Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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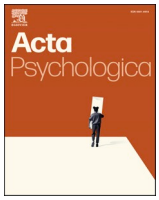

Depression and anxiety among individuals with medical conditions during the COVID-19 pandemic: Findings from a nationwide survey in Bangladesh

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ABSTRACT

Background: Coronavirus disease 2019 (COVID-19) disproportionately impacts individuals with medical conditions, including with respect to their mental health. The present study investigated depression and anxiety and their correlates among individuals with medical conditions in Bangladesh.

Methods: Subjects were recruited to participate in an internet-based survey. Data were collected from November 2020 to January 2021 using convenience sampling by a semi-structured questionnaire through online platforms. Multiple regression analyses were performed to determine associations applying Bonferroni correction ($p < 0.004$). The Patient Health Questionnaire (PHQ-9) and Generalized Anxiety Disorder (GAD-7) measured depression and anxiety, respectively.

Results: Nine-hundred-and-seventy-one participants (50.1% male; mean age = 42.29 ± 15.86 years; age range = 18-80 years) with medical conditions were included in final analyses. The most frequently reported conditions were diabetes, hypertension, obesity, heart disease, asthma, and anemia. Estimates of moderate to severe depression and anxiety were 38.9% and 35.2%, respectively. The mean depression and anxiety scores were significantly higher among participants who reported having hypertension, obesity, heart disease, asthma, anemia, cancer and chronic obstructive pulmonary disease (COPD). Using Bonferroni correction ($p < 0.004$), depression was associated with being female and a student, having poorer quality of life, poorer health status and greater numbers of co-morbidities, not engaging in physical exercise and tobacco smoking. Anxiety was associated with being female and a student, having lower socioeconomic status, poorer quality of life, poorer health status and greater numbers of co-morbidities, less sleep and tobacco smoking.

Conclusions: Depression and anxiety are prevalent among individuals with medical conditions and correlate with sociodemographic, quality-of-life and smoking measures. Interventions targeting vulnerable groups should be employed and investigated.

1. Introduction

A public health emergency situation related to the coronavirus diseases 2019 (COVID-19) pandemic is being experienced globally, as declared by the World Health Organization (WHO) (Mahase, 2020; Tasnim et al., 2021). Bangladesh, where the present study was conducted, is a South Asian developing country that has been significantly impacted with 533,444 confirmed COVID-19 cases and 8072 fatalities through January 28, 2021 (Worldometer, 2020). During the study period, Bangladesh was ranked 28th in the world and reported 0.57% of

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the global COVID-19 disease burden with 100,134 weekly new cases and a positive weekly test rate of 5.17% (World Health Organization, 2021). In Bangladesh as of January 17, 2021, 527,632 COVID-19 cases have been reported, including 7906 fatalities (World Health Organization, 2021). To prevent transmission of the virus, the government of Bangladesh declared public restrictions beginning March 26, 2020 (Ferdous et al., 2020), with nationwide lockdown and physical distancing guidelines that have disrupted many individuals' lives (Thakur & Jain, 2020).

Biophysiological factors may influence relationships between psychological and medical conditions in the setting of COVID-19 (Coughlin, 2012). Medical conditions may increase susceptibility to COVID-19 infection, and people with underlying medical conditions may experience increased COVID-19-related morbidity and mortality (Guan et al., 2020; Jakhmola et al., 2020). Associations between pre-existing medical conditions and severity and impacts of COVID-19 were initially demonstrated by case series and retrospective cohort studies (Fang et al., 2020). In China, a retrospective cohort study of 137 discharged and 54 patients who died found that older age and pre-existing medical conditions were associated with COVID-19 prognosis (Zhou et al., 2020). In addition, another report from China of 1590 patients showed that medical conditions were related to worse health outcomes (Guan et al., 2020).

COVID-19 pandemic-related consequences may have influences on psychological well-being among individuals with medical conditions by increasing distress, anxiety, and depression, and this could definitely happen due to the pandemic (Sigdel et al., 2020). Pre-COVID-19 evidence indicated that mental health disorders existed in 50% of cancer patients, with depressive disorders being most common (Akechi et al., 2008). Depression and anxiety are also common in patients with multiple sclerosis (Mohr et al., 2007), renal disease (Watnick et al., 2003), diabetes (Hermanns et al., 2005; Katon et al., 2004) and tuberculosis (Issa et al., 2009). During the COVID-19 pandemic, moderate to severe depression (16.5%) and anxiety (25%) have been reported among Spanish individuals with chronic medical conditions (Ozamiz-Etxebarria et al., 2020), with 32.4% and 18.7% of Italian individuals experiencing moderate or severe depression, respectively (Mazza et al., 2020). As depression and anxiety are associated with chronic diseases (Watnick et al., 2003), understanding affective concerns among individuals with pre-existing medical conditions during the COVID-19 pandemic is important.

