Larsen²

An aggravation in mental health during the COVID-19 lockdown has been suggested but the impact on self-injury, suicidality and eating disorders (EDs) are less elucidated. Using linear regression in different data set-ups that is longitudinal ($n = 7,579$) and repeated cross-sectional data ($n = 24,625$) from the Danish National Birth Cohort, we compared self-reported self-injury, suicidality and symptoms of EDs from before through different pandemic periods until spring 2021. The longitudinal data indicate a reduction in the proportion of self-injury in men (-3.2% points, 95% confidence interval (CI) = -4.3% ; -2.2% , $P < 0.001$, d.f. = 2) and women (5.7% points, 95% CI = -6.6% ; -4.8% , $P < 0.001$, d.f. = 2) and of suicide ideation in men (-3.0% points, 95% CI = -4.6% ; -1.4% , $P = 0.002$, d.f. = 2) and women (-7.4% points, 95% CI = -8.7% ; -6.0% , $P < 0.001$, d.f. = 2), as well as symptoms of EDs in women (-2.3% points, 95% CI = -3.2% ; -1.4% , $P < 0.001$, d.f. = 2). For suicide attempt, indication of an increase was observed in men only (0.4% points, 95% CI = 0.1% ; 0.7% , $P = 0.019$, d.f. = 2). In the repeated cross-sectional data, we observed no changes in any of the outcomes. Our findings provide no support for the increase in self-injury, suicidality and symptoms of EDs after the lockdowns. Key limitations are differential attrition and varying age in pre- and post-lockdown measures in the longitudinal data.

COVID-19 quickly spread globally at the beginning of 2020; on 11 March it was declared a global pandemic by the World Health Organization, which led to public health measures being implemented to mitigate the spread of COVID-19. Young adults are at low risk of being severely ill because of COVID-19, but it has been suggested that they are the most vulnerable to the collateral damages of lockdown. Several studies found an aggravation in the mental health of young adults during the initial lockdown, especially in young women^{1–5}. However, the literature exploring whether this aggravation in mental health also manifested as changes in self-injury, suicidality and eating disorders (EDs) during lockdown is sparse and its findings are inconsistent.

Most pre- and post-lockdown comparisons of self-injury and suicidality are based on health registries, which are compromised by the general reduction in patient contacts during lockdown and mostly refers to registrations of cases brought to hospital due to somatic injuries⁶. A Danish register-based study found a signal for increase in hospital-registered suicidal behaviour in young adults aged 18–29 years during the first lockdown but no change during the entire first year after the lockdown⁷. Register-based studies from other countries have documented a decrease in self-injury and suicide attempt among young adults^{8–11}. Studies from Norway and Korea based on self-reported repeated cross-sectional data found no pre-to-post-lockdown change

¹Danish Research Institute for Suicide Prevention, Mental Health Center Copenhagen, Copenhagen, Denmark. ²Section of Epidemiology, Department of Public Health, Faculty of Health and Medical Sciences, University of Copenhagen, Copenhagen, Denmark. ³Section of Biostatistics, Department of Public Health, Faculty of Health and Medical Sciences, University of Copenhagen, Copenhagen, Denmark. ✉e-mail: stine.danielsen@regionh.dk

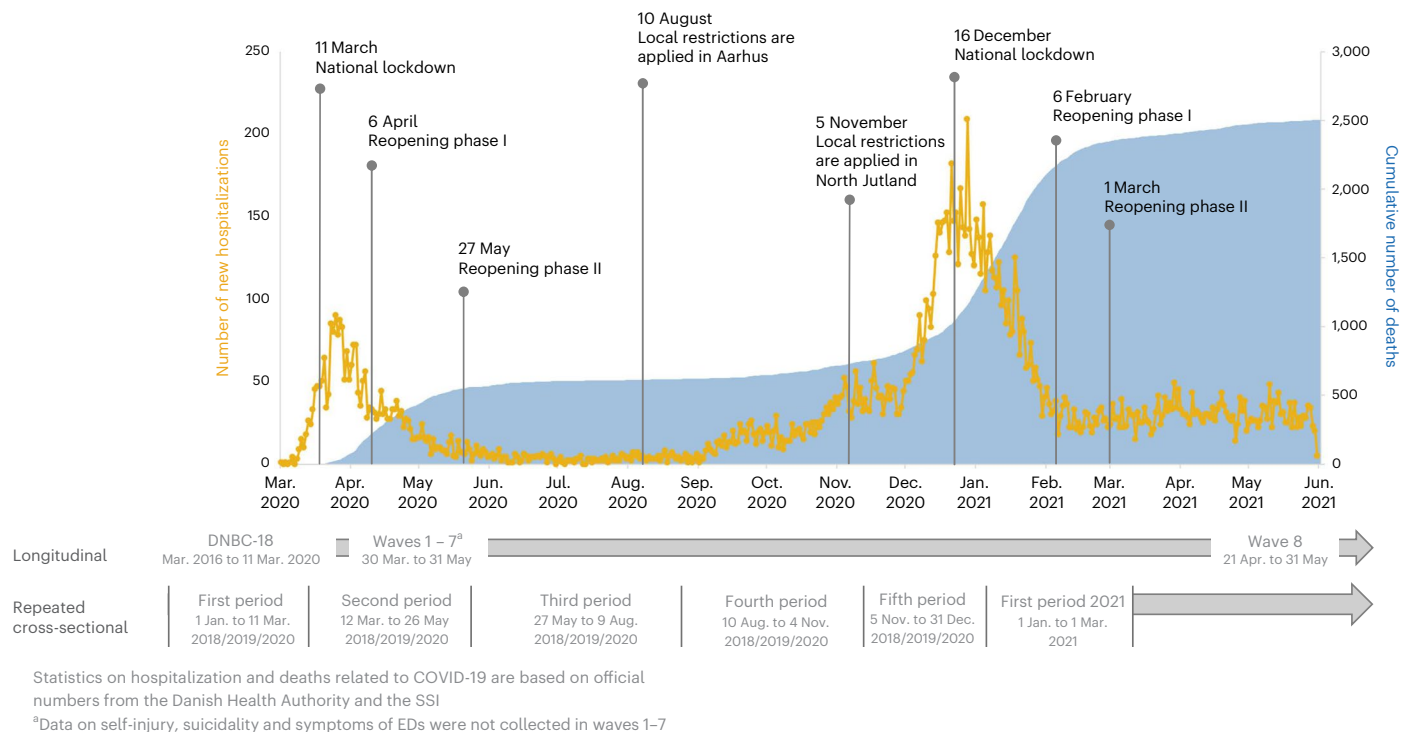


Fig. 1 | Outline of the COVID-19 lockdowns in Denmark. The development of the COVID-19 pandemic, aligned with seminal events during the lockdown in Denmark, together with the timing of the data collections.

in suicide ideation and a decrease in suicide ideation and attempts, respectively^{12,13}. On the other hand, a longitudinal study based on self-reported data in China demonstrated an increase in self-injury and suicide ideations and attempts during spring 2020 (ref. 14). An international register-based study, including preliminary suicide data from 21 countries in all age groups, showed no evidence of increased suicide rates during the first year of the pandemic¹⁵. However, other studies have suggested increased suicide rates during lockdown when including young adults only; preliminary and unvalidated data based on Danish registers revealed a signal of an increased number of suicides among young women aged 20–24 years^{16–18}.

Regarding EDs, studies from the USA and Canada found that hospital admissions and new diagnosis for restrictive EDs were twice as high among adolescents during the first year of lockdown compared to previous years^{19–21}. To our knowledge, no studies have compared pre- and post-pandemic self-reported data on EDs among young adults.

To mitigate the spread of COVID-19, the Danish government, like many other countries, implemented a national lockdown in March 2020 requiring a closure of schools, day-care centres, sport facilities, restaurants and shops; working from home was either mandatory or highly recommended in non-critical functions (Fig. 1)^{1,2,22}. The restrictions were slowly lifted during spring 2020 but gradually reinforced during autumn. In December, a second national lockdown was declared. This second lockdown turned out to be more prolonged and was slowly lifted during spring 2021. In this study, we compare the proportion of young men and women reporting self-injury, suicide ideation and attempts and symptoms of EDs with similar pre- and post-lockdown data across the two national lockdowns in Denmark.

