

Review Article

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Anxiety and Depression in Youth During COVID-19: A Narrative Review

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ABSTRACT

This narrative review on anxiety and depression in non-infected youth during COVID-19 is a summary of research on prevalence and risk factors derived from surveys on the Patient Health Questionnaire and the Generalized Anxiety Disorder Scale. Anxiety and depression symptoms have been noted in youth (on average in 38% and 36% respectively) across several countries, although most of the studies have been from China and the U.S. The prevalence rates for both anxiety and depression have been significantly greater for females and lower for children versus high school and in turn, university students. Comorbidities have included stress, insomnia, social anxiety, PTSD, OCD, and suicidality, and the most frequent risk factors have been worries about COVID infection and academics as well as inactivity (lack of exercise) and excessive time on social media. The studies are limited by being cross-sectional samples that lack generalizability and by being self-report data.

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Introduction

Children and young people comprise 42% of the world's population [1]. During COVID-19 they have experienced significant stressors including confinement during lockdowns, separation from their peers and teachers during school closures and related problems including more sedentary behavior and more time on social media [2]. Although the literature on youth during COVID-19 is limited as compared to research on adult samples, there has been a sufficient number of studies for one previous narrative review as well as the current narrative review on the more recent literature [2].

This narrative review is based on studies on anxiety and depression in youth that have appeared on PubMed for the years 2019-2021. The terms anxiety, depression, youth and COVID-19 were entered into the advanced search which yielded 123 papers. Inclusion criteria were peer-reviewed studies and exclusion criteria were case reports and non-English papers. Following these criteria, 38 papers were selected for this brief overview. The resulting review that reflects the current literature includes data on prevalence, comorbidities and risk factors as well as methodological limitations. Consistent with the literature and with the aims of this review, this paper is divided into sections on those topics.

Prevalence

Anxiety and depression among youth during COVID-19 have been most frequently assessed in cross-sectional, self-report studies by the Generalized Anxiety Disorder-7 Scale (GAD-7 for 7 items) and the Patient Health Questionnaire-9 (PHQ-9 for 9 items), assessments that are both scored on 4-point Likert scales. The

prevalence across countries has averaged 38% for anxiety and 36% for depression. Several of the prevalence data have come from China including three studies on children, two on adolescents and three on university students.

In the studies on children from China, the prevalence has varied across provinces from 2% for anxiety and 2% for depression in one province to 6% for anxiety and 12% for depression in a second province and 19% for anxiety and 12% for depression in a third province [1,3,4]. Significantly greater prevalence has been noted in adolescent and university student versus child samples where the prevalence of anxiety has averaged 35% (range = 31 to 37%) and depression has averaged 44% (range = 37 to 57%) [5-9].

Notably, in the two longitudinal studies from China, anxiety significantly increased across the first two weeks of the lockdown study periods. In one of those studies, anxiety increased from 19 to 37% and depression from 37 to 57% in the adolescents [9]. In the second longitudinal study from another province in China, the rates of anxiety increased from 34 to 50% and the rates of depression from 40 to 64% in high school students [5]. Interestingly, the authors also noted the rates for items on the anxiety scale including nervous (54%), worried (47%) and easily annoyed (47%) and on the depression scale including little interest (54%), tired (48%) and loss of appetite (46%).

Other data have come from the U.S. including one study on adolescents and four studies on university students. On average, the prevalence among these samples has been 40% for anxiety and 36% for depression with a range of 35 to 45% for anxiety and 10 to 48% for depression [10-14]. As was noted for the variability across provinces in China, differences also occurred across universities

in the U.S. data. For example, data from a Kentucky university suggested a prevalence of 44% for anxiety and 36% for depression, while those figures were reversed in a database from Texas A & M University where the prevalence of anxiety was 38% and 48% for depression [13,14]. In the only U.S. longitudinal study (from New York University), the prevalence for anxiety from pre-lockdown to lockdown to post-lockdown was 19% to 35% to 52% and the prevalence for depression across the same periods was 27% to 41% to 63%, suggesting significantly increasing prevalence for both anxiety and depression from pre-lockdown to lockdown to post-lockdown periods [12]. This has also been true for samples of children. For example, a study from the UK (N=168 children 8-12-years) showed a significant increase in depression and anxiety from pre to post lockdown based on the Revised Child Anxiety and Depression Scale [15]. These surprising increases may simply relate to the symptoms being exacerbated across time, as in the “reality setting in over time”.

