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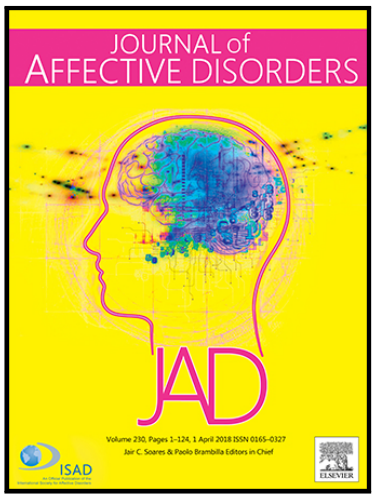

The COVID-19 pandemic and serious psychological consequences in Bangladesh: a population-based nationwide study

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Highlights

- Bangladesh has almost no country-representative researches addressing COVID-19 related mental health problems
- 5.0% suicidal ideation and 33.3% depression was reported from this nationwide study
- The risk factors for both depression and suicidal ideation included - younger age, female, smoker, comorbidities and insomnia
- Other COVID-19 related risk factors were its' poor knowledge and greater fear, and not engaging in its preventive behaviors
- GIS mapping presented district-wise distributions of depression and suicidal ideation.

The COVID-19 pandemic and serious psychological consequences in Bangladesh: a population-based nationwide study

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Authors' contribution
MAM conceived and designed the study outline. AKMIB developed the initial questionnaire and MAM finalized it. All authors then inputted and validated the plan and survey instrument, especially AHP. MAM, NS, AKMIB & SH led the project implementation with help of FAM, IH, MBS, AHA, MAS & IR. The project was supervised by MTS, MM, DG, MDG & AHP. Data collection ad data collector team were managed by MAM, NS, AKMIB, SH, MB-D, FAM, IH, MBS, AHA, MAS and IH. The dataset was cleaned by NS, & FAM. AHP and C-YL carried out the formal statistical analyses and incorporated results, and MB-D performed the GIS-mapping. MAM searched the literature and wrote the first draft with the help of NS & AHP. The first extensive review and edits were done by DG. Other authors reviewed and contributed subsequently in the draft, especially MDG. Final approval was provided by all authors.

Declaration of competing interest
The authors declare no completing interest to this work.

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The study was self-funded, whereas data collection was facilitated by approximately 250 research assistants from 64 districts. Therefore, the authors would like to acknowledge all the RAs' voluntary efforts.

Data sharing statement
Data will be available on its' acceptance.

Abstract

Background
As with countries worldwide, lockdown measures during the COVID-19 outbreak in Bangladesh were sudden and unexpected, and have the capacity to elicit serious psychological consequences. The present study examined the psychological consequences of COVID-19 in Bangladesh during the lockdown period.

Methods
A nationwide online cross-sectional survey study recruited 10,067 individuals covering all 64 districts in Bangladesh via social media (April 1-10, 2020). The survey comprised questions concerning socio-demographics, knowledge of COVID-19, behavior towards COVID-19, fear of COVID-19, insomnia, depression, and suicidal ideation. Logistic regression and structural equation modeling (SEM) analyses were performed to identify the risk factors depression and suicidal ideation. Geographical information system (GIS)-based spatial analysis was used to identify district-wise susceptibility to depression and suicidal ideation.

Findings
The prevalence rate of depression and suicidal ideation related to COVID-19 was 33% and 5%. Common risk factors for suicidal ideation and depression included being young, being female, being a cigarette smoker, having comorbid diseases, having high scores on the Fear COVID-19 Scale, and having insomnia symptoms. GIS-based maps detected high depression and suicidal ideation in the capital of Bangladesh and the districts near the capital as well as coastal areas where COVID-19 prevalence was high, as compared with districts with no reported cases.

Limitations
Self-reported scales and cross-sectional design of our study.

Conclusion
COVID-19 is associated with major psychological impact across Bangladesh, underlining the need of strategically located psychological support measures and improved access to mental health services, especially among women and younger people.

Keywords
COVID-19; Depression; Suicidal ideation; Psychological impact; Bangladeshi people.

1. Introduction

Any natural or manmade disaster can enhance the risk of (or exacerbate) underlying psychological and emotional problems among susceptible or affected individuals (Mamun et al., 2019; Mamun and Griffiths, 2020a). In the context of the current COVID-19 pandemic, the risk of being affected with the virus and the relative insufficiency of global healthcare systems in prevention and management of the virus at the national scale can generate substantial stress and serious mental health issues particularly among susceptible individuals (Dsouza et al., 2020; Usman et al., 2020). The most commonly observed psychological manifestations include fear of getting sick or dying, feelings of helplessness, depression, anxiety, isolation, and stigma (Khan et al., 2020). For example, around 10% to 30% of the general population were anxious about being affected by the H1N1 influenza virus during the 2009 outbreak in the UK (Rubin et al., 2010). Similarly, 15% of SARS (severe acute respiratory syndrome) epidemic quarantined individuals in Toronto exhibited symptoms of posttraumatic stress disorder and depression (Hawryluck et al., 2004). Likewise, studies during the SARS epidemic that investigated the psychological impact on the non-infected community, reported significant psychiatric morbidities that were associated with younger age and with increased self-blame (Sim et al., 2010). Furthermore, major psychosocial effects were also reported during the 2013–2016 Ebola outbreak in Guinea, Liberia, and Sierra Leone (Van Bortel et al., 2016).

The immediate psychological impact of COVID-19 was assessed by Li and colleagues (2020) in the Chinese population, and negative emotions such as depression and anxiety, as well as increased sensitivity to social risks and decreased happiness and life satisfaction were reported. Similarly, Wang et al. (2020) reported that 53.8% of Chinese people suffered from moderate to severe negative psychological impact related to COVID-19, and also found that 16.5% had depressive symptoms, 28.8% had anxiety disorders, and 8.1% had moderate to severe levels of stress. Another study conducted by Huang and Zhao (2020) in China reported that the prevalence of depression and anxiety was 20.1% and 35.1% respectively. As different sectors of the population may not exhibit analogous levels of psychological distress during the COVID-19 pandemic, Vindegaard and Benros (2020) recently reviewed the prevalence of mental disorders among different groups. The highest prevalence of mental problems emerged among COVID-19 patients (96.2% post-traumatic stress symptoms, 29.2% depression), followed by patients with psychiatric disorders prior to and during COVID-19 (37.5% reported worsening of their eating disorder symptomatology, 56.2% anxiety symptoms, 20.9% of patients with pre-existing psychiatric disorders reported worsening of their symptoms). Moreover, overall 23.2% anxiety, 22.8% depression, and 38.9% insomnia were reported among healthcare professionals (Pappa et al., 2020).

Bangladesh, a densely populated (~170 million people) and limited resourced country, is facing a widespread crisis and enormous challenges since the first confirmed COVID-19 cases were reported on March 8, 2020 (Islam et al., 2020), along with rapid escalation of both confirmed cases and deaths (WHO, 2020a). In response, the government of Bangladesh suspended many activities and imposed quarantine and lockdown measures (Islam et al., 2020). As a result, Bangladeshi residents have had to bear the risk of being both infected and isolated, inevitably exposing them to a significant additional burden to their psychological wellbeing while already suffering from higher rates of psychiatric issues than those reported globally, and higher rates of otherwise unexpected suicide cases (Bhuiyan et al., 2020; Mamun & Griffiths, 2020b; Mamun et

al., 2020a; 2020b). Mamun and Griffiths (2020b) recommended that a nationwide study in Bangladesh was needed to identify the extent of mental health problems related to COVID-19. In this context, the present study investigated the prevalence of common mental health disorders across the 64 districts in Bangladesh. Moreover, logistic models and structural equation modeling were utilized to understand the relationships between COVID-19-related factors and consequences.

