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Original article

Gender-Specific Changes in Life Satisfaction After the COVID-19–Related Lockdown in Dutch Adolescents: A Longitudinal Study

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A B S T R A C T

Purpose: The purposes of this study were to assess whether mental well-being has changed after introduction of the lockdown measures compared with that before, whether this change differs between boys and girls, and whether this change is associated with COVID-19–related concerns.

Methods: This is a two-wave prospective study among Dutch adolescents using data collected up to one year before the COVID-19 pandemic ($n = 224$) and 5–8 weeks after the first introduction of lockdown measures ($n = 158$). Mental well-being was assessed by three indicators: life satisfaction, internalizing symptoms, and psychosomatic health. General linear model repeated-measures analysis of variance was used to assess whether mental well-being has changed and if this differed by sex. Univariate linear regressions were used to assess associations between COVID-19–related concerns and a change in mental well-being.

Results: Life satisfaction decreased ($\eta^2_p = .079, p < .001$), but no change in internalizing symptoms was observed ($\eta^2_p = .014, p = .14$), and psychosomatic health increased ($\eta^2_p = .194, p < .001$) after the introduction of lockdown measures. Boys scored significantly better on all mental health indicators compared with girls at baseline and follow-up. However, boys' life satisfaction significantly decreased at the follow-up ($\eta^2_p = .038, p = .015$), whereas girls' life satisfaction did not change. Concerns about COVID-19 were significantly associated with a lower life satisfaction and more internalizing symptoms.

Conclusions: Adolescents', especially boys', life satisfaction decreased during the lockdown. They reported no change in internalizing symptoms and an improved psychosomatic health. Adolescents' mental well-being is expected to vary during the COVID-19 pandemic and should continue to be monitored.

IMPLICATIONS AND CONTRIBUTION

Adolescents', especially boys', life satisfaction decreased during the lockdown. They reported no change in internalizing symptoms and an improved psychosomatic health. Adolescents' mental well-being and concerns are expected to continue to vary during the COVID-19 pandemic and should continue to be monitored.

Conflicts of interest: The authors have no conflicts of interest to disclose.

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The coronavirus disease (COVID-19) outbreak rapidly progressed to a pandemic, affecting most countries globally [1]. Governments are implementing strict measures to control the spread of the virus that is responsible for this pandemic. Owing to lockdown measures, such as school closures, quarantine, and social distancing, millions of people worldwide face unprecedented periods of social isolation and stress [2]. Many families and children in particular are affected in multiple ways, school closures disrupt daily life structure and social interaction of all affected children and adolescents, and may lead to parents having to combine home schooling and work at the same time [2]. Recent narrative reviews and reports highlight the need for empirical research focusing on the effect of the pandemic on mental well-being in youth [2–5].

Adolescence is a key developmental time period marked by rapid neurocognitive and social developmental changes, as well as the first emergence of numerous mental health disorders [6–9]. During the adolescent years, young people spend increasingly more time with their peers, friendships grow stronger, and young people are more influenced by peers than adults [8,10,11]. Over these years, friendships are instrumental aspects of adolescent mental health and well-being [12]. Therefore, adolescents may be particularly susceptible to the social effects of lockdown measures. Indeed, scholars have warned that the pandemic could lead to a lower life satisfaction, increased stress, and mental health disorders in adolescents [13,14]. So far, several empirical articles have been published on various indicators of mental well-being in adolescents.

Studies, conducted in China and the Netherlands, reported a high prevalence of anxiety and depressive symptoms among children and adolescents (age range 8–18 years), especially girls, during the pandemic [15–17]. However, the aforementioned studies used cross-sectional designs and as such cannot disentangle whether the high prevalence of these symptoms is the effect of the pandemic. Longitudinal data with baseline measures assessed before COVID-19 are required to better understand the isolated, potentially causal, effects of lockdown measures on mental well-being in young people [2–5,18]. Several longitudinal studies reported on adolescent mental well-being in response to COVID-19 lockdown measures and found that anxiety and depressive symptoms increased in youth living in the Netherlands, Australia, and North America [19–22], and life satisfaction deteriorated during the first full lockdown in youth (8–18 years) living in Australia and North America [19–21]. These negative changes in mental well-being were more pronounced in girls compared with boys [20]. A large international collaborative effort using data of 12 longitudinal studies (10 performed in the U.S., one in the Netherlands, and one in Peru) identified an increase in depressive symptoms in adolescents (mean age 15.4 years) [23]. Although most countries have been affected by this COVID-19 pandemic, all national governments have implemented their own set of restriction measures to stop the spread of the virus. It is yet unknown whether the aforementioned findings are generalizable to other populations and

whether Dutch adolescents show a similar change in mental well-being after introduction of the lockdown measures.