Results

Longitudinal data

Our study population were aged 19–23 years, with a median age of 20.9 years in spring 2021; more women than men responded in the Danish National Birth Cohort (DNBC) 18-year follow-up (DNBC-18) and wave 8 of the COVID-19 survey. Less than 10% were living without parents

and 5% had another occupation than school at age 18 (Supplementary Table 1). In the analyses of the longitudinal data, the proportion of self-injury before lockdown was 13.9% (95% confidence interval (CI) = 13.4–14.4) and 5.7% (95% CI = 5.3–6.1) among women and men, respectively, and decreased post-lockdown in both women and men (Fig. 2a). The proportion reporting self-injury decreased with 5.7% points (95% CI = 6.6 to –4.8, $P < 0.001$, d.f. = 2) among women and 3.2% points (95% CI = –4.3 to –2.2, $P < 0.001$, d.f. = 2) among men (Fig. 3a). For suicide ideation, the absolute decrease in percentage points was similar; it was 7.4% points (95% CI = –8.7 to –6.0, $P < 0.001$, d.f. = 2) in women and 3.0% points (95% CI = –4.6 to –1.4, $P = 0.002$, d.f. = 2) in men. The pre-lockdown proportion of suicide ideation was 25.4% (95% CI = 24.7–26.1) and 18.4% (95% CI = 17.7–19.1), respectively (Figs. 2b and 3b). The pre-lockdown proportion of suicide attempts was 0.9% (95% CI = 0.8–1.0) in women and 0.5% (95% CI = 0.4–0.6) in men (Fig. 2c). For women, the proportion increased 0.1% points (95% CI = –0.2 to 0.4, $P = 0.371$, d.f. = 2), thus indicating that the data were compatible with no change. For men, the proportion increased 0.4% points (95% CI = 0.1–0.7, $P = 0.019$, d.f. = 2) but with wide confidence intervals due to the low absolute number of suicide attempts in men (Fig. 3c). Before lockdown, 14.1% (95% CI = 13.6–14.6) of women and 2.1% of men (95% CI = 1.8–2.4) reported symptoms of EDs within the last month (Fig. 2d). Post-lockdown these proportions decreased 2.3% points (95% CI = –3.2 to –1.4, $P < 0.001$, d.f. = 2) among women and 0.6% points (95% CI = –1.7 to 0.5, $P = 0.258$, d.f. = 2) among men (Fig. 3d). Thus, for men, the data were compatible with no change in symptoms of EDs. Bayes factors were calculated for the statistically non-significant results, that is, suicide attempts in women (Bayes factor = 0.021) and symptoms of EDs in men (Bayes factor = 0.10) and showed strong evidence of no effect of the lockdown (Table 1).

Repeated cross-sectional data

In the analyses of the repeated cross-sectional data, women had higher proportions of self-injury, suicide ideation and symptoms of EDs than men. The calendar periods showed no clear pattern of self-injury,

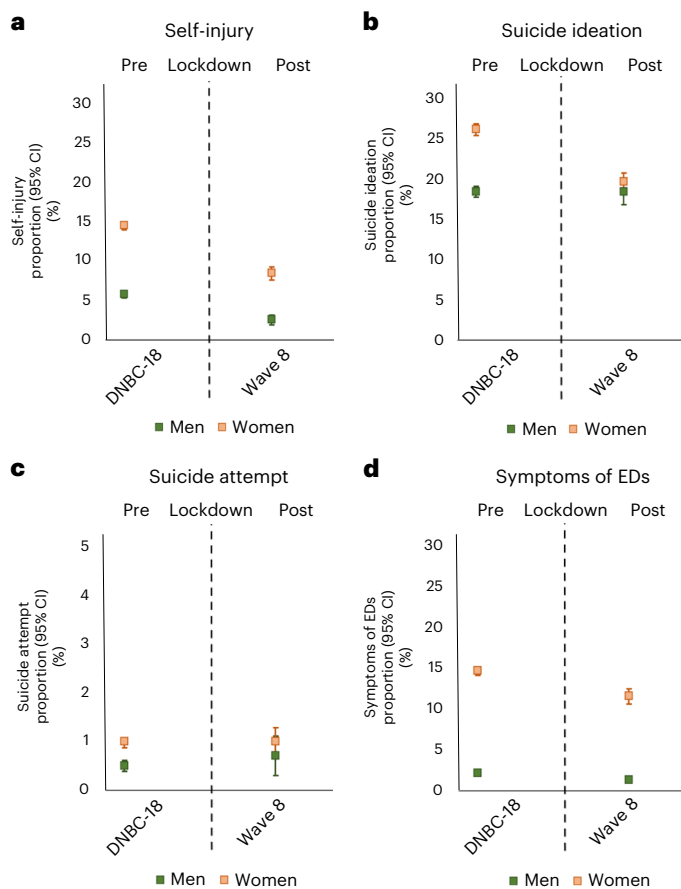


Fig. 2 | Self-injury, suicide ideation and attempt and symptoms of EDs in men and women pre- and post-lockdown (longitudinal data). **a–d**, Weighted proportions based on longitudinal data collected in the DNBC-18 ($n = 27,441$) and wave 8 ($n = 7,597$) of the COVID-19 survey, approximately 1 year after the initial lockdown stratified by sex. Data are presented as the mean (%) on a scale ranging from 0% to 100% $\pm$ s.e.m. **a**, Self-injury within the last year. **b**, Suicide ideation within the last year. **c**, Suicide attempt within the last year. **d**, Symptoms of EDs within the last month.

suicide ideation and attempt and symptoms of EDs, and there was no year-to-year variation of the measures (Fig. 4). The linear regression analyses did not suggest any change in the proportions of self-injury, suicide ideation and attempt and symptoms of EDs from pre- to post-lockdown in men or women (Fig. 5). Further, the estimated change for suicide attempt was similar in men -0.2% points (95% CI = -0.5 to 0.1 , $P = 0.197$, d.f. = 8) and women -0.2% points (95% CI = -0.5 to 0.2 , $P = 0.306$, d.f. = 8). The CIs for all measures were narrow, indicating that our data are most compatible with changes of no practical importance. Bayes factors for both self-injury (0.00020), suicide ideation (0.00015), suicide attempt (0.00011) and symptoms of EDs (0.000097) further supported strong evidence of no effect of the lockdown (Table 1).

Sensitivity analysis

In our analyses of the severity scale, quantifying frequency of self-injury, suicide ideation and symptoms of EDs, on the longitudinal data, we found a decline in self-injury before and after lockdown in both men (change estimate = -0.05 , 95% CI = -0.07 to -0.03 , $P < 0.001$, d.f. = 2) and women (change estimate = -0.10 , 95% CI = -0.12 to -0.08 , $P < 0.001$, d.f. = 2) (Extended Data Fig. 1). In women, we observed a decline in suicide ideation (change estimate = -0.08 , 95% CI = -0.11 to -0.05 , $P < 0.001$, d.f. = 2) and symptoms of EDs (change estimate = -0.03 , 95% CI = -0.04 to -0.02 , $P < 0.001$, d.f. = 2) while in men we observed

no change in suicide ideation (change estimate = 0, 95% CI = -0.04 to 0.04 , $P = 0.878$, d.f. = 2) or symptoms of EDs (change estimate = -0.01 , 95% CI = -0.02 to 0 , $P = 0.306$, d.f. = 2). Like our primary analyses, we did not find any changes in any of the severity scales from before to after lockdown in the repeated cross-sectional set-up (Extended Data Fig. 2). When leaving out participants who replied 'do not know' to having had self-injury and suicide ideation and attempt within the last year, respectively, the results did not change notably in either the longitudinal or repeated cross-sectional data (Extended Data Figs. 3 and 4). However, the increase in suicide attempt among men (change estimate = 0.26% points, 95% CI = -0.06 to 0.57 , $P = 0.116$, d.f. = 2) was lower and compatible with no change. Our sensitivity analyses in the longitudinal data restricted to participants aged 19–20 years when completing wave 8, that is, completing the DNBC-18 in 2019 or early 2020, resulted in similar results for suicide ideation and symptoms of EDs after lockdown (Extended Data Fig. 5). The decrease in self-injury in men (change estimate = 2.46% points, 95% CI = -3.92 to -0.99 , $P = 0.001$, d.f. = 2) and women (change estimate = 4.42% points, 95% CI = -5.2 to -3.22 , $P < 0.001$, d.f. = 2) were slightly smaller and the exclusion decreased the precision so that data were compatible with no change in suicide attempt among both men and women. Further, restricting self-injury and suicide ideation to within 4 weeks instead of 1 year in the repeated cross-sectional data did not change the results (Extended Data Fig. 6).

Discussion

In this study with tandem use of longitudinal and repeated cross-sectional data, we observed that during the lockdowns, including a more prolonged second lockdown during the winter season, there was no increase in self-injury, suicide ideation or symptoms of EDs. If anything, our longitudinal data indicate a post-lockdown reduction in self-injury and suicide ideation among both men and women and smaller reductions for symptoms of EDs in women. Further, we found no indication that the severity of self-injury, suicide ideation and symptoms of EDs worsened during lockdown. For suicide attempt in men, we found weak indication of an increase in the longitudinal data while no change was observed for women or for either men or women in the repeated cross-sectional data.

