Original Article

Depression and Anxiety Plus Levels of Stress among Secondary School Students during the COVID-19 Lockdown: an Online Cross-Sectional Survey

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Abstract:

Objective: To assess prevalence and factors associated with depression, anxiety and stress among adolescents experiencing lockdown during the 2019 coronavirus disease 2019 (COVID-19) in both Asian and Western countries.

Material and Methods: From May–June 2020, secondary school students were enrolled in an online cross-sectional survey, through social media; including, but not limited to, Instagram, Snapchat, WhatsApp and LINE. We assessed the presence and severity of depression (Patient Health Questionnaire-9), anxiety (Generalized Anxiety Disorder Scale-7) and stress (Perceived Stress Scale-10) within the last month, and assessed significant associations with demographics, degree of social distancing, and other associated issues using univariate and multivariate logistic regression analyses.

Results: From 392 respondents (56.4% male, 43.1% female), from Thailand (59.2%), the United Kingdom (26.5%) and other countries (14.3%), we identified depressive symptoms in 58.7%, anxiety in 40.3% and high levels of stress in 9.7%. By multivariate analysis, we found significant associations between being female and depression and anxiety, being in late secondary school years and depression, and changes in patterns of substance use and anxiety and stress. Participants not located in Thailand had increased risk of depression.

Conclusion: Our study demonstrated depression, anxiety and stress in six, four and one out of ten adolescents, respectively, who were experiencing lockdowns due to the COVID-19 pandemic. We found female gender, older school years, and changes in substance use patterns to be significantly associated with these mental health conditions.

Keywords: COVID, mental health, secondary school students

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Introduction

Due to the current 2019 novel coronavirus (SARS-CoV-2) pandemic, many governments have initiated unavoidable social distancing measures in an attempt to slow the spread of this disease. These were in the form of widespread lockdowns, of varying severity, as well as other ways; such as, closure of specific venues and curfews. These government enforced citywide lockdowns are not however unheard of; having been previously implemented in countries; such as, Canada and China during the 2003 severe acute respiratory syndrome (SARS) outbreaks, and efforts were made to quarantine whole villages in West Africa during the 2014 Ebola outbreak.[1] For adolescents, such lockdowns result in school closures, having to learn online, exam cancellations as well as being restricted socially in other ways. By the end of July 2020, over a billion enrolled learners were still not learning in the previously "normal" way of education.[2]

In today's world, adolescent mental health problems are becoming increasingly apparent. Adolescence can prove to be a crucial time of mental development, plagued with higher risks of developing psychiatric disorders, and both children and adolescents have been shown to be one of the most vulnerable groups with regards to mental health during extended periods of isolation.[3] Furthermore, adolescents have been identified as a population vulnerable to mental health issues; specifically during the coronavirus disease 2019 (COVID-19) pandemic, with risk factors; such as, loss of peer support because of school closures, and academic loss.[4]

In general, lockdowns and their associated elements of social and physical distancing elicit a toll on mental health; the World Health Organization affirms that social dysfunction will result in elevated prevalence of psychiatric illnesses.[5] Hawryluck et al. showed that people quarantined in Toronto, Canada, during the 2004, SARS outbreak displayed a high prevalence of depression.[6] Jeong et al. also reported higher rates of anxiety among individuals during their isolation period compared to 4 – 6 months after isolation, due to the 2015 Middle East Respiratory Syndrome (MERS) outbreak in Korea.[7] More recently, Huang and Zhao have identified a "major mental health burden" on the Chinese public amid the COVID-19 outbreak.[8]

Since the pandemic's inception, there have been some studies conducted that have begun to assess how COVID-19 social distancing and isolation can lead to adverse mental health effects[8,9], and further consequences; such as, substance abuse.[10-13] However, evidence and data on how large-scale public health measures affect adolescent mental health outcomes is scarce.[14] Xie et al. report higher prevalence of depression and anxiety among primary school children in home confinement during a Chinese nationwide school closure.[15] Zhou et al. additionally, described similar findings with Chinese high school students.[16] Despite this, there have not been any studies examining the disparities between mental health impacts from country to country, nor certain associated factors; such as, adolescent substance use.