Therefore, this two-wave prospective study among Dutch adolescents aimed to assess whether mental well-being changed after the introduction of lockdown measures by comparing mental well-being assessed up to one year before COVID-19 (baseline; $n = 224$) with that measured between 5 and 8 weeks after the first introduction of lockdown measures (follow-up; $n = 158$); whether changes differed between boys and girls; and whether changes were associated with adolescents' concerns about COVID-19 and lockdown measures. Based on the current literature, we expected that adolescent mental well-being would decrease after introduction of lockdown measures compared with before the pandemic.

Methods

Study design and study population

Baseline: up to a year before the COVID-19 pandemic. Data were obtained from an ongoing population-based birth cohort study in the Netherlands, named WHISTLER. The original aim of WHISTLER was to investigate determinants of wheezing illnesses [24]. Between 2001 and 2012, newborns were recruited from the general population ($n = 2,456$ at baseline) in a fairly affluent and newly built suburb of Utrecht, the Netherlands. The participants have been followed up at the age of 3, 5, and 8 years, and over the years, not only determinants of wheezing illnesses were researched but also many other topics. In March 2019, we invited the 12- to 16-year-old WHISTLER participants to complete a questionnaire and undergo a health assessment. One of the primary aims was to assess their mental well-being during adolescence. Owing to the start of the COVID-19 pandemic, we had to stop this follow-up round. Up to then, 224 adolescents completed the questionnaires (52.7% girls, mean age [standard deviation] 14.82 [1.24] years). Ethical approval for WHISTLER (file number: NL66918.041.18) was obtained from the Medical Ethics Review Committee of the University Medical Center Utrecht. Participants and their parents or legal guardians provided active written informed consent.

Follow-up: 5–8 weeks after introduction of lockdown measures. In the Netherlands, the first COVID-19–confirmed patient was diagnosed on February 27, 2020, and starting on March 15, a partial lockdown was enforced, meaning closure of schools and child care facilities (except for children of parent(s) with a profession classified as essential), as well as sport clubs, bars, and restaurants. In contrast to many other Western countries, Dutch citizens were allowed to receive up to three visitors, to go outside (without proof of the essentiality to go outdoors), and children were allowed to play outside without social distancing. On May 11, primary schools partially reopened and on June 2 secondary schools followed [25].

To indicate the stringency of the Dutch lockdown measures in comparison with other lockdowns, we used the Oxford COVID-19 Government Response Tracker to establish a lockdown stringency index of the Dutch lockdowns based on a composite measure of nine different lockdown measures. The index has values ranging from 0 to 100 (100 = strictest) [26]. This stringency index has been available from 1 January 2020 and identified that the stringency of the Dutch lockdown was 78.70 around April 2020. The 224 adolescents were invited to complete a follow-up questionnaire regarding mental well-being and adolescents' concerns about COVID-19 and lockdown measures. We sent the questionnaires on April 18 (5 weeks after introduction of lockdown measures), and the participants were able to complete the questionnaire until May 8.

The vast majority of adolescents completed the baseline questionnaire well ahead of the start of the pandemic: the mean time between the baseline and follow-up assessment was 227 days (range 46–405 days). A few adolescents completed the questionnaire 1.5 months before the start of the pandemic, and at that point in time, COVID-19 did not have a major impact on daily life in the Netherlands as the first Dutch case of COVID-19 was identified on February 27, 2020 (17 days before the start of the pandemic).

Mental well-being, measured at baseline and follow-up

In the WHISTLER cohort, mental well-being was assessed using three indicators: life satisfaction, internalizing symptoms, and psychosomatic health using the Cantril ladder [27,28], the Revised Child Anxiety and Depression Scale [29], and Health Behavior in School-Aged Children Symptom Checklist 2017 [30], respectively. To investigate whether mental well-being changed from baseline to follow-up, we assessed the same instruments at the follow-up. The specifics of these measures are briefly described here; refer to [Supplement 1](#) for full details about the instruments' content, subscales, items, values, and Cronbach's alpha.

Life satisfaction was assessed with the Cantril ladder, a validated and reliable instrument to measure life satisfaction in adolescence [27,31–35]. The Cantril ladder includes one question “Looking at the past 3 months, how do you feel about your life?” and adolescents answered this question on a scale from 0 to 10 (10 = best possible life) [27,31–35]. The Cantril ladder is shown to be valid and reliable in adolescents [27,35].

The Revised Child Anxiety and Depression Scale is used to assess the severity of self-reported anxiety and depressive symptoms based on selected DSM-4 anxiety disorders and depression, using multiple subdomains [29]. As in our study the correlation between the subdomains “anxiety” and “major depressive disorder” was $r > .7$, we choose to analyze these subdomains together as internalizing symptoms. Raw scores were converted into gender- and age-normed T-scores and evaluated as a continuous score.

