

Title: Mental health in adolescents during COVID-19-related social distancing and home-schooling

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Abstract

This study assessed mental health in adolescents during the COVID-19 pandemic in Austria. An online survey (between February 3rd and 28th, 2021) was conducted measuring well-being (WHO-5), depression (PHQ-9), anxiety (GAD-7), sleep quality (ISI), as well as disordered eating (EAT-8) in 14 to 20 year-old adolescents. In total N=3052 individuals participated (70.1 % female) and showed clinically relevant 1) depressive symptoms (55%), anxiety symptoms (47%), insomnia (23%), and eating disorder symptoms (64%). The prevalence of repeated suicidal ideation was 16% (9% nearly every day; 7% on more than half of the days per week). Compared to a HBSC-study from 2018 an increase of smartphone usage, a decrease of physical activity, and a decrease of mental well-being (WHO-5) from 43.7 (SD = 19.84) in 2018 to M = 35.79 (SD = 19.67) in female participants ($t(2136) = -18.58$; $p < 0.001$; $d = -0.40$) and a decrease from 53.1 (SD = 19.50) in 2018 to M = 43.93 (SD = 22.36) in male participants ($t(855) = -12.00$; $p < 0.001$; $d = -0.43$) was observed. Results suggests a high prevalence of mental disorders one year after the COVID-19 outbreak in Austria and highlight the need to implement health promotion and prevention strategies.

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic is determining our everyday lives for almost a year. Like many other countries, Austria imposed lockdown measures to reduce COVID-19 transmission. In addition to curfews, the Austrian government took the precaution of closing schools in an attempt to contain the spread of the virus. From October 2020 to February 2021 all schoolchildren aged 14 or higher received almost exclusively home schooling in Austria. Besides detrimental effects on learning outcomes, school closures have also been associated with negative biopsychosocial effects as schools offer many critical services beyond education, such as social contacts, physical exercise, nutrition and health services (Thorell et al., 2021).

Adolescence is a sensitive period of social development with social interactions becoming increasingly important (Orben et al., 2020). Adolescence involves numerous profound biopsychosocial transformations and psychological and social challenges (Ravens-Sieberer et al., 2021). Compared with children, adolescents spend less time with their family, while they form more complex peer relationships (Knoll et al., 2015). This facilitates gaining independence from parents and enables them to explore various domains of identity and to foster a more complete sense of social self-identity (Pfeifer & Berkman, 2018). High-quality peer relationships are also important to protect against mental health problems, as adolescence is well-known as a period of enhanced vulnerability to mental health disorders (Van Harmelen et al., 2017). Therefore, coping with the current COVID-19 situation and complying with the restrictions, such as enforced physical distancing and reduced in-person contact with peers, might substantially impair psychological development in adolescents since these conditions can be experienced being incongruent with their developmental tasks (Orben et al., 2020; Ravens-Sieberer et al., 2021). The challenges and consequences of COVID-19 have a tremendous impact on adolescents' quality of life and mental health as summarized previously (Octavius et al., 2020; Singh et al., 2020). Recent studies from several countries such as Brazil, China, Germany, India, Italy, Spain and the US highlight that the COVID-19 pandemic negatively impacts mental health in children and adolescents (Duan et al., 2020; Ezpeleta et al., 2020; Orgilés et al., 2020; Patrick et al., 2020; Ravens-Sieberer et al., 2021; Saurabh & Ranjan, 2020).

For example, a cross-sectional Chinese study conducted from March 30, 2020, to April 7, 2020 in 7890 adolescents aged between 12 and 18 years, found a prevalence for anxiety symptoms of 21.7% and for depressive symptoms of 24.6% measured with the Hospital Anxiety and Depression Scale (HADS) (Li et al., 2021).

There are no representative studies on mental health in Austrian children during COVID-19 so far; however, there are several studies available, looking into mental health of those 18 and above. With the period of adolescence often defined as 15-25 (Sawyer et al.; 2018), it seems warranted to specifically address this age group. A longitudinal representative Austrian study from April, June, and September 2020 found a consistently high prevalence of depressive symptoms in 18- to 24-year-olds of around 30 % (Pieh et al., 2020; Pieh, Budimir, et al., 2021; Pieh, Probst, et al., 2021). Around the turn of the year the prevalence of depressive symptoms even increased in this late-adolescents age group up to 50 % (Dale et al., 2021).

