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Research paper

# Adolescents' symptoms of anxiety and depression before and during the Covid-19 outbreak – A prospective population-based study of teenagers in Norway

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## ABSTRACT

**Background:** Lockdown policies related to the Sars-Cov-2 pandemic has potential negative consequences for mental health in youths.

**Methods:** Anxiety and depressive symptoms were assessed in 3 572 adolescents, age 13 to 16 using the Hopkins Symptom Checklist (HSCL-10), in a representative longitudinal survey of Norwegian youths between February 2019 (T1) and June 2020 (T2). Predictors for symptom change were analysed with linear mixed-effects models.

**Findings:** Overall, clinical levels of anxiety and depression increased slightly from 5.5% at T1 to 6.3% at T2; Chi square 224.4 ( $df = 1$ ),  $p < .001$ . However, the observed change was driven by the increase in age between assessments. Being a girl, having pre-existing mental health problems, and living in a single-parent household at T1, predicted higher levels of anxiety and depressive symptoms at T2 ( $p < .001$ ). Living in a single-parent household was associated with a significant increase in symptoms, also when age was controlled for ( $p < .001$ ). Living in a poor family however, or having a history of maltreatment, was associated with a significantly lower increase in symptoms ( $p < .001$ ).

**Interpretation:** Anxiety and depressive symptoms increased slightly in Norwegian youths between 2019 and 2020, but this change seemed to be driven by increase in age rather than pandemic-related measures. Symptom levels were unevenly distributed across demographic groups both before and during the pandemic outbreak, indicating that health disparities persist for adolescents in risk groups during a pandemic. Health inequities related to living conditions need to be addressed in future action plans, and intensified measures to mitigate inequities are needed.

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## 1. Introduction

On March 11, 2020, the World Health Organization (WHO) declared the spread of Covid-19 a global pandemic, and on March 12, Norwegian authorities, as in other countries across the globe, decided to shut down large parts of society in an attempt to limit the spread of infection. Measures taken by the government primarily comprised quarantine and social distancing, including closing schools at all levels for a good two months during spring 2020. During the first weeks of preventive measures, the entire country underwent the same

restrictions regardless of degree of contagion reported in local communities and regions. The situation has led to serious concerns about how child and adolescent mental health and well-being may have been impacted. The isolation from friends over time, uncertainty about the future both short- and long-term, as well as a continuous state of fear, such as the fear of being infected, have all evidenced to pose a risk for developing psychopathology in youth [1–3]. Family stressors pertinent to the pandemic outbreak, such as parental job loss and financial insecurity, may affect adolescents in general, and in particular those living in families with increased levels of psychosocial disadvantage. The described potential effects of the pandemic on adolescents' mental health, paired with the fact that the lockdown has affected adolescents' access to mental health services, may be

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## Research in Context

### Evidence before this study

We searched Medline, PsycInfo and Web of Science for peer-reviewed papers published from database inception to February 15, 2021, with the language restricted to English. We used the terms “Covid-19”, “Pandemic”, “Home confinement”, “Quarantine”, “Lockdown”, “Coronavirus”, “Disease outbreak”, “SARS”, “Ebola”, Swine influenza/flu and “mental health”, “well-being”, “depress\*”, “Quality of life”, “Anxiety”, “PTSD”, “PTSS”, “Stress”, “Psychological impact”, and “Psychopathology”. These searches were restricted to the following population characteristics: “Child\*”, “Youth”, and “Adolescent\*”. Additional papers were identified by checking citations and cited papers. We identified twenty-seven relevant empirical studies investigating the relationship between pandemic outbreaks and mental health problems in children and adolescents, twenty-three of which were related to the Covid-19 outbreak. These studies differed from the present study in that none had longitudinal designs with respondents below the age of 16. However, four prospective longitudinal studies with respondents at least 16 years of age were identified. Together, these studies found increased rates of symptoms of psychopathology during the confinement period, with the greatest increases found in young people, women and people living with younger children.

### Added value of this study

The present study focused on changes in self-reported anxiety and depression symptoms in adolescents and is among the first to show that vulnerable groups of youths were disproportionately affected by the pandemic and specific stressors during this crisis. Our study suggests that health disparities for adolescents living in low-income families and those with pre-existing mental health problems persist also in a crisis. For adolescents living in single-parent households symptoms became more pronounced.

