Research paper

Generalized anxiety among Finnish youth from 2013 to 2021—Trend and the impact of COVID-19

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A B S T R A C T

Background: Alarming levels of emotional symptoms among youth were reported during the COVID-19 pandemic. Studies assessing these figures against the pre-pandemic developments are rare. We examined the trend of generalized anxiety (GA) in adolescents in the 2010s and the effect of the COVID-19 pandemic against this trend.
Methods: Data from the Finnish School Health Promotion study with 750,000 participants aged 13–20 between 2013 and 2021 was analyzed using GAD-7 to measure self-reported GA (cut-off $\geq$10). Inquiries were made about remote learning arrangements. Effects of time and COVID-19 were analyzed with logistic regression.
Results: Among females, an increasing trend in GA between 2013 and 2019 was found (OR per year 1.05), and the prevalence increased from 15.5 % to 19.7 %. Among males, the trend was decreasing (OR = 0.98), with prevalence from 6.0 % to 5.5 %. Increase in GA from 2019 to 2021 was stronger in females (19.7 % to 30.2 %) than males (5.5 % to 7.8 %), while the effect of COVID-19 on GA was equally strong (OR = 1.59 vs. OR = 1.60) against the pre-pandemic trends. Remote learning was associated with elevated levels of GA, especially among those with unmet needs for learning support.
Limitations: The design of repeated cross-sectional surveys doesn't allow analyses of within individual changes.
Conclusions: Given the pre-pandemic trends of GA, the COVID-19 effect on it appeared equal in both sexes. The increasing pre-pandemic trend among adolescent females and the strong effect of COVID-19 on GA among both sexes warrants constant monitoring of mental health of the youth in the aftermath of the COVID-19 pandemic.

1. Introduction

Adolescence is a period of rapid growth and change, both biological and emotional, making adolescents vulnerable to mental health problems. Especially internalizing problems, including anxiety and depression, are common among adolescents (Costello et al., 2011). Today's rapidly changing world with major societal changes, demands, and crises exposes young people to an even increased number of stressors affecting their mental health (Poletti et al., 2022; Wiederhold, 2022). Mental health problems, in turn, may have serious impacts on adolescents' overall well-being and functioning with long-term consequences into adulthood (Jokela et al., 2009; Ormel et al., 2017).

Population-based studies have reported increasing trends of emotional problems such as depressive and anxiety symptoms among youth during the first two decades of the 21st century. These developments seem to have started already in the 2000s (Bor et al., 2014;

Collishaw, 2015; John et al., 2015), although some studies reported no change (e.g., Sourander et al., 2012; McMartin et al., 2014; Duinhof et al., 2015) or even decreasing prevalence trends in the 2000s (Pitchforth et al., 2019; Keyes et al., 2019). As indicated in the reviews by Bor et al. (2014) and Collishaw (2015), most studies reported increased emotional symptoms among adolescent females, with findings being more mixed for males. In the 2010s, these increasing and sex-divergent trends seem to have continued and become stronger (Thorisdottir et al., 2017; Mishina et al., 2018; Wiens et al., 2020; Knaappila et al., 2021; Daly, 2022). However, Fischer et al. (2022) reported a stable trend of internalizing symptoms during the 2010s. In contrast, Keyes et al. (2019) reported relatively rapid (and comparable to females) increases in depressive symptoms among US adolescent males between 2012 and 2018.

The COVID-19 pandemic and the various measures to restrict contagion have severely burdened adolescents' mental well-being

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(Meade, 2021; Racine et al., 2021; Bera et al., 2022; Kauhanen et al., 2022; Samji et al., 2022). School closures, remote learning arrangements, quarantine lockdowns, and restrictions on leisure time activities have disrupted adolescents' daily living, resulting in social isolation, less time spent with peers, and fewer opportunities for social support. For many adolescents, remote learning arrangements brought increased stress in keeping up with schoolwork (Samji et al., 2022; Viner et al., 2022) and disrupted predictable routines in their daily life. There is indeed deep global concern regarding the effects and sequelae of COVID-19 on adolescent mental health (Poletti et al., 2022; Hafstad and Augusti, 2021). In their meta-analysis, Racine et al. (2021) concluded that during the first year of the pandemic, 1 in 5 youth globally had experienced clinically elevated anxiety symptoms, and 1 in 4 had experienced clinically elevated depression symptoms, doubling pre-pandemic prevalence rates. Anxiety and depressive symptoms were higher among females, whereas age was not a significant moderator for anxiety symptoms (Racine et al., 2021).