2. Methods

2.1. Participants and procedure

A nationwide cross-sectional online survey was carried out between April 1 and April 10, 2020. To ensure participants would originate from each of the 64 districts in Bangladesh, three to four Research Assistants (RAs; more than 250 RAs in the total) were designated to collect data from each district. RAs were instructed to disperse the online survey form throughout their designated districts' social media users. The questionnaire was pre-validated and edited by a previous pilot study assessing 245 participants of different age groups. Approximately 11,000 participants were approached and of these, 10,067 took part in the survey. The inclusion criteria were (i) being Bangladeshi, (ii) residing in Bangladesh, and (iii) being aged over 10 years. The full questionnaire used in the survey is provided in Online Supplement Appendix 1.

2.2. Ethics

The study was conducted within the guidelines of Helsinki Declaration, 1975. Additionally, the ethical aspects were reviewed and approved by the Institute of Allergy and Clinical Immunology of Bangladesh ethics board, Bangladesh [IRBIACIB/CEC/03202005] and Biosafety, Biosecurity, and Ethical Committee of Jahangirnagar University, Bangladesh [BBEC, JU/M 2O20/COVlD-l9/ (9)2]. Online informed consent was provided before survey participation, and the online consent form included purpose of the study, data confidentiality, rights of participation, and the right to withdraw from the study at any time. Parental or guardian consent was obtained for participants aged below 18 years.

2.3. Measures

2.3.1. Socio-demographic information

The most relevant socio-demographic information was added to the questionnaire (Appendix pp.2-6). Socio-demographic information included age, gender, educational status, occupational status, current place of residence, marital status, current cigarette smoking behavior (yes/no), current alcohol drinking behavior (yes/no), their current health status, and their use of social media and its frequency. Current health status was observed using a single question (i.e., *"Are you suffering from any of the following health-related issues?"*) with seven response choices (i.e., diabetes, high blood pressure, asthma/respiratory problem, heart disease, kidney problem, cancer, and any others not listed). A total comorbidity score was calculated with a score of 1 point for each condition listed (i.e., someone with diabetes, asthma and high blood pressure would score 3).

2.3.2. COVID-19 knowledge-related questions

Questions were used to evaluate participant knowledge concerning the COVID-19 pandemic. Knowledge was assessed based on four domains: (i) spread of infection (six true/false

statements; e.g. *'COVID-19 can spread by touching others*), (ii) symptoms (six true/false statements; e.g., *'The most common symptoms of COVID-19 are fever, tiredness and dry cough'*), (iii) prevention (six true/false statements; e.g., *'Washing hands regularly for 20 seconds'*), and (iv) treatment (two statements; e.g., *'Taking pills like antibiotics when you have fever'*). One point was given for each correct answer and no points for an incorrect answer. Sub-totals were calculated for each item as well as a total score for all the items on a range from 0-20. The higher the score the better the participants' knowledge of COVID-19.

2.3.3. COVID-19 behavior-related questions

Behavior-related questions were used to examine how participants had behaved in the COVID-19 pandemic (e.g., Chang et al., 2020a; Lin et al., 2020). Behavior-related questions included four items (e.g., *"How often do you clean your hands with an alcohol-based hand rub or wash them with soap and water?"*) responded to on a five-point Likert scale from 1 (*never*) to 5 (*almost always*) with scores ranging from 4 to 20. The higher the score the better the participants' preventive behavior towards COVID-19.

2.3.4. Bangla Fear of COVID-19 Scale

Participants' fear of COVID-19 was assessed using the "Fear of COVID-19 scale" (FCV-19S; Ahorsu et al., 2020) by Sakib and colleagues (Sakib et al., 2020). The screening tool comprises seven items (e.g., "*I am afraid of losing my life because of coronavirus-19*") responded to on a five-point Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*) with scores ranging from 7 to 35 (Ahorsu et al., 2020). The higher the score the greater the fear of COVID-19. Cronbach's alpha was 0.88 in the present study.

2.3.5. Bangla Insomnia Severity Index

Participants' insomnia was assessed using the seven-item Bangla Insomnia Severity Index (Mamun and Pakpour, 2020). Insomnia-related issues were recorded based on the past two weeks (e.g., "How satisfied/dissatisfied are you with your current sleep pattern?"). Each of these items is rated on a five-point Likert scale (e.g., 0=*very satisfied, 4=very dissatisfied)* with scores ranging from 0 to 28, with higher scores indicating greater insomnia severity. Cronbach's alpha was 0.88 in the present study.

2.3.6. Bangla Patient Health Questionnaire

Participants' depression was assessed using the nine-item Bangla Patient Health Questionnaire (Chowdhury et al., 2004). Symptoms of depression were recorded based on the past two weeks. Items are answered on a four-point Likert scale (0=*not at all*, 1=*several days*, 2=*more than half of the days*, and 3=*nearly every day*) with scores ranging from 0 to 27. A score of 10 used as the cutoff score to indicate depression (Mamun et al., 2019). Cronbach's alpha was 0.83 in the present study.

2.3.7. COVID-19-Related Suicidal Behavior

Suicidal ideation related to COVID-19 issues was evaluated by a single question with a binary response ('Yes'/ 'No') based on previous studies (Jahan et al., 2020; Turecki and Brent, 2016;

Xu et al., 2016) (i.e., "*Do you think about committing suicide, and are these thoughts persistent and related to COVID-19 issues?"*).

3.4. Data analysis

Data were analyzed using the Statistical Package for Social Science (SPSS) version 23.0 (for descriptive statistics and logistic models), AMOS 23.0 (for structural equation modeling [SEM]), and ArcGIS 10.5 (for spatial analysis of COVID-19 cases and survey responses). Descriptive statistics (e.g., frequencies, percentages, means, and chi-squares tests) were performed before performing logistic regressions. All significant variables in univariate analyses (at $p<0.05$ level) were entered into the binary logistic regression in both unadjusted and adjusted models, with depression, and suicidal behaviors as the dependent variables. In the unadjusted models, each risk factor (e.g. gender) was individually used to predict its association with one dependent variable, while all the significant factors were included in the adjusted models. Structural equation modeling (SEM) was used to further examine whether fear of COVID-19 mediated the association between COVID-19 knowledge, and three outcome variables (i.e., preventive COVID-19 behaviors, depression, and insomnia). Missing data were handled using Full Information Maximum Likelihood (FIML) estimation. The following model fit insides were used to evaluate model fit: chi-square (χ^2), comparative fit index (CFI), and Tacker-Lewis index (TLI) > .90, root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR) < 0.08. The indirect effects were estimated using bias-corrected bootstrapping with 10,000 bootstrap resamples.