The aim of the current study was to assess mental health in adolescent pupils in Austria after several months almost exclusively in home schooling and to evaluate which groups have been most affected by examining differences between gender, migration background, and mobile phone usage.

2. Methods

2.1. Study design

This cross-sectional online study was conducted from February 3, 2021 to February 28, 2021 in Austria. It was supported by the Austrian Federal Ministry of Education, Science and Research. The Federal Ministry informed all schools and asked them to forward the link to their students. We aimed for a representative sample size according to region. The study was carried out via Research Electronic Data Capture (REDCap) (Harris et al., 2009, 2019). REDCap is hosted at the servers of the Danube-University Krems, Austria. All participating adolescents had to agree to the data protection declaration to start the survey (electronic informed consent) and had to confirm that they were aged 14 or older. The principles outlined in the Declaration of Helsinki were followed and the ethics committee of the Danube-University Krems as well as the data protection officer of the Danube-University Krems approved the study.

2.2. Restrictions and Home-Schooling in Austria

Since October 2020 secondary school took place mainly in home-schooling. In this time no team or indoor sport was allowed. In November 2020 and from December 2020 until January 2021 one was allowed to leave the house only in a few exceptions, such as meeting necessary basic needs of daily life, assistance for people in need or outdoor activities alone or with people from the same household. Starting on February 8, 2021 the strict lockdown was lifted, and secondary schools were allowed to reopen with classes in a shift system and extended protective measures such as weekly COVID-19 tests and wearing FFP2 face masks.

2.3 Measures

2.3.1 Well-being (WHO-5)

The WHO-5 questionnaire (Brähler et al., 2007) measures well-being with five self-rating items rated on a six-point Likert scale. The score can range from 0 (absence of well-being) to 25 (maximal well-being). To translate into a percentage scale from 0 to 100 raw scores were multiplied by four. The German version of the WHO-5 has good psychometric properties in adolescents (Allgaier, Pietsch, Frühe, Prast, et al., 2012; Allgaier, Pietsch, Frühe, Sigl-Glöckner, et al., 2012). Cronbach's alpha was $\alpha = 0.85$ in the current sample.

2.3.2 Depressive symptoms (PHQ-9)

The depression module of the Patient Health Questionnaire (PHQ-9) was used to measure depressive symptoms (Spitzer et al., 1999). The German version of the PHQ-9 is validated for adolescents (Allgaier et al., 2012). The PHQ-9 contains nine self-rating items on a four-point scale ranging from 0 ("not at all") to 3 ("nearly every day") with a sum score from 0 to 27. The recommended cut-off score of greater-equal 11 points for detecting major depression in adolescents (Richardson et al., 2010) was used to define clinically relevant depression. Cronbach's alpha was $\alpha = 0.88$ in the current sample.

Item 9 of the PHQ-9 has been shown to be a robust and age-independent predictor of suicide attempts and deaths (Rossom et al., 2017) and was therefore analyzed as a measure of suicidal ideation. This item asks "Over the last two weeks, how often have you been bothered by thoughts that you would be better off dead or of hurting yourself in some way?". Response to this question can be coded in a binary way to identify the presence of any recent suicidal ideas

within the last two weeks (presence of suicidal thoughts = item endorsed if response ranged from 1 to 3; no suicidal thoughts = item not endorsed if response was 0).

2.3.3 Anxiety symptoms (GAD-7)

The German version of the Generalized Anxiety Disorder 7 scale (GAD-7) was used to measure anxiety symptoms (Löwe et al., 2008). It measures anxiety with 7 self-rating items on a four-point scale, from 0 to 3 (maximum score 21). Cut-off points ≥ 11 for moderate and ≥ 17 for severe anxiety symptom levels were suggested for adolescents (Mossman et al., 2017). The 11-point cut-off was used in the current study to define clinically relevant anxiety. Cronbach's alpha for anxiety was $\alpha = 0.88$ in the current sample.

2.3.4 Sleep quality (ISI)

The German version of the Insomnia Severity Index (ISI) is a validated screening instrument for insomnia in adolescents (Gerber et al., 2016). It measures sleep quality and insomnia on 7 self-reported items on a four-point scale ranging from 0 to 4. The sum scores range from 0 to 28 with a recommended cut-off score for clinical insomnia (moderate severity) greater-equal 15 points (Morin et al., 2011). Cronbach's alpha was $\alpha = 0.80$ in the current sample.

