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# **BMJ Open** Anxiety symptoms and associated factors among school students after 2 years of the COVID-19 pandemic: a cross-sectional study in Zhejiang Province, China

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#### ABSTRACT

**Objectives** To ascertain the prevalence and associated factors of anxiety symptoms among middle and high school students in Zhejiang after 2 years of the COVID-19 pandemic.

**Design** A school-based cross-sectional study. **Setting** 30 counties/districts in Zhejiang Province, China. **Participants** 27 019 students attending middle and high schools.

**Outcome measures** Anxiety symptoms were assessed using the Generalised Anxiety Disorder 7-item scale (GAD-7). A total score of 10 or more is considered indicative of anxiety symptoms.

Results The overall prevalence (95% CI) of anxiety symptoms was 14.2% (13.4 to 15.0), higher among girls (18.6%, 95% CI: 17.5 to 19.7) than boys (10.2%, 95% CI: 9.5 to 10.9) (p<0.001), higher among rural students (15.1%, 95% CI: 14.1 to 16.2) than urban students (12.5%, 95% CI: 11.6 to 13.4) (p<0.001). Older age (14-15 years, OR=1.25, 95% CI: 1.09 to 1.44; ≥16 years, OR=1.32, 95% CI: 1.07 to 1.63), being girls (OR=1.76, 95% CI: 1.58 to 1.96), living in rural areas (OR=1.14, 95%CI: 1.01 to 1.29), poor academic performance (OR=1.20, 95% CI: 1.03 to 1.41), alcohol drinking (OR=1.15, 95% CI: 1.01 to 1.30), inadequate fruits (OR=1.31, 95% CI: 1.19 to 1.45) and vegetables intake (OR=1.32, 95% CI: 1.10 to 1.57), insomnia (sometimes, OR=2.14, 95% CI: 1.93 to 2.38; often/always, OR=4.73, 95% CI: 4.03 to 5.56), loneliness (sometimes, OR=2.97, 95%Cl: 2.59 to 3.41; often/always, OR=8.35, 95% CI: 7.20 to 9.69), sadness (OR=2.51, 95% Cl: 2.25 to 2.79) and physical fight (OR=1.29, 95% Cl: 1.13 to 1.48) were positively associated with anxiety symptoms, while studying at vocational high school (OR=0.61, 95% CI: 0.49 to 0.75), coming from family with middle income (OR=0.76, 95% CI: 0.64 to 0.89), being physically active 3-7 days weekly (OR=0.85, 95% CI: 0.75 to 0.95) were negatively associated with anxiety symptoms. Conclusion Anxiety symptoms prevailed among middle and high school students in China. A variety of factors, containing sociodemographic factors, lifestyle behaviours, mental health, academic performance and physical fight should be taken in consideration in addressing prevention and intervention of anxiety symptoms.

### STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This is a school-based study with a large sample size, a high response rate and a standardised procedure.
- ⇒ The questionnaire includes a wide range of factors, which might help us better understand how to prevent anxiety symptoms among adolescents.
- ⇒ The nature of cross-sectional study constrains establishment of the temporal relationship of associated factors with anxiety symptoms.
- ⇒ All data came from self-report. The indicated levels of anxiety may not always be in accordance with the appraisal of mental health professionals.

### INTRODUCTION

≥ Anxiety disorders are the most common training, mental health worldwide. The estimated incident anxiety disorders case number increased from 31.1 million in 1990 to 45.8 million in 2019 globally, with corresponding prevalent cases increasing from 194.9 million to 301.4 million.<sup>1</sup> There was 7.3 million incident anxiety disorders case in China (https://vizhub.healthdata.org/ gbd-results/), approximately accounting for 15.9% of the global total. Incident in China (https://vizhub.healthdata.org/ rate of anxiety disorders reached a peak @ at age of 10-14 years during the whole **3** life span, due to childhood abuse<sup>2</sup> and corporal punishment,<sup>3</sup> etc. Anxiety ranks as the ninth leading cause of disease and disability among adolescents of 15-19 years, and sixth for those aged 10-14 years worldwide.<sup>4</sup> Adolescents had a higher prevalence of anxiety symptoms than adults.<sup>5</sup> Anxiety is the painful feeling that people typically recognise as uneasiness, apprehension or

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worry.<sup>6</sup> Long-term and untreated anxiety disorders were not only associated with chronic diseases, including hypertension,<sup>7 8</sup> myocardial infarction,<sup>9</sup> dyslipidaemia,<sup>9</sup> obesity,9 diabetes,9 temporomandibular myalgia and migraine,<sup>10</sup> but also with committing suicide.<sup>11</sup> The prevalence of anxiety disorders varied across the world.