3. Results

Table 1 summarizes the characteristics of the participants. Table 1 also reports the comparisons of characteristics between those with and without (i) suicidal ideation and (ii) depression. Of the total sample (N=10,067; mean age = 29.9 ± 9.6 years), 56.1% were males, 58.4% were students, 70.3% were single, 14.8% were smokers, and 2.7% were alcohol users. One in 20 participants (5.0%) reported COVID-19-related suicidal ideation (n=506), and 33.3% reported depression (n=3349). Moreover, participants having suicidal ideation were more likely to also manifest significant depressive symptoms (10.3% vs. 2.4%; $\chi^2=295.877$, $p<0.001$) (appendix p.7). Participants who reported suicidal ideation were more likely to (i) be young, (ii) be female, (iii) be alcohol users, (iv) have higher illness comorbidity, (v) use social media more heavily, (vi) have less knowledge about COVID-19, (vii) engage in less preventive COVID-19 behaviors, and (viii) have insomnia problems. Participants reporting depression were more likely to (i) be young, (ii) be male, (iii) be alcohol users, (iv) have higher illness comorbidity, (v) use social media more heavily, (vi) have greater fear of COVID-19, and (vii) have insomnia problems.

(Insert Table 1 here)

Table 2 reports the potential risk factors for suicidal ideation that emerged from the multivariate analysis (Nagelkerke's $R^2=0.136$): age (AOR=0.944; 95% CI=0.918, 0.971), gender (using female as reference; AOR=0.535; 95% CI=0.427, 0.617), current smoker (using no smoking as reference; AOR=1.426; 95% CI=1.046, 1.945), self-reported comorbidity (AOR=1.508; 95% CI=1.279, 1.778), knowledge about COVID-19 (AOR=0.933, 95% CI=0.897, 0.970), preventive COVID-19 behaviors (AOR=0.792, 95% CI=0.690, 0.910), fear of COVID-19 (AOR=0.967;

95% CI=0.951, 0.984), and insomnia severity (AOR=1.115; 95% CI=1.099, 1.132) were significant predictors.

(Insert Table 2 here)

Table 3 reports the risk factors for depression following multivariate analysis (Nagelkerke's R^2=0.361). Age (AOR=0.965; 95% CI=0.953, 0.978), current smoker (using no smoking as reference; AOR=1.207; 95% CI=1.022, 1.425), current alcohol user (using no alcohol drinking as reference; AOR=1.462; 95% CI=1.045, 2.043), self-reported comorbidities (AOR=1.239; 95% CI=1.116, 1.375), preventive COVID-19 behaviors (AOR=0.880, 95% CI=0.812, 0.953), fear of COVID-19 (AOR=1.109; 95% CI=1.098, 1.121), and insomnia severity (AOR=1.173; 95% CI=1.162, 1.184) were significant predictors.

(Insert Table 3 here)

The optimal model that included COVID-19 knowledge, fear of COVID-19, preventive COVID-19 behavior, depression, and insomnia was found to have good fit (CFI=0.991; TLI=0.951; RMSEA=0.043; SRMR=0.018) (Figure 1). Moreover, COVID-19 knowledge significantly predicted fear of COVID-19 (standardized coefficient [β]=0.03; p<0.001); fear of COVID-19 subsequently and significantly predicted preventive behaviors (β=0.13; p=0.03), depression (β=0.43; p<0.001), and insomnia severity (β=0.35; p<0.001).

(Insert Figure 1 here)

District-wide variations in spatial distributions of depression and suicidal ideation were highly significant (χ^2=203.601, p<0.001 and χ^2=92.230, p<0.001 respectively). The degree of depression was significantly inflated in the capital city of Bangladesh and the districts near the capital city, where the prevalence of detected COVID-19 cases was high (as of 19 April, 2020; Figure 2; Dhaka proximal districts such as Dhaka, Narayanganj, Narsingdi, Gazipur and Munshiganj had 36.66%, 38.19%, 38.1%, 29.12% and 54.84% of participants as fulfilling the criteria for depression, respectively) (Figure 3).

(Insert Figures 2 and 3 here)

High levels of depression and suicidal ideation were found in the southern part of the country located near the coastal regions (e.g., for Barguna district, 36.36% and 9.09% respectively) (Figure 3, Figure 4; Appendix p. 9). Relatively low frequency of psychological impact emerged in the districts where no COVID-19 cases were reported until April 19, 2020 (Figure 2) (e.g., depression and suicidal ideation for Chapainawabganj and Kushtia districts were 21.43%, 12.70% and 0%, 2.91% respectively). However, although the number of cases reported until April 20 was low (Figure 2), a few districts from the topmost northern part of the country reported elevated prevalence of depression and suicidal ideation (e.g., depression and suicidal ideation for the districts Panchagargh, Dinajpur and Gaibandha were 27.27%, 36.23%, 45.83% and 18.18, 7.25, 10.42% respectively) (Figure 3, Figure 4; appendix p.8). A district-wise spatial distribution of suicidal ideation was strongly co-located with those fulfilling the criteria for being depressed (appendix p.9).

(Insert Figure 4 here)

4. Discussion

The COVID-19 pandemic has aggravated psychological burdens across cohorts throughout the entire world, is also contributing to the risen suicide incidences (Mamun and Ullah, 2020; Mamun et al., 2020c; 2020d; Manzar et al., 2020). For suppressing suicidality, early detection of mental disorders is beneficial. Thus, the present study was carried out among a large cohort in Bangladesh to facilitate policy level data, where a high prevalence rate of both depression and suicidal ideation was found. These significant psychiatric issues were more likely to be present among younger people, particularly women, and lack of knowledge of COVID-19 along with increased use of social media and insomnia were also independent risk factors. Furthermore, the study identified a clustering of depression and suicidal ideation in the capital metropolitan region and coastal districts where the number of COVID-19 cases being reported was particularly high. These findings suggest the presence of a discrete number of risk factors that contribute to the propensity for depression and suicidal ideation, and that the distribution of such high-risk individuals is associated with underlying pandemic contagion rates.

In a recent systematic review of mental health disorders in Bangladesh, prevalence rates of 6.5-31.0% (among adults) and 13.4-22.9% (among children) were reported (Hossain et al., 2014). These figures are compatible with another study whereby the pooled prevalence of depression was 25.3% (Newman, 2013). Therefore, the prevalence of 33.3% in the present study is higher and of concern. Such a rate should prompt healthcare providers to be particularly aware of the psychological responses in the communities they serve during the COVID-19 pandemic. Furthermore, in light of the co-occurrence between suicidal ideation and depression, identification of depressive symptoms should prompt screening for suicidal ideation, particularly among younger people and among women. In a recent study, 6.9% of Bangladeshi university students reported experiencing suicidal ideation in the preceding months, and 14.7% and 61.1% reported such thoughts in the past year and lifetime, respectively (Mamun et al., 2020e). Additionally, another study by Begum et al. among Bangladeshi adolescents aged 14-19 years reported the lifetime prevalence of suicidal ideation was 5% (Begum et al., 2017). A Bangladeshi review by Newman (2013) reported that suicidal ideation was 14% among pregnant women, 11-21% among ever-married women, and 28% among abused women. However, it should also be highlighted that (i) females are generally more prone to suicidal behaviors but less likely to commit suicide than men, but that (ii) Bangladeshi women appear to commit more suicide than men (Arafat, 2019; Bhuiyan et al., 2020).