Thus, our findings overall do not support that the aggravation in mental health documented in several countries after lockdown have yet resulted in young adults having a higher risk of self-injury, suicidality and ED symptoms. As outlined in the introduction, findings from previous studies are inconsistent. The mixed findings in the literature may result from methodological differences. Cross-sectional studies using health register data all found a decline in self-injury- and suicidal behaviour-related hospital contact during lockdown^{7–11}. This reduction might in part be due to bias caused by the general reduction in healthcare use and it is important to note that self-injury and suicidality with hospital contact only covers the most severe cases. However, cross-sectional studies using self-reported data, including this study, also found either a reduction or no change in self-injury and suicide ideation and attempts during lockdown^{12,13}. In contrast, a longitudinal study in China with self-reported data suggested an increase in both self-injury and suicide ideation and attempts during lockdown¹⁴. The longitudinal study only included 4 months of lockdown, had a small population ($n = 1,241$) and participants were aged 9–16 years, which could, together with differences in the lockdowns, explain why the findings differ from ours even though the methodology is very similar. We were not able to include suicides from the cause-of-death register to explore the potential increase in suicide among especially young women as suggested by preliminary unvalidated Danish data and current international literature^{15–18}. Regarding EDs, previous studies used data on new ED diagnosis or hospital admissions, which increased during lockdown contrary to our findings^{19–21}. Because there was a general reduction in healthcare use due to lockdown, this increase may even be understated but differences in healthcare systems and

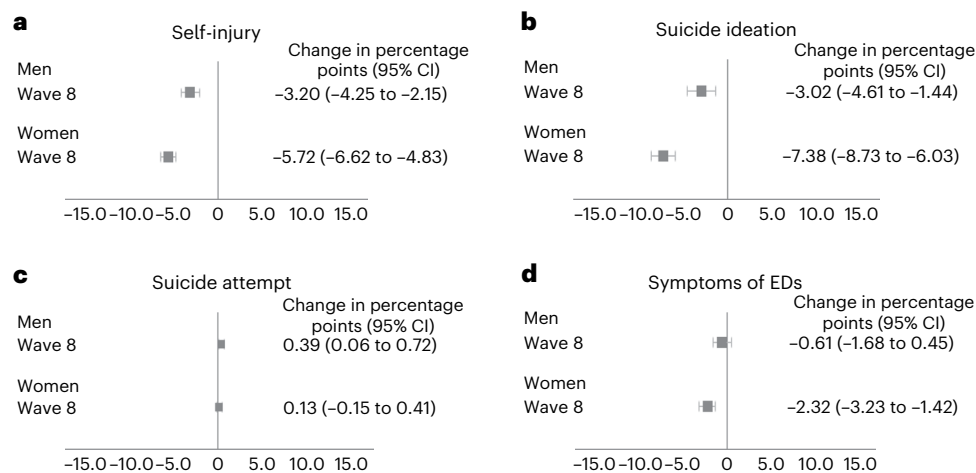


Fig. 3 | Change in self-injury, suicide ideation and attempt and symptoms of EDs in men and women from before to during lockdown (longitudinal data). **a–d**, Weighted fixed-effect linear regression estimating change in the proportions based on the longitudinal data collected in the DNBC-18 ($n = 7,597$) and wave 8 of the COVID-19 survey ($n = 7,597$), approximately 1 year after the initial lockdown. Data are presented as the mean change in percentage

points $\pm$ s.e.m. **a**, Self-injury within the last year in men ($P < 0.001$, d.f. = 2) and women ($P < 0.001$, d.f. = 2). **b**, Suicide ideation within the last year in men ($P = 0.002$, d.f. = 2) and women ($P < 0.001$, d.f. = 2). **c**, Suicide attempt within the last year in men ($P = 0.019$, d.f. = 2) and women ($P = 0.371$, d.f. = 2). **d**, Symptoms of EDs within the last month in men ($P = 0.258$, d.f. = 2) and women ($P < 0.001$, d.f. = 2).

Table 1 | Calculation of Bayes factors for non-significant results

Outcomes	Calculation of Bayes factor	Bayes factor
Longitudinal data		
Non-significant results		
Suicide attempt in women	$5066^{\wedge}((0-1)/2) \times (22/21.99644690)^{\wedge} (5066/2)$	0.021 ^a
Symptoms of EDs in men	$2531^{\wedge}((0-1)/2) \times (34.5/34.45555117)^{\wedge} (2531/2)$	0.10 ^b
Repeated cross-sectional data		
Non-significant results		
Self-injury	$24625^{\wedge}((7-9)/2) \times (2138.5601/2138.2811)^{\wedge} (24625/2)$	0.00020 ^c
Suicide ideation	$24625^{\wedge}((7-9)/2) \times (4213.1621/4212.7241)^{\wedge} (24625/2)$	0.00015 ^c
Suicide attempt	$24625^{\wedge}((7-9)/2) \times (167.7110/167.6976)^{\wedge} (24625/2)$	0.00011 ^c
Symptoms of EDs	$24625^{\wedge}((7-9)/2) \times (1859.6843/1859.5532)^{\wedge} (24625/2)$	0.000097 ^c

Interpretations as in Jeffreys³⁹ ^aVery strong evidence for H_0 compared to H_a . ^bSubstantial evidence for H_0 compared to H_a . ^cDecisive evidence for H_0 compared to H_a . Formula for Bayes factor: $n^{\wedge}((k_0-k_a)/2) \times (RSS_0/RSS_a)^{\wedge}(n/2)$, where H_0 = model (unweighted) without lockdown variable H_a = model (unweighted) with lockdown variable, n = size of study population, k = number of parameters in model, RSS = residual sum of squares^{36–38}. Bayes factors were based on the unweighted models because the weights did not change the results notably.

thereby the registers may also affect comparability between studies. In this study, we measured the prevalence of ED symptoms while register studies measure the incidence of new diagnoses. Further, these health register measures of EDs cover more severe cases compared to our self-reported symptoms of EDs. However, our sensitivity analyses, which included symptoms that fulfilled our definition of threshold EDs (weekly symptoms), likewise indicated no signal of an increase after lockdown (Extended Data Figs. 1c and 2c).

In general, the previous literature has varied with regard to follow-up time, origins from different countries, the course of the

pandemic, the public health precautions, for example, the extent of lockdown; thus, the impact on self-injury, suicidality and EDs may be different. Further, even small age differences in study populations focusing on young adults may explain the inconsistent result. Importantly, our population mainly consisted of young adults studying and still living at their parental home and our findings cannot necessarily be generalized to either younger nor older populations, who are more on their own and therefore could be more vulnerable to the collateral damages of lockdown.

Possible reasons for the decrease in self-injury, suicide ideation and symptoms of EDs in the longitudinal data is that the social distancing actually has been beneficial for some young adults²³. Being closer to their families, having more time and fewer obligations to activities such as sports, part-time jobs and parties, that is, generally a reduction in the pressure of living up to the social norms for young adults could have impacted mental health in a positive direction. Further, it is possible that the impact of lockdown has been positive in some groups while negative in other groups, which equalizes the impact. A similar DNBC study found slight interim deterioration in mental health in young adults without pre-existing depressive symptoms after lockdown while no differences were observed in young adults with pre-existing depressive symptoms¹. Furthermore, the initial decline mental health quickly attenuated and may have been a shock effect that did not manifest as self-injury, suicidality and symptoms of EDs.

A strength of this study is the use of self-reported data that capture more subtle cases than register data and still provide relevant information for screening and prevention purposes^{24,25}. Further, our study populations are from a large cohort consisting of relatively healthy and well-functioning young adults.

The results using longitudinal and repeated cross-sectional data were not completely consistent, although both suggested that the proportion of young adults with self-injury, suicide ideation and symptoms of EDs did not increase during lockdown. Different strengths and limitations in the study design could have resulted in the different results: (1) because the longitudinal data include a specific COVID-19 related survey, participants may have overstated or understated their answers in accordance with their feelings of lockdown making the comparison with the pre-lockdown measure biased. This is less of a concern in the repeated cross-sectional data only using the DNBC-18 because it was an ongoing survey that did not mention the COVID-19 pandemic in