Despite the almost universal presence of the pandemic, different countries along with their citizens have had differing experiences in terms of COVID-19 severity and policies. For example, Thailand and the United Kingdom (UK) are two countries which, despite similar population sizes, have experienced very different trajectories regarding the COVID-19 outbreak. Thailand reported the first case of COVID-19 outside of China on 13 January 2020[17], with the virus reaching the UK shortly after this later in the same month;[18] in response, social distancing measures were implemented by both governments. On 21 March 2020, the Bangkok Metropolitan Administration authority declared a widespread shutdown of various businesses, and a national public state of emergency was declared on the 25 of March, with the general lockdown and social distancing requirements instituted on the 26 of March; whereas, in

the UK the governmental response was initially in the form of guidance. As the situation escalated, legislation was enacted in the form of statutory instruments. These included: implementing the closure of schools, businesses and non-essential services, restrictions on movement and gatherings, and their enforcement; with a stay-at-home order coming into effect on the 26 of March. Despite taking action at similar times, the two countries currently find themselves in dissimilar situations. Since then, as of 7 September 2020, Thailand has had 3,445 COVID-19 cases, compared to 347,152 cases in the UK, with the death rates, per million people, differing substantially: 0.8 for Thailand, but 611 for the UK (making it the sixth-highest death rate per million people globally among major countries).[19]

Therefore, we aimed to pilot assess the impact of lockdowns and social distancing on the mental health of secondary school students; including, the degree and prevalence of depression, anxiety and stress, as well as how lockdown-specific associated factors can impact this. However, there were no geographical boundaries, due to the use of an online survey.

Material and Methods

We advertised a study survey link launched, initially to students based mainly in Thailand and the UK, via snowball sampling on social media popular with youths; including but not limited to: Instagram, Snapchat, WhatsApp and LINE. The location of the study had no physical space, and participants instead accessed the digital platform of *Google Forms* on an online system. Further distribution of the survey link was conducted by earlier participants via instant messaging as well as 'story reposts'. In order to answer the questions, participants had to be enrolled in school from Year 8 (Grade 7) to Year 13 (Grade 12), and be able to understand, read and write (type) in English.

Consent by action was obtained via a digitalised consent form, explaining the objectives and contents of the survey as well as potential risks and intended benefits. We designed the online survey layout such that no study procedures would occur prior to the participant giving informed consent. Despite most participants being under 18, parental consent was waived, due to the anonymous nature of the survey. The survey was anonymised by excluding any questions requesting personally identifiable information. The study was approved by the Institutional Review Board of the Faculty of Medicine, Chulalongkorn University.

The cross-sectional survey on mental health was created using the online service Google Forms, and participants could access the survey and answer questions on it. The survey was open to responses from May to June 2020. Content included: diagnostic instruments used to assess symptoms of depression, anxiety and stress, but also questions designed to identify general demographics, degree of social distancing and other associated factors. Open-ended questions were also implemented in order to allow participants to expand on certain issues or topics. Prior to official deployment, 10 individuals were selected to test the questionnaire. These individuals were specifically selected, so that feedback obtained later on was based on demographically diverse opinions.

The 9-item Patient Health Questionnaire-9 (PHQ-9) was used to assess depressive symptoms. PHQ-9 forms the depression module of the Patient Health Questionnaire (PHQ), which is the self-administered version of the Primary Care Evaluation of Mental Disorders (PRIME-MD) diagnostic tool, developed by Pfizer: it has been validated for adolescent use.[20] Participants scored their frequency of experience, with each of the nine Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV) criteria over the last two weeks (e.g. poor appetite or overeating, feeling tired or having little energy, with their 4-point Likert-scale ratings representing frequencies ('0' is not at all, '1' is several days, '2' is more than half the days, '3' is nearly every day). Scores were then totalled, with cut off points

correlating to level of perceived depression (0–4=none, 5–9=mild, 10–14=moderate, 15–19=moderately severe, 20–27=severe). Participants who scored above 4 were considered to exhibit depressive symptoms.

The 7-item Generalized Anxiety Disorder Scale (GAD-7) was used to assess anxiety symptoms. The GAD-7 items correspond with DSM-IV criteria using the same 4-point Likert-scale ratings, as PHQ-9, to assess frequency of experience with criteria over the last two weeks, and thus presence and severity of anxiety. Participants rated each item, and scores were then totalled. Cut-off points correlating to level of perceived anxiety were: 0–4=none, 5–9=mild, 10–14=moderate, 15–21=severe. Participants who scored above 4 were considered to exhibit anxiety symptoms.

The Perceived Stress Scale (PSS-10)[21,22] was used to assess participants' perception of stress. Participants scored the frequency of ten different relevant items (e.g. feeling that 'things were going your way') in the last month using a 5-point Likert-scale system (0=never, 1=almost never, 2=sometimes, 3=fairly often, 4=very often). Four positively stated items (namely questions 2, 4, 5 and 10) had their ratings reversed (0=4, 1=3, 2=2, 3=1 and 4=0), before ratings were totalled to score participants. There is no consensus on PSS-10 cut-off points for different levels of perceived stress, so we assigned these as follows; similarly to previous studies[23]: 0–13=low, 14–26=moderate, 27–40= high.