The prevalence of suicidal ideation will naturally increase if participants are asked if they have ever thought about it in the past month, past year, or over their lifetime. In the present study, suicidal ideation was specifically assessed in relation to COVID-19 issues, and all participants were surveyed within one month of the first COVID-19 case detection therefore the suicidal ideation prevalence rate reported here is for one month (or less). The aforementioned review by Newman (2013) reported much higher suicidal ideation rates than that here but Newman's review did not mention the time frame for suicidal ideation and his review only included women rather than the general population. Similar assertions can be made to be made for the suicidal ideation rate reported by Begum et al. (2017) which had a time frame of past-year suicidal ideation and a sample that only included adolescents. It should also be noted that the data for the present study were collected when only 2,948 COVID-19 cases had been reported (WHO,

2020b). The suicidal ideation rate might have been higher if the study had been carried out further into the pandemic period when there were many more cases and deaths. reported cases when the survey was conducted. Therefore, the suicidal ideation rate reported herein should be compared with studies general population suicidal ideation prevalence in the preceding month, and was similar to that described by Mamun and colleagues (2020e). In light of the publicly exposed mismanagement of Bangladesh workplace protective directives [e.g., opening garment factories suddenly during lockdown (The Business Standard, 2020)], low numbers of COVID-19 tests, and insufficient testing facilities (Anadolu Agency, 2020), COVID-19 test scams [e.g., selling COVID-19 positive or negative test reports without actual laboratory assays (Aljazeera, 2020) etc.], and the widely publicized emergence of community transmission, it is anticipated that depression and suicidal ideation rates will further increase, particularly considering the protracted and unfavorable COVID-19 trajectory and duration of the crisis.

The study here aimed to identify risk factors that would enable healthcare systems to act accordingly, and provide the necessary strategic and localized interventions to reduce such risk. Among the various risk factors identified, several are comparable to prior reported findings. For example, young age was associated with psychiatric morbidities during the SARS outbreak (Sim et al., 2010). Females have also been found to have a generally higher risk of developing psychological problems during both COVID-19 pandemic period (Wang et al., 2020) and other non-COVID-19 (Tolin and Foa, 2006) pandemic periods. In addition, cigarette smokers and alcohol drinkers in the present study were found to have increased risk of developing depression which has also been found in previous studies (Balogun et al., 2014; Kiviniemi et al., 2011). Considering that psychiatric disorders are a major underlying driver of suicides in more than 90% of suicide cases worldwide, the overlap between suicidal ideation with underlying depression in the present study is not surprising, and suggests that co-occurrence is particularly worrisome if such are identified during screening, particularly in younger people, females, and substance users during a crisis period such as a pandemic (Mamun et al., 2020e; Mamun and Griffiths, 2020a; 2020c).

The present study also found that the presence of illness comorbidities, fear of COVID-19, and preventive COVID-19 behaviors were risk factors for suicidal ideation and/or depression. Given that comorbidities are likely to worsen due to the outcomes of COVID-19 infection (Chen et al., 2020), it is possible that individuals with more comorbidities will sustain stronger negative psychological responses than those with fewer or no comorbidities. Moreover, the negative effects of fear on maladaptive behaviors and negative psychological health have been advanced (Bhuiyan et al., 2020; Chang et al., 2020b; Lin, 2020; Ren et al., 2020). Therefore, the present findings concur with prior evidence suggesting that fear of COVID-19 increases the risk of depression. The association between less preventive COVID-19 behaviors and suicidal ideation and depression may be because individuals with higher depression and suicidal ideation have may low self-esteem and low self-efficacy when engaging in COVID-19 related preventive behaviors. Moreover, individuals with higher depression and suicidal ideation have less interest in health and health education messages (Verger et al., 2009).

Insomnia severity was found to be another independent risk factor in developing suicidal ideation and depression. Poor sleep patterns have long been recognized as predisposing factors for both depression and suicidality across all age groups, but more prominently among younger people and those exposed to social media (Glozier et al., 2010; Itani et al., 2017). Indeed, short

sleepers have increased risk of developing psychological disorders. In addition, insomnia is more prevalent among women and may prompt use of alcohol or cigarette smoking (Inkelis et al., 2020; Suh et al., 2018). Because sleep problems have been well documented during the COVID-19 pandemic (Xiao et al., 2020), healthcare providers may wish to screen for and identify those who develop sleep difficulties during this period and provide timely and early intervention.

The present study found increased prevalence levels of depression in the capital city and the districts near the capital where the number of reported COVID-cases was high during the administration of the survey (WHO, 2020b). Similarly, in other regions in which the rate of contagion was higher, the prevalence of depression and suicidal ideation were also high. Therefore, any circumstances in which preventive measures against the pandemic appear to fail due to a variety of circumstances and lead to a surge in COVID-19 cases may further exacerbate the occurrence of such serious psychological problems. As aforementioned, the degree of depression and suicidal ideation was greater in the districts located in the southern part of Bangladesh, mainly near coastal areas. Women living in disaster-prone coastal areas (cyclones and other natural disasters) have been found to be at risk of developing and suffering from mental health problems (e.g., depression, PTSD; Mamun et al., 2019). Consequently, it could be that those who were already at risk for such problems due to the heightened risk for natural calamities while living near the Bay of Bengal could also be more predisposed to exhibit maladaptive responses to a threat such as the pandemic, and exhibit greater fear of COVID-19.

Strengths and limitations of the study

Several important strengths merit mention: (i) the present sample was recruited using a robust method to increase the representativeness of the sample, in which residents from all 64 districts in Bangla were approached and participated; (ii) rigorous, validated and standardized measures were employed in the survey along with robust inferential statistics to enable not only risk factor prediction but also geographical location risk estimates. As with every study, some limitations should be acknowledged. First, the major limitation of the study is the use of Patient Health Questionnaire to determine whether the participants had *depression*. More specifically, the PHQ is a self-report instrument and therefore depression was assessed through online survey in the present study. Therefore, there are many psychosocial confounders for participants to self-report their depressive symptoms and the participants may not have provided stable responses to the PHQ given these confounders can vary from time to time. Second, participants who have tested positive to COVID-19 infection and those whose family members have tested positive to COVID-19 infection are likely to report more depressive symptoms than those who had not. Therefore, the present findings cannot be generalized to the healthy population because the present study did not exclude individuals that had tested positive (or had family members who had tested positive) for COVID-19. Third, the study used a cross-sectional design, and therefore has the inability to derive causal relationships. Fourth, the study was conducted using an online platform, as dictated by the COVID-19 preventive measures in place. Therefore, potential participants without internet access could not be reached and the sample representativeness of those in the present study is restricted to internet users. Lastly, all the variables were assessed using self-reports, and therefore may suffer well-known methods biases such as social desirability bias and recall bias.

5. Implications of all the available evidence

The high prevalence rates of depression and suicidal ideation should prompt Bangladeshi healthcare providers to conduct depression and suicide screening and their associated risk factors among the general population during the COVID-19 pandemic, particularly as the trajectory of the pandemic becomes protracted, thereby potentially enhancing the risk for such serious psychological manifestations. Geolocation efforts further attest to heterogeneous distribution, thereby enabling focused regional investment of screening resources and efforts in those areas more likely to be affected.