### Implications of the available evidence

Overall, Norwegian adolescents did not show a pandemic-related increase in symptoms of anxiety and depression after the first wave of the Covid-19 outbreak. However, adolescents from single-parent households were at a higher risk for elevated symptoms of distress during Covid-19. The findings emphasise the importance of maintaining child and adolescent-centred services such as schools, after-school activities as well as mental health services available during a pandemic outbreak to reduce loneliness, increase belongingness and ensure continued treatment when needed, in particular in vulnerable groups. The results reflect the situation in Norway after 2.5 months in lockdown.

the adult population were reported to emerge during adolescence. Currently, rates of psychological distress among adolescents seem to be on a rising trend. For example, the prevalence of depression increased from 8.7% in 2005 to 13.2% in 2017 among adolescents aged 12 to 17 [13]. Stressful events such as the Covid-19 outbreak are potent adverse factors that may put youths at increased risk of internalising problems [14–16]. Indeed, the few longitudinal investigations published on mental health since the pandemic outbreak suggest that the levels of psychological distress increased on a population level [17–22] and that young people were one of the significant risk groups that needed particular attention [17]. Cross-sectional data from affected areas worldwide indicate that adolescents have shown high rates of psychological health problems during the Covid-19 outbreak [1,14,16], and adolescent girls are at particularly high risk for experiencing anxiety and depression during times of elevated stress [16]. Although many may experience transitory distress, there is reason to believe that some groups of the adolescent population may be disproportionately affected. For instance, adolescents with pre-existing vulnerabilities may be at particular risk during a pandemic [17,20,23]. Hence, there is a need to understand what characterises adolescents at greatest risk of developing psychopathology during a pandemic outbreak such as the current one. Only with this knowledge can we advise authorities on public health priorities and tailor interventions to more efficiently meet the needs of those who may be most affected by the current and future pandemics.

Determining the psychosocial consequences of the pandemic has been identified as a public health research priority [9], and the need to collect high-quality data on the mental health effects of the Covid-19 pandemic across the whole population including vulnerable groups has been highlighted [24–26]. To identify probable changes due to the pandemic or lockdown situation, we need prospective longitudinal studies with comparative data collected before the onset of the pandemic. So far, such studies are rare. Additionally, as Pierce and collaborators point out [27], longitudinal research must draw on probability-based samples from across the population to avoid the disproportional neglect of vulnerable groups of particular interest.

In the present research, we aimed to determine the short-term psychological impact of the Covid-19 outbreak in a representative sample of adolescents. After the lockdown of Spring 2020, we expected a moderate negative impact of the pandemic and preventive measures on adolescents' anxiety and depression symptoms. For adolescents at risk of mental distress and with family risk factors present, we expected a stronger association with anxiety and depression symptoms.

## 2. Methods

### 2.1. Design and sample

The study is part of an ongoing longitudinal survey study of a representative sample of 9 240 12-to-16-year-olds, the aim of which was to assess maltreatment experiences and health outcomes over time in a representative youth sample [28]. The survey was administered in schools sampled for representativeness with regard to geography (all regions of Norway were covered), school size, and ethnic minority status, and students participated by answering an online questionnaire. The survey was presented in the Norwegian language only, and students who did not have a sufficient level of Norwegian language skills could not take part. The first wave of the survey was conducted in February 2019, approximately one year before the outbreak of Covid-19, and a second assessment was planned for the spring term of 2021. Given the new research demands spurred by the pandemic and the dearth of prospective longitudinal research with representative youth samples, we designed a brief survey that was distributed to the original gross sample in May 2020, shortly (approx. two weeks) after schools reopened in Norway.

detrimental to adolescents' well-being [4,5–7]. As such, research in this area has been pointed out as a top research priority [8,9]. So far however, prospective longitudinal research examining the potential impact of the pandemic outbreak on the youth population is largely lacking [10].

Adolescence represents a developmental phase of adaptation, exploration and resilience towards adversity [11]. At the same time, adolescents are at a vulnerable stage of development, with the majority of mental disorders peaking during this time period [12]. Studies have indicated that about two thirds of mental health problems in