Participants inputted general demographical information; such as, gender, age, school year, country currently residing in and country studying in. We also asked questions relevant to their lockdown experience, regarding topics; such as, substance use (previous and current uses as well as changes in patterns of use) and issues with online learning and exam cancellations (experience, and whether this was problematic). Participants were also able to report any previously diagnosed mental illnesses, and whether they experienced any change in these during lockdown.

Depression and anxiety correspond to having a total PHQ-9 and GAD-7 score, respectively, of more than 4 (0–4=symptoms not present, 4+=symptoms present). For stress, higher levels correspond to having a total PSS-10 score of more than 26 (0–26=low/moderate, 26+=high).

Demographical and lockdown-related variables were compared between participants of differing levels of depression (Present/Not present), anxiety (Present/Not present) and perceived stress ('low'/'moderate to high'). Chi-square test was used for categorical variables, while Student's t-test was used for continuous variables. Logistic (nominal) regression analysis was used to evaluate significant associations between predictive variables and presence of depression, anxiety and severity of perceived stress. Odds ratios (ORs) of predictive factors were reported, together with 95% confidence intervals (CIs). Statistical significance was set at p-value<0.050. SPSS software (version 22) was used to perform statistical analysis.

Results

Baseline demographical and lockdown-related variables

From 392 respondents (56.4% male, 43.1% female, 0.3% non-binary), the mean (S.D.) age was 15.5 (1.7) years. Respondents reported currently living in Thailand (59.2%), the UK (26.5%), Hong Kong (3.3%), Singapore (1.8%), the United States (1.5%), Malaysia (1.2%), China (0.8%), Australia (0.5%), Belgium (0.5%), India (0.5%), Russia (0.5%), Saudi Arabia (0.5%), Italy (0.3%), Japan (0.3%), South Korea (0.3%), Luxembourg (0.3%), New Zealand (0.3%), Nigeria (0.3%), Turkey (0.3%) and Zambia (0.3%). The majority were in Year 12 (34.2%), followed by Year 10 (20.9%).

Since their physical school closure, 82.9% reported not having used public transport at all, while 52.3% had not talked face-to-face with someone, other than those in their household. Around half (46.4%) found not being able to shop in physical form problematic. Alcohol use was reported in

37.2% (11.0% increased usage, 14.0% reduced usage, while 12.2% stayed the same). Use of cigarettes, e-cigarettes and vapes was reported in 17.6% (6.6% increased usage, 7.7% reduced usage, while 3.3% stayed the same). Cannabis use was reported in 13.1% (3.6% increased usage, 6.4% reduced usage, while 3.1% stayed the same). Having undergone mandatory self-quarantine was reported by 49.7% of these 92.1% reported quarantining with their parents, 1.8% with family; but without parents, and 5.5% with others.

Prevalence of mental health conditions

Depression was identified in 58.7% (29.8% mild, 16.1% moderate, 7.9% moderately severe, 4.8% severe), and anxiety in 40.3% (22.2% mild, 10.7% moderate, 7.4% severe). Severities of stress ranged from low (35.7%) to moderate (54.6%) to high (9.7%). From this, 21.4% reported previous depression (9.4% worsened, 8.7% unchanged, 3.3% improved), and 35.5% reported previous anxiety (15.8% worsened, 13.3% unchanged, 6.4% improved). Additionally, 45.2% reported previous stress (19.4% worsened, 16.1% unchanged, 9.7% improved). For statistical analysis, we categorised depression and anxiety into two groups: one indicating presence (those who scored mild and above) and another indicating absence of mental illness symptoms. Stress was categorised to form two groups: "High" and "Moderate/Low". Among the study sample, the Cronbach's alpha statistics for PHQ-9, GAD-7 and PSS-10 were 0.869, 0.898 and 0.808, respectively.

Factors associated with depressive symptoms

Higher levels of depression were found in Years 11 and higher (72.4% vs 40.1%, p-value<0.001), residents of the UK and other countries versus Thailand (74.0%, 71.2% vs 50.0%, p-value<0.001), those who studied in the UK and other countries versus Thailand, (69.0%, 64.7% vs 52.3%, p-value=0.031) and older participants (M=15.90, S.D.=1.58 for depressed vs M=15.01, S.D.=1.755 for not depressed, p-value<0.001) (Table 1).

Depression was higher in those who reported previous depression, anxiety, and stress (p-value<0.001). Higher levels of depression were also reported in those who had undergone mandatory self-quarantine, felt COVID-19 had affected their daily life, reported not using public transport since school closure, believed that they would have a low chance of contracting COVID-19 themselves, and had no worries about going outside (p-value<0.050). In addition, those who perceived problems with the consequences of social distancing, including not being able to meet friends, inability to eat out, inability to go shopping and online learning, all displayed higher levels of depression (p-value<0.050) (Table 1).