The Bangladesh population has been battling major health problems including non-communicable diseases for years with high prevalence estimates of chronic medical conditions including diabetes (Akhtar et al., 2020), cardiovascular disease (Chowdhury et al., 2018), cancer (Hussain, 2013), and chronic kidney disease (Banik & Ghosh, 2020), and to a lesser extent, HIV/AIDS (Azim et al., 2008). Quarantine and social isolation may contribute to feelings of hopelessness, fear of death and dissatisfaction during the pandemic, and this may lead to an increase in depression and anxiety with both shorter- and longer-term effects (Islam, Sujan, et al., 2020). Additionally, unpredictability and uncertainty of future situations including when and how to receive care for medical conditions and minimize COVID-19-related risks may be especially difficult and challenging.

A meta-analysis of 40 articles involving 21,747 subjects with medical conditions in developing and emerging countries showed that the pooled prevalence of mental disorders was 36.6% (95% CI, 31.4–42.1) and the pooled odds ratio was 3.1 (95% CI, 1.7–5.2) (Daré et al., 2019). Multiple factors, such as female gender, educational level, relationship status, tobacco smoking, substance abuse, physical inactivity, socioeconomic status, underlying medical conditions and disease prognoses, have been associated with depression and anxiety among the general population as well as in people with medical conditions in other countries, such as Ethiopia and Canada (Edmealem & Olis, 2020; Hirschfeld & Cross, 1982; Murphy et al., 1991). Individuals with multiple medical conditions often report poorer health status (Hoogwegt et al., 2013), and related factors may precipitate or exacerbate mental health concerns including depression and anxiety (Kaplan, 1987; Verhaak et al., 2005). Together, this confluence may lead to poorer quality of life (Cully et al., 2006; Mei et al., 2021; Sareen et al., 2006). An improved understanding of factors related to depression and anxiety among people with medical conditions in Bangladesh would provide insight into this vulnerable group and potentially help target interventions.

We hypothesized that patients with pre-existing medical conditions in Bangladesh would frequently experience depression and anxiety. We further hypothesized that depression and anxiety would relate to sociodemographics (e.g., female gender), risk behaviors (e.g., tobacco smoking), perceived health (poorer), quality of life (poorer), and medical burden (e.g., number of medical conditions). To date, no study has investigated depression and anxiety and their correlates among Bangladeshi individuals with pre-existing medical conditions during the COVID-19 pandemic. Thus, we also explored relationships between depression and anxiety and specific medical conditions.

2. Methods

2.1. Study design and population

A cross-sectional study evaluated the symptoms of depression and anxiety and associated factors among the individuals with pre-existing medical conditions during the COVID-19 pandemic in Bangladesh. Inclusion criteria were i) being a Bangladeshi resident, ii) having at least one pre-existing medical condition (e.g., diabetes, hypertension, cancer, etc.), iii) having internet access, and iv) being willing to take part in the survey. An exclusion criterion was having incomplete surveys.

2.2. Sampling and survey procedures

The sample size was calculated using the following equation:

$$\mathrm{n} = \frac{z^2 pq}{d^2}; \mathrm{n} = \frac{1.96^2 \times 0.5 \times (1 - 0.5)}{0.05^2} = 384.16 \approx 384$$

Here,

n = number of samples
z = 1.96 (95% confidence level)
p = prevalence estimate (50% or 0.5) (as no study found)
q = (1-p)
d = precision of the prevalence estimate

The calculated sampling size was 384. Data were collected from November 2020 to January 2021 through a semi-structured and self-reported e-questionnaire using a Google survey tool (Google Forms) which was disseminated via different social platforms (e.g., Facebook, WhatsApp, LinkedIn, Gmail) to reach individuals with medical conditions. After providing e-consent, a confirmation of the participant's health status was obtained by asking, '*Have you been experiencing any underlying medical conditions* (e.g., hypertension, diabetes, heart diseases, kidney disease, cancer, obesity, HIV) *for long time*?' If the answer was "no", then a blank response was submitted. If the individual responded "yes", the full survey form became accessible. There was no monetary incentive for completing the survey. Initially, after providing informed consent, 1307 respondents submitted the survey form without any incentives or remuneration. Of them, 1293 completed the entire survey; we excluded 336 responses as they did not meet the inclusion criteria, leaving 971 respondents in the final sample. Thus, the acquired sample size was larger than that estimated as necessary from the power analysis.

2.3. Measures

To conduct the survey, a self-reported e-questionnaire containing informed consent and questions assessing socio-demographic,

psychiatric and medical measures was implemented. A clear indication of collecting information during the COVID-19 pandemic and our objectives in evaluating mental health concerns in relation to the pandemic and the subsequent public health initiatives was included in the informed consent. In addition, a specific question was asked during the survey to identify patients with pre-existing medical conditions, (i.e., "*Have you been experiencing any of the following diseases from a long time*?") and given possible responses (e.g., hypertension, diabetes, heart diseases, kidney disease, cancer, obesity, HIV).

2.3.1. Socio-demographic and lifestyle measures

Socio-demographic information was gathered through both open-ended and closed-ended questions. Variables assessed included age, gender, occupation, relationship status (married, unmarried, divorced or widowed), residence area (rural, suburban, urban) and monthly family income. Socioeconomic status (SES) was categorized into the following three classes based on monthly family income (lower SES [<15, 000 BDT], middle SES [15, 000–30, 000 BDT], upper SES [>30, 000 BDT]) (Rahman, Islam, Bishwas, et al., 2020; Rahman, Islam, Mamun, et al., 2020).