Psychosomatic health complaints are symptoms that are often related to psychosocial factors, such as stress [36]. Psychosomatic health was measured with the Health Behavior in School-Aged Children Symptom Checklist 2017 [30]. Psychosomatic health, such as having a headache, being nervous, or feeling dizzy, is expressed as the mean score of all 10 symptoms. The higher the mean score, the better psychosomatic health one is experiencing, meaning that one is feeling little stress. The Health Behavior in School-Aged Children Symptom Checklist has

good psychometric properties and has also been validated in Dutch youth [30,37,38].

Although some questions/symptoms seem to overlap between psychosomatic health and internalizing symptoms, we are measuring two different constructs. Internalizing symptoms were measured by the Revised Child Anxiety and Depression Scale, a validated scale based on the DSM criteria of anxiety and depressive symptoms. Stress, indicated as a low psychosomatic health, could be associated with (and might lead to) anxiety and depressive symptoms; however, it could also stand on itself. Moreover, sometimes adolescents experience stress not on a mental level but only on a physical level (being dizzy, having a stomachache, or having a headache). Therefore, it is of relevance to measure both internalizing symptoms and psychosomatic health.

Concerns about COVID-19 and lockdown measures, measured at the follow-up

At the follow-up, we assessed adolescents' concerns about COVID-19 and lockdown measures using a Dutch translation of the COVID-19 Adolescent Symptom and Psychological Experience Questionnaire developed by Ladouceur (2020) (concept version April 1, 2020, see [Supplement 2](#)) [39].

The COVID-19 Adolescent Symptom and Psychological Experience Questionnaire included 16 items about COVID-19- and lockdown measures-related concerns, such as: “I might get sick,” “people might die if they get sick,” “parents might lose their job,” and “not going to school.” A 5-point Likert scale was used to measure the extent of concern: (1) “very little or not at all;” (2) “a little;” (3) “some;” (4) “a lot;” or (5) “a great deal.” As these 16 items are not yet validated, we used factor analysis to explore whether there were underlying factors that explained variance across sets of items. To do so, we used exploratory factor analyses using orthogonal rotation (varimax). Based on Kaiser's criterion of >1 and the scree plot, we retained four factors. Factor 1 explained 14.9% of variance across four items that represented “concerns about health.” Factor 2 explained 12.6% of variance across six items representing “concerns about social consequences of lockdown measures.” Factor 3 explained 6.7% of variance across three items that represented “concerns about financial matters.” Finally, factor 4 explained 5.8% of variance across three items representing “concerns about family relations.” The factor loadings are shown in [Supplement 3](#). The Pearson correlation between the four factors ranged between .012 and .200, indicating that all factors measure a different construct.

Statistical analyses

We used descriptive statistics to summarize the characteristics of the study population at baseline ($n = 224$) and follow-up ($n = 158$).

To assess whether mental well-being changed after the introduction of the lockdown measures and whether this change differed between boys and girls, we used a general linear model repeated-measures analysis of variance for each mental well-being indicator separately. We specified well-being at baseline and follow-up as a repeated measure and gender as predictor. We further specified a gender*time interaction term. We used partial eta squared (η^2_p) as a measure of effect size. In addition, McNemar's Chi-squared tests were used to analyze whether the frequency of occurrence of psychosomatic symptoms differed between baseline and follow-up.

To assess whether a change in mental well-being was associated with adolescents' concerns about COVID-19 and lockdown measures, we conducted linear regressions with each mental well-being indicator assessed after the introduction of the lockdown measures as a dependent variable and one of the four factors, derived from the factor analysis, as an independent variable. We performed these univariate linear regressions on all four factors. Associations were expressed as differences (β s), and adjusted for the mental well-being indicator score as assessed before the pandemic and gender.

A p value $<.05$ was considered statistically significant. All analyses were carried out with SPSS 25.0.

Results

Study population

In total, 158 adolescents ($n_{girls} = 94$, mean age [standard deviation] 15.53 [1.25] years), representing 70.5% of the 224 baseline participants, also completed the questionnaire at the follow-up (see Table 1 and Figure 1). Adolescents that were willing to complete the follow-up questionnaire were not different from those that were not with respect to the distribution of age ($p = .354$), ethnicity ($p = .421$), and educational level ($p = .566$). However, more girls were willing to complete the follow-up questionnaire. Of these 158 adolescents, 96.2% has a Western ethnicity and 93.04% of the adolescents has a parent with a high or intermediate level of education.