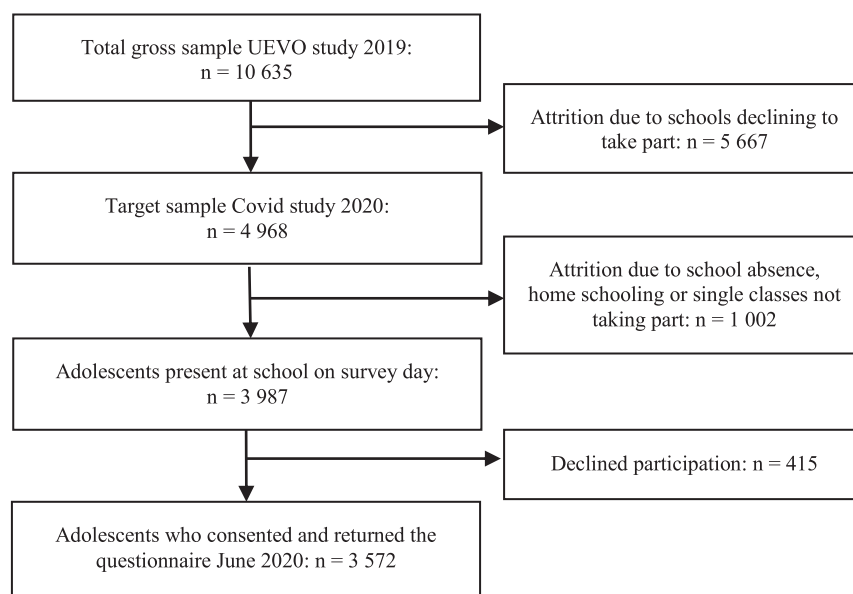


Fig. 1. Flowchart showing inclusion of participants.

A total of 3 572 (50.1% girls,  $n = 1 776$ ) adolescents between 12 and 16 years of age ( $M = 14.7$  years,  $SD = 4.1$  years) took part in the present study. The participants were primarily born in Norway, but a proportion of the study sample was also born abroad ( $n = 373$ , 10.5% of the total sample), and they represent middle-school students throughout Norway. Due to the extraordinary situation for schools and society in general during the Covid-19 pandemic outbreak, only about half ( $n = 30$ ) of the schools that we approached ( $n = 64$ ) agreed to distribute the survey to their students. Although not mapped in the present study, school absence could be due to home-schooling arrangements for parts of the student body in some participating schools. It could also be due to more ordinary reasons for school absence such as illness. See Fig. 1 for a flowchart depicting survey participation and attrition. The current sample was comparable to the 2019 sample, although the dropout analyses revealed somewhat lower odds for taking part at T2 for boys, youth from less affluent homes, youth from families with non-Nordic origin and at-risk families.

## 2.2. Measures

**Background variables:** The participants reported their age in years. Gender was reported as either boy, girl, or non-binary. Perceived family affluence was assessed with two questions regarding whether the adolescent experienced the family as having sufficient economic means allowing the family to buy necessary goods in addition to a question concerning whether the adolescent had experienced a decline in participation in after-school activities due to family finances. We also asked about parents' workforce status at both time points as well as Covid-19-related unemployment at T2.

**Anxiety and depression symptoms:** We examined anxiety and depression symptoms by the use of the Hopkins Symptom Checklist-10 (HSCL-10) at both time points. HSCL-10 is a widely used self-report questionnaire designed to measure psychological distress, primarily symptoms of depression and anxiety, in population surveys. Each item is presented on a four-point scale (i.e., 0–3), ranging from 'Not at all' and 'A little' to 'Quite a bit' and 'Extremely', summarised as a mean score that requires a valid response on at least half of the items for a score to be computed. Items covered symptoms of worry, anxiety and lack of interest (e.g., "Feeling tense or keyed up", "Suddenly scared for no reason", "Feeling blue"). A

valid cut-off value for the prediction of clinical mental distress is estimated as an average score  $\geq 1.60$  [29]. The scale is validated for the screening of internalising symptoms in adolescents between the ages of 14 and 16 years in Norwegian primary care institutions [29]. The HSCL-10 is found to perform almost as well as the full version (i.e., HSCL-25), from a psychometric perspective, yielding high correlations (0.97) between HSCL-25 and HSCL-10 [30]. HSCL-10 has a sensitivity of 87.5% for both genders, and specificity of 72.4% in girls and 87.9% in boys [29]. Furthermore, the scale is used as a valid instrument for the screening and identification of depression in adolescents between the ages of 14 to 16 years in Norwegian primary care institutions [29].

**Pandemic-related worries:** We assessed worries specifically related to the ongoing pandemic and possible consequences with a set of eight questions modified from the preliminary *Pandemic Anxiety Scale* [31] developed for the British Co-SPACE study (Covid-19: Supporting Parents, Adolescents and Children during an Epidemic; <https://osf.io/pa2xv/>). The questions were originally developed for parental and adolescent self-report [31] and were adapted for the use of self-report for Norwegian adolescents in the present study. The issues assessed were fear that oneself or family members would catch the virus, fear of passing the virus on to someone else, fear of going out due to the virus, fear of missing school, and fear that the pandemic would influence the family's financial situation or future plans. Each item was rated on a 5-point Likert scale ranging from 0 ('Strongly disagree') to 4 ('Strongly agree').