Numerous studies have described the patterns of anxiety symptoms among adolescents elsewhere. However, most studies focused on college students,<sup>13-15</sup> small sample size,<sup>16–19</sup> non-random sampling,<sup>20–24</sup> confined in specific cities.<sup>17-19</sup> The 2019 novel COVID-19 first outbroke in China, and was later declared a public health emergency of international concern by WHO in January 2020.<sup>25</sup> The outbreak of COVID-19 may increase anxiety and depres-sion among the public.<sup>26 27</sup> Adolescents who got used to routine activities were particularly vulnerable to the psychological effects of COVID-19 pandemic and its associated infection control measures.<sup>28</sup> However, majority of those studies were conducted before 2020 or at the early stage of COVID-19 pandemic (ie, first half year of 2020).<sup>13 14</sup> In addition, the effect of COVID-19 pandemic on adolescent mental health is not in full consensus. While some studies indicated that COVID-19 pandemic might increase the prevalence of mental health (eg, anxiety symptoms and depression symptoms) among adolescents,<sup>29</sup> a nationally representative study of 12–18 years South Korean adolescents demonstrated that the prevalence of suicidal ideation decreased from 13.5% to 10.9% between 2019 and 2020, with suicidal attempts from 2.8% to 2.0%,<sup>30</sup> and a longitudinal study of 1952 Chinese middle and high school students documented that the differences in anxiety and depression symptoms between before and during COVID-19 pandemic were not statistically significant.<sup>31</sup> Furthermore, scarce studies pay attention to the association of dietary behaviours with anxiety symptoms among adolescents. Hence, the current study was designed to describe the prevalence and associated factors of anxiety symptoms among middle and high school students in Zhejiang Province, China.

### **METHODS**

### Survey design and participants

A multistage cluster sampling design was carried out. In stage one, 30 counties/districts were sampled at random from all 90 counties/districts. In stage two, 11 classes of middle school, 6 classes of academic high school and 6 classes of vocational high school were selected at random from each chosen county/district. In stage three, all students in every selected class were invited to participate in the study. Inclusion criteria included: (1) students in the selected class; (2) returning signed informed written consent and exclusion criteria was having serious health condition or illness that would prevent students from participating, including intellectual disability or language disorder.

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validity.<sup>35</sup> Cronbach's alpha was between 0.90 and 0.92.<sup>33 36</sup> The GAD-7 scale has been widely utilised among adolescents in previous studies.<sup>32 37</sup>

### Main covariates

Covariates in the present study consisted of sociodemographic factors (birthdate, gender, region, types of school, parental education, parental marital status and family income), lifestyle behaviours (ie, cigarettes smoking, alcohol drinking, physical activity, dietary habit and insomnia), academic performance, mental health (ie, loneliness and sadness) and physical fight. Cigarettes smoking was defined as smoking cigarettes at least 1 day in the past 30 days. Alcohol drinking was defined as drinking alcohol at least 1 day in the past 30 days. Sadness was defined as ever experiencing feel sad or hopeless almost every day for 2 weeks or more in a row and stopped doing some usual activities in the past 12 months. Physical fight was defined as ever being involved in a physical fight at least once in the past 12 months.