Prevalence data have also been reported for six other cultures including Prague, Iran, Jordan, Saudi Arabia, Bangladesh and Nepal [16-22]. The prevalence data have been highly variable across these cultures with low prevalence rates reported for Nepal at 16% for anxiety and 11% for depression and similarly low prevalence for Bangladesh at 18% for anxiety and 15% for depression [22,20]. The prevalence rates for the other countries were similar to the U.S. for anxiety (41%), but highly variable for depression (range=31-72%). For example, the prevalence rates for Italy were 42% for anxiety and 31% for depression and for Jordan they were higher for depression (57%) than for anxiety (41%) [17,18].

It is surprising that no systematic reviews and meta-analyses have been conducted on these 19 prevalence studies given that they all used snowball sampling on social media platforms and were cross-sectional (all but the two longitudinal studies). And all were based on self-report questionnaire data. Further, they all used the PHQ-9 and the GAD-7 as measures of depression and anxiety except for one study from China and one from Bangladesh that used the CES-D for depression (Center for Epidemiological Studies for Depression). A meta-analysis may have been precluded by the variability across countries in the timing of the COVID-19 pandemics including the lockdown periods. And the data collection periods varied, with some studies based on lockdowns and others on non-lockdown periods. Nonetheless, that the prevalence rates were relatively low for children but moderately high for adolescent and university student samples for both anxiety and depression highlights the importance of further research and intervention programs.

Comorbidities

Several conditions have been notable comorbidities with anxiety and depression in youth during COVID-19 including stress, insomnia, social anxiety, posttraumatic stress disorder (PTSD), obsessive compulsive disorder (OCD) and suicidality. These may have been pre-existing conditions, although because most of these studies were cross-sectional, pre-existing conditions may not have been reliably assessed. In addition, anxiety and depression were self-reported via questionnaires, not clinically assessed by interviews. Nonetheless, the comorbidities likely exacerbated the anxiety and depression symptoms experienced by the youth.

Stress

Stress was one of the most frequently reported comorbidities (in 5 studies). It was typically assessed along with anxiety and depression on the Depression Anxiety and Stress Scale (DASS-21

for 21 items). Examples given of the depression items included loss of interest in daily activities, life or oneself and the examples given of anxiety items included nervousness and physiological tension. The items given for stress were irritability, edginess and inability to relax.

In a study from Ecuador (N=640 undergrads), stress was studied along with anxiety, depression and the fear of COVID-19 [23]. Anxiety and depression were assessed by the DASS and the fear of COVID-19 was assessed by the Fear of COVID-19 Scale (FCV-19S) (7 items). In a structural equations model, fear and stress contributed to 60% of the variance in anxiety, and stress and anxiety contributed to 80% of the variance in depression. The high levels of variance explained by these models suggest the comorbidity of these problems or at least the similarity of the measures.

In a similar study on 5 countries (Saudi Arabia, Jordan, Iraq, Arab Emirates, Egypt) (N=1057), 38% experienced stress, 41% anxiety and 57% depression as measured by the DASS [18]. In this sample, risk factors included being female, having a friend or family member with mental illness, being quarantined for two weeks and internet use. Limitations of this study included that the DASS is not a diagnostic tool and that self-selection occurred on the survey given that it was only available for those who had access to internet, as has been a limitation of many of the studies.