Those who reported use of alcohol, cigarettes/e-cigarettes/vapes, cannabis, and/or other drugs experienced higher levels of depression than those who never used them. Furthermore, those who experienced unchanged or increased use of alcohol, cigarettes/e-cigarettes/vapes and cannabis during lockdown experienced higher levels of depression than those who experienced reduced use of these substances (p-value<0.001) (Table 1).

By multivariate logistic regression analysis, we found that older year groups (Year 11/12/13 compared to Years 8/9/10, OR=2.26, 95% CI=1.11-4.58), females (compared to males, OR=2.46, 95% CI=1.19-5.08) and participants not located in the UK or Thailand (compared to being in Thailand, OR=3.07, 95% CI=1.06-8.94) had significantly increased risk of depression (Table 2).

Higher levels of depression were found to be significantly associated with an increase in levels of previous anxiety (OR=15.43, 95% CI=1.46-163.05), and previous stress (OR=17.62, 95% CI=4.04-76.81) during lockdown, compared to those who reported never having previous anxiety or stress. Those who reported decreased, or equal levels of previous depression during lockdown still had higher levels of depression than those who never had previous depression before the lockdown (OR=4.91, 95% CI=1.33-18.20).

Table 1 Demographic and lockdown–related variables, with depressive and anxiety symptoms and high levels of perceived stress

	Exhibiting depressive symptoms n	%	No depressive symptoms n	%	X²	df	p-values	Exhibiting anxiety symptoms n	%	No anxiety symptoms n	%	X²	df	p-values	High levels of perceived stress n	%	Low/moderate levels of perceived stress n	%	X²	df	p-value
UK School Year					41.306	1	<0.001					25.627	1	<0.001					14.919	1	<0.001
8/9/10	67	40.1	100	59.9				43	25.7	124	74.3				5	3.0	162	97.0			
11/12/13	163	72.4	62	27.6				115	51.1	110	48.9				33	14.7	192	85.3			
Female	108	63.9	61	36.1	4.015	2	0.134	85	50.3	84	49.7	13.961	2	0.001	29	17.2	140	82.8	29.323	2	<0.001
Age (mean/S.D.)	(15.9)	(1.6)	(15.0)	(1.8)	$t_{388}=-5.274$	–	<0.001	(15.2)	(1.8)	(15.2)	(1.6)	$t_{388}=-4.232$	–	0.005	(16.5)	(1.1)	(15.4)	(1.7)	$t_{388}=-3.726$	–	<0.001
Country currently living in					20.698	2	<0.001					6.924	2	0.031					2.682	2	0.262
Thailand	116	50.0	116	50.0				82	35.3	150	64.7				21	9.1	211	90.9			
UK	77	74.0	27	26.0				51	49.0	53	51.0				14	13.5	90	86.5			
Others	37	71.2	15	28.8				25	48.1	27	51.9				3	5.8	49	94.2			
Country currently studying in					6.949	2	0.031					2.014	2	0.365					4.384	2	0.112
Thailand	101	52.3	92	47.7				72	37.3	121	62.7				15	7.8	178	92.2			
UK	108	64.7	59	35.3				72	43.1	95	56.9				22	13.2	145	86.8			
Others	20	69.0	9	31.0				14	48.3	15	51.7				1	3.4	28	96.6			
Area currently living in					4.521	2	0.104					4.371	2	0.112					8.893	2	0.012
Urban	138	56.1	108	43.9				94	38.2	152	61.8				19	7.7	227	92.3			
Peri-urban	49	57.6	36	42.4				32	37.6	53	62.4				7	8.2	78	91.8			
Rural	42	71.2	17	28.8				31	52.5	28	47.5				12	20.3	47	79.7			
Being under mandatory self-quarantine	128	65.6	67	34.4	7.769	1	0.005	85	43.6	110	56.4	1.739	1	0.187	25	12.8	170	87.2	4.333	1	0.037
Level of feeling that COVID-19 affects daily life					10.066	2	0.007					2.984	2	0.225					3.100	2	0.212
Great effect	140	64.5	77	35.5				95	43.8	122	56.2				26	12.0	191	88.0			
Slight/little effect	83	53.9	71	46.1				57	37.0	97	63.0				10	6.5	144	93.5			
No effect	7	33.3	14	66.7				6	28.6	15	71.4				2	9.5	19	90.5			
Using public transport since the physical closure of school	21	31.3	46	68.7	24.894	1	<0.001	9	13.4	58	86.6	24.256	1	<0.001	1	1.5	66	98.5	6.209	1	0.013
Level of thinking that catching COVID-19					6.006	2	0.050					1.741	2	0.419					0.696	2	0.706
High chance	7	33.3	14	66.7				6	28.6	15	71.4				2	9.5	19	90.5			
Moderate chance	84	61.3	53	38.7				53	38.7	84	61.3				11	8.0	126	92.0			
Little/no chance	139	59.4	95	40.6				99	42.3	135	57.7				25	10.7	209	89.3			
Being worried about going outside					18.622	2	<0.001					11.265	2	0.004					0.292	2	0.864
Not at all	83	64.8	45	35.2				52	40.6	76	59.4				11	8.6	117	91.4			
Slightly/a bit worried	121	63.0	71	37.0				89	46.4	103	53.6				20	10.4	172	89.6			
Very worried	26	36.1	46	63.9				17	23.6	55	76.4				7	9.7	65	90.3			
Experience problems with sleep by thinking about COVID-19	61	67.0	30	33.0	3.415	1	0.065	50	54.9	41	45.1	10.556	1	0.001	17	18.7	74	81.3	10.935	1	0.001