2.3.5 Stress (PSS-10)

The Perceived Stress Scale (PSS-10) is a validated and widely used 10-item questionnaire to measure stress (Cohen et al., 1983). For the last month, the stress level is rated on five-point scales ranging from 0 to 4 (maximum score 40), with a higher score indicating higher perceived stress. The German version is validated for adolescents aged 14 years or older (Klein et al., 2016). Cronbach's alpha was $\alpha = 0.87$ in the current sample.

2.3.6 Eating attitudes test (EAT-8)

Disordered eating was measured with a reliable, validated, 8 items self-rating instrument, EAT-8 (Richter et al., 2016). It offers a screening instrument to screen individuals at high risk of developing clinical eating disorders. The EAT-8 is a short version of the EAT-26 (Garner et al., 1982) including 8 items in a dichotomized response format (1 = "I agree somewhat" and 0 = "I disagree somewhat"). Through the determination of a total score ranging from 0 to 8, the EAT-8 should classify into a low risk and a high-risk group. In this study, the more conservative cut-off points of 3 for female and 2 for male adolescents were used, as they were recommended for epidemiological purposes (Richter et al., 2016). was $\alpha = 0.84$.

2.3.7 Life satisfaction

Life satisfaction was measured with the Cantril ladder, an instrument that has been shown to be valid and reliable to assess overall mental well-being among adolescents (Jovanović, 2016; Levin & Currie, 2014). Adolescents were asked to rate their life satisfaction on a 11-point scale ranging from (0) "the worst possible life" to (10) "the best possible life".

2.3.8. Migration status, smartphone usage and self-harming behaviour

Students were asked whether both parents were born abroad, to assess their migration status. Mobile phone use was queried identically as in the Health-Behaviour in School-aged Children-study (HBSC-study) conducted in Austria in 2018 (Teutsch et al., 2018) in order to allow for comparison. To assess lifetime prevalence of Nonsuicidal Self-Injury (NSSI) students were asked whether they have ever intentionally injured themselves without wanting to die

(NSSI item taken from the validated German version of the Self-Injurious Thoughts and Behavior questionnaire SITBI-G; Fischer et al., 2014).

2.4 Statistical analyses

All data were analyzed using the IBM SPSS Statistics software version 26 (IBM, 2020). Descriptive statistics were performed to describe the sociodemographic characteristics of the sample, mean values of each variable, and the percentage of individuals scoring above the cut-off for depression, anxiety, insomnia and disordered eating.

T-tests for independent samples were computed to compare results with data from the nationwide, representative HBSC-study (n = 1564) conducted in Austria before the pandemic (Teutsch et al., 2018).

T-tests for independent samples were computed to assess potential differences between adolescents with migration status and those with no migration status.

Hedge's g was calculated as effect size measure for differences (small effect: 0.2 to 0.5, medium effect: 0.5 to 0.8, large effect: >0.8).

Univariate ANOVAs were computed to analyze differences in mental health outcomes with respect to gender and mobile phone usage. η^2 was used to categorize small ($\eta^2 = 0.01$), medium ($\eta^2 = 0.06$), and large ($\eta^2 = 0.14$) effects for ANOVAs.

The significance level was set at 0.05.

3. Results

A total of N = 3052 adolescents participated in the study (70.1% female, 28.1% male, 1.8% other). Participants were on average M = 16.47 (SD = 1.45) years old. Sociodemographic characteristics are summarized in Table 1.