In a smaller sample study on university students from France (N=292) during lockdown versus pre-lockdown, those with depression had greater anxiety (73% vs. 51%) and stress (72% vs. 49%) as well as concentration problems (87% vs. 73%) [24]. This study was limited by single ratings and the “lumping” of variables, and this sample was not representative of youth in general, as could be said for other university samples which are typically convenience samples as they are readily identified and parental informed consent is not required.

Two universities from the U.S. also reported stress as a comorbidity with anxiety and depression. Researchers from Texas A & M University (N=2031) cited a prevalence of stress as high as 71% during the pandemic [14]. Moderate to severe anxiety was reported by 38%, moderate to severe depression by 48% and suicidal thoughts by as many as 18%. The greatest concerns expressed by the students were academic (39% including difficulty concentrating, academic progress and performance, distance learning and greater workload), uncertainty about the pandemic, health (for self and others and including sleeping, eating, weight gain and lack of exercise) and lifestyle (including 87% for social isolation, 41% for changes in social relations and 85% for social distancing). The barriers to mental health care were cited as financial, social stigma, limited access and “they themselves” (41%). Fortunately, 43% reported being able to cope adequately. The coping they reported related to social support (85%), social media (16%) and creative activities (8%). Those participants also cited positive effects of the pandemic including not having to commute, having flexible schedules (lecture recordings), not having extracurricular activities (they could do hobbies), and having less social anxiety. Unfortunately this research, as in most of these studies, had the methodological limitations of self-selection given that those with pre-existing conditions would be inclined to participate. And the high rates of stress, anxiety and depression could have related to the high rate of participation by females who had higher scores on those scales.

In a study from New York University (N=1,821) the COVID-19 Stressors Scale was given in addition to the PHQ-9 and the GAD-7

[12]. As stressors increased, so did anxiety and depression. In this study, anxiety increased from 20 to 50% and depression increased from 18 to 40%. High stressor scores were noted for 50% of the sample (more than 5 stressors) and low stressor scores for 15% (1-2 stressors). The stressors included seeing the family less often, being with friends less often, having travel restrictions, having experienced death of a close relative or friend, family relationship problems, child care problems, feeling alone, food shortage, supply shortage, losing a job, member of the household losing a job, financial problems, problems with rent and being forced to leave campus. The limitation of this study, like so many others, was generalizability inasmuch as the pandemic was affecting different areas of the U.S. at different times and to different degrees.

Insomnia

Insomnia was one of the most frequently studied comorbidities (5 studies). Surprisingly, however, it was not the focus of any of the studies, perhaps because insomnia is a typical problem of youth irrespective of a pandemic. Nonetheless, insomnia was reported as a correlate of anxiety and depression in most of the studies on youth during COVID-19. As one example, in a study from Italy, as many as 40% reported insomnia as being comorbid with several psychological syndromes including 42% anxiety, 31% depression, 28% PTSD and 20% OCD [17]. As in most of the literature on anxiety and depression during COVID-19, this study was focused on youth who were not infected. As another example, in a study from Iran on high school students (N = 1,512), the relationship between insomnia, as measured by the Insomnia Severity Index, and quality of life, as measured by the Pediatric Quality of Life Scale, was mediated by depression, anxiety and stress based on the Depression, Anxiety and Stress Scale [25]. In this study, insomnia was also related to Internet gaming disorder.

Social Anxiety

Although generalized anxiety disorder symptoms have been researched in several of these studies, social anxiety symptoms were only assessed in one study on adolescents in the U.S. [10]. In this study (N=45) from Stony Brook New York, the Children's Depression Inventory and the Screen for Child Anxiety Related Symptoms (SCARED) were given. In this sample as many as 30% experienced social anxiety and as many as 40% had generalized anxiety disorder symptoms, but only 10% reported depression symptoms and 18% had panic symptoms. Social anxiety as well as generalized anxiety disorder symptoms were associated with greater academic concerns. Methodological limitations of this study included non-random recruitment with no time-matched controls as well as a high attrition rate (30%).