Table 1 (continued)

	Exhibiting depressive symptoms		No depressive symptoms		X²	df	p-values	Exhibiting anxiety symptoms		No anxiety symptoms		X²	df	p-values	High levels of perceived stress		Low/moderate levels of perceived stress		X²	df	p-value
	n	%	n	%				n	%	n	%				n	%	n	%			
Online learning																					
Experience with problems	170	68.5	78	31.5	30.117	2	<0.001	112	45.2	136	54.8	7.504	2	0.023	32	12.9	216	87.1	9.295	2	0.010
Experience without any problems	43	38.1	70	61.9				34	30.1	79	69.9				3	2.7	110	97.3			
No experience	16	53.3	14	46.7				11	36.7	19	63.3				3	10.0	27	90.0			
Cannot meet friends regularly																					
Experience with problems	188	62.3	114	37.7	8.020	2	0.018	129	42.7	173	57.3	3.546	2	0.170	35	11.6	267	88.4	5.626	2	0.060
Experience without any problems	35	50.7	34	49.3				24	34.8	45	65.2				3	4.3	66	95.7			
No experience	7	35.0	13	65.0				5	25.0	15	75.0				0	0.0	20	100.0			
Cannot go out to eat																					
Experience with problems	142	64.3	79	35.7	9.753	2	0.008	101	45.7	120	54.3	6.925	2	0.031	27	12.2	194	87.8	4.304	2	0.116
Experience without any problems	78	54.9	64	45.1				50	35.2	92	64.8				8	5.6	134	94.4			
No experience	10	35.7	18	64.3				7	25.0	21	75.0				3	10.7	25	89.3			
Cannot go out to shop																					
Experience with problems	134	73.6	48	26.4	31.840	2	<0.001	91	50.0	91	50.0	13.646	2	0.001	23	12.6	159	87.4	3.367	2	0.186
Experience without any problems	77	47.8	84	52.2				54	33.5	107	66.5				12	7.5	149	92.5			
No experience	19	39.6	29	60.4				13	27.1	35	72.9				3	6.3	45	93.8			
Depression																					
Has decreased or stayed the same	38	80.9	9	19.1	30.057	2	<0.001	33	70.2	14	29.8	58.802	2	<0.001	4	8.5	43	91.5	30.341	2	<0.001
Has increased	33	89.2	4	10.8				31	83.8	6	16.2				13	35.1	24	64.9			
Never had it	159	51.6	149	48.4				94	30.5	214	69.5				21	6.8	287	93.2			
Anxiety																					
Has decreased or stayed the same	44	57.1	33	42.9	49.361	2	<0.001	36	46.8	41	53.2	71.787	2	<0.001	8	10.4	69	89.6	23.431	2	<0.001
Has increased	61	98.4	1	1.6				53	85.5	9	14.5				16	25.8	46	74.2			
Never had it	125	49.4	128	50.6				69	27.3	184	72.7				14	5.5	239	94.5			
Stress																					
Has decreased or stayed the same	65	64.4	36	35.6	59.013	2	<0.001	45	44.6	56	55.4	69.822	2	<0.001	8	7.9	93	92.1	41.307	2	<0.001
Has increased	71	93.4	5	6.6				60	78.9	16	21.1				22	28.9	54	71.1			
Never had it	94	43.7	121	56.3				53	24.7	162	75.3				8	3.7	207	96.3			
Alcohol																					
Never used	123	50.4	121	49.6	19.009	2	<0.001	81	33.2	163	66.8	14.963	2	0.001	19	7.8	225	92.2	3.282	2	0.194
Reduced	38	69.1	17	30.9				27	49.1	28	50.9				6	10.9	49	89.1			
Used the same or increased	68	74.7	23	25.3				50	54.9	41	45.1				13	14.3	78	85.7			

Table 1 (continued)