Life satisfaction

At the follow-up, life satisfaction decreased ($F(1,153) = 13.195$, $p < .001$, $\eta^2_p = .079$) after the introduction of lockdown measures when compared with baseline assessments (Table 2). There was a significant main effect of gender on life satisfaction ($F(1,153) = 22.187$, $p < .001$, $\eta^2_p = .127$), such that boys had a significantly higher life satisfaction both at baseline and follow-up than girls. Moreover, there was a significant interaction between gender and time since lockdown onset on life satisfaction ($F(1,153) = 6.034$, $p = .015$, $\eta^2_p = .038$), meaning that boys' life satisfaction decreased at follow-up compared to their baseline life satisfaction, while the girls' life satisfaction did not significantly change over time (Figure 2).

Table 1

Demographics of the study population completing questionnaire before the COVID-19 pandemic and after introduction of lockdown measures

Demographics	Before (n = 224)	After (n = 158)
Age in years, mean (SD)	14.82 (1.24)	15.53 ^a (1.25)
Gender (%)		
Girl	118 (52.68)	94 (59.49)
Educational level of the adolescent ^b (%)		
Primary school	3 (1.34)	2 (1.26)
Low	52 (23.21)	34 (21.52)
Intermediate	63 (28.13)	39 (24.68)
High	101 (45.09)	79 (50.00)
Special education	8 (3.57)	4 (2.53)

^a Calculated based on completion date of follow-up questionnaire.

^b Low: pre-vocational secondary education; intermediate: higher general secondary education or intermediate vocational education; high: preuniversity education, higher vocational education, and university education.

The factor "concerned about social consequences of lockdown measures" was significantly associated with a lower life satisfaction (adjusted β : $-.25$, 95% CI: $-.43$; $-.06$, $p = .01$) (Table 3). The factors "concerns about health" (adjusted β : $-.04$, 95% confidence interval [CI]: $-.23$; $.14$, $p = .64$), "concerns about financial matters" (adjusted β : $-.02$, 95% CI: $-.23$; $.19$, $p = .86$), and "concerns about family relations" (adjusted β : $-.15$, 95% CI: $-.37$; $.08$, $p = .21$) were not significantly associated with a lower life satisfaction.

Internalizing symptoms

At the follow-up, the adolescents did not report more internalizing symptoms ($F(1,151) = 2.152$, $p = .144$, $\eta^2_p = .014$) after the introduction of lockdown measures when compared with baseline assessments (Table 2). There was a significant main effect of gender on internalizing symptoms ($F(1,153) = 12.486$, $p = .001$, $\eta^2_p = .127$), meaning that boys had significantly less internalizing symptoms when compared with girls, both at baseline and follow-up. No significant interaction between gender and time of assessment on internalizing symptoms ($F(1,153) = .018$, $p = .573$, $\eta^2_p = .002$) was observed (Figure 2).

The factors "concerns about health" (adjusted β : 1.93 , 95% CI: $.53$; 3.33 , $p = .01$), "concerns about social consequences of lockdown measures" (adjusted β : 2.39 , 95% CI: $.96$; 3.81 , $p = .001$), and "concerns about family relations" (adjusted β : 2.41 , 95% CI: $.73$; 4.08 , $p = .01$) were associated with more internalizing symptoms. The factor "financial matters" was not associated with more internalizing symptoms (adjusted β : $-.74$, 95% CI: -2.47 ; $.99$, $p = .40$) (Table 3).

Psychosomatic health

At the follow-up, our sample reported significantly better psychosomatic health ($F(1,152) = 36.544$, $p < .001$, $\eta^2_p = .194$) after the introduction of lockdown measures when compared with baseline assessments (Table 2). There was a significant main effect of gender on psychosomatic health ($F(1,152) = 16.405$, $p < .001$, $\eta^2_p = .097$), with boys displaying significantly better psychosomatic health than girls, both at baseline and follow-up. There was no significant interaction between gender and time of assessment ($F(1,152) = .100$, $p = .752$, $\eta^2_p = .001$) on psychosomatic health (Figure 2).

Contrary to our expectations, psychosomatic health improved over time, and therefore, in an exploratory analysis, we assessed changes in specific psychosomatic symptoms (Supplement 4). Adolescents were able to fall asleep more easily (41.52% vs. 20.25%, $p < .01$) during the lockdown compared with before the pandemic.

None of the factors were associated with a worse psychosomatic health ("concerns about health" [adjusted β : $-.04$, 95% CI: $-.12$; $.04$, $p = .30$], "concerns about social consequences of lockdown" [adjusted β : $-.08$, 95% CI: $-.17$; $.00$, $p = .06$], "concerns about financial matters" [adjusted β : $.08$, 95% CI: $-.01$; $.17$, $p = .09$], and "concerns about family relations" [adjusted β : $.01$, 95% CI: $-.09$; $.11$, $p = .88$]) (Table 3).