To reliably differentiate the effect of COVID-19 on mental health, it needs to be analyzed considering the preceding trend. There are only a few studies where the preceding trend (not just the pre-pandemic levels) has been controlled for when studying the effects of COVID-19. Thorisdottir et al. (2021) reported an increase of 3.2 % from 2016 to 2018 and of 9.5 % from 2018 to 2020 in depressive symptoms among 13–18-year-old Icelandic adolescents, thus suggesting an effect of COVID-19 (year 2020) on top of the earlier trend from 2016 and 2018. Females were reported to be more affected than males; among males in the younger age groups, there seemed to be no apparent COVID-19 effect on depressive symptoms. Using UK panel data of 16-year-olds and older, Banks and Xu (2020) isolated the effects of COVID-19 by comparing predicted mental health scores against observed ones and found the youngest age group studied (the 16–24-year-olds) and females to be the most affected.

Our primary aim in this exploratory study was to examine the trend of self-reported generalized anxiety among Finnish youth and the impact of the COVID-19 pandemic on this trend between 2013 and 2021. We studied these questions among females and males and within age groups. We also estimated the effects by region and presented them against regional COVID-19 virus infection incidence rates since there is some evidence of the impact of pandemic severity on adolescents' internalizing problems (Zheng et al., 2020; Fitzpatrick et al., 2021). Our secondary aim was to assess how remote learning arrangements (time spent in remote education, learning support received) were associated with self-reported generalized anxiety.

2. Methods

2.1. Participants

We used data from the School Health Promotion (SHP) study, a nationwide classroom survey conducted biennially by the Finnish Institute for Health and Welfare (THL), to monitor Finnish adolescents' health, well-being, and life circumstances (Helakorpi and Kivimäki, 2021). The study design is a repeated cross-sectional survey. The SHP is based on total sampling and the target groups are pupils in 4th and 5th grades and in 8th and 9th grades of comprehensive school, and 1st and 2nd-year students in general upper secondary schools and vocational education institutions. Pupils and students fill out the survey anonymously during a school lesson. Responding to the survey is voluntary, and participants give informed consent by answering the survey. Guardians of participants under 15 years old are informed in advance, and they have an option to decline their child's participation. The institutional review board of THL has evaluated the SHP research plan.

The present analyses used SHP data from year 2013 onwards, as the GAD-7 instrument to measure anxiety (see below) has been included in SHP since then. Similarly, 4th and 5th-grade respondents were not included, as the GAD-7 measure had not been included in their survey.

The SHP is conducted between March and May when most of the 8th graders are 14 to 15 years old (98.3 % in the present sample) and 9th graders are 15 to 16 years old (98.2 %), while 1st-year students in general upper secondary level and vocational education institutions are mostly 16 to 17 years old (93.0 %), and 2nd-year students 17 to 18 years old (95.0 %).

The coverage rate in 2021 was 75 % among 8th and 9th graders, 71 % in general upper secondary schools, and 32 % in vocational education institutions (Helakorpi and Kivimäki, 2021). Altogether, in 2013–2021, there were 402,335 participants from the 8th and 9th grades, 213,898 from general upper secondary schools, and 137,895 from vocational education institutions, for a total of 754,128 participants.

2.2. Measures

For more details and the coding of the measures, see the Supplementary Material.

2.2.1. Generalized anxiety

Generalized anxiety was measured with the 7-item Generalized Anxiety Disorder Scale (GAD-7; Spitzer et al., 2006). This widely used measure has proved to be a reliable and valid instrument for measuring self-reported generalized anxiety in the general population, both among adults (Löwe et al., 2008) and adolescents (Tiirikainen et al., 2019). The cut-off of 10 points or more was used to indicate cases with moderate to severe self-reported generalized anxiety symptoms (Spitzer et al., 2006), hereafter "generalized anxiety" or GA for short.

We used the GAD-7 to study the trend and the COVID-19 effect on mental health symptoms as it was the only mental health symptoms measure that has been included in every data collection of the SHP study between the years 2013 and 2021.

2.2.2. Sociodemographic measures

The respondents were asked to report their age and assigned sex at birth (male or female). From 2017 onwards, there has been an additional question about perceived gender identity, which was used to determine transgender identification. The mean age of the total sample was 15.8 (SD = 1.30) years. In the analyses, a three-category age group variable was used (Table 1). Respondents were asked to report their mother's and father's highest education. From these responses, a two-category variable, "Higher parental education" (yes/no), was formed, indicating that at least one parent had a university degree. Participants reported whether they lived in a household with both parents (yes/no). Immigrant status/family of origin (four categories, Table 1) was based on respondents' reports of their own and their mother's and father's country of birth. The geographical region was based on the seven Regional State Administrative Agencies (Table 1). These agencies also decided and administered many of the COVID-19-related restrictions, including restrictions on schools, leisure time activities, and hobbies.

2.2.3. COVID-19-related measures

The COVID-19 incidence rate was calculated for each region from August 1, 2020, to May 31, 2021, using data retrieved from the Finnish National Infectious Diseases Register. Respondents were questioned about the time spent in remote learning and whether they needed and received support while in remote learning (Table 5).