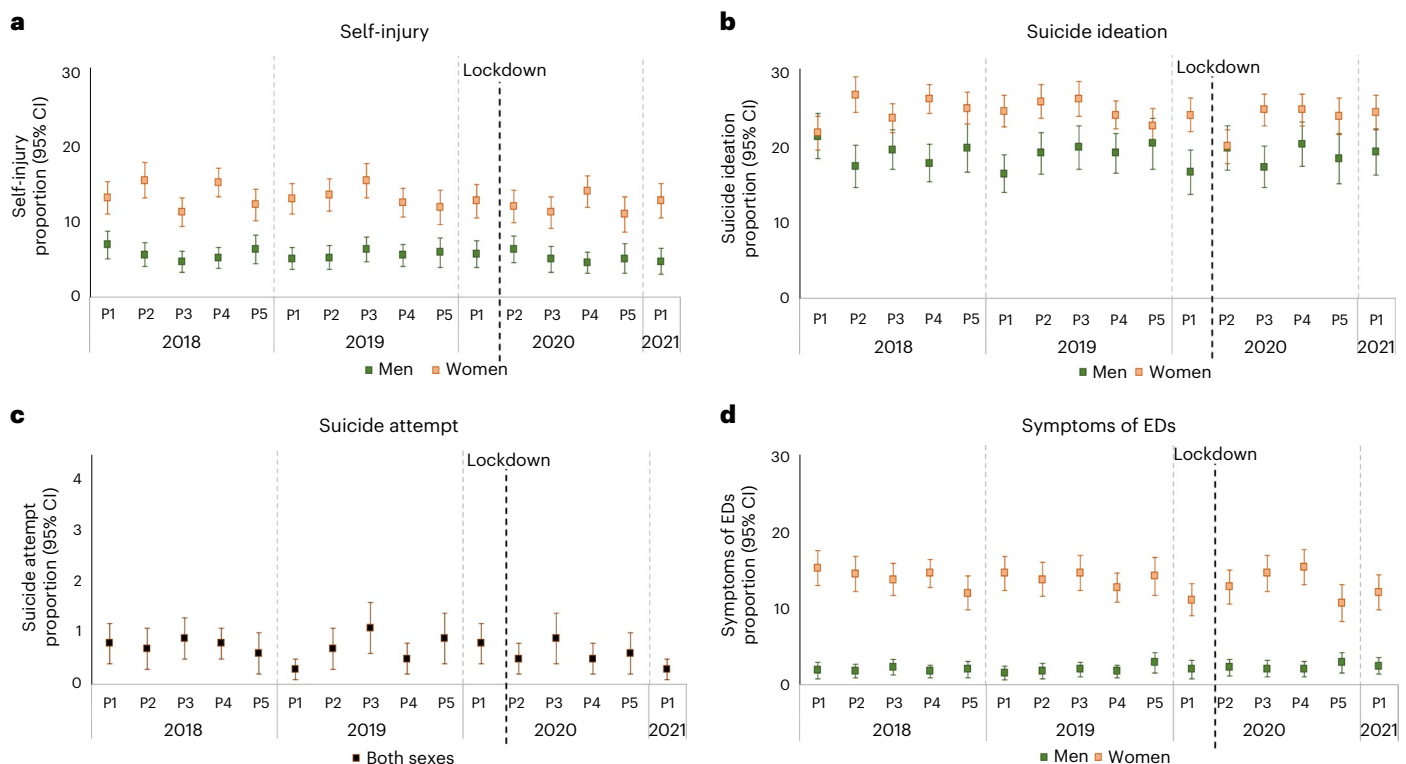


Fig. 4 | Self-injury, suicide ideation and attempt and symptoms of EDs in men and women pre- and post-lockdown (repeated cross-sectional data). **a–d**, Weighted proportions in different lockdown-related periods based on repeated cross-sectional data collected in the DNBC-18 ($n = 24,625$) in 2018–2021 and stratified by sex. Periods defined as: P1, 1 January to 11 March/1 January to 1 March in 2021; P2, 12 March to 26 May; P3, 27 May to 9 August; P4, 10 August to

4 November; P5, 5 November to 31 December. Data are presented as the mean (%) on a scale ranging from 0% to 100% $\pm$ s.e.m. **a**, Self-injury within the last year. **b**, Suicide ideation within the last year. **c**, Suicide attempt within the last year. It was not possible to stratify by sex due to low frequency. **d**, Symptoms of EDs within the last month.

any way; (2) when using longitudinal data there is a risk of differential attrition because young adults with mental health problems are less likely to participate in follow-ups²⁶. This may have resulted in bias as the observed decline in self-injury, suicide ideation and symptoms of EDs in wave 8 may be explained by loss to follow-up rather than the lockdown; however, we used sampling weight to limit this bias. Further, the indication of an increase in suicide attempts among men indicates that people with severe mental health problems also participated. The repeated cross-sectional data are only vulnerable to differential attrition if the participation in DNBC-18 systematically changed over year of birth. There were no notable differences in characteristics of participants completing the DNBC-18 in each year from 2018 to 2021 (Supplementary Table 1); (3) a major strength of the longitudinal data is that we analysed the same young adults pre- and post-lockdown and thereby all time-invariant factors are adjusted for. In the repeated cross-sectional data, we compared groups of young adults based on birth year and the results may reflect factors related to birth year rather than lockdown. However, the level of self-injury, suicidality and symptoms of EDs were stable during the entire pre-lockdown period and thus it is unlikely that a sudden change would have happened in the absence of lockdown; (4) a strength in comparing different young adults aged 18 years pre- and post-lockdown is that the age is adjusted for. In the longitudinal data, the pre-lockdown measures were collected at age 18 while the post-lockdown measures were collected at age 19–23. Thus, the time interval between pre- and post-measure varied; as many major events, such as graduating from high school, moving away from parents and starting to shape the future happens in this age range, the results may be biased. However, sensitivity analyses showed similar results when restricting the time interval to 2 years, indicating that the varying time

interval and thereby age cannot explain the entire observed decrease in self-injury, suicide ideation and symptoms of EDs during lockdown (Extended Data Fig. 5). The sensitivity analyses showed no change in the proportion of suicide attempts among men after lockdown, which could be explained by data insensitivity as the frequency was very low; (5) the measures of self-injury and suicidality were defined as being within the last year. Thus, in the longitudinal set-up the measures were restricted to an entire year of lockdown and thereby adjusted for seasonal differences even though the pre-lockdown data were collected at different times of the year. In the repeated cross-sectional data, the post-lockdown measures will somewhat overlap the pre-lockdown period until the last lockdown period that covers an entire year of lockdown. However, analyses where self-injury and suicide ideation were restricted to being within 4 weeks instead of 1 year did not change the results (Extended Data Fig. 6). Symptoms of EDs were defined as being within the last month. Seasonal differences in ED symptoms could bias the results in the longitudinal data because the pre- and post-lockdown data were mainly collected at different calendar periods. However, the repeated cross-sections did not reveal any clear seasonality because the predefined lockdown-relevant periods represent different periods of the year; (6) the self-reported measures of self-injury, suicidality and symptoms of EDs are prone to misclassification. For self-injury and suicidality, this is not a great concern because the possible misclassification is assumed to be the same before and during lockdown. The participants replying ‘do not know’ to these measures may be misclassified as not having the behaviour. Our sensitivity analyses excluding these participants did not change the results. For symptoms of EDs, the before and during lockdown measures may not be completely comparable because the lockdown led to more meals being prepared and eaten

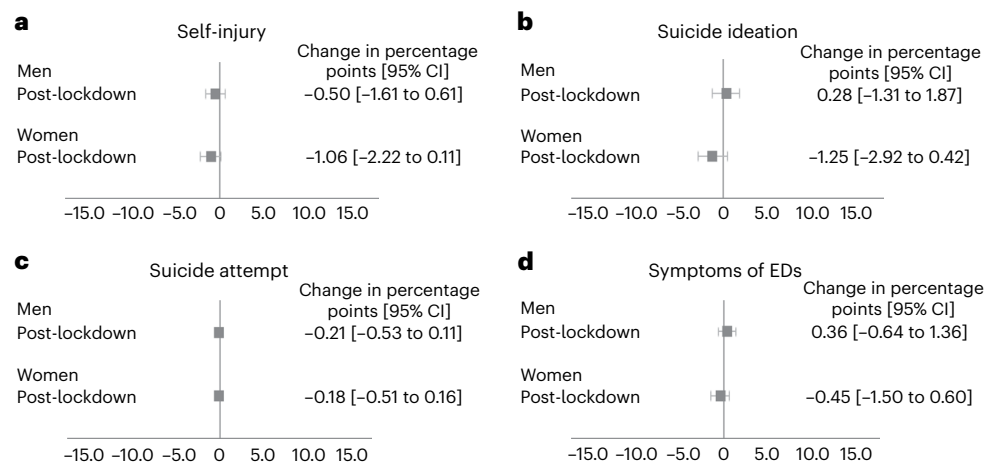


Fig. 5 | Change in self-injury, suicide ideation and attempt and symptoms of EDs in men and women before and during lockdown (repeated cross-sectional data). **a–d**, Weighted linear regression estimating change in the proportions based on the repeated cross-sectional data collected in the DNBC-18 ($n = 24,625$) in 2018–2021. Data are presented as the mean change in percentage points $\pm$ s.e.m. **a**, Self-injury within the last year in men ($P = 0.374$, d.f. = 8)

and women ($P = 0.076$, d.f. = 8). **b**, Suicide ideation within the last year in men ($P = 0.727$, d.f. = 8) and women ($P = 0.142$, d.f. = 8). **c**, Suicide attempt within the last year in men ($P = 0.197$, d.f. = 8) and women ($P = 0.306$, d.f. = 8). **d**, Symptoms of EDs within the last month in men ($P = 0.485$, d.f. = 8) and women ($P = 0.398$, d.f. = 8).

at home and limited the exercise opportunities (closed fitness centres and sports activities), which is measured in our ED items. However, from the beginning of the pandemic the Danish health authorities had campaigns on the importance of continuing physical activity outdoor. Because our study population is older than the peak age of incident EDs, it may not be possible to generalize these results to younger age groups²⁷. Further, because we measured prevalence rather than incidence in an age group with low incidence, our study population may not have been large enough to detect a possible increase. Self-reported symptoms of EDs are distinct from clinical diagnoses, which is why our frequency of EDs is higher than in studies using clinical diagnosis. Estimates indicate that only approximately 30% of people affected with EDs (fulfilling threshold diagnostic criteria) seek treatment; it may even be as low as 20% among adolescents^{25,28}. Since substantial cross-over between threshold and subthreshold variants of EDs exists, it is a strength that we could distinct severity, that is, weekly versus monthly frequency of symptoms²⁹.

In conclusion, this study suggests that during the lockdown, there was no increase in the proportion of young adults with self-injury, suicide ideation or symptoms of EDs. Findings from longitudinal analyses even indicate that the proportion of self-injury and suicide ideation decreased slightly post-lockdowns in both men and women, while a minor decrease in symptoms of EDs were observed only in women. An indication of increase in suicide attempts was observed only among men in the longitudinal data, while no indication of sex-specific changes was supported in the repeated cross-sectional analyses.