Posttraumatic Stress Disorder (PTSD)

Surprisingly, only a few studies in this COVID-19 youth literature assessed PTSD, unlike research from other pandemics, e.g. SARS and MERS. This may relate to the pandemic still happening and post-traumatic symptoms having not yet occurred or the lesser frequency of PTSD in youth. In a study from China (N= 584) 14% of the youth had high scores on the PTSD symptoms measure [26]. As many as 40% of the youth had psychological problems related to education. The junior high school students had higher scores than the high school students and the high school students, in turn, had higher scores than the college age sample. In a study from Italy, twice as many youth had PTSD symptoms (28%) [17]. The prevalence of PTSD as a comorbidity in that study included 42% with anxiety and 31% with depression.

In a sample from the U.S. (N=898), as many as 32% of the sample had PTSD symptoms and depression and anxiety were

also moderately prevalent at 43 and 45% respectively [11]. These symptoms were accompanied by COVID-19 related worries and loneliness. Resilience was associated with low levels of depression and anxiety but not PTSD. Surprisingly, social support from family but not partners or peers was associated with low levels of depression and PTSD.

In one of the few cross-cultural comparisons in this literature, Asian Americans as compared to white participants had lower levels of depression and Latinos had lower levels of anxiety [11]. Again, these samples of youth were not infected. Infected youth might be expected to experience more PTSD symptoms.

Obsessive Compulsive Disorder (OCD)

Pre-existing symptoms of OCD may have been exacerbated by the self-care precautions issued during COVID-19, for example, the frequent handwashing that was being advised. In some youth with a predisposition to obsessive compulsive behaviors, those precautions may have been comforting. In the sample from Italy only 20% experienced OCD symptoms [17]. OCD was significantly more prevalent in a sample from Saudi Arabia (62%) (32). But depression was also more prevalent in that sample (65%). The OCD symptoms in this sample were assessed by the Obsessive Compulsive Inventory Revised. The inventory measures doubting-checking, obsessing, hoarding, washing, ordering and neutralizing. In this sample, OCD occurred more frequently in Caucasians and males, although depression occurred more often in females.

OCD was also noted in a sample from Turkey (N= 598 adolescents) [27]. In this study, fear was related to OCD and that relationship was mediated by emotional reactivity, avoidance and depression/anxiety. OCD was exacerbated by handwashing, mask wearing and hoarding. This study, like most of the studies, had the problem of being limited to adolescents' self-report rather than including both parent and adolescent report. And once again, the results may not extend beyond Turkish culture. These results, like those of many studies had the limitation that the participants were those who had access to social media platforms. In addition, recall bias was a potential problem, as was the use of non-diagnostic measures.

Suicidality

Suicidality, which generally refers to suicidal ideation, has rarely appeared in this literature on youth during COVID-19 even though in the adult literature, suicidality has typically accompanied high levels of depression and anxiety [28]. In the Texas A & M study, high levels of depression and anxiety were noted at 48% and 38% respectively [14]. These were moderate to severe levels of depression and anxiety. In this sample, 18% were noted to have suicidal thoughts. In a sample from China (N= 5175) suicidal ideation was also correlated with depression and anxiety but at lower levels (12% for depression, 6% for anxiety and 3 % for suicidal thoughts) [3]. These were surprisingly low numbers for a lockdown sample, possibly because they were collected early in the lockdown. Suicidal ideation in this study was not only correlated with anxiety and depression but also with quarreling with parents, insomnia, difficulty concentrating, and online learning. In addition, many feelings were reported including psychological pressure (42%), being scared (28%), unhappiness (20%), and not liking parents (3%). Several disturbing behaviors were also noted including inattention during online learning (22%), not getting up on time (20%), not eating on time (8%), quarreling with parents (7%) and insomnia (6%). And 50% said they missed their classmates very much, 47% wanted to return to school and 40% missed their teachers. Some protective factors were also noted

including missing teachers and hoping to be back at school. Several limitations can be noted for this study including the snowball recruitment, cross-sectional data, child report (M age=13), no past history, no family history, recall bias, selection bias and non-response bias, with the response rate being only 56%. As the authors noted, a panel or cohort study would be needed to compare measures before, during and after the lockdown. This limitation applies to this literature in general.