6. Conclusions

In summary, several risk factors for suicidal ideation and depression emerged among a large cohort of citizens residing in every region of Bangladesh. More specifically, there was a significantly increased risk of reporting suicidal ideation or depression if the participants were (i) of younger age, (ii) female, (iii) current smokers and/or alcohol drinkers, (iv) less knowledgeable about COVID-19, (v) engaged in less preventive COVID-19 behaviors, (vi) had greater fear of COVID-19, and (vii) had increased insomnia symptoms. These risk factors may assist in the screening and identification of at-risk individuals in the context of healthcare facilities and enable implementation of preventive measures.

Ethics approval and consent to participate

The study was conducted within the guidelines of Helsinki Declaration, 1975. Additionally, the ethical aspects were reviewed and approved by the Institute of Allergy and Clinical Immunology of Bangladesh ethics board, Bangladesh [IRBIACIB/CEC/03202005] and Biosafety, Biosecurity, and Ethical Committee of Jahangirnagar University, Bangladesh [BBEC, JU/M 2O20/COVlD-l9/(9)2]. Online informed consent was provided before survey participation, and the online consent form included purpose of the study, data confidentiality, rights of participation, and the right to withdraw from the study at any time. Parental or guardian consent was obtained for participants aged below 18 years.

Authors' contribution

MAM conceived and designed the study outline. AKMIB developed the initial questionnaire and MAM finalized it. All authors then inputted and validated the plan and survey instrument, especially AHP. MAM, NS, AKMIB & SH led the project implementation with help of FAM, IH, AHA, MAS & IR. The project was supervised by MTS, MM, DG, MDG & AHP. Data collection ad data collector team were managed by MAM, NS, AKMIB, SH, MB-D, FAM, IH, AHA, MAS and IH. The dataset was cleaned by NS, & FAM. AHP and C-YL carried out the formal statistical analyses and incorporated results, and MB-D performed the GIS-mapping. MAM searched the literature and wrote the first draft with the help of NS & AHP. The first extensive review and edits were done by DG. Other authors reviewed and contributed subsequently in the draft, especially MDG. Final approval was provided by all authors.

Conflict of interest

All authors have no conflict of interest to declare.

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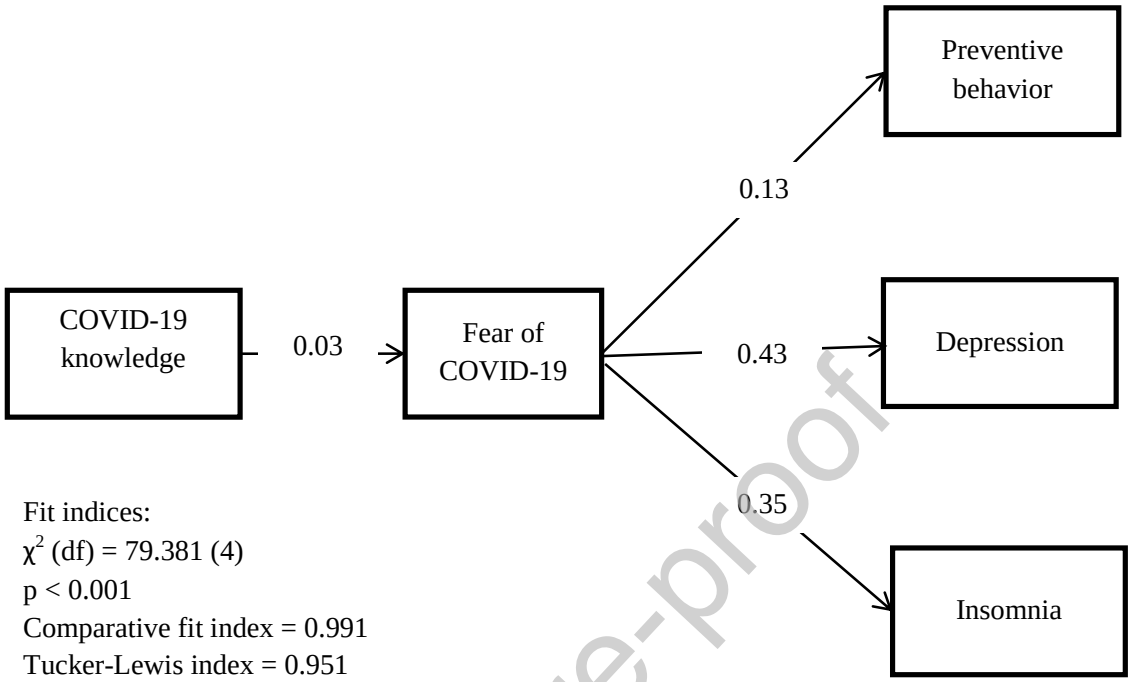

Fit indices:
χ^2 (df) = 79.381 (4)
$p < 0.001$
Comparative fit index = 0.991
Tucker-Lewis index = 0.951
Root mean square error of approximation = 0.043
Standardized root mean square residual = 0.018

All path coefficients were < 0.001, except for that of fear of COVID-19 to preventive behavior (p = 0.03). Age and gender were controlled in the path model.

Figure 1. Hypothesized paths in associations between COVID-19 knowledge, fear of COVID-19, preventive COVID-19 infection behavior, depression and insomnia.