#### Statistical analysis

A weighting factor was applied at the student-level to adjust for non-response and for the varying probabilities of selection.<sup>38</sup> Continuous variables were presented as mean±SD. Categorical variables were presented as percent and 95% CI. Weighted prevalence was calculated using the PROC SURVEYFREQ procedure. To ascertain the associations of each correlating factor with anxiety symptoms, univariate and multivariable logistic regression analyses were utilised using the PROC SURVEYLOGISTC procedure, to take into account the complex survey sampling methods. In univariate logistic regression, each variable was entered into a regression model. In multivariable logistic regression, all variables were entered simultaneously into model, and each OR was adjusted for all other variables. All these variables were reported to be associated with anxiety symptoms in previous papers.<sup>12 32 39-46</sup> All statistical analyses were conducted using SAS software V.9.4 (SAS Institute, Cary, North Carolina, USA). Statistical significance was determined as a two-sided p value<0.05.

#### RESULTS

#### **Descriptive statistics**

Overall, 28043 middle and high school students were invited to participate. Of whom 114 refused to participate and 859 were absent from school on the survey day, yielding a response rate of 96.5%. Owing to 51 incomplete questionnaires, 27019 eligible participants with a mean age of 15.7±1.7 years, comprising 13939 boys and 13080 girls, were included in the ultimate analyses.

Of the 27019 students, 35.3% came from urban areas; 51.8% were middle school students; 12.4% came from non-intact families; 55.2% of students' paternal educational level was middle school or below; 58.7% of students' maternal educational level was middle school or below; 5.5% of students came from low-income families;

55.0% of students reported being physically active  $\geq 3$  days weekly; 30.5% of students reported having poor academic performance; 3.9% of students smoked cigarettes in the past 30 days; 16.0% of students drank alcohol in the past 30 days; 29.0% of students consumed fruits less than once daily; 8.0% of students consumed vegetables less than once daily; 72.3% of students ite. suffered from insomnia; 13.1% of students often or always felt lonely and 13.7% of students reported ever engaging in physical fight in the past 12 months. than once daily; 10.2% of students consumed milk less

ŝ inclined to be old (table 1), to be girls (62.2% vs 45.0%), to come from rural areas (68.9% vs 64.0%), to be from **2** academic high school (28.9% vs 25.6%), to living in families with low or very low income (9.8% vs 4.8%), to have poor academic performance (39.6% vs 29.0%), to smoke cigarettes (6.5% vs 3.5%), to drink alcohol (24.4%vs 14.6%), to consume fruits less than once daily (38.1%)vs 27.5%), to consume vegetables less than once daily (12.0% vs 7.3%), to consume milk less than once daily (13.2% vs 9.8%), to feel lonely often or always (47.8% vs uses related 7.4%) or sad (49.5% vs 12.6%) and were less inclined to come from intact families (82.6% vs 88.4%), to be physically active. No significant difference was observed in parental education level by anxiety symptoms (p>0.05).

#### Prevalence of anxiety symptoms

The overall prevalence (95% CI) of anxiety symptoms was 14.2% (13.4 to 15.0) (table 2), higher among girls (18.6%, 95% CI: 17.5 to 19.7) than boys (10.2%, 95% CI: 9.5 to 10.9) (p<0.001), higher among rural students (15.1%, đ 95% CI: 14.1 to 16.2) than those living in urban areas (12.5%, 95% CI: 11.6 to 13.4) (p<0.001). The prevalence (95% CI) among students aged≤13 years, 14–15 years and ≥16 years was 12.7% (11.4–14.1), 15.5% (14.1–16.8) and 13.9% (12.9–14.9), respectively. The prevalence (95%) CI) among students attending middle school, academic ß high school and vocational high school was 14.4% (13.2-15.6), 15.7% (14.4–17.1) and 11.8% (10.4–13.2), respectively (p<0.001). In addition, the overall prevalence (95%) CI) of anxiety symptoms with a positive threshold≥5 was 45.5% (44.1–46.7), and the prevalence (95% CI) of mild, moderate and severe anxiety symptoms were 31.3% technologies (30.4–32.2), 9.2% (8.7–9.7) and 5.0% (4.6–5.4), respectively (additional file 1: online supplemental table S1).