Correlates/Risk Factors for Psychological Problems

In the only review that could be found in this literature, depression, anxiety and PTSD were cited as the most prevalent conditions [2]. Most of the review, however, was focused on correlates or risk factors for psychological problems including pre-existing conditions, grief, family confinement, domestic violence, excessive time on social media, and Internet addiction. The authors reported that predisposing COVID-19 factors were isolation and loneliness, Internet addiction, cyberbullying, abuse from domestic violence, containment measures, fear of the virus, loss of social support (from teachers and peers), and sleep problems.

Female Gender

Being female has been one of the most prevalent risk factors for anxiety and depression among youth during COVID-19. In a study from Poland (N=7728 university students), for example, females had higher depression, anxiety and stress scores [29]. In this 5-wave study that was conducted during the first two months of lockdown, not only the females had more psychological problems but also the younger students. The psychology students were an exception, reputedly because they had more social support. Females were also more likely to be depressed in a cross-cultural comparison of Chinese, Japanese and Korean students irrespective of their country of origin [30] and in students from Kentucky [13]. And the greater prevalence for females has not only been noted for most of the adult samples but also for samples of children, for example, from China [4].

COVID-19 Related Worries

As already mentioned, COVID-19 related worries have been associated with depression, anxiety and PTSD in a number of studies [2,7,11,12,31]. The scale that was designed to assess COVID-19 stressors included seeing family and friends less often, having travel restrictions, worrying about food and supplies shortages and losing jobs etc. [12]. Based on this scale, participants were characterized as those who were high on worrying and low on worrying.

Surprisingly, transmission of infection has rarely been included among worries. Although, in the cross-sectional study on Korea, China and Japan, 81% of the Japanese thought they would get infected but only 33% of the Koreans and 20% of the Chinese [30]. And in a study that assessed worries about COVID-19, airborne transmission was expressed by 23% [7]. In this study, perceived infection risk led to mental distress which was a mediator for depression. Worrying about getting the infection one's self was expressed by 11%, worrying about it happening to family members was reported by 12% and to classmates by 18%. As many as 36% worried about permanent damage. In this structural equations model, perceived infection risk was said to lead to mental distress which, in turn, was the mediator of the relationship between perceived infection risk and depression.

In a cross-cultural study that compared practices in students from China and Korea, greater knowledge about COVID-19 was said to

relate to less depression [31]. More careful practices were also said to lead to less depression. These included more washing hands and knowledge about transmission pathways. Interestingly although students from Korea reported more preventive practices than those from China, depression was more prevalent in the sample from Korea than that from China (29 versus 19%). That result seems counterintuitive to the theory about depression, COVID-19 knowledge and careful practices.

One of the most frequent worries has been academics. For example two thirds of students were depressed about falling behind academically in a study from Bangladesh [20]. In a similar study from the U.S., the greatest concern was academics for 39% of the students [14]. In a longitudinal study also from the U.S., school concerns were associated with greater generalized anxiety disorder as well as social anxiety symptoms [10]. In a study from Nepal, postponement of examinations was a significant contributor to depression for students [22]. Even junior high school students were troubled by academics as they faced the entrance examinations for high school [8].

Related to the worries about academics, at least two studies referred to online learning. In one of those from China, 50% were said to have disliked online learning [6]. And others from another sample in China complained that they had difficulty concentrating in online learning which was correlated with depression and anxiety [3]. Online learning was also correlated with depression, anxiety and stress in Lebanon (N= 520 undergraduate students) [32]. On the other hand in a sample of students from the U.S., 43% were experiencing less stress, they claimed, because they didn't have to commute to school, they had schedule flexibility (lecture recordings), they had no extracurricular activities so they could do hobbies, and they were experiencing less social anxiety [14]. In still another study on adolescents from China, distance-learning was associated with less depression which according to the students was related to greater teacher and classmate interaction on distance-learning [9].