Discussion

Main results

In this two-wave prospective study among adolescents, we investigated whether adolescent mental well-being changed

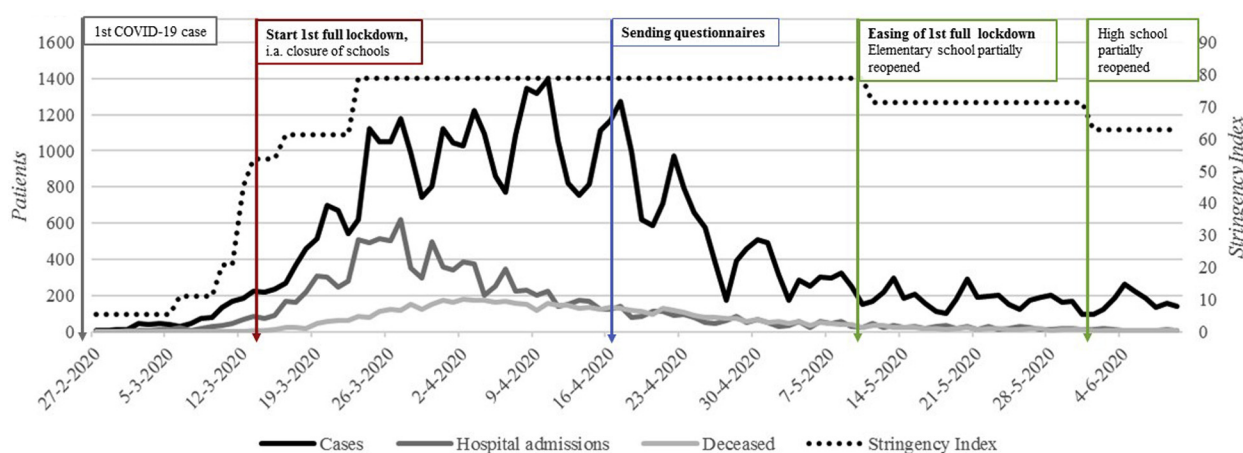


Figure 1. Prevalence of COVID-19 confirmed cases, hospital admissions, and deaths, stringency index, and specific time points of the current study.

after the introduction of lockdown measures, whether changes differed between boys and girls, and whether changes were associated with adolescents' concerns about the COVID-19 and lockdown measures. At 5–8 weeks after the introduction of the lockdown measures in the Netherlands, life satisfaction decreased compared with baseline (up to 1 year before the COVID-19 pandemic), but internalizing symptoms did not change. Contrary to expectations, our study sample reported an improved psychosomatic health at follow-up, when compared with baseline. Boys scored better on all three mental health indicators compared with girls both at baseline and follow-up. However, boys' life satisfaction significantly decreased over time, whereas girls' life satisfaction did not change. Adolescents' concerns about COVID-19 and the lockdown measures were significantly associated with lower life satisfaction and more internalizing symptoms.

Results in the context of previous literature

Life satisfaction during COVID-19–related lockdown restrictions decreased (stringency index: 78.80), which is in line with two longitudinal studies reporting that life satisfaction of Australian adolescents decreased during the pandemic compared with before (stringency index: 65.74–69.44) [19,20]. It should be noted that the findings could be specific for adolescents, as a decline in life satisfaction was not observed in younger

children (aged 8–10 years, stringency index: 50.46–65.74) living in South Korea nor in Chinese youth (aged 6–17 years) (stringency index: 79.17–81.02) [40,41]. In contrast to life satisfaction, there was no change in internalizing symptoms observed in our sample. However, a high prevalence of anxiety and depressive symptoms was observed among Chinese adolescents (12–18 years of age) [15,16] during the pandemic (stringency index: 56.94–81.02). Similarly, a Dutch sample (aged 8–18 years) reported more anxiety and depressive symptoms during the pandemic (stringency index: 78.80) than a similar sample of children and adolescents in 2017–2018 [17]. Dutch adolescents and young adults (10–25 years of age) experienced higher depression levels during the pandemic (stringency index: 78.70–65.74) than younger adolescents [22]. Moreover, Australian youth (8–18 years of age) (stringency index: 65.74–69.44) and adolescents (aged 14–17 years) living in the U.S. (stringency index: 67.13–72.69) reported more anxiety and depressive symptoms in the initial phase of the pandemic than before [20,21,42]. In addition, Barendse et al. [23] (2021) found an increase in depressive symptoms in an international sample of adolescents (mean age 15.4 years) during the pandemic compared with before, especially for biracial/multiracial adolescents. There might be several explanations for the differences in observations. First, the some of the previously described studies used cross-sectional designs [15–17] or did not have any prepandemic measures [22], and as such, these studies cannot

Table 2

Change in mental well-being after introduction of lockdown measures compared with before the pandemic and differences between boys and girls in change of mental well-being

Mental well-being	Before the pandemic (n = 224)	After introduction lockdown measures (n = 158)	Main effect of time		Main effect of gender		Main effect of interaction gender*time	
			F	η^2_p	F	η^2_p	F	η^2_p
Life satisfaction ^a mean (SD), range 0–10	7.62 (1.19)	7.15 (1.08)	13.195	.079***	22.187	.127***	6.034	.038*
Internalizing symptoms ^b mean (SD), range 0–141	40.28 (9.72)	41.77 (10.29)	2.152	.014	12.486	.076***	.018	.002
Psychosomatic health ^c mean (SD), range 0–5	3.91 (.67)	4.14 (.66)	36.544	.194***	16.405	.097***	.100	.001

* $p < .05$; ** $p \leq .01$; *** $p \leq .001$.