Table 1: Study sample characteristics (N=3174)

Variable	N	%
Total	3052	
Gender		
Female	2139	70.1
Male	857	28.1
Transgender	56	1.8
Age		
14	311	10.2
15	555	18.2
16	640	21.0
17	738	24.2
18	605	19.8
18+	203	6.7
Regions Austria		
North-East (aim 55 %) (Vienna, Lower Austria, Upper Austria)	1713	56.1
South-East (aim 23 %) (Carinthia, Styria, Burgenland)	710	23.3
West (aim 21 %) (Tyrol, Salzburg, Vorarlberg)	629	20.6
School		

Middle school	27	0.9
Polytechnical School	38	1.2
Part-Time Vocational School and Apprenticeship (Dual Training)	98	3.2
School for Intermediate Vocational Education	66	2.2
College for Higher Vocational Education	1439	47.1
Academic secondary school	1377	45.1
Others	7	0.2
Migration background		
No	2581	84.6
Yes	471	15.4

According to the official school data of the year 2018/19 the gender distribution in the Academic Secondary School (AHS) should be 58.4% and in the College for Higher Vocational Education (BHS) 53.0% females

(https://www.statistik.at/wcm/idc/idcplg?IdcService=GET_NATIVE_FILE&RevisionSelectionMethod=LatestReleased&dDocName=123225).

Mean scores for the measures of well-being, depression, anxiety, insomnia, stress level and disordered eating for the total sample, and divided by gender are summarized in Table 2. In total, 55.0% of adolescents scored above the cut-off for depression, 47.0% above the cut-off for anxiety, 22.8% above the cut-off for insomnia, and 59.5% above the cut-off for disordered eating, with female and diverse gender showing poorer mental health than male participants on all measures (Table 4).

Adolescents with migration background showed poorer mental health with respect to depression, anxiety, insomnia scores and stress level compared to adolescents with no migration background ($p \leq 0.001$). No difference was observed for the EAT-8 ($p = 0.094$) with respect to mean scores, whereas higher prevalences for disordered eating was observed for adolescents with migration background ($p < 0.001$; Table 3).

Mobile phone usage was associated with impaired mental health (Table 6).

The prevalence of suicidal ideation was on average 36.9%, with higher values observed in female (40.8%) and diverse (84.0%) participants compared to the male participants (23.9%; $\chi^2(2;2755) = 115.51$; $p < 0.001$). Higher prevalence was also observed in students with migration status (47.3%) as compared to those without (35.0%; $\chi^2(1;2755) = 22.73$; $p < 0.001$). In total 246 adolescents (8.9%) scored "Nearly every day" at the PHQ-9 question "Thoughts that you would be better off dead, or of hurting yourself in some way?" (10.3% female, 3.9% male, and 34.0% diverse adolescents; 12.9% with migration status, 8.2% no migration status).

26.3% of adolescents reported NSSI (31.1% female, 11.9% male, 66.1% diverse; $\chi^2(2;3050) = 162.35$; $p < 0.001$). No difference in NSSI was observed with respect to migration status (28.3% in students with migration status; 26.0% in students without migration status; $\chi^2(1;3050) = 1.11$; $p = 0.292$).

Table 2. Measures of psychological health by gender (Mean and (SD))

		Total	Female	Male	Diverse	Statistic
WHO-5	M	37.83	35.79	43.93	22.36	F(2; 3046) = 64.80; $p < 0.001$; $\eta^2 = 0.041$
	SD	(20.86)	(19.67)	(22.36)	(18.19)	
PHQ-9	M	11.90	12.82	9.15	18.24	F(2; 2749) = 117.16; $p < 0.001$; $\eta^2 = 0.079$
	SD	(6.61)	(6.35)	(6.38)	(5.39)	
GAD-7	M	10.32	11.09	8.12	14.22	F(2; 2818) = 110.95; $p < 0.001$; $\eta^2 = 0.073$
	SD	(5.27)	(5.00)	(5.28)	(4.92)	

PSS-10	M	23.50	24.70	20.10	29.39	F(2; 2878) = 136.75; p < 0.001; $\eta^2 = 0.087$
	SD	(7.47)	(6.81)	(7.93)	(7.24)	
ISI	M	10.31	11.01	8.44	12.21	F(2;2985) = 67.78; p < 0.001; $\eta^2 = 0.043$
	SD	(5.65)	(5.52)	(5.58)	(4.91)	
EAT-8	M	3.37	3.89	2.01	3.98	F(2; 2859) = 161.86; p < 0.001; $\eta^2 = 0.102$
	SD	(2.65)	(2.66)	(2.09)	(2.77)	

p: p-values (2-tailed); M: mean score; SD: standard deviation, F: F-test; ISI: Insomnia Severity Index, GAD-7 (Generalized Anxiety Disorder 7 scale); PHQ-9: Patient Health Questionnaire 9 scale; PSS-10: Perceived Stress Scale 10; WHO-5: Well-being questionnaire of the World Health Organization (WHO); EAT-8: Eating Attitudes Test 8.