Relationship Factors

Family as social support during the pandemic and specifically during lockdowns has been mentioned in a number of studies. In China, the absence of companions when parents went back to work (called "child left behind") was cited as a significant problem that contributed to depression. For example, in a study on children using the Depression Self-rating Scale for Children and the Screen for Child Anxiety and Related Disorders, 12% were noted to be depressed, 19% had anxiety symptoms and 7% had both depression and anxiety symptoms [4]. A significant contributor to these symptoms was the absence of a companion on week days. In a similar study from China that was conducted during the lockdown and post lockdown, 88% of the adolescents had not yet returned to school even though their parents had returned to work [9]. The leading contributor to the increased levels of depression (37 to 57%) and anxiety (19 to 37%) was the parents' return to work and the lack of care and supervision for their adolescents.

In other studies, living with parents and family has led to greater rather than less depression. For example, in a study from Bangladesh (N= 476), 15% of youth were depressed while 18% showed anxiety [20]. The students living with families experienced greater depression. Specifically, those students were 2.6 times more likely to be depressed and 1.8 times more likely to be anxious. Two-thirds of the students were also depressed about

falling behind academically. Unfortunately, this study lacked contact details due to the anonymity of the survey data making it impossible to conduct a follow-up. And it was also limited by the assessment of depression and anxiety based on self-report rather than psychological assessments which may have led to under or over-reporting. The authors also suggested that it would have been preferable to use scales that were specifically designed for COVID-19 like the Coronavirus Anxiety Scale.

The difficulty living with parents may be attributed to the quarreling that occurred. For example, in a study from China (N= 5175), 7% talked about quarreling with their parents [3]. In contrast, 50% said they missed their classmates very much, 47% said they couldn't wait to return to school and 40% missed their teachers. Surprisingly, missing peers and teachers rarely appeared in this literature even though prolonged periods of time were spent confined at home during school closures. It was also surprising that there was no mention of zoom time or social media time spent with peers to compensate for the lost time together. Although, at least this study suggested less depression related to distance-learning because of greater interaction with teachers and peers [3]. And just the act of missing teachers and peers was considered a protective factor in that study from China.

Risk-Related Behaviors

Social media. Excessive social media along with sedentary behavior and lack of exercise were the most frequently reported risk factors in the literature on anxiety and depression in youth during COVID-19. In the only published review on anxiety and depression in youth during COVID-19, excessive social media and Internet addiction were among the most frequently studied risk factors [2]. In the study from Texas, 50% of students were engaged in social media and 25% in traditional media [14]. In a sample of children from China, social media was referred to as electronic entertainment and was noted to covary with depression, anxiety and the combination of depression and anxiety [4]. Internet use was also given as a risk factor in the multi-country study on youth from Jordan along with being quarantined which are certainly related risk factors [18]. In the study from Nepal (N=409), Internet use and sleep problems were risk factors for depression which is not surprising since they are typically related factors [22]. In this sample, 98% of the youth were Facebook users, and the prevalence of depression was 2.2 times greater for those spending more time on the Internet. In a study on children from China (N= 1360), excessive media exposure was a risk factor for anxiety, depression and PTSD which occurred in 2%, 2% and 3% respectively for the sample [1]. These data were based on responses to the Self-report Anxiety Scale, the Self-report Depression Scale and the PTSD Checklist for Children. Interestingly, although excessive media exposure was a risk factor for the children, it was reported as a positive factor for parents. This finding might generalize to other samples, although having both child and parent reports was unique to this study.

Phone use was a contributor to depression and anxiety in a study called the Dartmouth study (N= 178) [33]. And news time was also related to depression and anxiety as well as sedentary activity in that study. The interesting methodology used in this study called "ecological momentary assessments" involved random calls on cell phones for recording the current activities of the students. News time was an issue in another study in which it was labeled misinformation and "infodemic" [5].