	Exhibiting depressive symptoms		No depressive symptoms		X^2	df	p-values	Exhibiting anxiety symptoms		No anxiety symptoms		X^2	df	p-values	High levels of perceived stress		Low/ moderate levels of perceived stress		X^2	df	p-value
	n	%	n	%				n	%	n	%				n	%	n	%			
Cigarettes, e-cigarettes, vapes																					
Never used	171	52.9	152	47.1	25.531	2	<0.001	120	37.2	203	62.8	9.148	2	0.010	26	8.0	297	92.0	6.666	2	0.036
Reduced	24	80.0	6	20.0				14	46.7	16	53.3				4	13.3	26	86.7			
Used the same or increased	35	89.7	4	10.3				24	61.5	15	38.5				8	20.5	31	79.5			
Cannabis																					
Never used	182	53.5	158	46.5	30.254	2	<0.001	126	37.1	214	62.9	12.305	2	0.002	27	7.9	313	92.1	11.119	2	0.004
Reduced	23	92.0	2	8.0				15	60.0	10	40.0				4	16.0	21	84.0			
Used the same or increased	25	96.2	1	3.8				17	65.4	9	34.6				7	26.9	19	73.1			
Other drugs																					
Never used	196	55.2	159	44.8	17.901	2	<0.001	136	38.3	219	61.7	8.499	2	0.014	32	9.0	323	91.0	2.182	2	0.336
Reduced	22	91.7	2	8.3				13	54.2	11	45.8				4	16.7	20	83.3			
Used the same or increased	11	91.7	1	8.3				9	75.0	3	25.0				2	16.7	10	83.3			

Univariate analysis was conducted using chi-square test and t-test. p-value<0.05 was considered significant.

df=degrees of freedom, S.D.=standard deviation, UK=United Kingdom

Table 2 Demographic and lockdown–related variables, with depressive and anxiety symptoms and high levels of high perceived stress using multivariate analysis

Variables	Exhibiting depressive symptoms			Exhibiting anxiety symptoms			Higher levels of high stress		
	ORs	95% CI	p–values	ORs	95% CI	p–values	ORs	95% CI	p–values
UK school year									
11/12/13	2.26	1.11–4.58	0.024						
8/9/10	1								
Gender									
Female	2.46	1.19–5.08	0.015	3.08	1.60–5.92	0.001			
Male	1			1					
Using public transport since the physical closure of school									
Not at all/No				8.31	2.49–27.76	0.001			
Sometimes/Yes				1					
Being worried about going outside									
Not at all							2.71	1.02–7.21	0.046
Slightly/a bit worried							2.78	1.19–6.53	0.019
Very worried							1		
Cannot go out to shop									
Experience with little or many problems							4.03	1.24–13.06	0.020
Experience without any problems							1.49	0.49–4.54	0.481
No experience							1		
Depression									
Has decreased or stayed the same	4.91	1.33–18.20	0.017	6.59	2.14–20.30	0.001			
Has increased	0.88	0.15–5.38	0.892	3.21	0.88–11.63	0.076			
Never had it	1			1					
Anxiety									
Has decreased or stayed the same	0.58	0.19–1.71	0.320	1.08	0.42–2.80	0.876			
Has increased	15.43	1.46–163.05	0.023	4.61	1.54–13.98	0.006			
Never had it	1			1					
Stress									
Has decreased or stayed the same	1.64	0.63–4.30	0.313	1.13	0.50–2.54	0.774			
Has increased	17.62	4.04–76.81	0.000	3.89	1.52–9.92	0.005			
Never had it	1			1					
Country currently living in									
UK	2.29	0.94–5.63	0.070						
Others	3.07	1.06–8.94	0.040						
Thailand	1								
Alcohol									
Used the same or increased							0.27	0.11–0.69	0.006
Reduced							0.53	0.18–1.53	0.241
Never used							1		
Cannabis									
Used the same or increased	5.76	0.34–96.69	0.224						
Reduced	10.20	1.19–87.18	0.034						
Never used	1								

Multivariate analysis was conducted using logistic nominal regression. p–value<0.050 was considered significant.

OR=odds ratio, CI=confidence interval, UK=United Kingdom

Compared to those who had never used cannabis, previous users who experienced decreased use during lockdown had higher levels of depression (OR=10.20, 95% CI=1.19–87.18).

Factors associated with anxiety symptoms

Higher levels of anxiety were found in Years 11 and higher (51.1% vs 25.7%, p-value<0.001), females (50.3% vs 32.6%, p=0.001), residents of the UK and other countries versus Thailand (49.0%, 48.1% vs 35.3%, p-value=0.031) (Table 1), and older participants (M=15.97, S.D.=1.56 for anxious vs M=15.24, S.D.=1.75 for not, p-value=0.005) (Table 1).

