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Mental health problems among Dutch adolescents of the general population before and 9 months after the COVID-19 outbreak: A longitudinal cohort study

Peter G. van der Velden [a,b,*], Hedwig J.A. van Bakel [b], Marcel Das [a]

[a] Centerdata, Warandelaan 2, Tilburg 5037 AB, the Netherland
[b] TRANZO, Scientific Center for Care and Welfare, Tilburg School of Social and Behavioral Sciences, Tilburg University, Professor Cobbenhagenlaan 125, Tilburg 5037 DB, the Netherland

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ABSTRACT

The aim of the present study is to examine whether the COVID-19 pandemic has increased the risk of mental health problems (MHP) in adolescents nine months post-outbreak. For this purpose, a longitudinal cohort study was conducted based on a probability sample of the Dutch population. We compared the prevalence and incidence of MHP in 16–20 year-old adolescents in November-December 2020 ($N = 251$) with the prevalence and incidence in adolescents in November-December 2012 ($N = 346$) and November-December 2016 ($N = 253$). Results showed a higher prevalence of moderate anxiety and depression symptoms in the 2020 than in the 2012 and 2016 cohorts, but differences in mean scores were absent or small. The prevalence of sleep problems, fatigue, use of medicines for symptoms did not differ between the three cohorts. The use of mental health services was more prevalent in the 2020 than in 2016 cohort, but there was already a statistical trend of higher use in the 2016 compared to the 2012 cohort. No differences in the incidence of any MHP, based on data of the previous year (2011, 2015, and 2019, respectively) were found. Results suggest a very limited negative effect of this pandemic on MHP among Dutch adolescents 9 months post-COVID-19 outbreak.

1. Introduction

The ongoing COVID-19 pandemic has especially affected adolescents due to, but not restricted to, closed schools, limited social contacts and home confinements, all of which may increase loneliness (van der Velden et al., 2021). Although effective vaccines have become available, the spread of the virus, including mutations of the virus, remains a major concern resulting in the prolonged imposition of various preventive measures such as (partial) lockdowns and in ongoing disruptions. An important question is to what extent these circumstances and related stressors have negatively affected the mental health of adolescents during this pandemic as well as in the aftermath, such as increased anxiety and depression symptomatology, sleep problems and fatigue.

To date, many cross-sectional studies have addressed this question. Racine and colleagues (2021) and Ma and colleagues (2021) conducted a meta-analysis of study findings. Racine et al. (2021), focusing on population-based studies among children and adolescents in various countries (conducted until July 2020), showed that the pooled estimates of anxiety and depression symptomatology increased over time and suggest that clinically elevated depression symptoms and clinically elevated anxiety symptoms were doubled compared to pre-pandemic prevalence data obtained in Finland and the US. Based on these findings, the authors expect an increase in mental health care needs. Ma et al. (2021), focusing on studies based on convenience samples (including samples based on purposive sampling) of Chinese children and adolescents (until March 2020), found that adolescents and females had a higher prevalence of depression and anxiety compared to children and males, respectively (cf. Díaz González-Colmenero et al., 2021).

These findings clearly suggest an increase in mental health problems (MHP) among adolescents due to this pandemic until the summer of 2020. However, longitudinal studies with post-outbreak and pre-outbreak data on MHP, or pre-outbreak reference data based on similar samples of adolescents, are needed to confirm these findings (cf. Singh et al., 2020; Manchia et al., 2022; Solmi et al., 2022). The

Abbreviations: MHP, Mental Health Problems.

* Corresponding author at: Centerdata, Warandelaan 2, Tilburg 5037 AB, the Netherland.
E-mail address: pg.vandervelden@tilburguniversity.edu (P.G. van der Velden).

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relatively few longitudinal studies have showed the following.