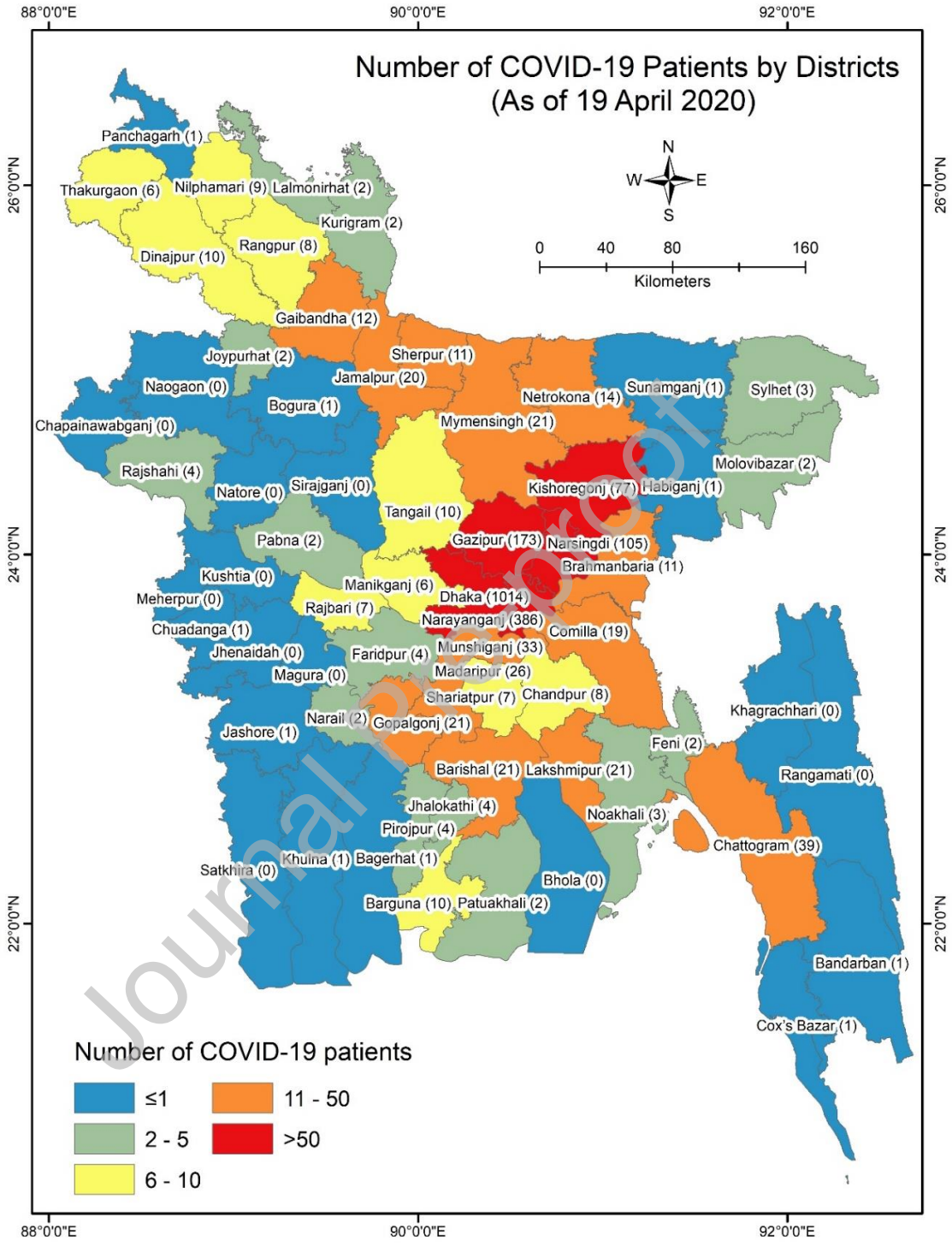

Figure 2. Map of the study area showing the number of COVID-19 confirmed patients. *Data source*: World Health Organization (2020b)

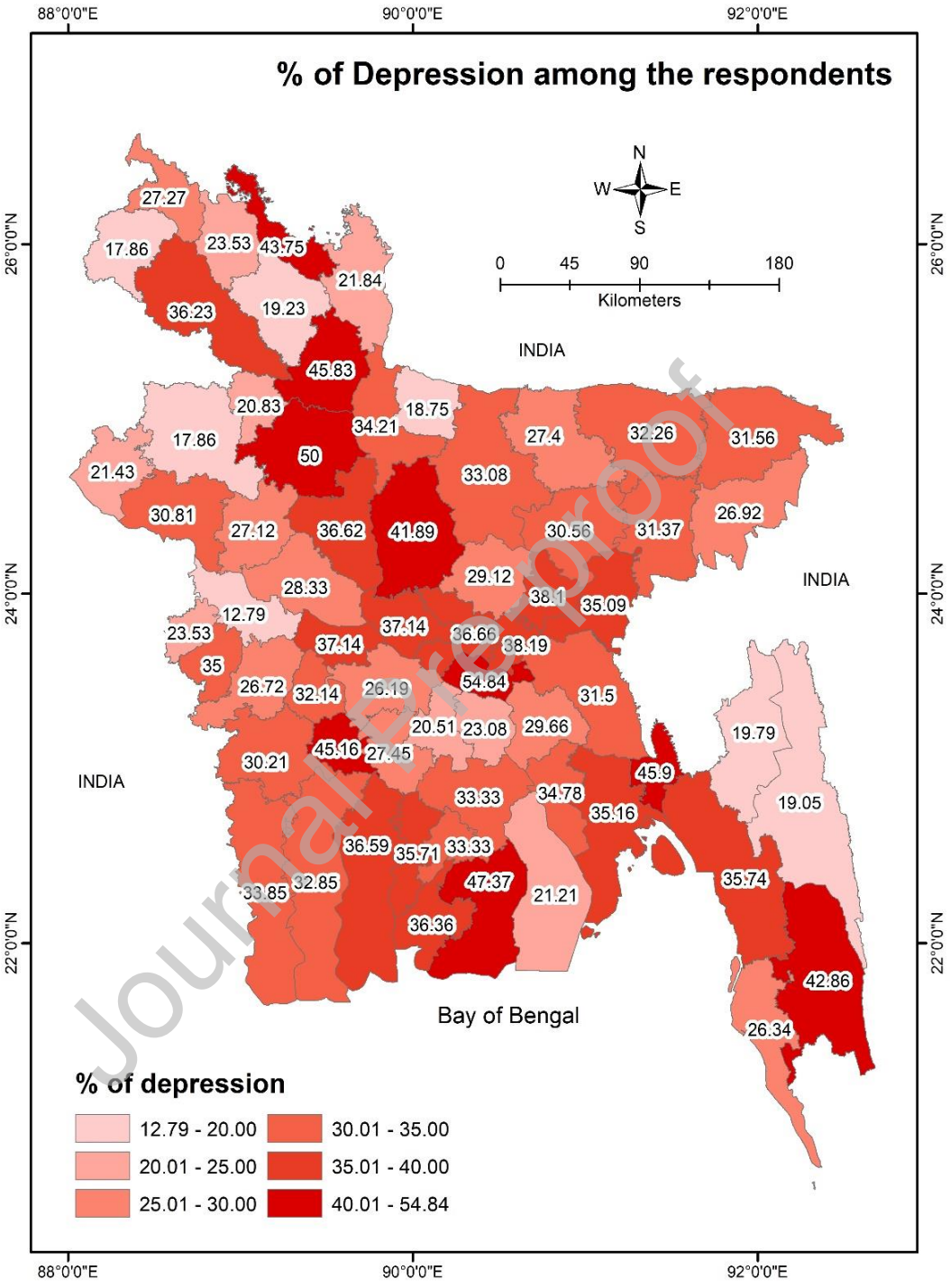

Figure 3. District-wise spatial distribution of depression among the participants