Sedentary Behavior or Limited Physical Activity. Several researchers have noted the problems of sedentary behavior and

limited exercise during COVID-19. Activity has been notably lower during COVID-19 and especially during lockdowns and it has been related to depression and anxiety in several studies including samples from the US and from Bangladesh [14,20,21,33]. And this has turned out to be a problem even for young children in a study from Bangladesh before [20].

In one of the studies from Bangladesh, 62% of those who were depressed had no exercise [20]. In a study that specifically focused on activity level, 59% of U.S. students were noted to have low levels of exercise based on the International Physical Activity Questionnaire [34]. In a similar study in China, inadequate activity was noted in 52% of the students [35]. These authors suggested that activity would have been preferably measured by actigraphy. And they also suggested that stretching and resistance training could buffer low activity levels. In that study, high activity contributed to low anxiety and moderate activity contributed to low depression. And even household chores were negatively correlated with depression in that study.

Surprisingly, even after the end of the lockdown in a study from Nevada, activity was noted to decrease and depression increase [36]. And still another study showed decreased activity and increased depression after the outbreak had remitted [9]. In this study, greater than 30 minutes of exercise per day was noted to be a protective factor.

Sedentary time has not only been associated with depression and anxiety but also with insomnia [8]. High physical activity acted as a buffer in this study. The authors interpreted this as the known relationship between physical activity and increased serotonin and decreased cortisol as well as decreased inflammation. Despite the extensive literature on activity as a buffer to anxiety and depression, this was the only reference to underlying physiological mechanisms. And even though the COVID-19 infection involves inflammation, none of the researchers raised the possibility that anxiety and depression would predispose the youth in their studies to infection.

Methodological Limitations and Future Directions

The methodological limitations can be divided into those that relate to the design of the studies, the recruitment of the samples, the biasing effects, the measures, and the data analyses. They accordingly suggest future directions.

The basic problem with most of the studies is their cross-sectional design, making it impossible to determine causality or directionality of the findings. Snowball sampling from social media platforms has also precluded longitudinal follow-ups as the data are anonymous and therefore missing contact details for conducting longitudinal follow ups. Only a few of the studies are longitudinal [9,12,24,33]. Having longitudinal assessments from pre and during COVID has highlighted the significance of pre-existing conditions. For example, in the study on French university students, those who had a history of depression (pre-COVID) had a greater increase in both anxiety (73 versus 51%) and stress (72 versus 49%) [24].

Related to the snowball sampling, the recruitment is virtually non-random with no time-matched controls. The snowball sampling involves several biasing effects including participation bias and social desirability bias. Other biases were memory recall and common methods variance. Most of the studies were self-report which would also introduce the bias of under or over-reporting for social desirability reasons. An interesting methodology in that

regard was the cell phone assessment that basically tapped youth activity at random intervals on cell phones (one).

Self-selection also had a potential biasing effect. Those who have and are on computers, Internet and social media are a self-selected sample. In the study from Nepal, for example, 98% of the sample were Facebook users [22]. And in the study from Saudi Arabia the participants were on What's App, Twitter, Instagram, Facebook and LinkedIn [19]. For these studies, this has typically meant a middle-income, white female high school or University student sample which is not representative of and may not generalize to the population of youth. This is illustrated by studies in which 73% female and 86% were white participants [3,13]. Only three studies on children could be found in this literature [1,3,4]. And only one study compared children's with their parents' responses [1]. The results of that study suggested that the children had greater anxiety but the parents had greater depression. Response rates were also limited with only 30% responding in some cases [33].

Other ways these samples may not generalize are that they are non-infected youth and they have been recruited at varying times during the pandemic with some samples being assessed during lockdown and others during non- lockdown periods. Different effects would be expected from surveys conducted at different times during the pandemic and in different places. Different effects would be expected in different cultures and even within cultures. This may explain the significant variability in results and the difficulty with performing meta-analyses and systematic reviews that are absent from the literature. Although, the fact that most of the research groups used the same measures for depression and anxiety (the PHQ-9 and the GAD-7) would seemingly facilitate the use of meta-analyses and systematic reviews [11,18,30,36].