#### Logistic regression analysis

After adjusting for other variables included in the model, multivariable logistic analyses indicated that, compared with those aged≤13 years, the OR (95% CI) of anxiety symptoms for students aged 14–15 years and  $\geq 16$  years were 1.25 (1.09-1.44) and 1.32 (1.07-1.63), respectively (table 3). Girls had a 1.8 (OR=1.76, 95% CI: 1.58 to 1.96) times higher probability of anxiety symptoms than boys (p<0.001). Students living in rural areas were 1.1 times more likely to suffer from anxiety symptoms in

to text

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Characteristics	Total	Without anxiety symptoms	With anxiety symptoms	P value
	(n=27019)	(n=23274)	(n=3745)	
Age range (years)		· · · ·		0.008
≤13	5595 (22.3)	4909 (22.7)	686 (20.1)	
14–15	8579 (33.8)	7277 (33.3)	1302 (36.9)	
≥16	12845 (43.9)	11 088 (44.0)	1757 (43.0)	
Gender				<0.001
Boys	13939 (52.6)	12521 (55.0)	1418 (37.8)	
Girls	13080 (47.4)	10753 (45.0)	2327 (62.2)	
Area				<0.001
Urban	10796 (35.3)	9438 (36.0)	1358 (31.1)	
Rural	16223 (64.7)	13836 (64.0)	2387 (68.9)	
Types of school	. ,			0.001
Middle school	12767 (51.8)	10987 (51.7)	1780 (52.7)	
Academic high school	7378 (26.1)	6199 (25.6)	1179 (28.9)	
Vocational high school	6874 (22.1)	6088 (22.7)	786 (18.4)	
Parental marital status	· /	· · /	. ,	< 0.001
Married	23530 (87.6)	20457 (88.4)	3073 (82.6)	
Others	3489 (12.4)	2817 (11.6)	672 (17.4)	
Paternal education level		. ,	. ,	0.62
Viddle school or below	14947 (55.2)	12869 (55.1)	2078 (55.8)	
High school	7176 (26.0)	6206 (26.1)	970 (25.2)	
College or above	4896 (18.8)	4199 (18.8)	697 (19.0)	
Vaternal education level		× /	. ,	0.40
Viddle or below	15985 (58.7)	13758 (58.6)	2227 (59.3)	
High school	6383 (23.2)	5488 (23.2)	895 (23.6)	
College or above	4651 (18.1)	4028 (18.2)	623 (17.1)	
Family income		. ,	. ,	<0.001
Very low/low	1572 (5.5)	1189 (4.8)	383 (9.8)	
Viddle	23157 (85.6)	20160 (86.6)	2997 (79.8)	
Very high/high	2290 (8.9)	1925 (8.6)	365 (10.4)	
Physical activity (day/week)			. ,	< 0.001
0	5410 (19.9)	4429 (18.9)	981 (26.3)	
1–2	6821 (25.1)	5882 (25.1)	939 (25.1)	
3–7	14788 (55.0)	12 963 (56.0)	1825 (48.6)	
Academic performance	· · · · · · · · · · · · · · · · · · ·			< 0.001
Excellent	5287 (19.6)	4680 (20.3)	607 (15.7)	
Middle	13484 (49.9)	11 841 (50.7)	1643 (44.7)	
Poor	8248 (30.5)	6753 (29.0)	1495 (39.6)	
Cigarettes smoking	1115 (3.9)	860 (3.5)	255 (6.5)	< 0.001
Alcohol drinking	4463 (16.0)	3527 (14.6)	936 (24.4)	< 0.001
Fruits intake<1 time/dav	7823 (29.0)	6407 (27.5)	1416 (38.1)	< 0.001
Vegetables intake<1 time/dav	2170 (8.0)	1713 (7.3)	457 (12.0)	< 0.001
Milk intake<1 time/dav	2690 (10.2)	2205 (9.8)	485 (13.2)	< 0.001
nsomnia	()			< 0.001
Never/occasional	19591 (72.3)	18284 (78.5)	1307 (34.5)	
	. ,			Continue

Characteristics	Total	Without anxiety symptoms	With anxiety symptoms	P value	
Sometimes	5376 (20.0)	4068 (17.5)	1308 (35.3)		
Often/always	2052 (7.7)	922 (4.0)	1130 (30.2)		
Loneliness				<0.001	
Never/occasional	16899 (62.2)	16116 (69.1)	783 (19.9)		
Sometimes	6697 (24.7)	5494 (23.5)	1203 (32.3)		
Often/always	3423 (13.1)	1664 (7.4)	1759 (47.8)		
Sadness	4783 (17.8)	2947 (12.6)	1836 (49.5)	< 0.001	
Physical fight	3573 (13.7)	2846 (12.6)	727 (20.5)	<0.001	
Number in brackets are weighte	ed proportions.				