2.3. Statistical analyses

All analyses were done using IBM SPSS Statistics 28.0 software. Non-missing values were required for sex, age, and the GAD-7 sum-score, resulting in the exclusion of 10,668 cases (1.4 %), with 743,460 cases remaining in the analyzed sample. In those analyses comprising only the years 2017–2021, an additional 1952 (0.4 %) cases were excluded due to implausible (or unreliable) responses (see Supplementary Material). In order to describe changes in GA prevalence, percentages and their

Table 1
Study participants and descriptive statistics by study year, %.

	Missing data %[a]	2013 N = 180,310	2015 N = 119,647	2017 N = 131,887	2019 N = 153,180	2021 N = 158,436
Sex	0.2/0.0					
Female		50.8	51.6	50.8	51.7	52.6
Male		49.2	48.4	49.2	48.3	47.4
Age group	0.3/0.0					
13–15 years old		43.3	33.7	43.4	45.7	46.5
16–17 years old		45.9	52.8	46.6	45.4	44.8
18–20 years old		10.8	13.5	10.0	8.9	8.6
Higher parental education[b]	5.6/5.1	46.3	45.7	49.2	54.2	56.6
Living with both parents	3.4/3.0	65.3	63.7	67.8	68.1	67.1
Immigrant status/family origin	3.2/2.7					
Finnish origin		90.1	88.9	88.3	87.6	87.0
One parent of foreign origin		5.7	6.2	6.7	7.2	7.4
Foreign origin, born in Finland		1.5	1.7	1.8	2.0	2.2
Foreign origin, not born in Finland		2.7	3.1	3.2	3.2	3.4
Region of Finland[c]	0.0/0.0					
Southern Finland		39.3	39.2	36.9	39.9	38.8
Southwestern Finland		12.6	14.0	13.4	12.5	12.3
Eastern Finland		10.7	10.4	10.5	9.6	9.7
Western and Inland Finland		23.1	22.7	24.4	23.8	24.0
Northern Finland		10.1	10.3	10.7	10.6	11.3
Lapland		3.6	2.9	3.4	3.0	3.2
Åland		0.6	0.6	0.7	0.6	0.6
Missing data %[d]		1.8	1.0	2.3	1.7	1.8

[a] Of all participants (before slash)/of those fulfilling the inclusion criteria for the study (after the slash).
[b] At least one parent with a university degree.
[c] Based on Regional State Administrative Agencies.
[d] Of all elements in the data matrix: number of study variables (13) × number of all participants in that year. The 13 variables include sex, age, parental education, living with both parents, immigrant status, region and the seven items of the GAD-7.

95 % CIs for 2013–2021 were first calculated for those with GA. Logistic regression was then used to analyze the effect of time and the COVID-19 pandemic on the prevalence of GA. Time was modeled with a linear parameter indicating continuous time (in years) beginning from the year 2013 and the effect of the COVID-19 pandemic with a dichotomous variable coded as "1" for year 2021, otherwise "0", for contrasting year 2021 against all other years (2013, 2015, 2017, and 2019) combined. Thus, the analysis resembles an interrupted time series analysis where the effect of COVID-19 is modeled as the deviation between values observed in 2021 and values that would have been projected for 2021 based on the pre-pandemic trend from 2013 to 2019.

Logistic models were estimated separately for females and males and within sexes by age group and region. Group differences in the effect of time and COVID-19 on GA were analyzed using interaction terms, that is, sex differences in the total group model with sex × time and sex × COVID-19 simultaneously in the model, et cetera. All models were estimated first with no control variables (unadjusted) and then adjusted for age group (if not separated by age group), parental education, living with both parents, immigrant status/family origin, and region (if not separated by region). Results from the adjusted models are reported in the main article. Generally, the effects did not change much between unadjusted and adjusted models.

In the analyses by region, the effects of time and COVD-19 on GA were displayed against regional coronavirus infection incidence rates during the school year 2020–2021. Supplementary analyses addressed whether gender identity or the type of educational institution would affect the effects of time and COVID-19 on GA. No adjustments of p-value thresholds for multiple testing were made.

3. Results

Descriptive statistics of the sample are given in Table 1. During the study years, the proportions of those having parents with higher education and those with an immigrant background have increased.

3.1. Trend and COVID-19 effect on GA

3.1.1. Sex

The percentage of those with GA increased among females from 15.5 % (95 % CI 15.3–15.7) in 2013 to 19.7 % (95 % CI 19.4–20.0) in 2019; among males, the prevalence decreased from 6.0 % (95 % CI 5.8–6.2) to 5.5 % (95 % CI 5.3–5.7) during the same period (Table 2). Among females, the linear trend in GA between 2013 and 2019 was increasing (OR per year 1.054, 95 % CI 1.050–1.058), while among males, the trend was slightly decreasing (OR per year 0.979, 95 % CI 0.972–0.986) (Table 3, Supplementary Fig. S1). The effect of the COVID-19 pandemic against these trends was apparent among both sexes (OR = 1.593 for females; OR = 1.598 for males) with a prevalence increase from 19.7 % (95 % CI 19.4–20.0) to 30.2 % (95 % CI 29.9–30.5) in females and from 5.5 % (95 % CI 5.3–5.7) to 7.8 % (95 % CI 7.6–8.0) in males from 2019 to 2021 (Tables 2 and 3, Supplementary Fig. S1). Results from unadjusted models are given in Supplementary Table S1.