Questions regarding self-rated health status (SHS), self-reported quality of life (SQL), average number of hours slept, tobacco smoking (yes/no) and physical exercise (yes/no) were asked. To assess SHS and SQL, participants were asked, "*In general, how would you rate your overall health*?" and "*In general, how would you rate your overall quality of life*?", respectively (Ahmed et al., 2020). The responses were based on a five-point Likert scale with response options: "excellent", "very good", "good", "fair", and "poor". In the present study, the responses for both SHS and SQL were recoded into good (excellent/very good/good) and poor (poor/ fair) (Ahmed et al., 2020). Based on average sleeping hours/day, sleep was categorized into three groups including normal (7-9 h), less than average (< 7 h) or more than average (> 9 h) (Islam, Ferdous, et al., 2021; Islam, Sujan, et al., 2020).

2.3.2. Patient Health Questionnaire (PHQ-9)

The nine-item Bangla version of the PHQ-9 scale, which corresponds to the DSM-IV diagnostic criteria for symptoms of major depressive disorder, was used to evaluate the level of participants' depressive symptoms (Chowdhury et al., 2004; Kroenke et al., 2010). Participants were asked to reply on a four-point Likert scale (from "0 = not at all" to "3 = almost every day") based on the last two weeks, with scores ranging from 0 (absence of depressive symptoms) to 27 (severe depressive symptoms) and measuring severity of depression (Spitzer et al., 1999). Five predefined cut-off points (Spitzer et al., 1999) were used as previously in Bangladesh (Islam, Akter, et al., 2020; Rahman, Islam, Mamun, et al., 2020) to determine severity levels of depression: i) '0–4′ for 'minimal'; ii) '5–9′ for 'mild'; iii) '10–14′ for 'moderate'; iv) '15–19′ for 'moderately severe'; and, v) '20 or higher' for 'severe.' The Cronbach's alpha of the PHQ-9 in the present study was 0.91.

2.3.3. Generalized Anxiety Disorder (GAD-7)

The Bangla version of the GAD-7 scale was used to assess the severity level of generalized anxiety (Hossain et al., 2019). The GAD-7 includes seven questions concerning problems related to anxiety symptomatology over the last two weeks with each question scored along a four-point Likert scale (from "0 = not at all" to "3 = almost every day") (Spitzer et al., 2006). The total scores ranged from 0 to 21 and were obtained by summating the raw scores of the seven items, with a higher score indicating more severe anxiety. Predefined cut points were employed to determine the following severity levels of generalized anxiety: i) '0–4′ for 'minimal'; ii) '5–9′ for 'mild'; iii) '10–14′ for 'moderate'; and, iv) '15–21′ for 'severe' as previously in Bangladesh (Islam, Ferdous, & Potenza, 2020; Moonajilin et al., 2020). The Cronbach's alpha of the GAD-7 in the present study was 0.91.

2.4. Statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS), version 25. Multiple regression analysis was executed to assess correlates of depression and anxiety in separate models for PHQ-9 scores and GAD-7 scores as dependent variables, respectively. After applying Bonferroni correction, the present study considered $p < 0.004$ as a statistical significance level to protect findings from type-I errors. A conventional level of significance ($p < 0.05$) was also considered.

2.5. Ethics

The present study was conducted according to the Institutional Research Ethics and human involving guidelines (e.g., Helsinki declaration). Formal ethics approval was granted by the Ethical Review Committee, Uttara Adhunik Medical College, Uttara, Dhaka-1260, Bangladesh [Ref: UAMC/ERC/27/2020]. The objectives and purpose of this study were clearly documented in the informed consent. The confidentiality and anonymity of participants' information, along with the freedom to withdraw responses from the study at any time, were also described in the informed consent.

3. Results

A total of 971 subjects with pre-existing medical conditions were included in the final analysis. The mean age of participants was 42.29 years (SD = 15.86) and age ranged from 18 to 80 years. Half of the participants were male (50.1%), the majority were married (65.3%) and reported good quality of life (52.9%), and many were employed (29.0%), resided in urban areas (62.7%), belonged to upper SES (46.1%), and reported poorer health status (55.9%) (Table 1). A sizeable minority reported sleeping less than 7 h/day (41.9%), and most did not engage in physical activity (77.5%). A considerable minority smoked cigarettes (17.7%).

3.1. Medical conditions

The distribution of participants' pre-existing medical conditions is presented in Table 2. The most frequently reported medical conditions were diabetes (44.9%) and hypertension (37.7%). The mean number of pre-existing medical conditions was 1.6 (SD = 0.9), and the range was 1 to 5 conditions. Mean depression and anxiety scores were significantly higher among participants who reported having hypertension, obesity, heart disease, asthma, anemia, cancer and chronic obstructive pulmonary disease (COPD; Table 2).