**Loneliness:** Adolescents' self-reported loneliness over the previous two weeks was mapped using the UCLA loneliness scale short form with three items [32,33]. The three-item UCLA version has proven to be valid in measuring loneliness in large-scale studies and is related to objective self-isolation [33]. The questions were rated on a three-point scale ranging from 1 ('Never') to 3 ('Always'), and a composite mean score was calculated for the three items.

## 2.3. Procedures

A subsample of schools included in the UEVO study [28] was approached and asked to administer the web-based survey to their entire student body, grades 8 through 10. The schools that agreed to take part administered the survey during school hours. The web-based survey took approximately 15 minutes to complete after

watching a short animated video about the study as well as animated information about the ethical principles of voluntary participation, confidentiality, and the right to withdraw at any time during the study without having to give a reason. Students answered the survey in class during school hours on either PC, tablet or cell phone.

#### 2.4. Ethics

The study protocol was approved by the Regional committee for ethics in medical and health research in the Southeastern region of Norway (Case #2018/522). All participants provided informed written consent, and no parental consent was required for the adolescents to participate.

#### 2.5. Data analyses

The statistical analyses were conducted in three steps. We first described the characteristics of the Covid-19 survey participants and their mental health, overall and based on consideration of their background characteristics. We ran a hierarchical linear regression model to determine what factors were associated with higher levels of mental health complaints during the pandemic outbreak. The first model included pre-existing risk factors assessed one year before the outbreak. Explanatory variables were added to the model simultaneously, and only factors that most likely were present before the T1 assessment were included in the first model, while the second model also included concurrent risk factors assessed at T2, i.e. pandemic-related worries and loneliness were entered in the second model. The distribution of the dependent variable was investigated and in order to adjust for non-normality in variables, both regression models were bootstrapped with 10 000 replications, producing confidence intervals for the estimates that did not depend on specific distributional assumptions. In addition, we conducted permutation tests to produce p-values that did not depend on specific distributional assumptions. In cases where we observed notable deviations from standard estimates, these are noted in the results section.

In the second step, we estimated the overall change in HSCL-10 scores from before to during the pandemic outbreak by fitting a linear mixed model including participants with observations at both time points. Because the sample had become one year older between the data collection points, age was included as covariate in the model as a second step.

The third step involved longitudinal analyses assessing the potential impact of the pandemic and lockdown by analysing changes in scores at the individual level by using mixed effects models with measurement time point as an explanatory variable. The model included a number of background variables with emphasis on their importance for change in HSCL-10, and thus only variables most likely present before the first HSCL-10 assessment (T1) were included as not to interfere with the temporal interaction. These were gender, low family affluence, family ethnic minority status, parental risk factors (i.e., living with parent(s) with mental health problems, who misused alcohol or other substances or who had ever been incarcerated) and a history of child maltreatment. Because mental health problems increase with age throughout adolescence, we controlled for age in the model. A positive coefficient from the mixed-effects model indicates worsening mental distress associated with the pandemic. Interactions between the time (before to during the pandemic) and the five pre-defined subgroups were fitted to investigate heterogeneity in the effect of the pandemic. Effect estimates are also reported by subgroup and the associated p values test the null hypothesis that there is no difference in change associated with the pandemic between different subgroups of people. To adjust for multiple testing, which may lead to inflated p-values in the mixed effects model, we applied the Holm procedure to p-values adjusted for multiple testing. The mixed effects models allowed for the use of all

observed data, regardless of whether the individuals had observations at both time points.

In general, missing data in outcome variables were handled by applying half rule, i.e. only participants with valid observations on at least half of the items were included in the scale scores. As for the mixed effects model, such models give valid inference with missing data in the dependent variable under the less restrictive missing at random assumption. For the HSCL-10 Omega and Cronbach's alpha were equal with two decimal places when the computation of Omega converged. The mixed effects models were run using the nlme package in R (R Core Team, 2020). Omega computations used the R package coefficientalpha with default downweighting (10%), bootstrap computations used the R package boot while permutation tests used core R. All other analyses were conducted in SPSS version 26 (IBM Corp, released 2019).