Longitudinal studies showing an increase in MHP appear to be studies focusing on MHP in the *short term* (during the first months after the outbreak) compared to pre-outbreak problems (Elmer et al., 2020; Evans, 2021; Genta et al., 2021; Hawes et al., 2021; Magson et al., 2021; Saraswathi et al., 2020). However, these longitudinal studies do not systematically show a *strong* increase in all assessed MHP and the findings vary. For instance, Elmer et al. (2020) found a significant increase in depression, anxiety, and stress scores but the Cohen's D (*d*) revealed that the differences were small (*d*'s between of 0.10 and 0.34). However, a comparison with another cohort of students showed no significant differences. Evans et al. (2021) found a significant and, according to the reported effect sizes, strong increase in depression scores and modest decreases in wellbeing and alcohol use among UK university undergraduates. Yet in contrast to Elmer et al. (2020), no significant differences were found in anxiety scores. The study by Hawes et al. (2021) showed a significant but, according to the Cohen's D (*d*'s between 0.24 and 0.42), small to medium increase in depression, panic/somatic symptoms, generalized anxiety and social anxiety symptoms. Saraswathi et al. (2020) found a significant and, according to the effect size r, small increase in anxiety mean scores ($r = 0.19$), but the prevalence of high depression scores did not change significantly (33.2% versus 35.5%). Magson et al. (2021), however, found a significant but small to medium increase (*d*'s were 0.15 and 0.40) in depression and anxiety symptoms. An outlier here is the study by Li et al. (2020). They found a significant small *decrease* (*d*'s were 0.30 and 0.17, computed by the authors) in negative affect and in anxiety and depression scores, but no significant differences were found in positive affect for Chinese college students between December 2019 and 15 to 17 days after the outbreak-related confinement.

The very few longitudinal studies focusing on MHP in the *longer term* (more than 8 months after the outbreak) hardly found evidence for an increase in MHP among adolescents at this stage of the pandemic (Andreas and Brunborg, 2021; Bouter et al., 2022; Li et al., 2021; Logie et al., 2022). For instance, the 3-wave study by Bouter et al. (2022) showed that adolescents who scored in the clinical range of mental health problems before the outbreak, had a small *decrease* in anxiety problems, depressive problems, psychotic symptoms and suicidality (*d*'s between 0.11 and 0.22) 1 to 2 months after the outbreak, which increased slightly 9 months later (*d*'s between 0.01 and 0.11). Changes in mental health problems among adolescents who scored in the normal range before the outbreak were also negligible (d's between 0.00 and 0.04). Andreas and Brunborg (2021) and Logie et al. (2022) found no differences in depression before and after the outbreak. Although the study by Li et al. (2021) included younger respondents (Chinese teenagers of 14–19 years old), they found a lower prevalence of mental health and sleep problems after the outbreak than before.

These longitudinal findings suggest that the effect of the disruptions caused by this pandemic have a time limited effect on adolescents' mental health (cf. Robinson et al., 2022); i.e., after some time adolescents were able to adapt to all disruptions. However, given the low number of longer-term longitudinal studies, additional longitudinal research is required to confirm this suggestion. For this purpose, we conducted a population-based comparative longitudinal cohort study using a Dutch national probability sample. Based on the results of Andreas and Brunborg (2021), Bouter et al. (2022), Li et al. (2021), and Logie et al. (2022), we formulated the following two hypotheses: 9 months after the COVID-19 outbreak, both the prevalence (H1) and incidence (H2) of mental health problems among 16–20 year-old adolescents were comparable to or only slightly higher than the prevalence and incidence of mental health problems among 16–20 year-old adolescents in the same period in the years before the pandemic. We used the same months of the year to control for possible seasonal effects and included two instead of one pre-COVID-19 comparison cohort of adolescents. The latter strengthens the results of this study and helps determine to what extent a possible higher prevalence of post-outbreak MHP might reflect an overall trend of increasing MHP among adolescents (cf. Pierce et al., 2020). We focused on anxiety and depression symptoms, fatigue and sleep problems, medicine use for anxiety and depression symptoms, and use of mental health services as indicators of mental health problems.