The sex difference in the effect of linear time on GA was statistically significant (p < 0.0001) as measured with the sex × time interaction term, while the sex difference in the effect of the COVID-19 pandemic on GA was not (p = 0.9710) when the linear trend was simultaneously modeled. If only pre-pandemic levels in 2019 were compared to those in 2021, then also the difference in the effect of COVID-19 between sexes was statistically significant (p < 0.0001) with the OR of COVID-19 being 1.777 (95 % CI 1.736–1.820) in females and 1.496 (95 % CI 1.430–1.565) in males.

Regarding gender identity, supplementary analyses covering the years 2017–2021 showed no significant differences between cisgender and transgender groups in the effect of COVID-19 on the prevalence of GA (see Supplementary Table S2).

3.1.2. Age group

Age group differences in the trend and COVID-19 effects on GA were significant among females, as indicated by age group × time interaction terms (p < 0.0001 for the linear trend, p < 0.0001 for COVID-19). For females from older age groups, the trend in GA increased faster between

Table 2

Percentages and 95 % Confidence Intervals (95 % CI) of those with generalized anxiety (GAD-7 ≥ 10) among 13–20-year-old Finns from 2013 to 2021 by sex and age group.

	2013	2015	2017	2019	2021
	% (95 % CI)	% (95 % CI)	% (95 % CI)	% (95 % CI)	% (95 % CI)
Females, total	15.5 (15.3–15.7)	16.9 (16.6–17.2)	18.3 (18.0–18.6)	19.7 (19.4–20.0)	30.2 (29.9–30.5)
Females by age group					
13–15 years old	15.9 (15.5–16.3)	16.2 (15.7–16.7)	17.4 (17.0–17.8)	19.0 (18.6–19.4)	29.7 (29.2–30.2)
16–17 years old	15.0 (14.7–15.3)	17.1 (16.7–17.5)	18.8 (18.4–19.2)	19.8 (19.4–20.2)	30.4 (29.9–30.9)
18–20 years old	16.2 (15.5–16.9)	17.6 (16.8–18.4)	20.1 (19.1–21.1)	23.0 (22.0–24.0)	31.4 (30.4–32.4)
Males, total	6.0 (5.8–6.2)	6.0 (5.8–6.2)	5.3 (5.1–5.5)	5.5 (5.3–5.7)	7.8 (7.6–8.0)
Males by age group					
13–15 years old	5.9 (5.7–6.1)	5.7 (5.4–6.0)	5.4 (5.1–5.7)	5.3 (5.1–5.5)	7.5 (7.2–7.8)
16–17 years old	5.9 (5.7–6.1)	5.9 (5.6–6.2)	5.1 (4.9–5.3)	5.4 (5.2–5.6)	7.7 (7.4–8.0)
18–20 years old	7.1 (6.6–7.6)	7.3 (6.7–7.9)	6.0 (5.4–6.6)	7.3 (6.7–7.9)	10.1 (9.3–10.9)

Table 3

Effects of linear time (years) and the COVID-19 pandemic outbreak (the year 2021) on generalized anxiety (GAD-7 ≥ 10) among 13–20-year-old Finns between 2013 and 2021 in females and males. Odds ratios (OR) and 95 % Confidence Intervals (95 % CI) from adjusted[a] logistic regression analyses by age group.

	Females		Males	
	OR (95 % CI)	p	OR (95 % CI)	p
Total				
Time since 2013, years	1.054 (1.050–1.058)	<0.0001	0.979*** (0.972–0.986)	<0.0001
COVID-19 (year 2021)[b]	1.593 (1.550–1.637)	<0.0001	1.598 (1.518–1.682)	<0.0001
Age group 13–15 years old				
Time since 2013, years	1.040 (1.033–1.047)	<0.0001	0.970 (0.959–0.982)	<0.0001
COVID-19 (year 2021)[b]	1.709 (1.640–1.782)	<0.0001	1.635 (1.510–1.770)	<0.0001
Age group 16–17 years old				
Time since 2013, years	1.060### (1.054–1.067)	<0.0001	0.979 (0.969–0.990)	0.0001
COVID-19 (year 2021)[b]	1.552## (1.492–1.616)	<0.0001	1.614 (1.497–1.740)	<0.0001
Age group 18–20 years old				
Time since 2013, years	1.080### (1.066–1.093)	<0.0001	1.003## (0.982–1.024)	0.8137
COVID-19 (year 2021)[b]	1.345### (1.236–1.465)	<0.0001	1.483 (1.275–1.725)	<0.0001

[a] All models adjusted for age group (total models only), parental education, living with both parents, immigrant status and region (for unadjusted models see Supplementary Table S1).
[b] Coded "1" for the year 2021, otherwise "0".
*** p < 0.001—effect significantly different compared to females.
p < 0.01, ### p < 0.001—effect significantly different compared to the corresponding effect in 13–15-year-olds (within sexes).