### 3. Role of the funding source

The funder had no role in the study design; in the collection, analysis, and interpretation of data; in the writing of the manuscript; or in the decision to submit the paper for publication.

### 4. Results

#### 4.1. Symptoms of anxiety and depression during the outbreak

In June 2020, shortly after the reopening of schools, but with the pandemic still ongoing and threats of new waves approaching, the mean HSCL-10 score in this sample of 12- to 16-year-olds was 0.55 (SD=0.64), with 6.3% reporting a symptom level above the suggested clinical cut-off for this age group [29]. Adolescents in some subgroups showed more symptoms than others (see Table 1). The mean HSCL-10 scores increased with age and were higher for girls than for boys. At both time points significantly higher HSCL-10 mean scores were also observed for adolescents who reported low family affluence, living in a single-parent household, having parents with mental health or drug use problems, or having a history of maltreatment, as compared to their peers who did not report these risk factors (all p-values < .001), suggesting that health inequities that were observed before the outbreak persisted into the pandemic. No meaningful difference was observed for adolescents born in Norway versus those from other countries of origin at either time point.

As shown in Table 2 model 1, girls, adolescents with pre-existing mental health problems, and those living in a single-parent household one year prior to the outbreak were significantly more affected three months into the lockdown, as evidenced by significantly higher mean scores on the HSCL-10. Prior mental health problems were highly predictive of mental health problems during the outbreak; higher HSCL-10 scores one year prior to the outbreak were strongly associated with higher HSCL scores also during the outbreak. Model 2 included concurrent risk factors assessed at T2, while still controlling for pre-existing risks. In this model, feeling lonely over the two weeks before the assessment and pandemic-related worries were also strongly related to HSCL-10 scores, also when pre-existing risk factors were taken into account. Whether parents had been laid off due to the crisis did not significantly affect adolescents' mental health problems when other factors were taken into account.

#### 4.2. Change in symptoms of anxiety and depression from before to during the pandemic outbreak

There was a statistically significant increase in the scores for symptoms of anxiety and depression (HSCL-10 mean score) from before (M=0.51, SD =0.62) to during the pandemic outbreak (M=0.57, SD=0.64), mean difference 0.06, p<0.001 (95% CI 0.03, 0.08 p < .001). However, the observed difference was small with questionable

**Table 1**

Mean scores of mental health symptoms (HSCL-10) in February 2019 and June 2020.

	N T1 (%)	Mean HSCL T1 score (95% CI)	p-value, partial eta sq.	N T2	Mean HSCL T2 score (95% CI)	p-value, partial eta sq.
<b>Age</b>			<.001, .015			0.722, 0.001
13 or younger	2676 (29.9)	0.46 (0.43,0.48)		769 (43.2)	0.55 (0.51,0.60)	
14	2996 (33.5)	0.58 (0.56,0.60)		907 (50.9)	0.57 (0.53,0.62)	
15	2927 (32.7)	0.66 (0.63,0.68)		104 (5.8)	0.61 (0.48,0.73)	
16	340 (3.8)	0.62 (0.54,0.69) Bootstrap (0.55,0.69)		2 (0.1)	0.25	
<b>Gender</b>			<.001, .100			<0.001, 0.090
Girl	4516 (50.6)	0.78 (0.75,0.80)		1731 (51.1)	0.73 (0.70,0.77)	
Boy	4413 (49.4)	0.36 (0.34,0.37)		1657 (48.9)	0.35 (0.33,0.37)	
<b>Parents' country of origin</b>		p=0.001	<.001, .001			0.827, 0.000
Norway/Nordic country	6572 (74.7)	0.58 (0.57,0.60)		1360 (77.5)	0.56 (0.53,0.60)	
Outside the Nordic region	2220 (25.3)	0.53 (0.50,0.56)		395 (22.5)	0.57 (0.51,0.64)	
<b>Single-parent household</b>			<.001, .015			<0.001, 0.019
No	6289 (70.4)	0.52 (0.50,0.53)		1300 (73.1)	0.51 (0.48,0.55)	
Yes	2641 (29.6)	0.69 (0.67,0.72)		479 (26.9)	0.71 (0.65,0.78)	
<b>Family affluence</b>			<.001, .029			0.002, 0.013
Low	325 (3.7)	1.14 (1.05,1.24)		42 (2.4)	1.03 (0.75,1.32)	
High	8553 (96.3)	0.55 (0.53,0.56)		1729 (97.6)	0.56 (0.53,0.59)	
<b>Parental risk</b>			<.001, .074			<0.001, 0.028
High	1589 (17.8)	0.95 (0.92,0.99)		253 (14.3)	0.83 (0.73,0.92)	
Low	7329 (82.2)	0.49 (0.47,0.50)		1520 (85.7)	0.52 (0.49,0.55)	
<b>A history of abuse exposure</b>			<.001, .130			<0.001, 0.052
Yes	3777 (45.6)	0.83 (0.80,0.85)		650 (39.5)	0.74 (0.68,0.79)	
No	4513 (54.4)	0.35 (0.34,0.36)		997 (60.5)	0.44 (0.41,0.48)	