Method

Our research of human participants complies with all relevant ethical regulations. This study was approved by the Danish Data Protection Agency via a joint notification to the Faculty of Medicine and Health Sciences, University of Copenhagen (ref. no. 514-0497/20-3000, 'Standing together at a distance: how are Danish National Birth Cohort participants experiencing the corona crisis?'). The cohort was approved by the Danish Data Protection Agency and the Committee on Health Research Ethics (case no. (KF) 01-471/94). Data handling in the DNBC has been approved by the Statens Serum Institut (SSI) under ref. no. 18/04608 and is covered by the general approval (Fællesanmeldelse) given to the SSI. The DNBC-18 was approved under ref. no. 2015-41-3961. DNBC participants were enrolled by written informed consent.

The DNBC

The DNBC is a nationwide cohort established in the mid-1990s, which includes about 30% of all children born in Denmark in 1996–2003 (ref. 30). Data from prenatal life through early adulthood has been collected with the latest collection being the 18-year follow-up (DNBC-18). DNBC-18 data collection started in 2016 and was completed in December 2021 when the last participant reached 18 years and 3 months, which was the age of invitation. Further information about the cohort and DNBC-18 is available at www.dnbc.dk. For our purpose, we used two different study populations; one with longitudinal data collected pre- and post-lockdown and one consisting of repeated cross-sections of lockdown-appropriate periods in 2020–2021, as well as similar periods in 2018–2019 (Fig. 1)^{1,2}. To create sampling weights, both study populations were restricted to DNBC participants with information on the following characteristics collected during pregnancy of the participant's mother: household and socio-occupational status; parity; and maternal smoking during pregnancy. Moreover, we used information on maternal age at childbirth when generating the sampling weights.

Longitudinal data

In April 2020, during the initial lockdown, a COVID-19 survey was launched and consisted of seven weekly waves, in which questions about self-injury, suicidality or symptoms of EDs were not included²². In April–May 2021, when the second national COVID-19 lockdown was gradually lifted, the DNBC invited participants to complete an additional wave, that is, wave 8 including questions about self-injury, suicidality and symptoms of EDs. All DNBC participants with an active social security number, who had not actively withdrawn their participation and provided either their private postal address or phone number were invited; the overall response rate was 44%. From a population of 67,346 participants born into the DNBC, for whom we had information obtained from their mothers during pregnancy, 27,441 participants completed the DNBC-18 before 11 March 2020 and provided complete data on self-injury, suicidality and symptoms of EDs (Supplementary Fig. 1). This resulted in a retention rate of 37% for men and 49% for women. The population was further restricted to 7,597 participants with information on self-injury, suicidality and symptoms of EDs from wave 8, that is, pre- and post-lockdown measures. The response rate in wave 8 was 25% for men and 39% for women.

Repeated cross-sectional data

Participants in the DNBC were born over a period spanning 8 years. Thus, per design, they completed the DNBC-18 in different years and we exploited this feature to perform cross-sectional comparisons of participants completing the DNBC-18 between 1 January 2018 and 11 March 2020 with those completing thereafter until 1 March 2021. The study population included 24,625 participants with data on self-injury, suicidality and symptoms of EDs subdivided into the years 2018–2021; this was 38% and 51%, respectively, of the invited men and women (Supplementary Fig. 2). Based on the date completing the DNBC-18, participants were assigned to 1 of 16 different periods; 11 periods represented pre-lockdown (January 2018–11 March 2020) and 5 periods represented post-lockdown (12 March 2020–1 March 2021) (Fig. 1)^{1,2}.

Measures of self-injury, suicidality and symptoms of EDs

To measure self-injury, suicide ideation and suicide attempt, items in the DNBC-18 and wave 8 of the COVID-19 survey were used to measure whether these behaviours had occurred within the last year (yes versus no) (Supplementary Table 2). Self-injury was worded as ‘have you harmed or hurt yourself on purpose within the last year’ and suicide ideation was worded as ‘have you thought about taking your own life (even though you would not do it) within the last year’. Suicide attempt was worded as ‘have you tried to take your own life within the last year’. If participants answered ‘do not know’ to items on self-injury or suicidality, they were categorized as not having the behaviour. Symptoms of EDs were collected in the DNBC-18 with items adapted from the McKnight Risk Factor Survey on weight and shape concerns and items from the Youth Risk Behavior Surveillance System survey on binge eating, self-induced vomiting and use of laxatives^{31,32}. We defined symptoms of EDs in accordance with definitions used and described by Micali et al.³³ to classify threshold (weekly) and subthreshold (monthly) anorexia, bulimia, purging disorder and binge eating disorder (Supplementary Tables 3 and 4). Because of the low frequency of threshold EDs in men, we chose to combine threshold and subthreshold EDs into one measure reflecting symptoms of EDs within the last month (yes versus no). If participants answered ‘do not know’ to the items included in the definition of symptoms of EDs, they were categorized as not having the specific symptom; because the final ED symptom variable was based on 15 items, it was still possible for an individual to be categorized as having symptoms of EDs if answering ‘do not know’ to some items.

Statistical analysis

Sampling weights were estimated to account for differential attrition in DNBC-18 and wave 8 of the COVID-19 survey. For the inverse probability weighting, we used logistic regressions with participation, that is, having data as outcome and the following predictors: sex; household and socio-occupational status; maternal age at childbirth; parity; and maternal smoking, which were collected during pregnancy, categorized as shown in Supplementary Table 1. These predictors were included because they were important predictors of loss to follow-up in previous DNBC data collections^{34,35}. Separate analyses were performed for DNBC-18 and wave 8 of the COVID-19 survey and performed on the relevant baseline populations described in Supplementary Figs. 1 and 2. The relevant sampling weights were used in all analyses in this study, except in the calculation of Bayes factors.

Sex-specific proportions of self-injury, suicidality and symptoms of EDs were estimated with corresponding 95% CIs pre- (DNBC-18) and post-lockdown (wave 8), with the longitudinal data and for each period in the repeated cross-sections to illustrate any differences. Subsequently, we estimated changes in the proportion of young adults with self-injury, suicide ideation and attempt as well as symptoms of EDs from pre- to post-lockdown by fixed-effect linear regression on the longitudinal data and linear regression on the cross-sectional data. We used linear regressions, instead of logistic regressions, to get an

estimate of the absolute change (that is, in percentage points) of the proportions reporting self-injury, suicidality and symptoms of EDs from pre- to post-lockdown. Separate regressions were conducted for self-injury, suicide ideation and attempt, and symptoms of EDs, respectively. To examine changes during the lockdown on any of the outcomes in men and women, we added an interaction between lockdown (pre versus post) and sex. In the linear regressions on the repeated cross-sectional data, we initially tested if changes during lockdown varied across periods by including an interaction between lockdown (pre versus post) and period; if non-significant, this interaction was omitted. Bayes factors were calculated to support non-significant results with the equation: Bayes factor = $n^{((k_0 - k_a)/2)} \times (RSS_0 / RSS_a)^{(n/2)}$, where H_0 = model (unweighted) without lockdown variable and H_a = model (unweighted) with lockdown variable, n = size of the study population, k = number of parameters in model and RSS = the residual sum of squares^{36–38}. Thus, we tested if the model with versus without the lockdown variable were most suitable. We interpreted Bayes factors as in Jeffreys³⁹. All analyses were performed unadjusted and with SAS v.9.4 (SAS Institute) using the commands `proc surveyfreq`, `proc genmod` and `proc glm` and by applying sampling weights and the `absorb` statement. The level of statistical significance was set at $P < 0.05$.

Sensitivity analysis

To investigate if the severity of self-injury and suicide ideation changed during lockdown, we used an item about how many times the participants had experienced self-injury and suicide ideation, respectively, within the last year. The 5 category items were transformed into a scale ranging from 0 to 4 (at no time = 0, once = 1, 2–5 times = 2, 6–10 times = 3, more than 10 times = 4). For symptoms of EDs, we used threshold EDs (weekly symptoms) and subthreshold EDs (monthly symptoms) to create a scale ranging from 0 to 2 (no symptoms = 0, monthly symptoms = 1, weekly symptoms = 2). In sensitivity analyses, these scales replaced the binary variables in the linear regression models. We also conducted sensitivity analysis where participants answering ‘do not know’ to items on self-injury and suicidality were categorized as missing because they might differ from those without self-injury and suicidality. This was not necessary for symptoms of EDs because it was possible to be categorized as having ED symptoms even when answering ‘do not know’ to some items.

The results in the longitudinal set-up may be biased because all participants were aged 18 years at the pre-lockdown measure but between 19 and 23 years at the post-lockdown measure. In the sensitivity analyses, we addressed this by restricting to participants aged 19–20 years when completing wave 8 to limit the time gap and thereby in-built age difference. Further, we did sensitivity analyses in the repeated cross-sectional data where self-injury and suicide ideation were restricted to being within 4 weeks instead of 1 year using the items presented in Supplementary Table 2.