3.2. Depression

The prevalence estimates of minimal, mild, moderate, moderately severe, and severe depression were 35.4%, 25.6%, 19.2%, 12.0%, and 7.7%, respectively. Based on the PHQ-9 cutoff (≥10), 38.9% of participants experienced moderate to severe depression. Based on multiple regression, PHQ-9 scores were significantly ($p < 0.05$) higher among participants who reported being female, a student, or retired and among those reporting lower/middle SES, poorer quality of life, poorer health status, greater numbers of medical conditions, more/less sleep, not engaging in physical exercise and tobacco smoking (Table 3). Among these, being female, being a student, reporting poorer quality of life, reporting poorer health status, having greater numbers of medical conditions, not engaging in physical exercise and smoking tobacco withstood Bonferroni correction ($p < 0.004$) for multiple comparisons. The largest standardized effect size (0.29) was associated with participants' quality of life. The overall regression model predicted 42% of the variance in depression [$F_{(20,950)} = 35.74$, $p < 0.001$].

Table 1
Descriptive analysis of participants' characteristics.

Variables	Total		Male		Female	
	n	(%)	*n*	(%)	*n*	(%)
Total	*971*	(*100*)	*486*	(*50.1*)	*485*	(*49.9*)
Marital status						
Unmarried	263	(27.1)	109	(22.4)	154	(31.8)
Married	634	(65.3)	359	(73.9)	275	(56.7)
Widowed	74	(7.6)	18	(3.7)	56	(11.5)
Occupation						
Housewife	209	(21.5)	10	(2.1)	199	(41.0)
Student	234	(24.1)	86	(17.7)	148	(30.5)
Employee	282	(29.0)	184	(37.9)	98	(20.2)
Businessman	137	(14.1)	124	(25.5)	13	(2.7)
Retired	84	(8.7)	66	(13.6)	18	(3.7)
Unemployed	25	(2.6)	16	(3.3)	9	(1.9)
Residence						
Rural	235	(24.2)	128	(26.3)	107	(22.1)
Suburban	127	(13.1)	66	(13.6)	61	(12.6)
Urban	609	(62.7)	292	(60.1)	317	(65.4)
Socioeconomic status (SES)						
Lower	169	(17.4)	75	(15.4)	94	(19.4)
Middle	354	(36.5)	196	(40.3)	158	(32.6)
Upper	448	(46.1)	215	(44.2)	233	(48.0)
Self-reported quality of life						
Poor	457	(47.1)	213	(43.8)	244	(50.3)
Good	514	(52.9)	273	(56.2)	241	(49.7)
Self-reported health status						
Poor	543	(55.9)	251	(51.6)	292	(60.2)
Good	428	(44.1)	235	(48.4)	193	(39.8)
Sleeping hours						
<7 h	407	(41.9)	199	(40.9)	208	(42.9)
7-9 h	519	(53.5)	258	(53.1)	261	(53.8)
>9 h	45	(4.6)	29	(6.0)	16	(3.3)
Physical exercise						
No	753	(77.5)	358	(73.7)	395	(81.4)
Yes	218	(22.5)	128	(26.3)	90	(18.6)
Tobacco smoking						
No	799	(82.3)	336	(69.1)	463	(95.5)
Yes	172	(17.7)	150	(30.9)	22	(4.5)
Continuous variables	**Mean**	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**
Age	42.3	(15.9)	44.9	(15.8)	39.7	(15.5)
Number of medical conditions	1.6	(0.9)	1.7	(0.9)	1.6	(0.8)
Total PHQ9	8.4	(7.0)	7.5	(6.8)	9.3	(7.1)
Total GAD7	7.5	(6.0)	6.8	(5.8)	8.2	(6.1)

3.3. Anxiety

The prevalence estimates of minimal, mild, moderate, and severe anxiety were 35.2%, 29.6%, 21.5%, and 13.7%, respectively. Based on the GAD-7 cutoff (≥10), 35.2% of participants experienced moderate to severe generalized anxiety. Based on multiple regression, GAD-7 scores were significantly ($p < 0.05$) higher among participants who reported female gender, student status, lower/middle SES, poorer quality of life, poorer health status, more medical conditions, less sleep, not engaging in physical exercise and tobacco smoking (Table 4). Among these, being female and a student and reporting lower SES, poorer quality of life, poorer health status, more medical conditions, less sleep, and smoking tobacco withstood Bonferroni correction ($p < 0.004$) for multiple comparisons. The largest standardized effect size (0.28) was associated with participants' health status. The overall regression model predicted 39% of the variance in generalized anxiety [$F_{(20,950)} = 32.02$, $p < 0.001$].

3.4. Association between depression and anxiety

The mean PHQ-9 and GAD-7 scores were 8.39 (SD = 7.02) and 7.52 (SD = 5.96), respectively. The PHQ-9 and GAD-7 scores were significantly and strongly correlated with each other ($r = 0.80$, $p < 0.001$). Depression was significantly more common among participants with vs. without anxiety (78.1% vs. 17.6%; $\chi^2 = 340.22$, $p < 0.001$). Similarly, anxiety was significantly more common among participants with vs. without depression (70.6% vs. 12.6%; $\chi^2 = 340.22$, $p < 0.001$).