Fig. 1. Percentages of those with generalized anxiety (GAD-7 ≥ 10) among 13–20-year-old Finns from 2013 to 2021 by sex and age group.

further studied whether the effects of time and the COVID-19 pandemic on GA were different between the school levels (see Supplementary Table S3). As indicated by school level × time interaction terms, there was a more substantial increase of GA between 2013 and 2019 among general upper secondary students as compared to students in vocational schools among both females and males in both age groups, while there were no statistically significant differences in the effect of COVID-19.

3.1.3. Region and COVID-19 incidence rate

The regional prevalence rates of GA in 2021 and the effects of time and COVID-19 on GA are presented in Table 4 against the regional COVID-19 incidence rates during the 2020–2021 school year. When comparing ranks based on the magnitude of the parameter estimates given for each region, there seemed to be a slight tendency for regions with a more severe pandemic to have a higher prevalence of anxiety in 2021, especially among males. However, when the effects of time and COVID-19 were simultaneously modeled, there were no indications that regional coronavirus incidence rates were associated with regional effects of COVID-19 on GA. Instead, among both males and females, an inverse congruence between the ranks of the effects of time and COVID-19 seemed to emerge, in that the larger the effect of time between 2013 and 2019, the smaller the effect of COVID-19 on GA in that region.

2013 and 2019 compared to 13–15-year-old females, but this was compensated by smaller increases in the older age groups in 2021 (Table 3, Fig. 1). Among males, age group differences were smaller (Table 3, Fig. 1). Results from unadjusted models are given in Supplementary Table S1.

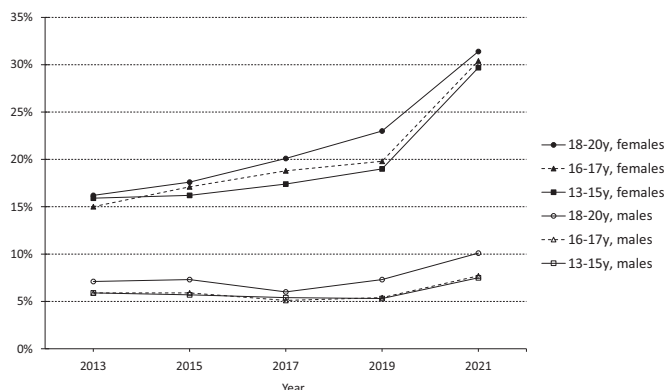In supplementary analyses among the two oldest age groups, it was

Table 4
COVID-19 incidence rates, percentages of those with generalized anxiety (GAD-7 ≥ 10) in 2021, and ORs for linear time and COVID-19 pandemic on generalized anxiety in females and males by region of Finland.

Region of Finland	COVID-19 incidence rate August/2020 – May/2021[a]		Females						Males					
			Generalized anxiety (GAD-7 ≥ 10) in 2021		Logistic regression model predicting generalized anxiety[c]				Generalized anxiety (GAD-7 ≥ 10) in 2021		Logistic regression model predicting generalized anxiety[c]			
					Linear time 2013–2019		COVID-19 outbreak (year 2021)				Linear time 2013–2019		COVID-19 outbreak (year 2021)	
	Per 100,000	Rank[b]	%	Rank[b]	OR (95 % CI)	Rank[b]	OR (95 % CI)	Rank[b]	%	Rank[b]	OR (95 % CI)	Rank[b]	OR (95 % CI)	Rank[b]
Eastern Finland	557	1	29.6	2	1.05[#] (1.04–1.07)	6	1.58 (1.45–1.73)	2	7.5	3	0.97 (0.96–0.99)	3	1.83 (1.54–2.17)	6
Lapland	580	2	31.0	5	1.03[###] (1.00–1.05)	2	1.85[#] (1.59–2.16)	6	7.3	2	0.96 (0.92–1.00)	2	1.65 (1.23–2.20)	5
Northern Finland	679	3	27.6	1	1.03 (1.02–1.04)	3	1.72[##] (1.57–1.87)	5	6.7	1	0.95[##] (0.93–0.97)	1	1.85[#] (1.56–2.19)	7
Western and Inland Finland	881	4	29.7	4	1.05[###] (1.04–1.05)	5	1.61 (1.52–1.70)	3	7.5	4	0.97 (0.96–0.99)	4	1.61 (1.44–1.79)	4
Åland	1207	5	36.0	7	0.99[##] (0.94–1.04)	1	2.20[#] (1.57–3.08)	7	10.7	7	1.00 (0.93–1.09)	7	1.28 (0.74–2.21)	1
Southwestern Finland	1595	6	29.6	3	1.04[#] (1.03–1.06)	4	1.69[#] (1.57–1.83)	4	8.3	6	0.99 (0.97–1.01)	5	1.56 (1.36–1.79)	3
Southern Finland	2343	7	31.4	6	1.07 (1.06–1.08)	7	1.51 (1.45–1.57)	1	8.2	5	0.99 (0.98–1.00)	6	1.52 (1.40–1.64)	2