Reporting summary

Further information on research design is available in the Nature Portfolio Reporting Summary linked to this article.

Data availability

According to European law (General Data Protection Regulation), data containing potentially identifying or sensitive personal information are restricted. However, for academic researchers, data can be made available after approval. The newest version of the DNBC application form can be requested at dncb-research@ssi.dk. The application form and a research protocol should be returned to the same e-mail address. The application will be given a reference number and will be submitted to the DNBC Management and then to the DNBC Steering Committee. You can expect a decision after 6–8 weeks. There is an application fee of approximately €540 and a data fee of approximately €2,900 (for one published paper). For data where individuals may be identified,

the DNBC project must be listed on your institution's record of data processing activities. Access to biological material need permission from the Committee on Biomedical Research Ethics. For more details about data see <https://www.dnbc.dk/access-to-dnbc-data>.

Code availability

All analyses were performed unadjusted and with the SAS v.9.4 (SAS Institute) using the commands `proc surveyfreq`, `proc genmod` and `proc glm`, applying sampling weights and `absorb` statement. The code is provided in Supplementary Table 5.

References

- Joensen, A., Danielsen, S., Andersen, P. K., Groot, J. & Strandberg-Larsen, K. The impact of the initial and second national COVID-19 lockdown on mental health in young people with and without pre-existing depressive symptoms. *J. Psychiatr. Res.* **149**, 233–242 (2022).
- Varga, T. V. et al. Loneliness, worries, anxiety, and precautionary behaviours in response to the COVID-19 pandemic: a longitudinal analysis of 200,000 Western and Northern Europeans. *Lancet Reg. Health Eur.* **2**, 100020 (2021).
- Niedzwiedz, C. L. et al. Mental health and health behaviours before and during the initial phase of the COVID-19 lockdown: longitudinal analyses of the UK Household Longitudinal Study. *J. Epidemiol. Community Health* **75**, 224–231 (2021).
- Kwong, A. S. F. et al. Mental health before and during the COVID-19 pandemic in two longitudinal UK population cohorts. *Br. J. Psychiatry* **218**, 334–343 (2020).
- Pierce, M. et al. Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. *Lancet Psychiatry* **7**, 883–892 (2020).
- Pierce, M. et al. Says who? The significance of sampling in mental health surveys during COVID-19. *Lancet Psychiatry* **7**, 567–568 (2020).
- Rømer, T. B. et al. Psychiatric admissions, referrals, and suicidal behavior before and during the COVID-19 pandemic in Denmark: a time-trend study. *Acta Psychiatr. Scand.* **144**, 553–562 (2021).
- Carr, M. J. et al. Effects of the COVID-19 pandemic on primary care-recorded mental illness and self-harm episodes in the UK: a population-based cohort study. *Lancet Public Health* **6**, e124–e135 (2021).
- Mourouvey, M. et al. Association between suicide behaviours in children and adolescents and the COVID-19 lockdown in Paris, France: a retrospective observational study. *Arch. Dis. Child.* **106**, 918–919 (2020).
- Jollant, F. et al. Hospitalization for self-harm during the early months of the COVID-19 pandemic in France: a nationwide retrospective observational cohort study. *Lancet Reg. Health Eur.* **6**, 100102 (2021).
- Ray, J. G., Austin, P. C., Aflaki, K., Guttman, A. & Park, A. L. Comparison of self-harm or overdose among adolescents and young adults before versus during the COVID-19 pandemic in Ontario. *JAMA Netw. Open* **5**, e2143144 (2022).
- Knudsen, A. S. et al. Prevalence of mental disorders, suicidal ideation and suicides in the general population before and during the COVID-19 pandemic in Norway: a population-based repeated cross-sectional analysis. *Lancet Reg. Health Eur.* **4**, 100071 (2021).
- Kim, S. Y., Kim, H.-R., Park, B. & Choi, H. G. Comparison of stress and suicide-related behaviors among Korean youths before and during the COVID-19 pandemic. *JAMA Netw. Open* **4**, e2136137 (2021).
- Zhang, L. et al. Assessment of mental health of Chinese primary school students before and after school closing and opening during the COVID-19 pandemic. *JAMA Netw. Open* **3**, e2021482 (2020).
- Pirkis, J. et al. Suicide trends in the early months of the COVID-19 pandemic: an interrupted time-series analysis of preliminary data from 21 countries. *Lancet Psychiatry* **8**, 579–588 (2021).
- Tanaka, T. & Okamoto, S. Increase in suicide following an initial decline during the COVID-19 pandemic in Japan. *Nat. Hum. Behav.* **5**, 229–238 (2021).
- Clapperton, A. et al. Patterns of suicide in the context of COVID-19: evidence from three Australian states. *Front. Psychiatry* **12**, 797601 (2021).
- Rosenqvist, E. Suicide among young women is the highest in 20 years [Selvmord blandt unge kvinder er det højeste i 20 år]. *DR News* (30 March 2021); <https://www.dr.dk/nyheder/indland/selvmord-blandt-unge-kvinder-er-det-hoejeste-i-20-aar-det-er-bekymrende-vi-har-saa>
- Agostino, H. et al. Trends in the incidence of new-onset anorexia nervosa and atypical anorexia nervosa among youth during the COVID-19 pandemic in Canada. *JAMA Netw. Open* **4**, e2137395 (2021).
- Otto, A. K. et al. Medical admissions among adolescents with eating disorders during the COVID-19 pandemic. *Pediatrics* **148**, e2021052201 (2021).
- Taquet, M., Geddes, J. R., Luciano, S. & Harrison, P. J. Incidence and outcomes of eating disorders during the COVID-19 pandemic. *Br. J. Psychiatry* **220**, 262–264 (2021).
- Clotworthy, A. et al. 'Standing together – at a distance': documenting changes in mental-health indicators in Denmark during the COVID-19 pandemic. *Scand. J. Public Health* **49**, 79–87 (2020).
- Soneson, E. et al. Happier during lockdown: a descriptive analysis of self-reported wellbeing in 17,000 UK school students during Covid-19 lockdown. *Eur. Child Adolesc. Psychiatry*; <https://doi.org/10.1007/s00787-021-01934-z> (2022).
- Hawton, K., Saunders, K. E. & O'Connor, R. C. Self-harm and suicide in adolescents. *Lancet* **379**, 2373–2382 (2012).
- Forrest, L. N., Smith, A. R. & Swanson, S. A. Characteristics of seeking treatment among U.S. adolescents with eating disorders. *Int. J. Eat. Disord.* **50**, 826–833 (2017).
- Young, A. F., Powers, J. R. & Bell, S. L. Attrition in longitudinal studies: who do you lose? *Aust. N. Z. J. Public Health* **30**, 353–361 (2006).
- Zerwas, S. et al. The incidence of eating disorders in a Danish register study: associations with suicide risk and mortality. *J. Psychiatr. Res.* **65**, 16–22 (2015).
- Keski-Rahkonen, A. & Mustelin, L. Epidemiology of eating disorders in Europe. *Curr. Opin. Psychiatry* **29**, 340–345 (2016).
- Glazer, K. B. et al. The course of eating disorders involving bingeing and purging among adolescent girls: prevalence, stability, and transitions. *J. Adolesc. Health* **64**, 165–171 (2019).
- Olsen, J. et al. The Danish National Birth Cohort—its background, structure and aim. *Scand. J. Public Health* **29**, 300–307 (2001).
- Shisslak, C. M. et al. Development and evaluation of the McKnight risk factor survey for assessing potential risk and protective factors for disordered eating in preadolescent and adolescent girls. *Int. J. Eat. Disord.* **25**, 195–214 (1999).
- Kann, L. et al. Youth risk behavior surveillance—United States, 1995. *J. Sch. Health* **66**, 365–377 (1996).
- Micali, N. et al. Adolescent eating disorders predict psychiatric, high-risk behaviors and weight outcomes in young adulthood. *J. Am. Acad. Child Adolesc. Psychiatry* **54**, 652–659 (2015).
- Dreier, J. W. et al. Fever and infections during pregnancy and psychosis-like experiences in the offspring at age 11. A prospective study within the Danish National Birth Cohort. *Psychol. Med.* **48**, 426–436 (2017).
- Greene, N., Greenland, S., Olsen, J. & Nohr, E. Estimating bias from loss to follow-up in the Danish National Birth Cohort. *Epidemiology* **22**, 815–822 (2011).

36. Dienes, Z. Using Bayes to get the most out of non-significant results. *Front. Psychol.* **5**, 781 (2014).
37. Wagenmakers, E.-J. A practical solution to the pervasive problems of *p* values. *Psychon. Bull. Rev.* **14**, 779–804 (2007).
38. Kass, R. & Raftery, A. Bayes factors. *J. Am. Stat. Assoc.* **90**, 773–795 (1995).
39. Jeffreys, H. *Theory of Probability*, 3rd edn (Oxford Univ. Press, 1961).