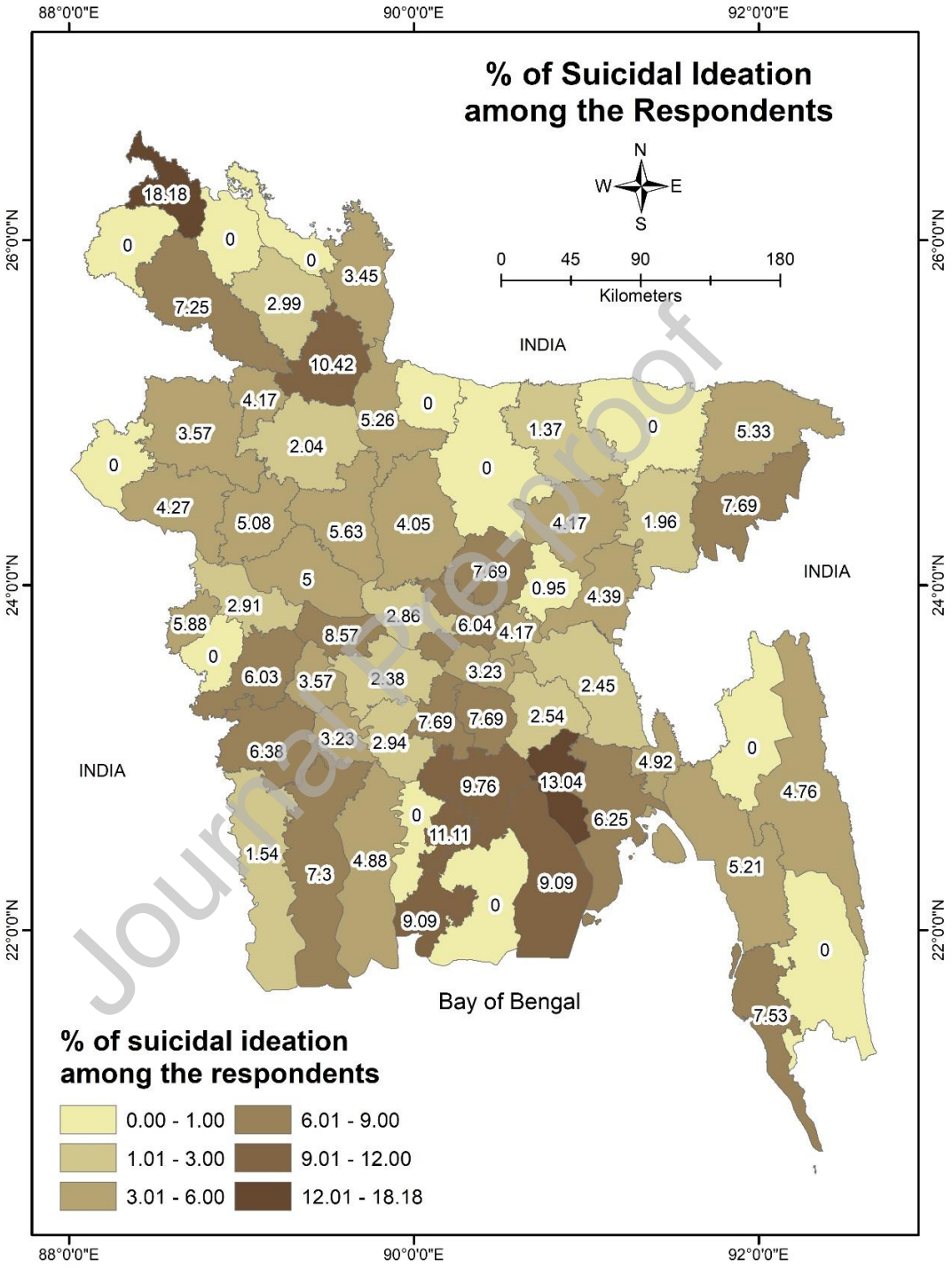

Figure 4. District-wise spatial distribution of suicidal ideation among the participants

Table. 1. General characteristics of the study sample (N=10067)

	Total	**Suicidal ideation (N=10056)**		**Statistics[b] Z , t or X^2**	***p*-value**	**Depression N=10067**		**Statistics[b] Z , t or X^2**	***p*-value**
		Yes (n=506; 5%)	**No (n=9550; 95%)**			**Yes (n=3349; 33.3%)**	**No (n=6718; 66.7%)**		
Age (year)	29.94±9.63	23.95±6.0	27.10±9.76	7.199	<0.001	25.47±7.97	27.68±10.28	10.879	<0.001
Gender (male)[a]	5650 (56.1%)	215 (42.7%)	5435 (56.9%)	38.997	<0.001	1697 (50.8%)	3953 (58.9%)	58.883	<0.001
Educational status				4.237	0.375			14.386	0.006
No formal education	197 (2.0%)	8 (1.6%)	18 (2.0%)			58 (1.7%)	139 (2.1%)		
Primary school	169 (1.7%)	5 (1.0%)	164 (1.7%)			42 (1.3%)	127 (1.9%)		
Secondary school	427 (4.2%)	18 (3.6%)	409 (4.3%)			117 (3.5%)	310 (4.6%)		
Higher secondary level	1139 (11.3%)	67 (13.2%)	1072 (11.2%)			383 (11.4%)	756 (11.3%)		
Tertiary education	8135 (80.8%)	408 (80.6%)	7727 (80.8%)			2749 (82.1%)	5386 (80.2%)		
Occupational status				38.71	<0.001			127.620	<0.001
Unemployed	361 (3.6%)	*26 (5.1%)*	*335 (3.5%)*			144 (4.3%)	217 (3.2%)		
Employed	2586 (25.7%)	*87 (17.2%)*	*2499 (26.1%)*			665 (19.9%)	1921 (28.6%)		
Retired	92 (0.9%)	*1 (0.2%)*	*91 (1.0%)*			19 (0.6%)	73 (1.1%)		
Housewife	1150 (11.4%)	*40 (7.9%)*	*1110 (11.6%)*			338 (10.1%)	812 (12.1%)		
Student	5878 (58.4%)	*352 (69.6%)*	*5526 (57.8%)*			2183 (65.2%)	3695 (55.0%)		
Residence				18.432	*<0.001*			18.119	<0.001
Village	2336 (23.2%)	*88 (17.4%)*	*2248 (23.5%)*			697 (20.8%)	1639 (24.4%)		
Sub-district town	1359 (13.5%)	*54 (10.7%)*	*1305 (13.6%)*			462 (13.8%)	897 (13.4%)		
District town	2334 (23.2%)	*124 (24.5%)*	*2210 (13.1%)*			777 (23.2%)	1557 (23.2%)		

Divisional town	4038 (40.1%)	*240 (47.4%)*	*3798 (39.7%)*			1413 (42.2%)	2625 (39.1%)		
Marital status				*40.462*	*<0.001*			81.998	<0.001
Single	7081 (70.3%)	418 (82.6%)	6663 (69.7%)			2542 (75.9%)	4539 (67.6%)		
Married	2839 (28.2%)	80 (15.8%)	2759 (28.9%)			752 (22.5%)	2087 (31.1%)		
Divorced/widowed	147 (1.5%)	8 (1.6%)	139 (1.5%)			55 (1.6%)	92 (1.4%)		
Currently smoker (Yes)	1486 (14.8%)	88 (17.4%)	1398 (14.6%)	2.929	0.092	524 (15.6%)	962 (14.3%)	3.127	0.077
Alcohol use (Yes)	267 (2.7%)	23 (4.5%)	244 (2.6%)	7.396	0.007	110 (3.3%)	157 (2.3%)	7.772	0.005
Self-reported total comorbidity counts[c]	0.31±0.61	*0.40*±0.64	*0.30*±61	*-4.685*	*<0.001*	0.34±0.63	0.29±0.60	-5.799	<0.001
Social media use (yes)	9152 (90.9%)	*484 (95.7%)*	*8668 (90.7%)*	*14.494*	*<0.001*	3114 (93.0%)	6038 (89.9%)	26.077	<0.001
Frequency of Social media use									
Less than 4 day a week	292 (2.9%)	7 (1.4%)	285 (3.3%)	33.158	<0.001	87 (2.8%)	205 (3.4%)	87.326	<0.001
2/3 days a week	318 (3.2%)	17 (3.5%)	301 (3.5%)			71 (2.3%)	247 (4.1%)		
Everyday	4082 (40.5%)	168 (34.3%)	3914 (45.2%)			1249 (39.9%)	2833 (47.1%)		
Several times a day	4451 (44.2%)	298 (60.8%)	4153 (48.0%)			1726 (55.1%)	2725 (45.3%)		
Knowledge about COVID-19	11.48±2.29	11.27±2.65	11.49±2.27	2.18	*0.029*	11.52±2.37	11.46±2.25	-1.320	0.187
Preventive COVID-19 behaviors	4.23±0.73	4.14±0.75	4.23±0.73	2.81	*0.005*	4.23±0.71	4.23±0.74	0.090	0.928
Fear of COVID-19	21.30±6.01	21.76±5.91	21.28±6.01	-1.75	*0.08*	24.12±5.59	19.89±5.71	-35.267	<0.001
Insomnia	7.92±6.23	12.76±6.94	7.66±6.09	11.09	*<0.001*	12.11±6.33	5.82±5.01	-54.220	<0.001