[a] All registered COVID-19 infections between 2020-01-08 and 2021-05-31 divided by the region's total population (on 2020-12-31) × 100,000.
[b] Rank based on values in the preceding column in ascending order.
[c] Adjusted for age group, parental education, living with both parents, and immigrant status.
[#] p < 0.05, [##] p < 0.01, [###] p < 0.001—effect significantly different from the corresponding effect in Southern Finland.

3.2. Remote learning and GA in 2021

The percentage of those reporting not receiving the support they would have needed for studies and learning while in remote education was greater among females than males (19.3 % vs. 10.0 %) (Supplementary Table S4). Time spent in remote learning was associated with GA in 2021 among both sexes (Table 5). Associations were modest, increasing in a dose-response fashion. Those reporting an unmet need for support for studies while in remote learning had an OR of 3.115 (95 % CI 2.981–3.256) in females and 4.338 (95 % CI 3.997–4.707) in males on GA, the effect being significantly more pronounced among males.

Table 5
Effects of remote learning arrangements on generalized anxiety (GAD-7 ≥ 10) in 2021 among 13–20-year-old Finns in females and males[a]. Odds ratios (OR) and 95 % Confidence Intervals (95 % CI) from adjusted[b] logistic regression analyses.

	Females		Males	
	OR (95 % CI)	p	OR (95 % CI)	p
Time spent in remote learning during the school year				
<1 month per semester (ref)	1.000		1.000	
1–2 months per semester at most	1.066 (1.022–1.112)	0.0027	1.057 (0.976–1.144)	0.1706
Over 2 months in either semester	1.170 (1.110–1.235)	<0.0001	1.213 (1.098–1.339)	0.0001
Over 2 months in both semesters	1.434 (1.337–1.537)	<0.0001	1.372 (1.223–1.539)	<0.0001
Support received for studies/learning while in remote education				
Not needed/received a lot (ref)	1.000		1.000	
Received some	1.313 (1.263–1.365)	<0.0001	1.304 (1.210–1.405)	<0.0001
Not received, would have needed	3.115 (2.981–3.256)	<0.0001	4.338*** (3.997–4.707)	<0.0001

[a] Suspected implausible/unreliable answers excluded (see Supplementary Material).
[b] All models adjusted for age group, parental education, living with both parents, immigrant status and region.
*** p < 0.001—effect significantly different compared to females.

4. Discussion

We studied changes in the prevalence of self-reported generalized anxiety (GA) between 2013 and 2021 among Finnish young people aged 13 to 20 years old, using data from the large nationwide SHP study. We found an increasing pre-pandemic trend in GA from 2013 to 2019 in females but not in males. The impact of COVID-19 on the prevalence of GA was very strong when comparing the projected trend from pre-pandemic years to the year 2021. The effect of the pandemic appeared stronger in females than males when considering only the change from year 2019–2021. Still, it proved equally strong for both sexes when the sex-specific projected estimates from the pre-pandemic trends were considered. We found no indications of regional pandemic severity being associated with changes in the prevalence of GA. Those who had spent more time in remote education, and particularly those who did not perceive reception of adequate support for studies and learning while in remote education, had a higher risk of having GA.

We found that along the 2010s, there has been a clear linearly increasing trend in the prevalence of generalized anxiety among females (from 15.5 % in 2013 to 19.7 % in 2019), while in males, the respective pre-pandemic trend has been stable or even somewhat decreasing (from 6.0 % to 5.5 %, respectively). These trends were unaffected by adjustments for sociodemographic factors, thus indicating independence from possible changes in these factors during the study period. Increases in depressive and anxiety symptoms during the 2010s as well as the sex-divergent trajectories have also been reported in previous studies (Thorisdottir et al., 2017; Mishina et al., 2018; Keyes et al., 2019; Wiens et al., 2020; Knaappila et al., 2021; Daly, 2022). Regarding age group differences, increases in our study were somewhat faster among older than younger age groups, especially among females. This is in line with Wiens et al. (2020) reporting stronger increases in symptoms among older adolescent and young adult females. Also, Keyes et al. (2019) reported more increases in older adolescents, but only among males.