^a A higher score indicates a higher life satisfaction.

^b A higher score indicates more severe self-reported internalizing symptoms.

^c A higher score indicates experiencing psychosomatic complaints less frequently.

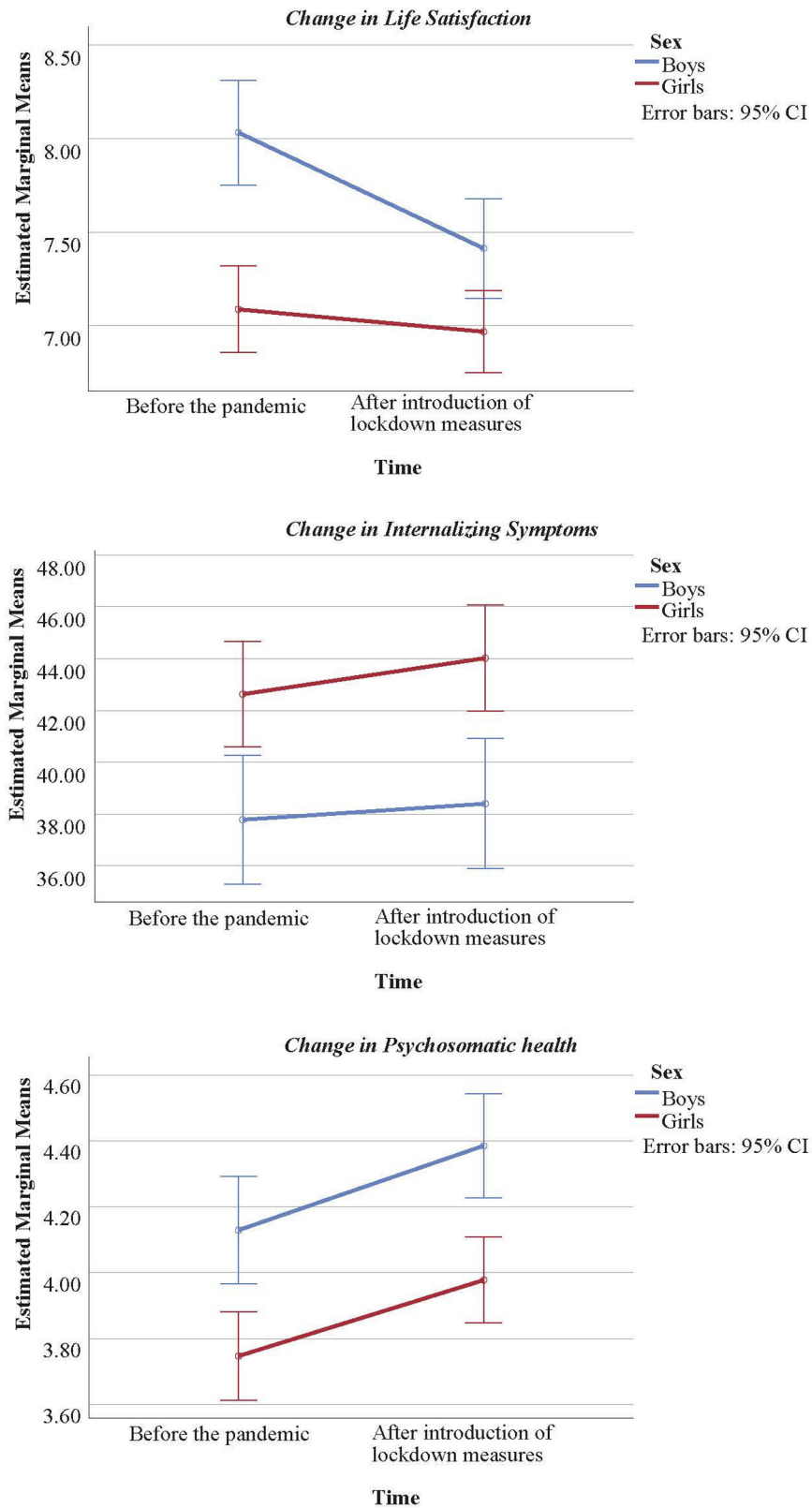


Figure 2. Changes in mental well-being after introduction of the lockdown measures compared to before the pandemic.