Acknowledgements

The DNBC was established with a significant grant from the Danish National Research Foundation. Additional support was obtained from the Danish Regional Committees, the Pharmacy Foundation, the Egmont Foundation, the March of Dimes Birth Defects Foundation, the Health Foundation and other minor grants. The DNBC Biobank has been supported by the Novo Nordisk Foundation and the Lundbeck Foundation. The follow-up of mothers and children has been supported by the Danish Medical Research Council (SSVF 0646, 271-08-0839/06-066023, 0602-01042B, 0602-02738B), the Lundbeck Foundation (195/04, R100-A9193), the Innovation Fund Denmark 0603-00294B (09-067124), the Nordea Foundation (02-2013-2014), Aarhus Ideas (AU R9-A959-13-S804), a University of Copenhagen Strategic Grant (IFSV 2012) and the Danish Council for Independent Research (DFF-4183-00594 and DFF-4183-00152). The 18-year follow-up was funded by the Danish Council for Independent Research (DFF-4183-00594B; Close to Adult: 17-year follow-up of the Danish National Birth Cohort). This study was made possible by a grant from the Velux Foundation (grant no. 36336, 'Standing together at a distance—how Danes are handling the corona crisis'). Finally, salary (full or part-time) for S.D. and T.M. was granted by the Lundbeck Foundation (R344-2020-1019), and for A.J. and K.S.-L. granted by the Independent Research Fund Denmark (8045-00047B). The funders had no role in study design, data collection and analysis, decision to publish or preparation of the manuscript.

Author contributions

S.D., A.J., P.K.A. and K.S.-L. conceived and designed the study. A.J., K.S.-L. and S.D. were involved in the data collection and data management of the DNBC-18 and COVID-19 survey. S.D. conducted

the analyses, supervised by A.J. and P.K.A. S.D. and K.S.-L. wrote the first draft of the manuscript. T.M. contributed with specific inputs for the suicide behaviour categorization. All authors contributed to the analytical approach and interpretation of the data, revisions of the manuscript and submission of the final manuscript.

Competing interests

The authors declare no competing interests.

Additional information

Extended data is available for this paper at <https://doi.org/10.1038/s41562-022-01511-7>.

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1038/s41562-022-01511-7>.

Correspondence and requests for materials should be addressed to Stine Danielsen.

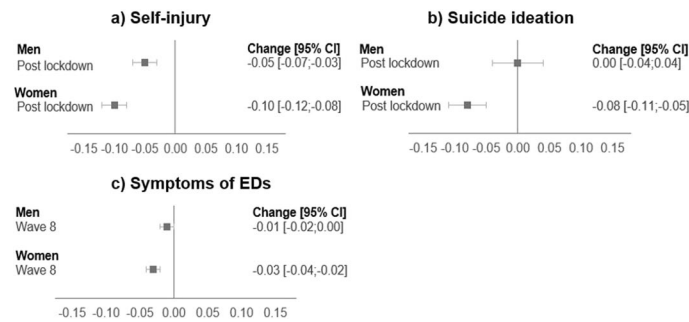
Peer review information *Nature Human Behaviour* thanks Ann Kristin Skrinko Knudsen and the other, anonymous, reviewer(s) for their contribution to the peer review of this work. Peer reviewer reports are available.

Reprints and permissions information is available at www.nature.com/reprints.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

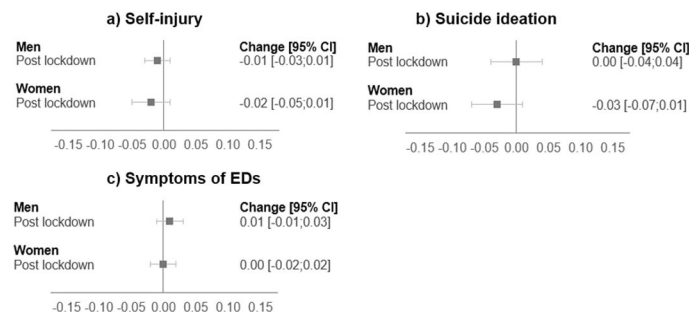
Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.

© The Author(s), under exclusive licence to Springer Nature Limited 2023



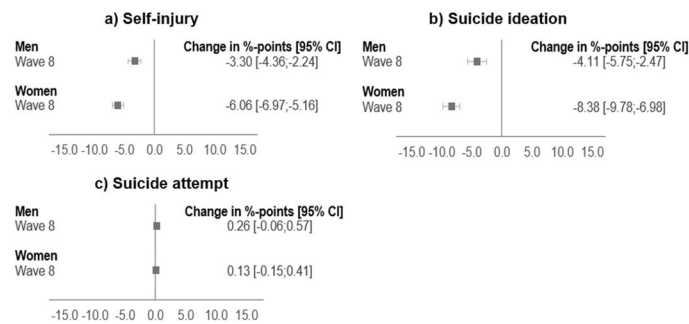
Extended Data Fig. 1 | Change in severity of self-injury, suicide ideation and attempt and symptoms of EDs in men and women from pre to during lockdown (longitudinal data). **a–c,** Weighted fixed effect linear regression estimating change in severity scales based on the longitudinal data collected in the DNBC-18 (N = 7,597) and wave 8 of the COVID-19 survey (N = 7,597), approximately 1 year post the initial lockdown. Data are presented as mean on the scale + /- standard error of mean (SEM). **(a)** Frequency of self-injury within

the last year (scale ranging from 0–4) in men (statistics: p-value < 0.001, DF = 2) and women (statistics: p-value < 0.001, DF = 2). **(b)** Frequency of suicide ideation within the last year (scale ranging from 0–4) in men (statistics: p-value = 0.878, DF = 2) and women (statistics: p-value = <0.001, DF = 2). **(c)** Weekly, monthly or no symptoms of EDs (scale ranging from 0–2) in men (statistics: p-value = 0.306, DF = 2) and women (statistics: p-value = 0.001, DF = 2).



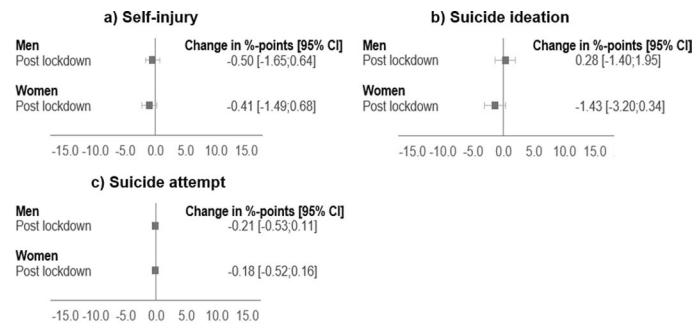
Extended Data Fig. 2 | Change in severity of self-injury, suicide ideation and attempt and symptoms of EDs in men and women from pre to during lockdown (repeated cross-sectional data). **a–c,** Weighted linear regression estimating change in severity scales based on the repeated cross-sectional data collected in the DNBC-18 (N = 24,625) in 2018–2021. Data are presented as mean change on the scale +/- standard error of mean (SEM). **(a)** Frequency

of self-injury within the last year (scale ranging from 0–4) in men (statistics: p-value = 0.446, DF = 8) and women (statistics: p-value = 0.069, DF = 8). **(b)** Frequency of suicide ideation within the last year (scale ranging from 0–4) in men (statistics: p-value = 0.960, DF = 8) and women (statistics: p-value = 0.175, DF = 8). **(c)** Weekly, monthly or no symptoms of EDs (scale ranging from 0–2) in men (statistics: p-value = 0.475, DF = 8) and women (statistics: p-value = 0.554, DF = 8).



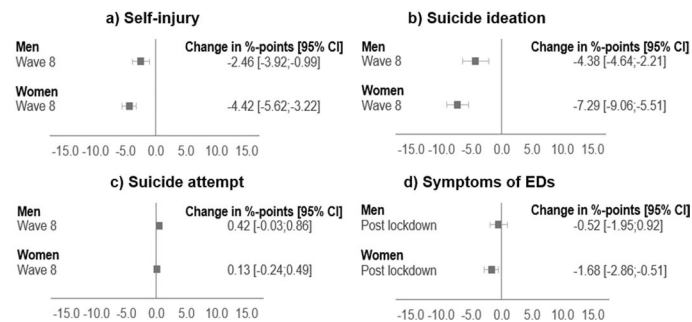
Extended Data Fig. 3 | Change in self-injury, suicide ideation and attempt and symptoms of EDs in men and women from pre to during lockdown, with participants replying ‘do not know’ excluded (longitudinal data). a–c. Weighted fixed effect linear regression estimating change in the proportions based on the longitudinal data collected in the DNBC-18 and wave 8 of the COVID-19 survey, approximately 1 year after the initial lockdown. Participants replying ‘do not know’ to an outcome were excluded in the analyses. Data are

presented as mean change in %-points $\pm$ standard error of mean (SEM). (a) $N = 7,326$, Self-injury within the last year in men (statistics: p -value < 0.001 , $DF = 2$) and women (statistics: p -value < 0.001 , $DF = 2$). (b) $N = 7,017$ Suicide ideation within the last year in men (statistics: p -value < 0.001 , $DF = 2$) and women (statistics: p -value < 0.001 , $DF = 2$). (c) $N = 7,529$, suicide attempt within the last year in men (statistics: p -value = 0.116, $DF = 2$) and women (statistics: p -value = 0.531, $DF = 2$).