Note: p-values are reported for comparisons within each time point. Permutation tests and bootstrap analyses were run for all comparisons to adjust for biases caused by non-normality of the outcome variable. Generally, these analyses did not produce diverging estimates, except from the following cases: Country of origin permutation test  $p = 0.836$ , Family affluence Bootstrap 95% CI (0.77,1.31)

clinical significance. Moreover, when controlling for the increase in age between assessment points, the difference decreased to 0.01 (95% CI -0.046, 0.064), and was no longer significant,  $p=0.751$ . The percentage of youths with a clinically significant level of anxiety and depression symptoms increased slightly from 5.5% to 6.3% over the same time period,  $\chi^2 224.4$  ( $df = 1$ ),  $p < .001$ .

We expected that for some groups, symptom levels may have increased disproportionately during the pandemic outbreak. We were particularly interested in groups with a higher risk of mental health problems before the pandemic outbreak, and we therefore ran a mixed effects model investigating the interaction of time with a set of predefined risk factors for mental health problems. Because mental health problems generally increase throughout adolescence, we controlled for age in the model. As shown in Table 3, adolescents living in a single-parent household had a significantly larger increase in anxiety and depression symptoms from before to during the pandemic than their peers who lived with both parents. Adolescents who reported that their family's financial situation was poor in 2019 had a significantly lower increase in anxiety and depressive symptoms than their more affluent

peers. The same pattern was observed for adolescents with a history of maltreatment: their symptom level increased significantly less than was the case for their peers who did not report abusive experiences. Although statistically significant, the longitudinal change for these groups was close to zero and must be interpreted accordingly.

## 5. Discussion

The paper presents one of the first prospective longitudinal studies on adolescent mental health before and during the outbreak of the Covid-19 pandemic and thus offers the possibility of studying changes in mental health over this time period. We observed an overall significant increase in symptoms of anxiety and depression in the youth population compared to the year prior to the pandemic. However, the observed change in symptoms of anxiety and depression was small and we cannot be conclusive regarding the public health significance. Moreover, this change was driven by an increase in participants' age between assessment points. An increase from 5.5% to 6.3% in clinical levels of symptoms within this short period may

**Table 2**

Linear regression model predicting the level of anxiety and depressive symptoms during the pandemic.

	Model 1 B (95% CI)	$\beta$	P, partial $\eta^2$	Model 2 B (95% CI)	$\beta$	P, partial $\eta^2$
<b>T1 variables</b>						
HSCL	0.54 (0.48,0.60)	0.53	<0.001, 0.27	0.40 (0.34,0.45)	0.39	<0.001, 0.19
Male gender	-0.19 (-0.24,-0.14)	-0.13	<0.001, 0.03	-0.11 (-0.16,-0.07)	-0.09	<0.001, 0.01
Family affluence	-0.01 (-0.24,0.28)	0.00	0.90, 0.00	0.06 (-0.17,0.28)	0.01	0.45, 0.00
Non-Nordic country of origin	0.00 (-0.06,0.06)	0.00	0.99, 0.00	-0.02 (-0.07,0.04)	-0.01	0.57, 0.00
Single-parent household	0.12 (0.05,0.18)	0.08	<0.001, 0.01	0.09 (0.04,0.14)	0.06	0.001, 0.01
Abuse exposure (lifetime)	0.06 (-0.00,0.11)	0.04	0.048, 0.00	0.02 (-0.03,0.07)	0.01	0.49, 0.00
<b>T2 variables</b>						
Loneliness				0.47 (0.42,0.53)	0.41	<0.001, 0.23
Pandemic-related worries				0.08 (0.04,0.11)	0.09	<0.001, 0.02
Parents' pandemic-related job loss				0.03 (-0.03,0.09)	0.02	0.94, 0.00
	$R^2 = 0.37$		<0.001	$R^2 = 0.53$		<0.001
				$\Delta R^2 = 0.16$		<0.001

**Table 3**  
Mixed effects model predicting changes in anxiety and depressive symptoms from before to during the pandemic outbreak.