comparison with their counterparts living in urban areas (OR=1.14, 95% CI: 1.01 to 1.29) (p=0.031). Compared with students attending middle school, those attending vocational high school had lower probability of anxiety symptoms (OR=0.61, 95% CI: 0.49 to 0.75) (p<0.001). Students from family with middle income was 0.8 times more likely to suffer from anxiety symptoms in comparison to those from families with very low or low income (OR=0.76, 95% CI: 0.64 to 0.89) (p<0.001). Compared with students who were physically inactive within the past 7 days, students who were physically active on 3-7 days had lower probability of anxiety symptoms (OR=0.85, 95% CI: 0.75 to 0.95) (p=0.007). Students with poor academic performance were 1.2 times more likely to suffer from anxiety symptoms in comparison to their counterparts with excellent academic performance (OR=1.20, 95% CI:

Table 2 Weighted prevalence of anxiety symptoms by characteristics				
	Prevalence (95% Cl)	P value		
Age (years)		0.008		
≤13	12.7 (11.4 to 14.1)			
14–15	15.5 (14.1 to 16.8)			
≥16	13.9 (12.9 to 14.9)			
Gender		< 0.001		
Boys	10.2 (9.5 to 10.9)			
Girls	18.6 (17.5 to 19.7)			
Area		<0.001		
Urban	12.5 (11.6 to 13.4)			
Rural	15.1 (14.1 to 16.2)			
Types of school		0.001		
Middle school	14.4 (13.2 to 15.6)			
Academic high school	15.7 (14.4 to 17.1)			
Vocational high school	11.8 (10.4 to 13.2)			
Prevalence was based	on the weighted data.			

ison to non-drinkers (OR=1.15, 95% CI: 1.01 to 1.30) (p=0.031). Students consuming fruits less than once daily was 1.3 times more likely to suffer from anxiety symptoms in comparison to those consuming fruits at least once daily (OR=1.31, 95% CI: 1.19 to 1.45) (p<0.001), and the corresponding ORs (95% CI) for consuming vegetables and consuming milk were 1.32 (1.10-1.57) (p=0.003) and 1.11 (0.94–1.30) (p=0.208), respectively. Compared with students suffering from insomnia never or occasionally, those suffering sometimes and often or always were 2.1 times (OR=2.14, 95% CI: 1.93 to 2.38) and 4.7 (OR=4.73, 95% CI: 4.03 to 5.56) times, respectively, more likely to experience anxiety symptoms (p<0.001). Students who sometimes and often or always felt lonely were 3.0 times (OR=2.97, 95% CI: 2.59 to 3.41) and 8.4 times (OR=8.35, 95% CI: 7.20 to 9.69), respectively, more likely to experience anxiety symptoms than those never or occasionally felt lonely (p<0.001). Students who ever felt sad d had a 2.5 times higher odds of anxiety symptoms than  $\triangleright$ those without sadness (OR=2.51, 95% CI: 2.25 to 2.79) (p<0.001). Students being involved in physical fight had a 1.3 times higher odds of anxiety symptoms than those without physical fight (OR=1.29, 95% CI: 1.13 to 1.48) (p<0.001).

### DISCUSSION

and similar technol In this provincially representative study of middle and high school students from China, 14.2% of middle and high school students have anxiety symptoms, and sociodemographic factors (age, gender, living area and family **3** income), lifestyle behaviours (alcohol drinking, physical activity, fruits intake, vegetables intake and insomnia), mental health (loneliness and sadness), academic performance and physical fight were associated with anxiety symptoms among adolescents.