Table 3

Changes in mental well-being indicators associated with concerns related to COVID-19 and lockdown measures

Life satisfaction ^b	Factors, concerns about:	Crude β	(95% CI)	<i>p</i>	Adj. β^a	(95% CI)	<i>p</i>
	Health	-.02	(-.21; .18)	.88	-.04	(-.23; .14)	.64
	Social consequences of lockdown measures	-.25	(-.45; -.05)	.02	-.25	(-.43; -.06)	.01
	Financial matters	-.12	(-.35; .10)	.29	-.02	(-.23; .19)	.86
	Family relations	-.21	(-.45; .03)	.09	-.15	(-.37; .08)	.21
Internalizing symptoms ^c	Factors, concerns about:	Crude β	(95% CI)	<i>p</i>	Adj. β^a	(95% CI)	<i>p</i>
	Health	2.54	(.67; 4.41)	.01	1.93	(.53; 3.33)	.01
	Social consequences of lockdown measures	4.41	(2.32; 5.93)	<.001	2.39	(.96; 3.81)	.001
	Financial matters	-.26	(-2.57; 2.05)	.82	-.74	(-2.47; .99)	.40
	Family relations	2.36	(.08; 4.63)	.04	2.41	(.73; 4.08)	.01
Psychosomatic health ^d	Factors, concerns about:	Crude β	(95% CI)	<i>p</i>	Adj. β^a	(95% CI)	<i>p</i>
	Health	-.05	(-.17; .07)	.39	-.04	(-.12; .04)	.30
	Social consequences of lockdown measures	-.17	(-.29; -.06)	.01	-.08	(-.17; .00)	.06
	Financial matters	.02	(-.11; .16)	.73	.08	(-.01; .17)	.09
	Family relations	-.05	(-.20; .10)	.52	.01	(-.09; .11)	.88

Significant associations in bold.

^a Adjusted for life satisfaction before the pandemic, gender, age, and level of education of the adolescent.^b A higher score indicates a higher life satisfaction.^c A higher score indicates more severe self-reported internalizing symptoms.^d A higher score indicates experiencing psychosomatic complaints less frequently.

speak to potentially causal effects of lockdown measures: the high prevalence of anxiety and depressive symptoms could be preexisting. Second, although all children and adolescents were encouraged to stay at home, the social distancing rules have been differently applied to youth between countries. For instance, Dutch youth younger than 18 years of age and youth younger than 16 years of age living in the United Kingdom did not have to comply with social distancing rules [43,44]. This is in contrast to, for example, Australia and China, where social distancing rules were applied to all children [45,46]. Third, there might be a difference in experienced loneliness between the different study populations in the aforementioned studies. Luchetti et al. [47] examined COVID-19–related effects on loneliness in the USA and reported that, although people were physically isolated as a consequence of the social distancing measures, there was no increase in loneliness in the first 4–8 weeks after implementation of lockdown measures. Feeling socially supported might have acted as a protective factor against internalizing symptoms because friendship quality aids resilient functioning in adolescence and could therefore be a protective factor [12,47,48]. Owing to the lack of sufficient data, we were not able to test this suggestion in our sample. Therefore, future research could examine whether friendship interactions and/or social support remained comparable at follow-up as before and whether this acted as protective factor on internalizing symptoms. Moreover, it is conceivable that loneliness increases as the pandemic continues. Therefore, future research might also focus on the role of loneliness on internalizing symptoms during this pandemic.

Interestingly, the COVID-19 pandemic might even have a positive effect on adolescents' mental well-being as our study found that adolescents had a better psychosomatic health during the COVID-19–related lockdown compared with before the pandemic. Specifically, on average, our sample was able to fall asleep more easily. During puberty, hormonal changes alter the homeostatic and circadian regulation of sleep with the result that adolescents tend to stay up and sleep in later [49]. This altered sleep rhythm often conflicts with early school start times. At the

time of completing the follow-up questionnaires, schools in the Netherlands were closed and most adolescents attended their classes online. It is conceivable that this allowed our sample of adolescents to stay up late and sleep in, resulting in a better alignment of their sleep-wake behavior with their circadian rhythm. Both Munasinghe et al. [19] and Orgiles et al. [50] also reported that youth more often slept 8 hours or longer during the COVID-19–related lockdown when compared with their rhythms before the pandemic. In prepandemic studies, it is shown that, particularly for adolescents, chronic sleep loss is a common phenomenon. Sleep deprivation might lead to a lower mental and physical health and therewith represents an important health risk [51–54]. Studies showed that delaying school start times lead to better alignment of circadian system and therefore result in better sleep quantity and quality. Moreover, delaying school start times is associated with less mental health issues, better physical health, and higher academic performances [51,52,55–57]. As multiple studies, including this present study, showed that adolescents' sleep improved [19,50] during the pandemic, probably owing to a better alignment of their sleep-wake behavior with their circadian rhythm, national governments may consider possibilities that could enhance this alignment, for example, by delaying school start times.