	Estimate	95% CI	P value	
			Unadjusted	Holm
<b>Interactions with time (difference in change from T1 to T2)</b>				
Gender (ref. boy)	0.02	-0.03,0.07	0.58	0.58
Family affluence (ref. low)	0.21	0.04,0.38	0.011	0.044
Parents' country of origin (ref. Norway/Nordic country)	0.04	-0.02, 0.10	0.18	0.36
Single-parent household	0.07	0.02,0.13	0.011	0.044
Prior abuse exposure (ref. no prior abuse)	-0.14	-0.19,-0.09	<0.001	<0.001

Analyses are based on the 9689 of totally 10815 persons with binary gender, with no missing values on the covariates in the model. Standard deviations for random variation are 0.41 (95% CI 0.40, 0.43) between and 0.40 (0.39, 0.42) within persons. The model is controlled for age (the results are virtually the same without controlling for age). Holm p-value adjusted for multiple testing.

however, reflect a progressive effect in mental health problems in the adolescent population during Covid-19 that needs to be further investigated. Certain demographic groups experienced higher levels of mental health complaints than others, both before and during the outbreak, indicating the persistence of health inequities for adolescents living in low-income and single-parent households, households where parents have either drug use or mental health issues, and families in which child abuse had been reported. We observed that both before and during the outbreak, the mean scores of anxiety and depressive symptoms were markedly higher for all risk groups than for those not presenting with those risks. Although anxiety and depressive symptoms did not increase substantially for the youth population as a whole, some groups were disproportionately affected by the pandemic and specific stressors during this crisis. Adolescents living in a single-parent household one year prior to the pandemic outbreak were also those most affected in June 2020, as evidenced by a significant increase in levels of anxiety and depressive symptoms. Previous research suggest that adolescents living in a single-parent household display increased risk for mental health problems [34,35].

Accounting for individual and familial risk factors, prior mental health problems was an important pre-existing risk factor predicting higher HSCL-10 scores during the pandemic. Young people with pre-existing mental health issues have been identified as one of the primary pandemic risk groups due to the reduced availability of services during lockdown, the impact of isolation and the generally increased stress caused by the crisis. This study adds to the concern by showing that mental health problems persisted and were also exacerbated three months into the outbreak. This finding indicates that a continuous effort to prevent and treat mental health problems in young people is of paramount importance to make more vulnerable adolescents better equipped to deal with future crises. We know that our society will face new crises that will present children and young people with new challenges. Prevention and treatment of young people's mental health problems will and should be on the political agenda. Also because we know that mental health problems tend to emerge during adolescence and persist into adulthood [12], with the additional burden this represents for the individual but also society at large.

Loneliness and pandemic-related worries during the outbreak were both related to symptoms of anxiety and depression in June 2020, accounting for all other risk factors. The finding pertaining to loneliness echoes findings from a systematic review, suggesting that loneliness in children and adolescents was associated with increased anxiety and depression symptoms both cross-sectionally and longitudinally [36]. This further underscores the importance of peer networks for adolescents and how a lack thereof puts adolescents at risk

of developing internalising symptoms (cf. [37]). Additionally, the finding may have a strong practical impact in that, as noted by Holmes and collaborators [9] reducing a sustained feeling of loneliness and promoting belongingness are central mechanisms in protecting against mental health problems. Pandemic-related worries may be a contributing factor by fuelling general tendencies of worry in adolescents predisposed to mental health problems [31]. Thus, both direct (worries for health and well-being) and indirect (loneliness) insecurities associated with crises such as the Covid-19 pandemic are associated with psychological distress for these adolescents, even when controlling for other known risk factors. Importantly, the cross-sectional nature of this relationship implies that we cannot make any inferences about the direction of effects.

Living in a single-parent household was the only pre-existing risk factor which significantly impacted the increase in HSCL scores. Approximately one-third of the sample at both measurement points lived in single-parent households, and we believe that these families may stand to suffer more of other strains that could break through the surface in a crisis situation, such as conflict, family stress, family affluence, and complicated intrafamilial relationships [34]. For families where youths had shared residence, the lockdown situation could create difficulties in meeting with the other parent and adhering to weekly routines [35]. It is possible that this situation may have induced more responsibility and pressure on the parent with whom the adolescents predominantly stayed – which again could have exerted more stress on the youths. In addition, not being able to see their other parent for a long period of time would probably increase the adolescents' stress level. That said, we must note again that effect sizes were rather small.