Table 3. Measures of psychological health by migration background (Mean and (SD))

		Total	Migration Background	No Migration background	Statistic
WHO-5	M	37.83	33.34	38.65	t(3047) = -5.10; p < 0.001; g = 0.256
	SD	(20.86)	(20.59)	(20.81)	
PHQ-9	M	11.90	13.56	11.61	t(2750) = 5.54; p < 0.001; g = -0.297
	SD	(6.61)	(6.57)	(6.57)	
GAD-7	M	10.32	11.26	10.16	t(2819) = 3.94; p < 0.001; g = -0.290
	SD	(5.27)	(5.24)	(5.26)	
PSS-10	M	23.50	24.50	23.32	t(641.1) = 3.29; p = 0.001; g = -0.158
	SD	(7.47)	(6.72)	(7.58)	
ISI	M	10.31	11.98	10.01	t(2986) = 6.89; p < 0.001; g = -0.351
	SD	(5.65)	(5.52)	(5.62)	
EAT-8	M	3.37	3.57	3.34	t(2860) = 1.675; p = 0.094; g = -0.087
	SD	(2.65)	(2.66)	(2.65)	

p: p-values (2-tailed); M: mean score; SD: standard deviation, t: T-test; ISI: Insomnia Severity Index, GAD-7 (Generalized Anxiety Disorder 7 scale); PHQ-9: Patient Health Questionnaire 9 scale; PSS-10: Perceived Stress Scale 10; WHO-5: Well-being questionnaire of the World Health Organization (WHO); EAT-8: Eating Attitudes Test 8; a EAT-8 cut-off score of ≥ 2 in male and ≥ 3 in female and diverse adolescents was considered as being indicative of disordered eating.

Table 4. Number and percentages of participants exceeding the cut-off score for moderate depression/anxiety/insomnia/disordered eating by gender.

		Total	Female	Male	Diverse	Statistics
PHQ-9 score	<11	1238 (45.0)	743 (38.3)	492 (64.4)	3 (6.0)	$\chi^2(2;2752) = 181.64$; p < 0.001
	≥ 11	1514 (55.0)	1195 (61.7)	272 (35.6)	47 (94.0)	
GAD-7 score	<11	1495 (53.0)	947 (47.6)	533 (68.1)	15 (30.0)	$\chi^2(2;2821) = 104.98$; p < 0.001
	≥ 11	1326 (47.0)	1041 (52.4)	250 (31.9)	35 (70.0)	
ISI score	<15	2308 (77.2%)	1558 (74.2%)	713 (85.4)	37 (71.2)	$\chi^2(2;2988) = 44.02$; p < 0.001
	≥ 15	680 (22.8%)	543 (25.8%)	122 (14.6)	15 (28.8)	
EAT-8 score	<2/<3	1160 (40.5%)	722 (35.8)	417 (52.5)	21 (41.2)	$\chi^2(2;2862) = 66.11$;

N (%)	≥2/≥3	1702 (59.5%)	1295 (64.2)	377 (47.5)	305 (58.8)	p < 0.001
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p: p-values (2-tailed); M: mean score; SD: standard deviation, χ^2 : Chi-square; ISI: Insomnia Severity Index, GAD-7 (Generalized Anxiety Disorder 7 scale); PHQ-9: Patient Health Questionnaire 9 scale; EAT-8: Eating Attitudes Test 8; a EAT-8 cut-off score of ≥ 2 in male and ≥ 3 in female and diverse adolescents was considered as being indicative of disordered eating.

Table 5. Number and percentages of participants exceeding the cut-off score for moderate depression/anxiety/insomnia by migration status.