Changes in mental well-being differed between boys and girls. Although boys scored better on all three mental well-being indicators compared with girls, their life satisfaction decreased, whereas girls' life satisfaction did not significantly change. Our findings are in line with those that show that adolescent girls, on average, have lower mental well-being than boys [6]. However, Magson et al. [20] reported that a decline of life satisfaction in adolescents (aged 13–16 years) during the pandemic was particularly pronounced in girls. There might be multiple explanations for why boys' life satisfaction decreased, about which we can only speculate. For instance, boys are more likely to hang out in groups, whereas girls tend to spend more time in friendship dyads [58,59]. The lockdown measures discouraged group gatherings, which might have affected boys' life satisfaction

more than girls' life satisfaction. Moreover, adolescent girls might have more tools to cope with lockdown measures and the pandemic, as girls are more likely to ask for help, have more positive connections to their parents, and communicate more than boys [60]. Future research could focus on why gender matters when it comes to changes in life satisfaction during this pandemic.

In summary, the findings of this study provide a nuanced picture of the mental well-being of adolescents. On the one hand, on average, adolescents were doing quite well during the first lockdown during the pandemic, suggesting that adolescents are coping resiliently with this crisis. The unexpected positive change in psychosomatic health could be a lead for national governments to create possibilities that could encourage this positive change also after pandemic. On the other hand, we also observed negative changes in life satisfaction among boys but not girls. Future studies might examine whether our results are also generalizable to adolescents with different ethnic backgrounds, other socioeconomic status, or chronically ill adolescents. Adolescents' mental well-being and concerns are expected to continue to vary during the COVID-19 pandemic and should continue to be monitored.

Strengths and limitations

An important strength of this study was that we benefitted from a prospective design where we were able to compare mental well-being up to 1 year before the onset of pandemic with mental well-being about 5–8 weeks after the introduction of lockdown measures within the same adolescents. Moreover, we assessed multiple indicators of mental well-being. There are also some limitations. The participants of the WHISTLER birth cohort were recruited from the general population [24] living in a fairly affluent and newly built suburb of Utrecht, the Netherlands. As a result, this sample is not completely representative of the general Dutch adolescent population as adolescents with parents with a lower educational background and a non-Western migration background were underrepresented. This implies that our results may not be generalizable to populations with different educational, ethnic, and/or cultural backgrounds. Moreover, data on mental well-being before the lockdown were collected between March 2019 and March 2020, whereas all included participants were invited to complete the follow-up questionnaire on April 18, 2020. Consequently, not only the time between baseline and follow-up assessment but also the timing (during summer holiday vs. during a stressful school week) of the baseline assessment varied between the adolescents. This could have affected our results in such a way that although a change in mental well-being was reported, it might not have been the effect of COVID-19–related lockdown measures. In cohort studies, loss-to-follow-up is a common phenomenon which can lead to attrition bias. In this study, no difference with respect to the distribution of age, ethnicity, educational level, internalizing symptoms and psychosomatic health were observed between the participants that completed the follow-up questionnaire compared with adolescents that did not. However, girls were more willing to complete the follow-up questionnaire compared with boys. In addition, girls who completed the follow-up questionnaire at baseline reported a lower life satisfaction than girls who did not. In this study, no significant change in life satisfaction in girls was observed. If all girls had completed the follow-up questionnaire, it is likely that

the change in life satisfaction in girls would have become even smaller (and still not significant). Therefore, this attrition is unlikely to have biased our results.

Conclusion

This study yielded an interesting picture of changes in adolescent mental well-being. Adolescents' life satisfaction decreased after the introduction of lockdown measures compared to before the pandemic, especially in boys. However, no change in internalizing symptoms was reported. Yet, adolescents experienced a better psychosomatic health, potentially driven by falling asleep more easily during the pandemic compared with before.

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Author Contribution: Van der Laan conceptualized and drafted the initial manuscript, carried out the initial analyses and revised the manuscript. Van der Ent is PI of the WHISTLER study since the start of the study in 2002. He contributed to the design and follow-up of the study and coordinated and supervised data collection and data management. He also reviewed and revised the manuscript. Nijhof conceptualized the initial manuscript. Finkenauer, Lenters, and van Harmelen gave advice and support with the analysis. Finkenauer, Lenters, Nijhof, van Harmelen, and van der Ent conceptualized and designed the study, reviewed, and revised the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Supplementary Data

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