The measures also have problems. Several are single ratings, and others are lumped variables. More specific COVID-19 related measures were rarely used, for example, the Coronavirus Anxiety Scale. Severity levels, for example, on depression and anxiety were only assessed in a couple studies [14,20]. Although standardized depression and anxiety measures were used, the severity may have been under or over- reported. And specific depression and anxiety problems were rarely assessed [5]. Several variables might have been considered covariates but were either not measured or not entered such as pre-existing conditions, isolation, loneliness, social support, family characteristics, and teachers' psychological states. And more precise measures could have been used such as the cell phone for collecting random activity data and the actigraph for activity.

Some relevant comorbidities were also overlooked, for example, anger and aggression that are often associated with anxiety and depression as well as alcohol and drug use that are often used to alleviate anxiety and depression. One exception is research from Prague that noted a significant correlation between depression and alcohol use in university students [16].

Positive effects variables including coping mechanisms [14] and resilience [11] have only been mentioned in a couple of the studies [11,14]. Further, several variables need to be explored in the same samples as in multivariate analysis. This has appeared in a few studies [9,12,14,20,33].

In terms of data analysis, very few regression models have been used to explain the relative variance in the dependent measures. In some cases, minimal variance has been explained but in other studies, significant mediators were noted and in structural equation

modeling significant amounts of variance have been explained [3,7,23,35]. For example, fear and stress accounted for 60% of the variance in anxiety and stress and anxiety accounted for 80% of the variance in depression [23].

Future panel or cohort studies are needed to assess relations between exposure before, during and after lock downs and within time zones of the pandemic, as in longitudinal repeated measures studies. In addition, intervention studies are needed. Only one intervention could be found in this literature [37]. For this intervention, aerobics was provided via webcasts for middle school students two times a day three days a week. This effectively reduced anxiety and enhanced sleep quality in the students. Massage therapy and exercise including walking and yoga have been effective buffers for anxiety and depression during COVID-19 [38]. These authors attributed their buffering effects to the stimulation of pressure receptors under the skin that, in turn, increases vagal activity. Increased vagal activity would reduce cortisol, the stress hormone that is typically elevated in anxiety, and increase serotonin, the anti-depressant neurotransmitter that is often depleted in depression. Potential biochemical effects like these were not included in the research protocols that were limited to surveys during COVID-19. Barriers to intervention have been cited as limited mental health services that were not designed for adolescents and the perceived stigma of those therapies [13,14]. For example, in the university study in Kentucky, 60% of students never used the free mental health services on campus. And infected youth, who also experience anxiety and depression, were typically not included in these survey studies but would be expected to significantly benefit from mental health services [39]. Interventions are needed to not only prevent anxiety and depression but also to prevent the associated risks like alcoholism and suicidality [16,40].

Despite the methodological limitations of these studies, this literature has highlighted the psychological problems for youth during the COVID-19 pandemic and during lockdowns in particular. Hopefully the findings will inform intervention efforts to prevent depression and anxiety in youth during world crises like the COVID-19 pandemic.

Conclusion

This narrative review on anxiety and depression in non-infected youth during COVID-19 has highlighted a significant prevalence of these psychological problems based on surveys on the Patient Health Questionnaire and the Generalized Anxiety Disorder Scale. These psychological symptoms have averaged 38% for anxiety and 36% for depression from studies across several countries, but predominantly from China and the U.S. The prevalence has been significantly greater for females and lower for children versus high school and university students. Several other problems have been comorbid with anxiety and depression including stress, insomnia, social anxiety, PTSD, OCD, and suicidality. Worries about COVID infection and academics as well as inactivity and excessive time on social media have been the most frequent risk factors. Methodological limitations of the studies have included their being self-reported data by self-selected, cross-sectional samples. They, nonetheless, highlight the importance of future longitudinal research and interventions for reducing anxiety and depression and related problems in youth during pandemics like COVID-19.

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