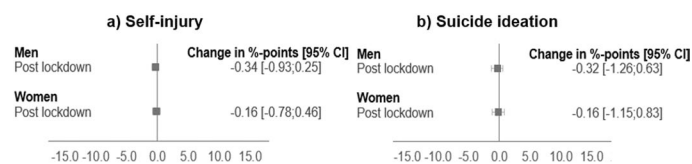
Extended Data Fig. 4 | Change in self-injury, suicide ideation and attempt and symptoms of EDs in men and women from pre to during lockdown, with participants replying ‘do not know’ excluded (repeated cross-sectional data). **a–c**, Weighted linear regression estimating change in the proportions based on the repeated cross-sectional data collected in the DNBC-18 (N = 24,625) in 2018–2021. Participants replying ‘do not know’ to an outcome were excluded in the analyses. Data are presented as mean change in %-points $\pm$ standard error

of mean (SEM). **(a)**; N = 23,782, Self-injury within the last year in men (statistics: p-value = 0.344, DF = 8) and women (statistics: p-value = 0.111, DF = 8) **(b)**; N = 23,061 Suicide ideation within the last year in men (statistics: p-value = 0.745, DF = 8) and women (statistics: p-value = 0.113, DF = 8) **(c)**; N = 24,366, Suicide attempt within the last year in men (statistics: p-value = 0.197, DF = 8) and women (statistics: p-value = 0.296, DF = 8).



Extended Data Fig. 5 | Change in self-injury, suicide ideation and attempt and symptoms of EDs in men and women from pre to during lockdown in participants aged 19-20 years in wave 8 (longitudinal data). a-d, Weighted fixed effect linear regression estimating change in the proportions based on the longitudinal data collected in the DNBC-18 (N = 3,927) and wave 8 of the COVID-19 survey (N = 3,927), approximately 1 year after the initial lockdown restricted to participants aged 19-20 years when participating in wave 8. Data are presented as mean change in %-points $\pm$ standard error of mean (SEM). (a) Self-injury within

the last year in men (statistics: p-value = 0.001, DF = 2) and women (statistics: p-value < 0.001, DF = 2). (b) Suicide ideation within the last year in men (statistics: p-value < 0.001, DF = 2) and women (statistics: p-value < 0.001, DF = 2). (c) Suicide attempt within the last year in men (statistics: p-value = 0.066, DF = 2) and women (statistics: p-value = 0.490, DF = 2) (d); Symptoms of EDs within the last month in men (statistics: p-value = 0.478, DF = 2) and women (statistics: p-value = 0.005, DF = 2).



Extended Data Fig. 6 | Change in self-injury and suicide ideation within the last four weeks in men and women from pre to during lockdown (repeated cross-sectional data). **a, b,** Weighted linear regression estimating change in the proportions based on the repeated cross-sectional data collected in the DNBC-18 (N = 24,625) in 2018–2021. Data are presented as mean change in %-points + /-

standard error of mean (SEM). **(a)** Self-injury within the last 4 weeks in men (statistics: p-value = 0.260, DF = 8) and women (statistics: p-value = 0.613, DF = 8) **(b);** Suicide ideation within the last 4 weeks in men (statistics: p-value = 0.510, DF = 8) and women (statistics: p-value = 0.757, DF = 8).

Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Portfolio policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a Confirmed

- | | | |
|-------------------------------------|-------------------------------------|--|
| ☐ | ☒ | The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement |
| ☐ | ☒ | A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly |
| ☒ | ☐ | The statistical test(s) used AND whether they are one- or two-sided
<i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i> |
| ☐ | ☒ | A description of all covariates tested |
| ☒ | ☐ | A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons |
| ☐ | ☒ | A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals) |
| ☐ | ☒ | For null hypothesis testing, the test statistic (e.g. F , t , r) with confidence intervals, effect sizes, degrees of freedom and P value noted
<i>Give P values as exact values whenever suitable.</i> |
| ☒ | ☐ | For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings |
| ☒ | ☐ | For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes |
| ☒ | ☐ | Estimates of effect sizes (e.g. Cohen's d , Pearson's r), indicating how they were calculated |

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

Data collection The data was collected through an online questionnaire using survey servers from Inquisite/Allegiance/Maritz.

Data analysis All analyses were performed unadjusted and with SAS Software, version 9.4 (SAS Institute, North Carolina, US) using the commands proc surveyfreq, proc genmod, proc glm and applying sampling weights and absorb statement

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

According to European law (General Data Protection Regulation), data containing potentially identifying or sensitive personal information are restricted. However, for academic researchers, data can be available after approval. The newest version of the DNBC application form can be requested at dNBC-research@ssi.dk. The application form and a research protocol should be returned to the same e-mail address. The application will be given a reference number and will be submitted to the DNBC Management and then to the DNBC Steering Committee. You can expect a decision after 6-8 weeks. There is an application fee of approximately 540 euros and a data fee of approximately 2900 euros (for 1 published paper). Data where individuals may be identified, the DNBC project must be listed on your

institution's record of data processing activities. Access to biological material need permission from the Committee on Biomedical Research Ethics. For more details about data see; <https://www.dnbc.dk/access-to-dnbc-data>

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☒ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see [nature.com/documents/nr-reporting-summary-flat.pdf](https://www.nature.com/documents/nr-reporting-summary-flat.pdf)

Behavioural & social sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	This is an observational epidemiological study using quantitative longitudinal and repeated cross-sectional data.
Research sample	The research sample consists of participants in the pre-existing Danish National Birth Cohort that includes children born in Denmark in 1996-2003. The sample size is 7,597 in the longitudinal data and 24,625 in the repeated cross-sectional data. Only participants completing the 18-year follow-up and the COVID-19 survey were included and the sample may not be representative due to attrition, but sampling weights were applied to adjust for this. Participants are aged 18-24 years in the longitudinal data and 18 years in the repeated cross-sectional data. Both men and women are represented. We choose this study population based on relevant data collections during the COVID-19 lockdown.
Sampling strategy	We used an existing data source and did not have any influence on the sample size, but we consider it to be sufficient. The Danish National Birth Cohort was established in the mid-nineties when pregnant women and their unborn children were recruited nationwide through their general practitioner. About 1/3 of the children born in Denmark in the enrollment period were included in the cohort. The invitation to participate in the cohort was random but self-selection made the cohort less representative. Invitation to participate in the 18-year follow-up was sent out to everyone in the cohort. Invitation to the COVID-19 survey was only sent out to people who previously had provided an active email or phone number.
Data collection	The participants completed online questionnaires based on survey servers from Inquisit/Allegiance/Maritz without any involvement of the researcher. The questionnaire was sent to participants through secure email and the participants had up to three months to complete the questionnaire. In the invitation, it was recommended to be alone when replying to the questionnaire. The data has been used for many other purposes and the purpose of this particular study was not stated.
Timing	Longitudinal data collected between 03/16 and 05/21 Repeated cross-sectional data collected between 01/18 and 02/21
Data exclusions	Longitudinal data: We excluded participants with mothers who did not participate in the first interview during pregnancy (N=6,217). Further, we excluded participants who were not eligible for invitation before March 11, 2021 (N=23,262) as this was lockdown date. Repeated cross-sectional data: We excluded participants with mothers who did not participate in the first interview during pregnancy (N=6,217). Further, we excluded participants who were not eligible for invitation between January 1, 2018 and March 1, 2021 (N=31,970).
Non-participation	15,503 (67%) did not respond in the longitudinal data 34,013 (58%) did not respond in the repeated cross-sectional data
Randomization	Observational study, no randomization

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

Methods

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☒	☐ Animals and other organisms
☐	☒ Human research participants
☒	☐ Clinical data
☒	☐ Dual use research of concern

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Human research participants

Policy information about [studies involving human research participants](#)

Population characteristics

Young people from Denmark aged 18-23 years enrolled (see above) in the Danish National Birth Cohort.

Recruitment

The recruitment into the DNBC have been described above. Participants in the DNBC have higher socio-economic status than non-participants which makes the results less representative. All participants in the cohort were invited to participate in the 18-year follow-up consisting of an online questionnaire. The COVID-19 survey were only sent out to participants who previously had provided an active email or phone number. Only participants completing the 18-year follow-up and the COVID-19 survey were included in this study. Self-selection bias is a concern as people with poor mental health including self-injury, suicidality and ED symptoms may be less likely to participate. Thus, the proportion of these outcomes may be underestimated. We used sample weights based on early life factors to adjust for differential attrition/self-selection bias.

Ethics oversight

This study was approved by the Danish Data Protection Agency via a joint notification to the Faculty of Medicine and Health Sciences – University of Copenhagen (ref. 514-0497/20-3000, ‘Standing together at a distance: how are Danish National Birth Cohort participants experiencing the corona crisis?’). The cohort is approved by the Danish Data Protection Agency and the Committee on Health Research Ethics under case no. (KF) 01-471/94. Data handling in the DNBC has been approved by Statens Serum Institut (SSI) under ref. no 18/04608 and is covered by the general approval (Fællesanmeldelse) given to SSI. The 18-year follow-up was approved under ref. no 2015-41-3961. The DNBC participants were enrolled by informed consent.

Note that full information on the approval of the study protocol must also be provided in the manuscript.