The post-outbreak survey was conducted in a period of ongoing (partial) lockdown measures in the Netherlands since March 2020. These measures were only partially relaxed during the 2020 summer period. Universities and institutes for higher vocational education were largely closed until the end of 2020. According to the COVID-19 Stringency Index (Oxford University, 2022), a composite measure based on nine response indicators including school closures, workplace closures and travel bans in countries around the world, the lockdown policies in the Netherlands during the first months after the outbreak and during the 2020 survey were more or less comparable with other Western countries (for details, see interactive COVID-19 Government Response Tracker; Oxford University, 2022). It is estimated that 169,000 persons died in the Netherlands in 2020, 10% more than usual compared to previous years (CBS, 2021). This increase was very likely due to COVID-19. From the beginning of the outbreak until the end of November 2020, a total of 493,744 persons were infected according to the Dutch National Institute for Public Health and the Environment, although the actual number is presumably larger (RIVM, 2020).

2. Methods

2.1. Procedures and participants

For the present study, data were extracted from the LISS (*Longitudinal Internet studies for the Social Sciences*) panel (Scherpenzeel and Das, 2011). The set-up of the LISS panel was funded by the Dutch Research Council (NWO). The original sample was drawn in 2007, and refreshment samples were drawn every two years since then to correct for attrition. Recruitment of panel members for the LISS panel is based on a probability sample drawn by Statistics Netherlands (CBS). All persons aged 16 and older in the selected households are asked to participate in the panel, including the adolescents that were targeted in this particular study. Panel members are invited to participate in the surveys each month.

Participants receive an incentive of 15 euros per hour. Panel members who do not have a computer and/or internet access are provided with the necessary equipment at home. In accordance with the General Data Protection Regulation (GDPR), participants give explicit written consent for the use of the collected data for scientific and policy relevant research. For further information about the panel and free access to the data see: https://www.dataarchive.lissdata.nl/ (in English). All procedures have been approved by the Board of Overseers, an Internal Review Board (IRB) in place until 2014.

To examine the prevalence of MHP we used the data from three surveys of the Health module of the LISS panel conducted in November-December 2012 (response = 72.7%), in November-December 2016 (response = 70.5%) and in November-December 2020 (response = 67.8%). We selected 16–20 year-old respondents from each survey. A small group of respondents participated in multiple surveys. There is an overlap of 30 respondents for the 2012 and 2016 cohort, and for the 2016 and 2020 cohort, 22 respondents participated in both surveys. The small group of respondents who participated in two surveys were randomly assigned to one of the two surveys, creating three independent cohorts. Note that due to the period of four years between surveys, there is no respondent in the specified age category that could have participated in all three surveys. The total study sample consisted of 850 adolescents (N of 2012 cohort = 346, N of 2016 cohort = 253, and N of 2020 cohort = 251). The data of each cohort were weighted using 10 demographic profiles (Age: 5 years of age (16–20) * Sex (2 categories: male, female)) of Dutch adolescents of 16–20 years old in the corresponding year (2012, 2016, and 2020).

To compare the incidence of MHP among the three cohorts and to examine within-cohort MHP changes, we extracted data from Health module surveys conducted one year previously (for the same respondents who were selected for the survey): i.e., in November-December 2011 (response = 61.4%) for the 2012 cohort, in July-August 2015 (response = 67.6%) for the 2016 cohort, and in November-December 2019 (response = 72.1%) for 2020 cohort.

2.2. Measures

We assessed five indicators of mental health problems. Anxiety and depression symptoms were assessed with the 5-item Mental Health Inventory (MHI-5: Means-Christensen et al., 2005; Ware and Sherbourne, 1992). The MHI-5 asks respondents to rate their mental health during the past month on 6-point Likert scales, such as 'This past month I felt very anxious' and 'I felt depressed and gloomy' (0=never, 1=seldom, 2=sometimes, 3=often, 4=mostly, 5=continuously). After recoding the three negative formulated items, the total scores were computed and multiplied by four (to arrive at a 0–100 scale) where lower scores indicate more anxiety and depression symptom levels (all Cronbachs Alpha's $\geq$ 0.83). We used two cut-off scores: 59 for the prevalence of moderate symptom levels and 44 for the prevalence of severe symptom (clinical) levels (Driessen, 2011).