It has been suggested that increased online behaviors, especially

social media use, increased educational and school pressures, and worries related to the climate change, together with an ever more rapidly changing society, could play a role in these developments (Twenge et al., 2018; Högberg et al., 2020; Högberg, 2021; Poletti et al., 2022). It is also possible that females are more vulnerable to experiencing these stressors and the related consequences, which could explain the sex-divergent trends. For example, social media use is more common among adolescent females than males (Twenge and Martin, 2020), while the correlation between social media use and depressive symptoms also seems to be higher in adolescent females than males (Twenge et al., 2018). Similarly, school stress and school burnout seem to have increased, especially among adolescent females (Högberg et al., 2020; Read et al., 2022). In their study Högberg et al. (2020) found an increasing trend in psychosomatic symptoms among Swedish adolescents in general and a widening gap between the sexes in reported symptoms, with females reporting more symptoms than males. While they found only weak evidence for educational stressors explaining the overall trend in symptoms, they found strong evidence for them to explain the growing gap between the sexes. The increasing trend in school stress they suggested to be related to a coincidental major school reform emphasizing goal-attainment and grading in schools (Högberg et al., 2020). In Finland, major school reform with a strong emphasis on goal-attainment also was implemented in 2016. However, the increasing trend in GA among females in our study seems already to have started between 2013 and 2015, which is in line with the study by Read et al. (2022), suggesting that an increase in school burnout among Finnish adolescent females was evident already from year 2012 onwards when cutbacks to school resources due to an economic recession took place. Nevertheless, in supplementary analyses between different school levels, we found among both females and males a faster increasing trend in GA in students from general upper secondary schools compared to students their age in vocational schools. Hence, further studies are needed to evaluate the role the school reforms at different levels might have played, if at all, in the increasing trend of GA in females, already prevalent before the COVID-19 pandemic.

Comparing the years 2019 and 2021, the effect of the COVID-19 pandemic on adolescents' anxiety levels was more prominent among females. However, when examining the prevalence of GA during the COVID-19 pandemic against projected levels based on the pre-pandemic trends in the 2010s, we discovered the actual effect of the COVID-19 pandemic on GA to be of equal size in both sexes. This result contrasts with many previous findings suggesting that the effect of COVID-19 has been stronger among females (Racine et al., 2021; Kauhanen et al., 2022), although there have been studies reporting no sex differences in the effects of COVID-19 on depressive symptoms (Xiang et al., 2020; Ren et al., 2021). Further, unlike some earlier research based on cross-sectional and retrospective data suggesting gender-diverse youth to be at increased risk for mental health difficulties during the pandemic (Hawke et al., 2021; Scott et al., 2021), we found no significant differences between cisgender and transgender groups regarding the effect of COVID-19 on the prevalence of GA. These differences in results may relate to the differences in the way pre-pandemic levels and trends in mental health measures have been included in the analyses and points to the importance of careful modeling when trying to estimate the effects of the COVID-19 pandemic (see e.g., Banks and Xu, 2020).

We found females and males to differ in how age was associated with the increase in GA during the pandemic. While the pre-pandemic trend among older females was increasing faster than in younger age groups, it was followed by a relatively moderate rise between 2019 and 2021 compared to younger age groups. In turn, the more moderate increase in the pre-pandemic trend among younger females was followed by a sharper rise between 2019 and 2021, resulting in a similar prevalence of GA in 2021 across all female age groups. This pattern of findings was more evident among females than males. Earlier research has indicated the COVID-19 pandemic has increased older adolescents' emotional symptoms (Racine et al., 2021; Kauhanen et al., 2022). However,

regarding anxiety specifically, Racine et al. (2021) did not find age to moderate its prevalence during the pandemic.

We also investigated whether GA would be correlated with regional pandemic severity and found no such association. In Finland, lockdown measures in the early phases of the pandemic (spring 2020) were very similar all over the country, although regional incidence rates varied. In contrast, at the time of the SHP study a year later, active lockdown measures depended more on pandemic severity. Some earlier studies have reported a higher incidence of COVID-19 infections and stricter confinement measures to be associated with higher levels of internalizing symptoms among adolescents (Tang et al., 2020; Zheng et al., 2020; Agostino et al., 2021; Fitzpatrick et al., 2021; Ren et al., 2021). One reason for the differences between these studies and our findings might be because regions in our study were based on relatively large geographical areas. Thus, more subtle differences between smaller-scale communities and living areas might have gone undetected. On the other hand, the regions in our study were based on administrative agencies that decided many of the COVID-19-related restrictions, including restrictions on schools, leisure time activities, and hobbies.