		Total	Migration background	No migration background	Statistics
PHQ-9 score	<11	1238 (45.0)	140 (34.0)	1098 (46.9)	$\chi^2(1;2752) = 23.71$; p < 0.001
N (%)	≥11	1514 (55.0)	272 (68.0)	1242 (53.1)	
GAD-7 score	<11	1495 (53.0)	187 (44.4)	1308 (54.5)	$\chi^2(1;2821) = 14.62$; p < 0.001
N (%)	≥11	1326 (47.0)	234 (55.6)	1092 (45.5)	
ISI score	<15	2308 (77.2%)	306 (67.5)	2002 (79.0)	$\chi^2(1;2988) = 28.54$; p < 0.001
N (%)	≥15	680 (22.8%)	147 (32.5)	533 (21.0)	
EAT-8 score	<2/<3	1160 (40.5%)	153 (35.7)	1007 (41.4)	$\chi^2(1;2862) = 4.78$; p = 0.029
N (%)	≥2/≥3	1702 (59.5%)	275 (64.3)	1427 (58.6)	

p: p-values (2-tailed); M: mean score; SD: standard deviation, χ^2 : Chi-square; ISI: Insomnia Severity Index, GAD-7 (Generalized Anxiety Disorder 7 scale); PHQ-9: Patient Health Questionnaire 9 scale.

Table 6. Measures of psychological health by mobile phone usage

	Hours per day						Statistics
	<1	1-2	3-4	5-6	7-8	>8	
WHO-5	48.51 (25.13)	45.29 (22.13)	42.79 (20.77)	37.13 (19.62)	31.24 (17.97)	28.18 (18.20)	F(5;3042) = 56.42; p < 0.001; $\eta^2 = 0.085$
PHQ-9	9.31 (7.39)	8.98 (6.10)	10.15 (6.15)	12.36 (6.22)	13.73 (6.12)	15.62 (6.57)	F(5;2746) = 67.01; p < 0.001; $\eta^2 = 0.109$
GAD-7	9.20 (6.80)	8.64 (5.22)	9.24 (5.03)	10.59 (5.08)	11.21 (4.99)	12.73 (5.15)	F(5;2815) = 37.65; p < 0.001; $\eta^2 = 0.063$
ISI	8.26 (7.01)	8.42 (5.66)	9.14 (5.37)	10.71 (5.35)	11.43 (5.35)	12.71 (5.64)	F(5;2982) = 40.64; p < 0.001; $\eta^2 = 0.064$
EAT-8	2.24 (2.31)	2.90 (2.55)	3.04 (2.55)	3.52 (2.68)	3.77 (2.65)	3.92 (2.75)	F(5;2856) = 12.88; p < 0.001; $\eta^2 = 0.022$
PSS-10	19.51 (8.85)	20.57 (8.20)	21.93 (7.34)	24.08 (6.85)	25.47 (6.49)	26.65 (7.00)	F(5;2875) = 46.83; p < 0.001; $\eta^2 = 0.075$

Compared to the „Health Behaviour in School-aged Children” (HBSC) study conducted in 2018 mental well-being decreased from 7.1 (SD = 1.78) to 5.9 (SD = 2.01) in female ($t(2138) = -27.91$; $p < 0.001$; $g = -0.62$) and from 7.6 (SD = 1.63) to 6.3 (SD = 2.14) in male ($t(856) = -17.83$; $p < 0.001$; $d = -0.66$) adolescents.

Also, mental well-being assessed with the WHO-5 was lower in the current study as compared to the HBSC study, with a decrease from 43.7 (SD = 19.84) in 2018 to $M = 35.79$ (SD = 19.67) in female participants ($t(2136) = -18.58$; $p < 0.001$; $d = -0.40$) and a decrease from 53.1 (SD = 19.50) in 2018 to $M = 43.93$ (SD = 22.36) in male participants ($t(855) = -12.00$; $p < 0.001$; $d = -0.43$).

In male as well as female adolescents a strong increase in mobile phone usage compared to the HBSC study was observed (Table 7).

Table 7. Mobile phone usage in hours per day by gender.

	Male		Female		Statistics
	2018	2021	2018	2021	
<1 h/d	38 (8.0)	21(2.5)	18 (1.7)	26 (1.2)	Male: $\chi^2(5) = 104.48$; $p < 0.001$
1-2h/d	146 (30.7)	156 (18.2)	255 (23.6)	220 (10.3)	
3-4 h/d	194 (40.8)	282 (32.9)	459 (42.5)	638 (29.8)	Female: $\chi^2(5) = 278.53$; $p < 0.001$
5-6 h/d	56 (11.8)	200 (23.3)	245 (22.7)	575 (26.9)	
7-8 h/d	24 (5.0)	92 (10.7)	72 (6.7)	328 (15.3)	
>8 h/d	18 (3.8)	106 (12.4)	32 (3.0)	351 (16.4)	

4. Discussion

The current study explored mental health about one year after the COVID-19 outbreak in Austria and after about six months of almost exclusively home schooling. The major finding of the study is that the COVID-19 situation seems to severely burden mental health in adolescents, with high numbers of adolescents scoring above cut-offs for depression, anxiety, insomnia and disordered eating. Our study further demonstrates that female and transgender adolescents as well as those with migration background are at a higher risk to suffer from COVID-19 consequences.