4. Discussion

Depression and generalized anxiety are common mental health concerns among individuals with pre-existing medical conditions, especially in low- and middle-income countries (Sandmire et al., 1976). Depression and anxiety may negatively affect the management and progression of pre-existing medical conditions and COVID-19. In both developed and developing nations, depression and anxiety are important public health problems and can be especially burdensome for people who have multiple chronic conditions. The co-occurrence of medical and affective disorders has been linked to poorer medical outcomes. Depression and anxiety are common during the COVID-19 pandemic (Hossain et al., 2021; Islam, Ferdous, et al., 2021; Islam, Ferdous, & Potenza, 2020; Islam, Sujan, et al., 2020; Islam, Tasnim, et al., 2021; Tasnim et al., 2021), and people with affective and medical concerns may be particularly vulnerable to experiencing COVID-19. Thus, we examined the frequencies and correlates of depression and generalized anxiety among Bangladeshi individuals with pre-existing medical conditions during the COVID-19 pandemic. Findings indicate frequent depression and anxiety, which were correlated with one another. We place the current findings in the context of prior Bangladeshi studies. Since there are limited studies about the prevalence of depression and anxiety among Bangladeshi individuals with pre-existing medical conditions, we also compare the current findings with those from studies in other jurisdictions.

The present study revealed that close to 40% (38.9%) of individuals experienced moderate to severe depression. This percentage is lower than those in earlier studies conducted in Bangladesh which found depressive symptoms in 61.9% of patients with type 2 diabetes (Islam et al., 2015) and 46.9% of post-stroke patients (Islam et al., 2016). Other pre-COVID-19 studies showed lower estimates of depression (25.9%) among individuals with gestational diabetes mellitus (Natasha et al., 2015) or coronary artery disease (21.9%) (Thombs et al., 2008). The current percentage more closely approximates that observed among diabetic patients in an urban hospital of Bangladesh (34.8%) (Rahman et al., 2011).

Slightly more than one-third (35.2%) of participants reported moderate to severe generalized anxiety. This percentage is higher than those from earlier studies conducted before the pandemic in India (Rajput et al., 2016) and Ethiopia among HIV patients (Tesfaw et al., 2016), and lower than that from a study in South Ethiopia (Duko et al., 2015) where the prevalence of anxiety among patients was 41.5%. Of note, prevalence estimates of depression and anxiety have varied among different populations with different medical conditions in different settings. Additionally, direct comparison is limited as the aforementioned studies were conducted prior to the COVID-19 pandemic. The burden of anxiety and depression both in developed and developing countries may be concealed by poor understanding in the general population, lack of training among health care professionals and shortage of services including treatment opportunities (Thornicroft et al., 2007; World Health Organization, 2020). Therefore, longitudinal studies are warranted to gather information in these domains, investigate relationships with anxiety and depression and identify patterns over time.

In this study, depression and anxiety were strongly linked to being female, in line with several previous pre-COVID-19 studies from India (Islam et al., 2015; Katon et al., 2004; Rahman et al., 2011; Rajput et al., 2016). Depression is expected to be the leading cause of disease burden by 2030 and is already the leading cause of disease burden in women globally (World Health Organization, 2004). The finding of similar

Table 2
Multivariable correlates of depression and anxiety for specific medical conditions.

Variables	Total = 971	Depression[a]						Anxiety[b]					
	N (%)	Mean (SD)	B	SE	t	β	*p*-value	Mean (SD)	B	SE	t	β	*p*-value
Diabetes													
No	535 (55.1)	9.13 (7.32)				†		7.74 (6.06)				†	
Yes	436 (44.9)	7.49 (6.53)	−0.54	0.47	−1.14	−0.04	0.255	7.26 (5.84)	0.41	0.40	1.02	0.03	0.310
High blood pressure/hypertension													
No	605 (62.3)	8.03 (7.15)				†		7 (5.98)				†	
Yes	366 (37.7)	8.99 (6.76)	1.80	0.47	3.82	0.12	<0.001	8.39 (5.85)	2.05	0.40	5.15	0.17	<0.001
Obesity													
No	778 (80.1)	8.09 (6.98)				†		7.42 (6.02)				†	
Yes	193 (19.9)	9.62 (7.06)	2.38	0.58	4.08	0.14	<0.001	7.95 (5.72)	1.64	0.49	3.33	0.11	0.001
Heart disease													
No	810 (83.4)	8.15 (7.04)				†		7.23 (5.98)				†	
Yes	161 (16.6)	9.6 (6.78)	1.93	0.60	3.22	0.10	0.001	9.01 (5.66)	2.03	0.51	3.99	0.13	<0.001
Asthma													
No	829 (85.4)	8.08 (6.9)						7.25 (5.8)				†	
Yes	142 (14.6)	10.2 (7.46)	2.36	0.63	3.73	0.12	<0.001	9.15 (6.64)	2.33	0.54	4.35	0.14	<0.001
Anemia													
No	860 (88.6)	8.1 (6.87)				†		7.3 (5.77)				†	
Yes	111 (11.4)	10.68 (7.72)	3.34	0.72	4.62	0.15	<0.001	9.25 (7.11)	2.98	0.61	4.87	0.16	<0.001
Thyroid problems													
No	904 (93.1)	8.32 (7.03)				†		7.46 (5.94)				†	
Yes	67 (6.9)	9.36 (6.78)	1.03	0.87	1.19	0.04	0.236	8.34 (6.22)	1.07	0.73	1.46	0.05	0.143
Kidney problems													
No	905 (93.2)	8.35 (7)				†		7.53 (5.99)				†	
Yes	66 (6.8)	9.05 (7.33)	0.57	0.87	0.65	0.02	0.516	7.42 (5.6)	−0.35	0.74	−0.47	−0.02	0.636
Liver cirrhosis													
No	948 (97.6)	8.37 (6.98)				†		7.5 (5.95)				†	
Yes	23 (2.4)	9.35 (8.53)	1.19	1.44	0.83	0.03	0.409	8.57 (6.78)	1.39	1.22	1.14	0.04	0.256
Cancer													
No	961 (99)	8.35 (7.01)				†		7.48 (5.95)				†	
Yes	10 (1)	12.6 (6.67)	4.79	2.17	2.21	0.07	0.027	11.9 (5.65)	5.32	1.83	2.90	0.09	0.004
Chronic Obstructive Pulmonary Disease (COPD)													
No	963 (99.2)	8.33 (6.98)				†		7.47 (5.94)				†	
Yes	8 (0.8)	16.5 (7.54)	8.20	2.43	3.38	0.11	0.001	14.13 (6.01)	7.08	2.06	3.45	0.11	0.001