[a] 15 transgender individuals were excluded due to low cell counts
[b] Based on independent *t*-test, chi square and Mann-Whitney U-test
[c] Analyzed using the Mann-Whitney U-test

Table 2. Risk factors of the suicidal ideation

	Unadjusted model			Adjusted model		
Variables	Odds ratio (OR)	95% Confidence Interval (CI)	p-value	Odds ratio (OR)	95% Confidence Interval (CI)	p-value
Age (Year)	0.945	0.930-0.960	<0.001	0.944	0.918-0.971	<0.001
Gender						
Female	Ref.					
Male	0.565	0.471-0.677	<0.001	0.535	0.427-0.617	<0.001
Educational status						
No formal education	Ref.					
Primary school	0.720	0.231-0.2.245	0.572	-	-	-
Secondary school	1.040	0.444-2.434	0.928	-	-	-
Higher secondary level	1.477	0.698-3.124	0.308	-	-	-
Tertiary education	1.247	0.611-2.549	0.544	-	-	-
Occupational status						
Unemployed	Ref.					
Employed	0.449	0.285-0.705	0.001	0.852	0.511-1.418	0.537
Retired	NA			NA		
Housewife	0.646	0.279-0.772	0.003	0.921	0.515-1.647	0.782
Student	0.821	0.543-1.241	0.349	0.790	0.493-1.264	*0.326*
Residence						
Village	Ref.					
Sub-district town	1.057	0.748-1.493	0.753	0.832	0.573-1.208	0.333
District town	1.433	1.084-1.895	0.012	1.096	0.806-1.490	0.559
Divisional town	1.614	1.257-2.072	<0.001	1.175	0.885-1.561	0.265
Marital status						
Single	Ref.					
Married	0.462	0.362-0.589	<0.001	0.590	0.254-1.370	*0.220*
Divorced/widowed	0.917	0.447-1.884	0.814	0.435	0.185-1.020	0.055
Current smoker						
Yes	1.229	0.970-1.558	0.087	1.426	1.046-1.945	0.025
No	Ref.					
Alcohol use (Yes)						
Yes	1.818	1.174-2.815	0.007	1.341	0.786-2.288	0.281
No	Ref.					
Self-reported total comorbidity counts[c]	1.257	1.10-1.423	<0.001	1.508	1.279-1.778	<0.001
Social media use (yes)						
Yes	2.266	1.470-3.494	<0.001	0.638	0.289-1.407	0.265
No	Ref.					
Frequency of social media use						
Less than 4 day a week	Ref.					

2/3 days a week	2.299	0.940-5.627	0.068	2.393	0.949-6.034	0.064
Everyday	1.748	0.813-3.758	0.153	1.671	0.762-3.664	0.200
Several times a day	2.921	1.368-6.241	0.006	2.338	1.071-5.104	0.033
Knowledge about COVID-19	0.960	0.926-0.996	0.029	0.933	0.897-0.970	0.001
Preventive COVID-19 behaviors	0.849	0.757-0.952	0.005	0.792	0.690-0.910	0.001
Fear of COVID-19	1.014	0.998-1.029	0.080	0.967	0.951-0.984	<0.001
Insomnia	1.122	1.107-1.137	<0.001	1.115	1.099-1.132	<0.001

Model is significant (P <0.001), -2 log likelihood = 3375.093, Nagelkerke R^2 = 0.136.

Table 3. Risk factors of the depression

	Unadjusted model			Adjusted model		
Variables	Odds ratio (OR)	95% Confidence Interval (CI)	p-value	Odds ratio (OR)	95% Confidence Interval (CI)	p-value
Age (Year)	0.973	0.68-0.378	<0.001	0.965	0.953-0.978	<0.001
Gender						
Female	Ref.					
Male	0.656	0.417-0.677	<0.001	1.048	0.931-1.180	0.434
Educational status						
No formal education	Ref.					
Primary school	0.793	0.498-1.261	0.326	-	-	-
Secondary school	0.905	0.623-1.313	0.598	-	-	-
Higher secondary level	1.214	0.873-1.689	0.249	-	-	-
Tertiary education	1.223	0.897-1.667	0.202	-	-	-
Occupational status						
Unemployed	Ref.					
Employed	0.522	0.415-0.656	<0.001	0.586	0.438-0.784	<0.001
Retired	0.392	0.227-0.678	0.001	0.745	0.255-2.178	0.591
Housewife	0.627	0.491-0.802	<0.001	0.718	0.517-0.998	0.048
Student	0.890	0.716-1.106	0.294	0.841	0.639-1.107	0.218
Residence						
Village	Ref.					
Sub-district town	1.211	1.050-1.397	0.009	1.027	0.888-1.187	0.721
District town	1.173	1.037-1.328	0.011	0.864	0.734-1.018	0.081
Divisional town	1.266	1.134-1.413	<0.001	0.936	0.819-1.069	0.327
Marital status						
Single	Ref.					
Married	0.643	0.584-0.709	<0.001	0.865	0.729-1.027	0.097
Divorced/widowed	1.067	0.762-1.496	0.705	1.783	0.985-3.228	0.056
Currently smoker						
Yes	1.110	0.989-1.246	0.077	1.207	1.022-1.425	0.026
No	Ref.					
Alcohol use (Yes)						
Yes	1.419	1.108-1.817	0.006	1.462	1.045-2.043	0.026
No	Ref.					
Self-reported total comorbidity counts[c]				1.239	1.116-1.375	<0.001
Social media use (yes)						
Yes	2.266	1.470-3.494	<0.001	0.638	0.298-1.407	0.265
No	Ref.					
Frequency of social media use						
Less than 4 day a week	Ref.					

2/3 days a week	0.677	0.471-0.975	0.036	0.706	0.460-1.082	0.110
Everyday	1.039	0.801-1.347	0.773	0.979	0.725-1.322	0.892
Several times a day	1.492	1.153-1.932	0.002	1.286	0.952-1.737	0.101
Knowledge about COVID-19	1.012	0.994-1.031	0.187	0.987	0.964-1.011	0.299
Preventive COVID-19 behaviors	0.997	0.942-1.056	0.928	0.880	0.812-0.953	0.002
Fear of COVID-19	1.145	1.136-1.155	<0.001	1.109	1.098-1.121	<0.001
Insomnia	1.202	1.192-1.212	<0.001	1.173	1.162-1.184	<0.001

Model is significant (P <0.001), -2 log likelihood = 8965.151, Nagelkerke R^2 = 0.361.

The self-reported total comorbidity counts included diabetes, hypertension, hyperlipidemia, chronic liver disease, and chronic kidney disease.