In the current study, 55% scored 11 points or higher on the PHQ-9. In accordance, two-thirds of $n = 1040$ 11 to 17-year-old children and adolescents reported being highly burdened in a representative study in Germany conducted between May and June 2020 (Ravens-Sieberer et al., 2021). Children with low socioeconomic status, migration background and limited living space were affected significantly more (Ravens-Sieberer et al., 2021). Also, studies conducted in China reported that among 12- to 18-year-old 44% displayed depressive symptoms (Zhou et al., 2020). At the beginning of the pandemic a study from Wuhan, China found a prevalence of 21.7% for anxiety and 24.6% for depression (Li et al. 2021). This study and sample is only partially comparable to ours, however, it might indicate an increase in psychological symptoms in adolescents. In addition, 47% showed anxiety symptoms (above the cut-off greater-equal 11 points) on the GAD-7. A study conducted in Germany at the beginning of the COVID-19 pandemic observed an increase in generalized anxiety from 15 to 24%. Zhou et al. (2020) reported that 37% 12- to 18-year-old displayed anxiety symptoms. In our study a GAD-7 mean score of 10.8 was observed, with higher scores in females (11.4) than males (8.7). A large Finnish study ($N=111.171$) in adolescents (14 to 18 years) before

COVID-19 showed mean GAD-7 score of 3.94 (± 4.67). This study also showed the gender difference on the GAD-7 scores (females: M (SD) 5.23 (4.96) and males (M (SD) 2.56 (3.89)) (Tiirikainen et al. 2017).

In the PHQ-9, 33% stated they had suicidal thoughts several days during the past two weeks and 8.9% nearly daily and 26.3% reported a lifetime prevalence of NSSI. A European study reported an elevated risk of suicidality within the last two weeks in 4.9% of adolescent participants (Kaess et al., 2020). Data from the same European study found a lifetime prevalence of NSSI of 27% in Austria (Brunner et al., 2014). Suicidal thoughts seem to have increased, with constant rates of NSSI. To our knowledge there are no studies available on adolescent suicidality during epidemics, a preliminary study conducted in the US revealed a potential association of COVID-19 related fears and confinement measures with suicidal thoughts and attempts in adults (Ammerman et al., 2021).

The ISI mean score was 10.3 (SD = 5.65) females: 11.0 (SD = 5.52) and males: 8.4 (SD = 5.58). 22.8 % scored above the cut-off for clinical insomnia of moderate severity (ISI ≥ 15 points; females: 25.8 % and males: 14.6 %). In total 101 adolescents (3.3%) scored above the ISI cut-off for severe clinical insomnia (≥ 22 points). A study from Germany in 2016 (Gerber et al., 2016) of N=1475 adolescents (range: 11 to 16 years) found an ISI mean score of 6.67 (SD = 4.39). Females showed higher scores (M = 7.23, SD = 4.46) than males (M = 6.08, SD = 4.24). 4.7 % of the adolescents scored above the ISI score for clinical insomnia of moderate severity (15 points), and 1 % above the cut-off greater-equal 22 points for severe clinical insomnia. However, a comparison of this study with our results is only permitted to a limited extent due to the different age groups.

According to the EAT-8, 64.2 % of females (EAT-8 ≥ 3 points) and 47.5 % of males (EAT-8 ≥ 2 points) were at risk for disordered eating. Previous studies conducted on adolescents observed prevalence of disordered eating in a range from 9.1 to 42.7% in female and 0.3 to 47.3% in male adolescents as summarized by Richter et al. (2016). A German study conducted in 2013 observed a risk for disordered eating assessed with the EAT-13 of 31.4% in female and 12.2% in male adolescents and young adults (aged 14-29). Therefore, results suggest that the COVID-19 situation goes along with an increased risk for eating disorders. Several risk factors that might contribute to an increase in eating disorders during COVID-19 have been recently highlighted, such as real or perceived food scarcity, exposure to distressing media and media massaging, limited exercise options and restricted healthcare access (Cooper et al., 2020).