Note:
SD = Standard deviation.
B = Unstandardized regression coefficient.
SE = Standard error.
β = Standardized regression coefficient.
COPD = Chronic obstructive pulmonary disease.
† Reference category.
[a] Model summary: $F_{(11,959)} = 7.65$, $p < 0.001$, $R^2_{Adj} = 0.07$.
[b] Model summary: $F_{(11,959)} = 8.39$, $p < 0.001$, $R^2_{Adj} = 0.08$.

female-to-male prevalence estimate ratios globally suggests that differential risks may relate to biological sex factors and be less sensitive to differences in ethnicity, culture, diet, education and other jurisdictional factors (Albert, 2015). Hormonal changes in females, particularly during puberty, before menstruation, after pregnancy and during menopause, suggest that hormonal fluctuations may predispose to depression (Albert, 2015). Nonetheless, other factors (e.g., those related to interpersonal relationship sensitivities) may also contribute (Kendler & Gardner, 2014).

In the present study, the levels of depression and anxiety were significantly higher among individuals with hypertension, obesity, heart disease, asthma, anemia, cancer and CPOD. The findings resonate with those from a previous study conducted in Ghana and Nigeria (Ademola et al., 2019) in which depression prevalence was higher among individuals with hypertension. A study conducted in Ethiopia found the prevalence of anxiety to be higher among individuals with hypertension (Aberha et al., 2016). A study in Malaysia demonstrated a high prevalence of depression and anxiety among obese individuals with chronic medical illnesses (Hassan et al., 2019), consistent with the findings of this current study but seemingly inconsistent with an earlier study in Bangladesh (Moonajilin et al., 2020). In line with the current study, depression and anxiety were found to be elevated in individuals with heart failure in prior studies (AbuRuz, 2018; Konstam et al., 2005). Similarly, prior studies have linked depression and anxiety to asthma (Vieira et al., 2011), anemia (Beard et al., 2005), and COPD (Thapa et al., 2017).

Student status was significantly associated with depression and anxiety in this study. Several pre-COVID-19 studies also found higher depression and anxiety among students (Islam, Akter, et al., 2020; Koly et al., 2020; Mamun et al., 2019). A study conducted early during the COVID-19 pandemic in Bangladesh found high prevalence of depression among students (Islam, Sujan, et al., 2020). Several factors may predispose students to depression including neuroticism, loneliness, and drug abuse; of particular note, disease or physical illness may substantially increase the risk for depression among students (Sujan et al., 2021). More studies, especially longitudinal investigations, are needed to understand how specific medical conditions may impact depression (and vice versa) among students.

Table 3
Multiple regression analysis predicting depression.