Somewhat surprisingly, two groups displayed a significantly smaller increase in symptoms of anxiety and depression from before to during the pandemic outbreak, namely, adolescents with a history of child maltreatment and those living in less affluent households. It is well established that these groups are overrepresented among youths with mental health problems, and we hypothesised that the crisis would exacerbate their difficulties. Indeed, both groups did display higher levels of anxiety and depression symptoms than their non-exposed and more affluent peers both before and during the pandemic. However, their symptoms changed less than their peers' symptoms over time. It could be that HSCL scores did not change negatively for the marginalised groups because their immediate response to the pandemic and preventative measures did not necessarily outperform the distress they experiences due to other stressors in their life (e.g., maltreatment experiences or economic hardship). Thus, their HSCL scores were not significantly affected by the pandemic immediately after school reopening. Also, Norway was one of the countries in the world with few fatalities

and cases of severe illness, resulting in adolescents in general experiencing few losses and severe illness in close family and relatives. Thus, anxiety related to the virus, and grief reactions due to loss and severe illness, were not prevalent in the population, possibly partly explaining the present results of minimal change in symptom severity right after the schools reopened. Finally, the fact that pre-existing levels of anxiety and depression symptoms were a strong predictor of internalising difficulties after the Covid-19 outbreak might have made it more difficult to detect the effects of pre-existing risk factors already strongly associated with mental health difficulties.

### 5.1. Strengths and limitations

The prospective longitudinal design with pre-pandemic baseline data, allowing for direct comparisons with the adolescents' self-reported health one year before Covid-19 struck the world, is an obvious strength of this study, as is the relative representativeness of the sample. This is an important addition to the body of literature that has identified a high prevalence of poor mental health during the pandemic, as our longitudinal data suggest that only certain groups were meaningfully affected [1, 16].

However, school-based surveys always entail the risk of selection bias, unintentionally excluding the most disadvantaged groups of young people. While the metropolitan area of the capital city of Norway was among the regions most affected by the virus, we were not able to include schools from this area due to an overload of research invitations to these schools during the lockdown period. We may therefore have underestimated the effects of the pandemic and the lockdown on children and adolescents. Additionally, an increase in stress-related symptoms is expected shortly after the outbreak of a global crisis. Long-term effects need to be followed up in future research. Due to the course of the pandemic, as well as ethical considerations concerning surveying youths about sensitive issues during home confinement, assessment was possible only after school reopening, which occurred in May 2020. The prior assessment was conducted in February 2019, and assessments of symptom levels may have been affected by seasonal variations. It is well established that seasonal variations in scores on anxiety and depression assessments do occur, with higher mean ratings of depression during the winter months [38], and that youths may be even more affected than adults [39]. Finally, it is important to note caveats concerning self-report survey methods, which allows for uncertainty about the validity of responses. These uncertainties could have been mitigated if we had included social desirability scales or the like.

## 6. Conclusion

Symptoms of anxiety and depression increased slightly in a representative sample of Norwegian youths during the Covid-19 outbreak in spring 2020. However, this change was driven by an increase in age between assessment points, rather than by pandemic-related factors. Independent of age, those most vulnerable before the outbreak were those who still showed higher levels of symptoms of anxiety and depression three months into the pandemic. This indicates that health inequities endure for adolescents living in low-income and single-parent households. This study reflects the situation for youth shortly after the reopening of the society, and the changes observed are thus short-term effects. Future research should study youths over time to get a better picture of the long-term effects of the pandemic and measures to mitigate the spread of the virus. In particular, this should be done in a diverse sample of youth, as possible health inequities will be important to monitor and prevent well into the future.

### Data sharing

The dataset is administrated by the Norwegian Centre for Violence and Traumatic Stress Studies. Approval from a Norwegian regional

committee for medical and health research ethics (<https://helseforskning.etikkom.no>) is a pre-requirement. Guidelines for access to the data are found at the longitudinal cohort website [uevo.nkvts.no](http://uevo.nkvts.no).

### Author Contributions

Author Contribution GSH and EMA designed the study, were responsible the acquisition of funding, and were in charge of data collection. GSH, SSS and TWL carried out all data analyses and produced tables. GSH wrote the first draft of the manuscript and all authors commented on and edited the final version.

### Declaration of Competing Interests

We declare no competing interests.

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