Overall, our findings suggest that the COVID-19 pandemic had a major impact on mental health. The mental well-being was significantly lower than 2018 in Austrian adolescents. Compared to the „Health Behaviour in School-aged Children” (HBSC) study conducted in 2018, lower mental life satisfaction was reported during the COVID-19 pandemic with medium effect size. Also, mental well-being assessed with the WHO-5 was significantly decreased compared to the Austrian study from 2018, with small effect size. However, comparison with the HBSC study is limited by the different sample used in both studies.

As expected, gender showed a strong impact on mental health in the current study, with female and transgender participants showing more impaired mental health compared to male adolescents. This is in line with previous studies, showing that female gender was the highest

risk factor for depressive and anxiety symptoms in adolescents during the COVID-19 outbreak were higher in females (Octavius et al., 2020). Transgender and gender-diverse youth have been reported to have a particular mental health vulnerability and seem to be experiencing severe mental health impacts during the COVID-19 pandemic (Hawke et al., 2021). This is in line with our findings, revealing that mental health of gender-diverse adolescents was burdened the most. One potential explanation might be that social distancing might be especially challenging for transgender adolescents, as they might be forced to close contacts to rejecting family members while losing contact with supportive social networks (Grant et al., 2021). However, as no pre-pandemic data on mental health of gender-diverse Austrian adolescents are available, no causal conclusions can be drawn whether the COVID-19 situation further aggravated mental health issues in gender-diverse adolescents.

In the current study, a strong increase in mobile phone usage as compared to the HBSC study conducted in 2018 was observed. Associations between mobile phone usage and mental well-being is supported by several cross-sectional and longitudinal studies, highlighting that mobile phone usage decreases mental well-being, sleep quality, and increases NSSI and suicidality in adolescents (Abi-Jaoude et al., 2020). However, for adolescents today – especially in times of the COVID-19 pandemic – online relationships are the norm to share information and interact with peers (Cho, 2020). Therefore, mobile phone usage has both benefits and costs, and appropriate approaches are needed to mitigate potential harms from mobile phone usage. Besides limiting the daily usage time of mobile phones, adolescents should be encouraged to use their mobile phones responsibly (Lee et al., 2015). For instance, adolescents might also benefit from online access to productive mental health information, such as online interventions for mental health or low barriers to resources such as crisis interventions (Abi-Jaoude et al., 2020).

The COVID-19 pandemic and lockdown measures have multiple consequences on the lives of adolescents, such as home confinement, home schooling, disruption of social contacts, worry for their families, worry for the future job situation as well as chronic and acute stress, among others. Therefore, it is not possible to draw causal conclusions whether the increased mental health symptoms are a result of the disease itself (e.g., worry about the health, the issue of death etc.) or its confinement measures such as lockdowns (e.g. separation from friends, school disruption etc.). Lockdowns are assumed to be experienced as insufferable for some adolescents, especially for those with pre-existing mental health issues, as the daily school routines represent an important anchor in their lives. Therefore, there is a high risk that home schooling increases inequalities between children, further exposing those with preexisting psychological disorders to adverse effects.

Overall, this study suggests that the COVID-19 pandemic and associated confinement measures such as home schooling negatively affect mental health. Female and transgender adolescents as well as those with migration background were particularly burdened, which might significantly contribute to increased inequalities. Therefore, it is crucial to carefully balance potential benefits on reduced COVID-19 transmission and detrimental effects of home schooling, before further school closings are implemented during additional waves of the COVID-19 pandemic.

This study has several limitations. First, the cross-sectional conduction of the study allows no causal conclusions. An additional measurement point before the COVID-19 pandemic would

have been needed to study changes in mental health adequately. Furthermore, due to the online nature of the study, a self-selection bias cannot be excluded, which may have led to participation of adolescents with a higher mental health burden. Although the sample is representative for region, it is not representative for gender and age. Overall, more female adolescents participated than male adolescents. Therefore, all analyses were conducted not only for the total sample, but also for each gender separately. Furthermore, mental health was assessed only based on self-reports.

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