Variables	Mean	SD	B	SE	t	β	*p*-value
Age	———	———	0.02	0.02	0.85	0.03	0.396
Sex							
Male	7.5	(6.8)				†	
Female	9.3	(7.1)	1.48	0.45	3.31	0.11	0.001
Marital status							
Widowed	9.6	(7.0)				†	
Unmarried	10.9	(7.4)	0.96	1.03	0.93	0.06	0.354
Married	7.2	(6.5)	−0.06	0.71	−0.08	−0.00	0.938
Occupation							
Housewife	7.8	(6.7)				†	
Student	11.6	(7.6)	3.90	0.92	4.26	0.24	<0.001
Employee	6.4	(5.9)	0.08	0.58	0.13	0.01	0.894
Businessman	7.8	(7.4)	0.90	0.71	1.27	0.04	0.205
Retired	8.9	(6.5)	1.97	0.82	2.40	0.08	0.016
Unemployed	7.8	(6.1)	−0.96	1.21	−0.80	−0.02	0.426
Socioeconomic status (SES)							
Upper	7.1	(7.0)				†	
Lower	10.4	(6.8)	1.20	0.52	2.32	0.06	0.021
Middle	9.1	(6.8)	0.81	0.40	2.02	0.06	0.043
Residence							
Rural	9.1	(7.2)				†	
Suburban	7.0	(6.9)	−0.86	0.61	−1.43	−0.04	0.154
Urban	8.4	(6.9)	−0.07	0.44	−0.16	−0.00	0.876
Self-reported quality of life							
Good	5.0	(5.4)					
Poor	12.3	(6.7)	4.14	0.46	9.05	0.29	<0.001
Self-reported health status							
Good	4.5	(5.1)				†	
Poor	11.5	(6.8)	3.37	0.46	7.30	0.24	<0.001
No. of co-morbidities			0.78	0.23	3.46	0.10	0.001
Sleeping hours							
7-9 h	7.9	(6.5)				†	
<7 h	8.7	(7.4)	1.00	0.36	2.74	0.07	0.006
>9 h	11.9	(7.7)	2.31	0.86	2.69	0.07	0.007
Physical exercise							
Yes	6.1	(6.3)				†	
No	9.1	(7.1)	2.10	0.42	4.99	0.12	<0.001
Tobacco smoking							
No	8.0	(6.8)				†	
Yes	10.1	(7.7)	1.63	0.50	3.23	0.09	0.001

SD = Standard deviation.
B = Unstandardized regression coefficient.
SE = Standard error.
β = Standardized regression coefficient.
BDT = Bangladeshi Taka.
Model summary: $F_{(20,950)} = 35.74$, $p < 0.001$, $R^2_{Adj} = 0.42$.
† Reference category.

Depression and anxiety were linked to lower SES, consistent with prior findings (Hirschfeld & Cross, 1982; Murphy et al., 1991). A prior study found that depression was associated with shortage of food or medicine and loss of livelihood (Islam et al., 2015), and these factors warrant further investigation among people with medical concerns. Poor health status and poor quality of life may result from poverty or low SES (Starfield, 1992; Yen & Kaplan, 1999; Lubetkin et al., 2003). Among people with COPD, poor health status was associated with depression and anxiety (Gudmundsson et al., 2006). Among people with heart failure, poor quality of life was linked to depression and anxiety (Aggelopoulou et al., 2017). Similarly, poor quality of life was associated with depression and anxiety among people with cardiovascular disease (Mei et al., 2021).

The prevalence estimates of moderate to extremely severe depression and anxiety in the current study were significantly higher among individuals having more pre-existing medical conditions. Pre-existing medical conditions have been reported as a risk factor for COVID-19 (Wang et al., 2020), and knowledge of this relationship may induce anxiety or depression. This observed association is also consistent with prior findings from Bangladesh (Islam et al., 2015; Islam et al., 2016; Katon et al., 2004).

Shorter sleep duration was related to anxiety but not depression. The former observation resonates with findings among cancer patients, where duration of sleep was associated with anxiety (de Sousa et al., 2020). This finding carries clinical significance as insomnia was a main factor motivating treatment seeking among cancer patients with depression and anxiety (Cha et al., 2017).

Physical exercise can enhance cognitive performance and overall health and may help prevent or treat anxiety and depression (Nyström et al., 2015). Here, depression and anxiety were associated with physical inactivity, in line with prior findings among people with diabetes (Melin et al., 2014) and other medical conditions (Bishwajit et al., 2017). This association has also been observed among other populations during the COVID-19 pandemic (Islam et al., 2020; Tasnim et al., 2021), including people with obesity (Almandoz et al., 2021).

Smoking was associated with depression and anxiety, similar to prior findings among people with diabetes (Katon et al., 2004; Saleh et al., 2014) and those with obesity and chronic illnesses (Hassan et al., 2019). Smoking increases the likelihood of many diseases and may cause serious health problems, including cardiovascular diseases (Siddiqi et al., 2015) and cancers (Lee, 2011). As smoking is the most preventable cause of death in Bangladesh (Islam & Walton, 2019), targeting

Table 4
Multiple regression analysis predicting anxiety.