In the Health module, respondents are asked whether they regularly suffer from fatigue and regularly suffer sleep problems (0=no, 1=yes), if they use medicines at least once a week for anxiety/depression symptoms (0=no, 1=yes), and if they used mental health services (MHS) in the past year (contact with a psychiatrist/ psychologist/ psychotherapist; 0=no,1=one or more contacts). These fatigue, sleep, medicine and MHS variables were used in a previous longitudinal cohort study with the LISS panel among 19–24 year-old respondents (Velden et al., 2019). Respondents are furthermore asked: "*Has a physician told you this last year that you suffer from one of the following diseases/ problems*?". For the present study we created the variable physical disease (1=no, 2=one or more) based on 19 examined diseases, such as asthma and cancer (CentERdata, 2021).

2.3. Statistical analyses

Differences in demographics and physical disease between the three cohorts were assessed using Chi-square tests.

To test the first hypothesis (prevalence of MHP), multivariate logistic regression analyses were conducted with the five dichotomous mental health variables as dependent variables, and cohort membership (1 = 2012 cohort, 2 = 2016 cohort, 3 = 2020 cohort) as predictor. All cohorts were pairwise compared. Sex, age, education level and physical disease were added as control variables (see Table 1 in the Results section). We also assessed differences in anxiety and depression mean scores between the three cohorts using ANOVA, with the same control variables.

To test the second hypothesis (incidence of MHP), similar logistic regression analyses were conducted. For each cohort, the incidence was calculated using the corresponding MHP assessed one year before. For instance, for the incidence among the 2012 cohort, MHP assessed in the 2011 survey were used by dividing the number of adolescents with problems in 2012 without the corresponding problem in 2011, by the total number of adolescents who participated in both surveys.

The small number of missing values were imputed using Multiple Imputations (number of imputations = 50; total imputed missing values in the 2012, 2016, and 2020 survey: MHI5 = 2; sleep problems = 13; fatigue = 13; use of MHS = 7; use of medicines = 9. Total imputed missing values in the 2011–2012, 2015–2016, and 2019–2020 surveys: MHI5 = 1, sleep problems = 6; fatigue = 6; use of MHS = 7; use of medicines = 1). All results are based on pooled weighted data. Analyses were conducted with IBM SPSS 26.

Table 1
Characteristics of adolescents in 2012, 2016, and 2020.

	2012 cohort (N = 346)	2016 cohort (N = 253)	2020 cohort (N = 251)			
	n (%)	n (%)	n (%)	χ^2	df	p
Sex						
- males	177 (51.2)	129 (51.0)	128 (51.0)	0.002	1	0.999
- females	169 (48.8)	124 (49.0)	123 (49.0)			
Age						
- 16 years	66 (19.1)	51 (20.2)	48 (19.1)	0.323	4	1.000
- 17 years	68 (19.7)	51 (20.2)	48 (19.1)			
- 18 years	69 (19.9)	50 (19.8)	50 (19.9)			
- 19 years	70 (20.2)	50 (19.8)	53 (21.1)			
- 20 years	72 (20.8)	51 (20.2)	52 (20.7)			
Education						
- low	210 (60.7)	153 (60.5)	158 (62.9)	0.414	1	0.813
- medium	136 (39.3)	100 (39.5)	93 (37.1)			
Physical disease						
- no	333 (96.2)	232 (91.7)	228 (90.8)	8.260	1	0.016
- yes	13 (3.8)	21 (8.3)	23 (9.2)			

3. Results

3.1. Characteristics of study samples

The characteristics of the three study samples are presented in Table 1. Similar to the Dutch population in 2012, 2016, and 2020, the distribution of 16–20 year-old males and females was about 51 and 49%. Of each cohort, about 61% had a primary school or intermediate secondary education level (low), and 39% a higher secondary education/ preparatory university education or intermediate vocational education level (medium). Table 1 shows that the cohorts differed significantly ($p < 0.05$) with regard to physical illness: 3.8% of the 2012, 8.3% of the 2016 cohort, and 9.2% of the 2020 cohort had a physical illness.