Finland, too, implemented school closures as part of lockdown efforts. At the time of the study, most adolescents from high schools and vocational schools had spent almost the entire 2020–2021 school year in online instruction but recently returned to in-person learning, whereas younger students in comprehensive schools had spent virtually the whole 2020–2021 school year in on-site instruction. Our results showed that the more time spent in online schooling, the more probable above threshold scoring was on GAD-7 in both males and females. This accords with the systematic review by Viner et al. (2022), reporting some evidence for mental health associations being stronger where school lockdown was more prolonged. One plausible explanation for the association is the reduction of social contacts, which might be especially detrimental in adolescence when the need for peer interaction is elevated (Orben et al., 2020). Other factors, such as reduced access to school health services, negative changes in sleeping behavior, decreased physical activity, and increased screen time, may also play a role. One further school-related reason for increased GA might be worries about not being able to cope with educational demands during remote learning, as has been reported in some previous studies (Samji et al., 2022). In our study, females reported more often than males an unmet need for support in learning while in remote education. And associations between these unmet needs for support and self-reported GA were quite strong, with odds ratios rising to 3.1 in females and 4.3 in males. However, here the possibility of reverse causation needs to be kept in mind, that is, self-reported GA may be associated with a higher need for support and therefore greater likelihood of unmet needs. Nevertheless, our findings and those from other studies indicate the challenges of remote learning arrangements and the various ill effects they likely have on adolescent mental health, thus warranting cautiousness on the part of policy makers when summoning school closures in possible future crises to come.

4.1. Strengths and limitations

A major strength of the study is the large population-based dataset with over 750,000 participants, good nationwide coverage, and generally high response rates. The study design of biennial assessments from 2013 to 2021 gave us a unique opportunity to reliably analyze the trend in self-reported generalized anxiety in youth in the 2010s and to demonstrate the effect of COVID-19 on top of this trend. However, it needs to be noted that in the analyses comprising all age groups, there is some overlap in the samples between two adjacent data collections (e.g., an eight-grader participating in the next round as a 1st year secondary student). This might have produced some bias to the estimates in the total sample analyses. This was not accounted in the analyses, as no means to link answer between data collection rounds was available. Using GAD-7, a validated and widely used measure to assess GA, is a strength, especially as its psychometric properties have been shown to

be good in the very same SHP data (Tiirikainen et al., 2019). However, the used cut-off ≥10 for GAD-7 is intended to indicate those with at least moderate levels of GA symptoms, not cases with GA disorder diagnosis – for that purpose the cut-off of 10 points would likely be too sensitive, without required specificity. Furthermore, this cut-off has not been validated against GA diagnosis in adolescents. Using only self-report measures is a limitation and mental disorder diagnoses cannot be confirmed based on these data. Nevertheless, there is international evidence suggesting that the widely reported increase in symptomatology trends reflects a true increase in the actual symptom burden and not merely changes in reporting behavior (Collishaw, 2015).

As the SHP is done anonymously and there are no identification numbers to enable linkage to official service use registers, we do not know, for example, whether the participants used psychotherapy or were prescribed psychotropic drugs during the pandemic. This information would have been needed to assess if and to what extent the mental health services were able to maintain or prevent even stronger increases in the prevalence of GA among the youth during the pandemic. More generally, we know from administrative registers that school services were in trouble during the pandemic, especially due to the health care personnel transfers to other, COVID-19-related tasks, while in specialized health care (e.g., psychiatric outpatient visits and rehabilitative psychotherapies) service use increased also during the pandemic. Some caution is warranted when generalizing the results to the whole Finnish youth population, as those not attending school at the time of the study or unwilling to participate may be at greater risk for mental distress, including symptoms of GA than those who took part in the study. Finally, due to the affordances of the large dataset, even small differences pass the test of statistical significance — this has been kept in mind when interpreting the results and drawing conclusions.

5. Conclusions

We found an increasing pre-pandemic trend in generalized anxiety in adolescent females but not males. On top of these trends, the impact of COVID-19 was very strong while of equal size in both sexes, thus contrasting many previous studies suggesting females to be more vulnerable to the ill effects of COVID-19. This highlights the importance of carefully modeling of pre-pandemic trends when assessing the effects of the COVID-19 pandemic. Considering the pervasive strain on adolescents' everyday life caused by COVID-19 measures, especially school closures and other restrictions on social life, the rise in prevalence of anxiety is no surprise — especially when taking place at a phase of life with an elevated need for peer contacts and a desire for independence, autonomy, and future orientation. Despite awareness of increasing distress among young people during and in the aftermath of the COVID-19 pandemic, school-based health services, being essential low-threshold services for adolescents, have in most areas been less accessible because of remote learning arrangements and transfers of school health care personnel to COVID-19-related work. In 2022, these services have not yet been entirely restored. The contrast between increased distress and decreased access to health care facilities, including school health care services, has resulted in unmet needs for mental health services, most strongly affecting already vulnerable adolescents. Further research and follow-ups both at individual and population levels are warranted regarding the short and long-term effects of the COVID-19 pandemic on mental health, but also on the development of mental health trends, their causes, and their correlates.

CRediT authorship contribution statement

OK and TA-S were primarily responsible for writing of the article. OK conducted the data analyses. All authors together conceptualized the paper. HH, ML, ST, MM, JS commented on the drafts and contributed critically to the writing of the article. All authors have approved the final article.

Conflict of interest

The authors declare no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2023.03.010.

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