### Prevalence of anxiety symptoms

An updated meta-analysis of 604491 primary and secondary school students or children and adolescents≤18

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Variables	Crude ORs	P value	Adjusted OBs	P value
Age range (ref. $\leq$ 13 years)	1 26 (1 10-1 44)	0.001	1 25 (1 00_1 44)	0 002
14-13	1.11 (0.06, 1.20)	0.16	1.23 (1.03-1.44)	0.002
210 Girls (raf: bays)	2.01 (1.95.2.19)	<0.001	1.32 (1.07-1.03)	<0.011
Burel (ref: urben)	1.05 (1.11, 1.41)	<0.001	1.14 (1.01.1.20)	0.001
Turas of school (rof: middle school)	1.25 (1.11–1.41)	<0.001	1.14 (1.01–1.29)	0.031
	1 11 (0 06 1 28)	0 1/7	0.06 (0.70, 1.17)	0.679
	0.80 (0.68, 0.04)	0.147	0.90 (0.79–1.17)	<0.070
Perental marital status (raf: marriad)	0.80 (0.86–0.94)	0.007	0.01 (0.49-0.75)	<0.001
	1 60 (1 40 1 84)	<0.001	1 10 (0 04 1 20)	0.021
Deternal advantion lovel (ref: middle or below)	1.00 (1.40-1.04)	<0.001	1.10 (0.94–1.29)	0.231
High school		0.325	1 00 (0 80 1 13)	0.074
	1.00 (0.80, 1.12)	0.325	1.00 (0.09-1.13)	0.974
Maternal education lovel (ref: middle or below)	1.00 (0.89–1.13)	0.974	1.07 (0.90-1.27)	0.400
	1 00 (0 01 1 11)	0.028	1 02 (0 00 1 16)	0 711
	0.03 (0.82-1.05)	0.320	1.02 (0.90-1.10)	0.711
Eamily income (ref: yery low/low)	0.33 (0.82-1.03)	0.220	1.01 (0.05-1.20)	0.941
	0 45 (0 30-0 52)	<0.001	0.76 (0.64-0.89)	~0.001
Very high/high	0.43 (0.39-0.32)	<0.001	0.95 (0.76_1.18)	0.001
Physical activity (ref: none)	0.00 (0.40-0.72)	<0.001	0.00 (0.70-1.10)	0.020
1_2 day/week	0.71 (0.63_0.80)	<0.001	0.87 (0.75_1.01)	0.075
3-7 day/week	0.62 (0.56-0.69)	<0.001	0.85 (0.75-0.95)	0.073
Academic performance (ref: excellent)	0.02 (0.00-0.00)	<0.001	0.00 (0.70-0.00)	0.007
	1 1/ (1 02_1 27)	0.02	1 01 (0 88-1 16)	0.866
Poor	1.76 (1.55–2.01)	<0.02	1 20 (1 03–1 41)	0.000
Cigarettes smoking	1.92 (1.59-2.32)	<0.001	1 12 (0 92–1 37)	0.02
Alcohol drinking	1.89 (1.69–2.11)	<0.001	1 15 (1 01–1 30)	0.201
Fruits intake<1 time/day	1 62 (1 48–1 78)	<0.001	1.31 (1.19–1.45)	<0.001
Vegetables intake<1 time/day	1 72 (1 49–1 98)	<0.001	1 32 (1 10–1 57)	0.003
Milk intake<1 time/day	1 39 (1 24–1 57)	<0.001	1 11 (0 94–1 30)	0.208
Insomnia (ref: never/occasional)				0.200
Sometimes	4 60 (4 18–5 07)	<0.001	2 14 (1 93–2 38)	<0.001
Often/always	17.2 (15 2–19 6)	<0.001	4.73 (4.03–5.56)	<0.001
oneliness (ref: never/occasional)	11.2 (10.2 10.0)	.0.001		<0.001
Sometimes	4,78 (4,18–5,46)	<0.001	2.97 (2.59-3.41)	<0.001
Often/always	22 4 (19 6-25 7)	<0.001	8 35 (7 20-9 69)	<0.001
Sadness	6.79 (6.23–7.40)	<0.001	2.51 (2.25-2.79)	<0.001
Dhysical fight	1 70 (1 60 2 00)	<0.001	1.00 (1.12, 1.40)	<0.001

Adjusted ORs are adjusted for all other covariates in the model.