3.2. Differences in prevalence of mental health problems between cohorts

Table 2 shows that the prevalence of moderate anxiety and depression symptoms in the 2020 cohort (31.9%), 9 months after the outbreak, was significantly higher than in the 2012 cohort (24.0%) and in 2016 cohort (20.2%). The prevalence of severe anxiety and depression symptoms was higher in the 2020 cohort (13.1%) than in 2016 cohort (6.3%), but not higher than in the 2012 cohort (9.5%). Mental health services (MHS) use was significantly higher in the 2020 cohort (16.3%) than in the 2012 cohort (5.8%) and the 2016 cohort (9.9%). However, there was a statistical trend ($p < 0.10$) that the 2016 cohort more often used MHS than the 2012 cohort. No significant differences in sleep problems and fatigue were found between the three cohorts. The prevalence of medicine use was too low to examine statistically.

With respect to anxiety and depression total scores (not shown in Table), the results of ANOVA showed that the 2012 cohort (M = 68.9, SD = 16.8) did not differ significantly from the 2020 cohort (66.3, SD = 17.4), and not significantly from the 2016 cohort (M = 70.7, SD = 15.4) while controlling for sex, age, education level and physical disease. The 2020 cohort had significantly lower scores, indicating higher symptoms levels, than the 2016 cohort ($F(1, 503)=9.64$, p = 0.002; Cohen's D = 0.27).

3.3. Differences in incidence of mental health problems between cohorts

In Table 3, the differences between the three cohorts in the incidence of mental health problems are presented (for demographic characteristics see Appendix). Before describing the results it should be noted that all LISS panel members are 16 years and older. In the analyses with respect to the incidence, adolescents who were 16 years old in 2012, 2016 or 2020 and could therefore not be compared to a previous year were omitted. In addition, adolescents who were 20 years in 2011, 2015 or 2019 were omitted from the analyses because they were 21 years old

Table 2
Prevalence of mental health problems among adolescents in 2012, 2016, and 2020.

	2012 cohort (N = 346)	2016 cohort (N = 253)	2020 cohort (N = 251)	2012 cohortversus 2016 cohort		2012 cohortversus 2020 cohort		2016 cohort versus 2020 cohort	
	n (%)	n (%)	n (%)	aOR (95% CI)	p	aOR (95% CI)	p	aOR (95% CI)	p
Moderate anxiety-depression symptoms	83 (24.0)	51 (20.2)	80 (31.9)	0.80 (0.53–1.19)	0.267	1.48 (1.02–2.14)	0.040	1.85 (1.22–2.80)	0.004
Severe anxiety-depression symptoms	33 (9.5)	16 (6.3)	33 (13.1)	0.63 (0.34–1.19)	0.152	1.40 (0.83–2.36)	0.211	2.21 (1.18–4.16)	0.014
Sleep problems	46 (13.3)	41 (16.2)	49 (19.5)	1.24 (0.78–1.99)	0.364	1.56 (0.99–2.45)	0.055	1.27 (0.79–2.03)	0.327
Fatigue	127 (36.7)	89 (35.2)	75 (29.9)	0.91 (0.64–1.30)	0.608	0.71 (0.50–1.02)	0.065	0.78 (0.53–1.15)	0.207
Use of mental health services	20 (5.8)	25 (9.9)	41 (16.3)	1.74 (0.93–3.23)	0.081	3.19 (1.81–5.63)	0.000	1.84 (1.07–3.15)	0.026
Medicine for anxiety or depression	4 (1.2)	2 (0.8)	4 (1.6)	n.c.		n.c.		n.c.	

aOR=Odds Ratio adjusted for sex, age, education level, and physical disease. 95%=CI 95% confidence interval of aOR. n.c.=not computed due to low cell counts. Due to weighting numbers may differ slightly.

Table 3
Incidence of mental health problems among adolescents in 2012, 2016, and 2020.