Variables	Mean	SD	B	SE	t	β	*p*-value
Age	———	———	0.02	0.02	1.52	0.06	0.128
Sex							
Male	6.8	(5.8)				†	
Female	8.2	(6.1)	1.35	0.39	3.49	0.11	<0.001
Marital status							
Widowed	8.5	(6.1)				†	
Unmarried	8.8	(6.3)	1.09	0.90	1.21	0.08	0.225
Married	6.9	(5.7)	0.40	0.62	0.65	0.03	0.513
Occupation							
Housewife	7.4	(5.9)				†	
Student	9.2	(6.3)	2.49	0.80	3.13	0.18	0.002
Employee	6.2	(5.1)	0.04	0.50	0.08	0.00	0.933
Businessman	7.6	(6.3)	1.10	0.62	1.78	0.06	0.076
Retired	7.7	(5.8)	0.72	0.71	1.01	0.03	0.314
Unemployed	6.4	(6.5)	−1.13	1.05	−1.07	−0.03	0.283
Socioeconomic status (SES)							
Upper	6.4	(5.9)				†	
Lower	9.5	(5.8)	1.58	0.45	3.51	0.10	<0.001
Middle	8.1	(5.9)	0.88	0.35	2.53	0.07	0.012
Residence							
Rural	8.1	(6.2)				†	
Suburban	6.6	(6.2)	−0.35	0.53	−0.67	−0.02	0.503
Urban	7.5	(5.8)	0.06	0.38	0.14	0.00	0.885
Self-reported quality of life							
Good	4.6	(4.8)				†	
Poor	10.8	(5.5)	3.20	0.40	8.04	0.27	<0.001
Self-reported health status							
Good						†	
Poor	4.0	(4.4)	3.35	0.40	8.34	0.28	<0.001
No. of co-morbidities	10.3	(5.6)	0.91	0.20	4.65	0.13	<0.001
Sleeping hours							
7-9 h	7.1	(5.4)				†	
<7 h	8.0	(6.7)	0.96	0.32	3.04	0.08	0.002
>9 h	8.3	(5.4)	−0.19	0.75	−0.26	−0.01	0.797
Physical exercise							
Yes	6.3	(6.0)				†	
No	7.9	(5.9)	0.85	0.37	2.31	0.06	0.021
Tobacco smoking							
No	7.2	(5.8)				†	
Yes	9.0	(6.4)	1.47	0.44	3.37	0.09	0.001

SD = Standard deviation.
B = Unstandardized regression coefficient.
SE = Standard error.
β = Standardized regression coefficient.
BDT = Bangladeshi Taka.
Model summary: $F_{(20,950)} = 32.02$, $p < 0.001$, $R^2_{Adj} = 0.39$.
† Reference category.

depression and anxiety in conjunction with smoking cessation efforts is important among people with medical concerns.

This current study also found a strong relationship between depression and anxiety, similar to findings in people with heart failure (Årestedt et al., 2014) and in other populations (DiMatteo et al., 2000; Gaynes et al., 1999; Hiller et al., 1989). However, our study found no significant association between depression and anxiety and age or marital status, seemingly different from a prior report and possibly reflecting participant differences or other factors (Islam et al., 2015).

4.1. Limitations

Study limitations should be noted. First, the study was cross-sectional so causality cannot be determined. Future longitudinal studies should examine people with pre-existing medical conditions and factors related to depression and generalized anxiety as the COVID-19 pandemic progresses and hopefully subsides. Second, the study utilized online self-reporting measures that may be sensitive to social desire and memory recall biases, and this should be considered when interpreting the results. Third, the present sample was not representative of the general population of Bangladesh due to its convenient sampling technique and online methods used in the present study. As such, the study may not be representative of the general population in Bangladesh. For example, it is estimated that 37.4% (2019 estimate) of the Bangladeshi population resides in urban areas, and 62.7% of respondents in the current study reported urban living status. As such, urban residents may be considerably over-represented. We also did not collect information from people without medical conditions. Thus, we could not assess differences between individuals with and without underlying medical conditions. Further, limited data were collected regarding the medical conditions (e.g., relating to medications being used, treatment status). Moreover, the study did not include COVID-19-related variables (e.g., history of SARS-CoV-2 infection and COVID, SARS-CoV-2 infection and COVID in friends or family, etc.). As pre-pandemic levels of distress were not available, it is not possible to estimate the 'true' impact of the COVID-19 pandemic on the population under investigation. The data captures their psychological well-being during a particular time in the pandemic and future longitudinal studies need to establish how these levels of distress may change over time.

5. Conclusions

This study demonstrates high prevalence estimates of depression and generalized anxiety among Bangladeshi people with pre-existing medical conditions during the COVID-19 pandemic and investigates the correlates of depression and generalized anxiety. Notably, poorer quality of life and health status related considerably to depression and anxiety. The findings suggest that interventions (e.g., mental health screening programs, mental health counseling, social support) and health policy reforms, especially during this pandemic are likely needed to help people with co-occurring mental health and medical concerns. Such efforts may require the education and training of health staff in multiple fields of medicine and other disciplines. This study suggests a potentially important role for psychiatrists and psychologists in multidisciplinary teams providing care for individuals with medical conditions, as well as the possible need for additional training. Further, vaccination programs may target individuals with medical conditions on a priority basis, and in this process, the impacts on mental health should be considered and assessed. The current findings may also help guide policy efforts to help healthcare providers have appropriate means to address mental health concerns among people with medical conditions, particularly at times when more severe symptoms may be experienced during crises such as the COVID-19 pandemic.

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CRediT authorship contribution statement

Rafia Tasnim: Conceptualization, Investigation, Methodology, Writing - original draft, Validation., **Md. Safaet Hossain Sujan**: Conceptualization, Investigation, Methodology, Writing - original draft, Validation., **Md. Saiful Islam**: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing - original draft, Writing - review & editing, Validation., **Most. Zannatul Ferdous**: Supervision, Investigation, Writing - review & editing, Validation., **Mohammad Mohiuddin Hasan**: Writing - review & editing, Validation., **Kamrun Nahar Koly**: Writing - review & editing, Validation., **Marc N. Potenza**: Writing - review & editing, Validation.

Declaration of competing interest

All authors declare that they have no potential conflict of interest in the dissemination of the study's findings.

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