Anxiety was higher in those who reported previous depression, anxiety, and stress (p-value<0.001). Higher levels of anxiety were also reported in those who reported not using public transport since school closure, and 'sometimes or regularly' had sleep problems, due to thinking about COVID-19 (p-value<0.050). In addition, those who perceived problems with the consequences of social distancing, including online learning, inability to eat out and inability to go shopping, all displayed higher levels of anxiety (p-value<0.050). Conversely, the lowest levels of anxiety were found in those who were the most worried about going outside (p-value=0.004) (Table 1).

Those who reported use of alcohol, cigarettes/e-cigarettes/vapes, cannabis, and/or other drugs experienced higher levels of anxiety than those who never used them. Additionally, those who experienced unchanged or increased use of all four substance categories during lockdown experienced higher levels of anxiety than those who experienced reduced use (p-value<0.050) (Table 1).

By multivariate analysis, we found that females (compared to males, OR=3.08, 95% CI=1.60–5.92) and participants who had not used public transport at all since the physical closure of their school (compared to those who sometimes used it, OR=8.31, 95% CI=2.49–27.76) had significantly increased risk of anxiety (Table 2).

Higher levels of anxiety were found to be significantly associated with an increase in levels of previous anxiety (OR=4.61, 95% CI=1.54–13.80), and previous stress (OR=3.89, 95% CI=1.52–9.92) during lockdown, compared to those who reported never having previous anxiety or stress. Those who reported decreased or equal levels of previous depression during lockdown still had higher levels of anxiety than those who never had previous depression before the lockdown (OR=6.59, 95% CI=2.14–20.30).

Factors associated with perceived stress

Higher levels of high stress were found in Years 11 and higher (14.7% vs 3.0%, p-value<0.001), females (17.2% vs 3.6%, p-value<0.001) (Table 1), and older participants (M=16.50, S.D.=1.08 for high stress vs M=15.24, S.D.=1.75 for low/moderate stress, p-value<0.001) (Table 1).

High stress levels were greater in those who reported previous depression, anxiety, and stress; which had increased/worsened due to lockdown (p-value<0.001). Higher levels of high stress were also reported in those who lived in rural areas, reported not using public transport since school closure, 'sometimes or regularly' had sleep problems, due to thinking about COVID-19, had undergone mandatory self-quarantine, and perceived problems with online learning (p-value<0.050) (Table 1).

Those who reported use of cigarettes/e-cigarettes/vapes and cannabis experienced higher levels of high stress than those who never used them. Additionally, those who experienced unchanged or increased use of the two substances experienced higher levels of high stress than those who experienced reduced use (p-value<0.050) (Table 1).

By multivariate analysis, significantly increased risk of high stress was found in those who had no worry (OR=2.71, 95% CI=1.02–7.21) or slight worry (OR=2.78, 95% CI=1.19–6.53) about going outside, compared to those who were very worried. Those who found not being able to go shopping problematic (compared to those who were

able to go shopping, OR=4.03, 95% CI=1.24–13.06) had significantly increased risk of high stress. Participants who experienced increased or unchanged alcohol use during lockdown were found to not have as high levels of high stress as those who had never used alcohol (OR=0.27, 95% CI=0.11–0.69) (Table 2).

Higher levels of high stress were found to be significantly associated with an increase in levels of previous anxiety (OR=4.53, 95% CI=1.03–19.83) as well as previous stress (OR=15.43, 95% CI=3.67–64.98), compared to those who never had anxiety or stress during lockdown. Those who reported decreased or equal levels of previous depression during lockdown still had higher levels of high stress than those who never had previous depression before the lockdown (OR=14.61, 95% CI=2.83–75.42) (Table 2).

Discussion

We conducted an online survey study that found a high prevalence of mental health conditions among secondary school students, across a range of countries during the COVID-19 lockdown in May and June 2020. Approximately 60% had depression, 40% had anxiety and 10% experienced a high level of stress. Additionally, being female enhanced depression and anxiety as well as being enrolled in the last three years of high/secondary school enhanced depression. Changes in patterns of substance use were also significantly associated with anxiety and stress.

Although, one must take into account the environment in which adolescents live in, as it will ultimately affect their mental health, it is clear to see that our findings demonstrate a higher prevalence of depressive, anxiety and stress symptoms. Compared to previous studies, conducted during arguably more normal times, our prevalence of depressive symptoms was higher than 53.2% in Norwegian secondary school students[24], 55.9% in Nigerian secondary school students[25], and 52.9% in Chinese adolescents.[26] Similarly,

our findings indicate a higher prevalence of anxiety compared to around 10.0% in Canadian secondary school students[27] and higher-education students from the UK[28], from studies conducted during non-COVID19 times. High stress levels were also found to be more common than the 4.0% among Thai students aged 15–19 years[29] before COVID-19.