	2012 cohort (N = 175[1])	2016 cohort (N = 134[1])	2020 cohort (N = 135[1])	2012 cohort versus 2016 cohort		2012 cohort versuscohort 2020		2016 cohort versus 2020 cohort	
	n (%)	n (%)	n (%)	aOR (95% CI)	p	aOR (95% CI)	p	aOR (95% CI)	p
Moderate anxiety-depression symptoms	22 (12.6)	21 (15.8)	19 (14.1)	1.25 (0.65–2.42)	0.506	1.08 (0.55–2.12)	0.817	0.80 (0.41–1.55)	0.506
Severe anxiety-depression symptoms	12 (6.8)	5 (3.7)	5 (3.7)	0.39 (0.13–1.23)	0.108	0.46 (0.15–1.40)	0.171	1.17 (0.31–4.41)	0.822
Sleep problems	5 (2.9)	8 (6.0)	5 (3.7)	1.90 (0.58–6.26)	0.293	1.29 (0.36–4.58)	0.698	0.68 (0.21–2.24)	0.524
Fatigue	5 (2.9)	10 (7.5)	5 (3.7)	2.61 (0.88–7.70)	0.084	1.11 (0.32–3.82)	0.872	0.43 (0.14–1.30)	0.132
Use of mental health services	8 (4.5)	12 (9.0)	10 (7.4)	1.98 (0.76–5.13)	0.161	1.64 (0.62–4.33)	0.332	0.83 (0.34–2.03)	0.679
Medicine for anxiety or depression	0 (0.0)	1 (0.7)	0 (0.0)	n.c.		n.c.		n.c.	

Incidence=prevalence of mental health problems among those without corresponding mental health problems one year earlier divided by total number of respondents participating in both surveys.
aOR=Odds Ratio adjusted for sex, age, education level, and physical disease. 95%=CI 95% confidence interval of aOR. n.c.=not computed due to low cell counts.
[1] Total number of respondents between 17 and 20 years old that also participated in the survey one year earlier. Respondents aged 16 in 2012, 2016, or 2020 were omitted from the analyses because there are no respondents aged 15 in the LISS panel.
Due to weighting numbers may differ slightly.

in 2012, 2016 and 2020, respectively. This explains why the total number of respondents for each of the three cohorts in Table 3 is lower than in Table 2. Results of the multivariate logistic regression analyses show that the three cohorts did not significantly differ in the incidence of the assessed mental health problems.

4. Discussion

The first aim of the present longitudinal cohort study was to test the hypothesis (H1) that the prevalence of various mental health problems (MHP) in 16–20 year-old adolescents nine months after the COVID-19 outbreak (November-December 2020) was comparable to or only slightly higher than the prevalence of MHP in adolescents who were 16–20 years old in November-December 2012 and adolescents who were 16–20 years old in November-December 2016. The second aim was to test the hypothesis (H2) that the incidence of mental health problems in the 2020 cohort was comparable to or only slightly higher than the incidence in the 2012 and 2016 cohort.

Results confirm the first hypothesis. Although the prevalence of moderate anxiety and depression symptoms among Dutch adolescents (16–20 years old) 9 months after the COVID-outbreak was higher than the prevalence in adolescents in the same study period in 2012 and 2016, the total scores of anxiety and depression symptoms did not differ between the 2020 cohort and 2012 cohort, and only slightly between the 2020 and 2016 cohort. Results with respect to severe symptom levels were mixed: the prevalence of severe symptoms in the 2020 cohort was significantly higher than in the 2016 cohort, but not higher than in 2012 cohort. In addition, the prevalence of mental health services (MHS) utilization in the past 12 months among the 2020 cohort was higher than among adolescents in the 2012 cohort and 2016 cohort. However, findings suggest that the increase in MHS among adolescents already started among the 2016 cohort compared to the 2012 cohort and is therefore not necessarily related to COVID-19 (cf. Racine et al., 2021). In the study by Saraswathi et al. (2020), 34.6% suffered poor sleep quality a few months after the COVID-19 outbreak (June 2020), but the pre-COVID prevalence is unknown. In our study, no significant increase in sleep problems was found, comparable to the studies by Evans et al. (2021) and Genta et al. (2021) conducted during the first months of the pandemic. Fatigue, although very prevalent across the years (>29%), did not significantly differ between the three cohorts. With respect to the last two findings, the longitudinal study by Saxvig et al. (2021) might be of interest for showing an increase in school day sleep duration and reduced social jetlag among Norwegian high school students (cf. Gruber et al., 2021). Finally, conform our second hypothesis, we found no differences in the incidence of MHP between the three cohorts, suggesting that the higher prevalence of moderate anxiety and depression

symptoms was not necessarily COVID-19 related.