years included 27 studies published between January 2020 and October 2022, with GAD-7 scale as screening tool and score≥5 as a positive threshold of anxiety symptoms, and the results of which documented that the prevalence of anxiety symptoms was 35%.<sup>39</sup> The prevalence of anxiety symptoms with a positive threshold≥5 in our study

was 45.5%, higher than the results of the aforementioned meta-analysis, implying that the prevalence of anxiety symptoms among adolescents may be underestimated worldwide. One study of 50361 Chinese primary and secondary school students from five Provinces conducted between 2008 and 2015 observed that the prevalence

of anxiety was 7%.40 Another survey of 8079 Chinese junior and senior high school students from 21 Provinces conducted in March 2020 indicated that the prevalence of moderate and severe anxiety symptoms (ie, the score of GAD-7 not less than 10) was 10.4%.<sup>32</sup> The prevalence of anxiety symptoms in the present study was higher than the results of the two studies above. One possible explanation was variation of geographic regions and survey year. Another explanation was long-term of COVID-19 epidemic might increase the prevalence of anxiety symptoms. A longitudinal study of 164101 Chinese college students revealed that the prevalence of probable acute stress symptoms decreased, while the prevalence of anxiety and depressive symptoms increased from the COVID-19 outbreak to the COVID-19 remission stage.<sup>29</sup> Kastner and colleagues surveyed 840 8- to 18-year-old German children and adolescents, and found that they continued to exhibit low health-related quality of life 2 years after the outbreak of the COVID-19 pandemic.<sup>47</sup> Hence, the present study sheds light on the importance of strengthening surveillance of anxiety symptoms among adolescents in postepidemic era of COVID-19 and observing the long-term effect of pandemic of COVID-19 on adolescent mental health. In line with previous studies,<sup>48 49</sup> girls had a higher prevalence of anxiety symptoms than boys.

### Associated factors of anxiety symptoms

Association of sociodemographic factors with anxiety symptoms in the present study was consistent with most previous studies. Older age,<sup>32</sup> living in rural coming from family with low income,<sup>40 42</sup> areas, were positively associated with anxiety symptoms, and there was no association between maternal education level and adolescent anxiety symptoms.<sup>50</sup> In align with previous studies,<sup>40 43</sup> poor academic performance was positively related to anxiety symptoms. Zhou and colleagues found students attending high school had higher odds of anxiety symptoms than those attending middle school during the outbreak of COVID-19.<sup>3</sup> However, they failed to differentiate academic and vocational high school. Students attending vocational high school had lower odds of anxiety symptoms than those attending middle school after adjusting for all other covariates in the present study.

An inverse correlation of high-intensity activity with anxiety symptoms was documented in the findings of Korea Youth Health Behavior Survey 2021.49 Additionally, a school-based survey of 11110 adolescents from 10 European countries demonstrated that frequent physical activity was found to independently contribute to lower levels of anxiety symptoms,<sup>51</sup> similar with the present results. Our study extended evidence that physical activity may be an effective approach to addressing anxiety symptoms among adolescents. A cross-sectional study of 1074 college students indicated that frequent consumption of alcohol was significantly associated with anxiety symptoms,<sup>44</sup> consistent with the present study. A study of <page-header><page-header><text><text><text><text>

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limitations need to be mentioned. First, the nature of cross-sectional study constrains establishment of the temporal relationship of associated factors with anxiety symptoms. Second, all data came from selfreport. The indicated levels of anxiety may not always be in accordance with the appraisal of mental health professionals. Large-scale longitudinal studies are needed to track the effect of COVID-19 pandemic on physical and mental health, and to establish the temporal relationship of influencing factors with adolescent anxiety disorders in the future.

#### **CONCLUSIONS**

Our findings might provide insights on prevention and intervention of adolescent anxiety symptoms, and shed light on the associated factors of anxiety symptoms among middle and high school students in Zhejiang China. We found that anxiety symptoms remain prevailing among adolescents after 2 years of the COVID-19 pandemic. A variety of correlates, including sociodemographic factors, lifestyle behaviours, mental health and physical fight should be taken in consideration in solving adolescent anxiety symptoms.

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