Furthermore, a recent study conducted on Chinese adolescents aged 12–18 years also demonstrated similar findings of elevated prevalence (43.7% exhibiting depressive symptoms, 37.4% exhibiting symptoms of anxiety) during COVID-19.[16] There were no reports of stress prevalence among secondary school students during COVID-19.

In our study, being female was found to be significantly associated with higher levels of depression and anxiety. This was found to be in accordance with previous studies concerning lockdown mental health[9,30,31] as well as during more general times.[32,33] However, Cao et al. did not find gender to be significantly associative with higher levels of anxiety during COVID-19 lockdowns.[34] The reason why female students were more likely to develop depression/anxiety may be explained by gender socialisation/norms (i.e., higher lack of autonomy and control over life decisions), lower self-esteem and body image.

Being enrolled in senior high school (Years 11–13 or Grades 10–12) was found to be significantly associated with higher levels of depression, but not anxiety, in our study. Zhou et al. found similarly significant associations with both anxiety and depression during COVID-19.[16] Older participants may find study and other similar duties increasingly important, resulting in increased anxiety during lockdowns. In addition, not being able to go outside, despite now being older, may further explain these results.

A combination of emotions; such as, boredom, anxiety, depression and fear may lead to increased substance use as a means of coping.[35] With many countries closing down shops and public services[36], with some even enacting coronavirus alcohol bans[37], many

may find themselves in forced abstinence.[12,38] Access to recreational substances normally used, which have been limited; for example, due to lockdowns or otherwise, can exacerbate mental health effects.[10,11] We found that reports of decreased cannabis use were significantly associated with higher levels of depression. Furthermore, increased or unchanged alcohol use was found to be associated with lower levels of stress. Despite likely being a protective factor in this study, adolescent alcohol use has been found to predict development of alcohol problems into young adulthood[39], so this should be treated with caution. In times of lockdown, those with substance use disorders tend to be ignored.[10] This problem is further worsened due to the fact that adolescents who use substances tend to not want to disclose their use; for example, to their parents or those in authority. Therefore, there is a chance that those concealing their use within their household may face adverse effects. Lack of access to supervised substance use may also increase hazardous use, due to interruption of opening hours of harm reduction services as well as general fears of COVID-19 infection among clients.[40] The United Nations Office on Drugs and Crime reported in May 2020 that: COVID-19 may have adverse effects on drug supply chains. This may lead to harmful adaptations by both producers; such as, reduced street purity, and users or a shift towards drug injection as well as sharing paraphernalia.[41]

To address these elevated prevalence of mental health conditions as well as those reported in other similar studies, a COVID19-specific mental health toolkit to equip healthcare providers in dealing with this may be useful.[42] Telepsychiatry has also been advocated to combat this;[4] however, digital inequity, which limits access, may need to be considered. In addition, intersecting stigma related to infectious diseases outbreaks; such as, gender, ethnicity and pre-existing health conditions, have been spotlighted during the COVID-19 pandemic.

There are limitations to this study. This is a cross-sectional study; therefore, we were not able to assess any long-term impacts or progressions of mental health conditions, as a longitudinal study would be able to. Furthermore, due to our use of snowball sampling, we were unable to record or know the number of people who had been formally 'invited' to take part in the survey. We also cannot ensure that all participants, especially those residents in non-English-speaking countries, understood the English content correctly. Therefore, this may affect reliability. Additionally, our participants (who were presumed to understand, read and write/type in English) will not be representative of national and global adolescent populations. Therefore, many potentially associative factors; such as, social and geographical backgrounds and lockdown-related issues, may be distorted. Hence, this selection bias means that these study results are not generalisable. Moreover, we also allowed participants to report how their previously diagnosed mental health conditions had changed (decreased, stayed the same, increased) due to the COVID-19 situation. Without measurements comparing two time points, it is difficult to reliably measure and assess changes to these mental health conditions. Furthermore, recall bias may reduce reliability.

Conclusion

In conclusion, amidst lockdown measures, around half of adolescents exhibited depression and/or anxiety. Particular attention must be paid to females, older adolescents and substance users. Girl-centred mental health support platforms should be readily available, and tailored to fit specific countries' contexts. Schools must closely monitor, and act upon any concerns which arise from their students; especially the more senior individuals who may be particularly stressed about academic commitments; such as, exam cancellations[14], university preparation and

work experience opportunities. However, apart from their parents, schools must also monitor the child's mental health wellbeing in general, as school forms a very important aspect of their life and these changes due to COVID-19 could be drastic for some. Harm reduction services must receive support to maintain service delivery, perhaps adapting and utilising innovative interventions; such as, telemedicine-delivered prescription and treatments as well as a focus on more tailoring towards adolescent users.

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Conflict of interest

The authors declare that they have no conflict of interests.

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