Taken together, these results suggest a very limited negative effect of the pandemic on MHP among Dutch adolescents 9 months post-COVID-19 outbreak. Our results are in line with the findings by Andreas and Brunborg (2021), Bouter et al. (2022), Li et al. (2021), Logie et al. (2022) and the meta-analysis by Robinson et al. (2022) of peer-reviewed and eligible unpublished COVID-19-related studies (not limited to adolescents) with pre-COVID-19 data. Robinson et al. (2022, p. 567) concluded that "*There was a small increase in mental health symptoms soon after the outbreak of the COVID-19 pandemic that decreased and was comparable to pre-pandemic levels by mid-2020 among most population sub-groups and symptom types*".

However, it should be noted that both the US and UK faced political tensions and a divided country, due to elections and politized COVID-19 preventive measures (US) and Brexit (UK). It is unclear if and how these circumstances influenced the results of Evans et al. (2021) and Hawes et al. (2021), compared to the study by Bouter et al. (2022) with assessments (second wave) in April 2020.

4.1. Strengths and limitations

The strengths of the present study are the use of a national probability sample with acceptable response rates (between 61 and 73%), the weighting of data to optimize the representativeness and the imputation of missing values, and the inclusion of two pre-COVID reference cohorts of adolescents from the same longitudinal panel. In the analyses we controlled for sex, age, education level and physical disease. To the best of our knowledge, this is the first prospective study among adolescents based on a probability sample of the general population.

An important limitation is the absence of clinical interviews. Although we compared the prevalence of severe anxiety and depression symptom levels, future studies are warranted to examine mental disorders such as generalized anxiety and major depression. We did not examine other relevant mental health-related topics such as life-satisfaction (cf. Magson et al., 2021), alcohol use (Evans et al., 2021), and externalizing or internalizing problems (cf. Rosen et al., 2021; Houghton et al., 2022). Since the LISS panel does not include adolescents younger than 16 year old, we could not examine the course of mental health problems of adolescents aged 16–20 in 2020 in the years before 2020, such as over the years 2017, 2018, 2019, and 2020. The numbers of the different age categories were too small to examine possible differences in prevalence and incidence between 16 and 20 year-old respondents. We therefore cannot rule out the possibility that adolescents of some age categories in 2020 had a higher prevalence or incidence than adolescents of the same age in 2012 and 2016 (cf. Ma et al., 2021). We have no explanation for the higher prevalence of physical diseases in the 2016 and 2020 cohorts compared to the 2012 cohort. For the 2016 cohort, the period for which the incidence was computed was about 15 months instead of about 12 months for the 2012 and 2020 cohort. However, we found no indications that the incidence was lower in the 2016 cohort.

5. Conclusions

In sum, we found no evidence that the prevalence of severe anxiety and depression symptoms, sleep problems and fatigue among adolescents was systematically higher at the end of 2020 than among adolescents at the end of 2012 or the end of 2016. Importantly, no differences in the incidence of mental health problems (MHP) between the three cohorts were found while controlling for sex, age, education level and physical disease, indicating that MHP were rather stable in each cohort. These findings clearly suggest that the effects of the pandemic on the mental health of Dutch adolescents 9-months post-outbreak was very limited and that the resilience of adolescents should not be underestimated (cf. Bouter et al., 2022). However, future international studies with pre-pandemic data on mental health focusing on adolescents in the longer term and using the same measures at the same time point are needed to determine whether our results are country-specific or not.

CRediT authorship contribution statement

Peter G. van der Velden: Conceptualization, Visualization, Formal analysis, Methodology, Data curation, Writing – original draft, Writing – review & editing. **Hedwig J.A. van Bakel:** Conceptualization, Visualization, Formal analysis, Methodology, Data curation, Writing – original draft, Writing – review & editing. **Marcel Das:** Conceptualization, Visualization, Formal analysis, Methodology, Data curation, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

All authors confirm that they have no conflicts of interest.

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