Loneliness, anxiety, and wellbeing before and during COVID-19 in Bangladesh.

by

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Abstract

Background:

COVID-19 has significant impact on mental health and wellbeing of population all over the globe. The study used collected data from a large research project by International Citizen Project COVID-19 (ICPCOVID), Bangladesh chapter, to assess a potential difference between participants' loneliness, anxiety, and wellbeing before and during COVID-19 as well as the associated factors in Bangladesh.

Methods:

The primary study was a web-based cross-sectional study which used non-probability sampling method (convenience sampling) to collect data using a survey link (www.icpcovid.com/en/home). Invitations to participate were sent through different platforms, including social media (e.g., WhatsApp groups, and Facebook, email messages). In Bangladesh, data were collected from May to September 2020. To assess loneliness, anxiety, and wellbeing of the participants University of California, Los Angeles (UCLA) 3-item Loneliness Questionnaire, Generalized Anxiety Disorder 7-item (GAD-7), and WHO-5 Wellbeing Index tools were used respectively. To compare before COVID-19 and during COVID-19 scenario, each item of the used tools in the survey asked the participants to respond for two time points: "two weeks before COVID-19 crisis" and "since the beginning of COVID-19 crisis" in Bangladesh. A total of 1360 individuals responded to the questionnaire and 890 of them were included in the final analysis in order to conduct complete case analysis. Primary outcome of this study were loneliness, anxiety, and wellbeing as measured by the tools (UCLA-3 item questionnaire, GAD-7, WHO-5) and Sociodemographic variables, COVID-19-related questions,

and time spending patterns during COVID-19 were considered covariates. At first, Chi-square test was done to see the association between the dichotomized outcome variables and independent variables. Backward elimination stepwise multivariable logistic regression was conducted to see the associated factors of the outcome variables.

Result:

Majority of the respondents were from the urban area of Bangladesh (75.3%). Most of the participants (70.3%) were less than 25 years old and were single (78.7%). More than half of the participants' highest level of education was a Bachelor's degree (54.9%). Almost two-thirds of the respondents were students (68.9%). Two weeks before COVID-19 crisis, among the respondents 43.4% were found to be lonely, 33.4% had mild to severe anxiety symptoms, and 42.2% had impaired wellbeing (as recalled). Since the beginning of the pandemic, 57.2% respondents were found to be lonely, 68.8% had mild to severe anxiety symptoms, and 79.6% had impaired wellbeing. McNemar chi-square tests showed that the proportions of participants who were lonely, had mild to severe anxiety symptoms, and had impaired wellbeing were different since the beginning of COVID-19 than 2 weeks before COVID-19 (as recalled) ($p<0.001$) by the participants. Multivariable logistic regression analysis showed that, as recalled by the participants, 2 weeks before COVID-19, loneliness was associated with being male (OR: 1.5, 95% CI: 1.1, 2.2), urban population (OR: 1.5, 95% CI: 1.1, 2.2), widowed/separated/divorced participants (OR: 3.1, 95% CI: 0.2, 0.9). In that period, mild to moderate anxiety was associated with married participants (OR: 0.5, 95%CI: 0.3, 0.8), presence of comorbidities (OR: 1.5, 95%CI: >1.0, 2.3). Since the beginning of the pandemic, multivariable logistic regression analysis showed that, loneliness was associated with male participants (OR: 0.6, 95% CI: 0.5, 0.9), married participants (OR: 0.4, 95% CI: 0.2, 0.7),

presence of comorbidity (OR: 1.5, 95%CI: 1.03, 2.3), and more social media use (OR: 1.4, 95% CI: 0.7, 2.6). Anxiety symptoms were associated with being male (OR: 0.7, 95%CI: 0.5, 0.9), presence of comorbidity (OR: 1.7, 95%CI: 1.04, 2.7), found it difficult to avoid COVID-19 related news (OR: 2.4, 95%CI: 1.4, 4.1), and more social media use (OR:3.1, 95%CI: 1.5, 6.2). Impaired wellbeing was associated with being male (OR: 0.7, 95%CI: 0.4, 1.0), found it difficult to avoid COVID-19 related news (OR: 2.4, 95%CI: 1.4, 4.2), more social media use (OR: 2.5, 95%CI: 1.2), and work from home (OR: 0.4, 95%CI: 0.2, 0.7). Multivariable analysis also showed that, loneliness was associated with anxiety (OR: 3.8, 95% CI: 2.6, 5.4) and impaired wellbeing (OR: 1.8, 95%CI: 1.2, 2.6).

Conclusion:

This study provided evidence on prevalence and associated factors of loneliness, anxiety, and wellbeing as well as their associated factors in before and during COVID-19 scenario. The findings will try to fill the void in mental health research related to COVID-19 in Bangladesh.

Preface

This thesis titled “Loneliness, anxiety, and wellbeing before and during COVID-19 in Bangladesh” received research ethics approval from the University of Alberta Research Ethics Board (ID: Pro00117900). The data of thesis was obtained from a large study by ICPCOVID (www.icpcovid.com), titled “Personal and Family Coping With COVID-19 in the Global South”, Bangladesh chapter and secondary data analysis was done. All the chapters of the thesis are my original work based on the data obtained from the large study under the supervision of Dr. Stephen Hodgins and Prof. Gian S. Jhangri. No part of this thesis was previously published.

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List of Abbreviations

APA	American Psychological Association
BAI	Beck Anxiety Inventory
CDC	Centers for Disease Control and Prevention
CES-D	Center for Epidemiological Studies Depression Scale
CI	Confidence Interval
COVID-19	Coronavirus Disease 2019
DASS-21	Depression Anxiety and Stress Scale-21
FAO	Food and Agriculture Organization
GAD-7	Generalized Anxiety Disorder-7
GHQ-12	General Health Questionnaire-12
HADS-A	Hospital Anxiety and Depression Scale-Anxiety
HAM-A	Hamilton Anxiety Rating Scale
HARS	Hamilton Anxiety Rating Scale
ICPCOVID	International Citizen Project COVID-19
ICTV	International Committee on Taxonomy of Viruses
ICU	Intensive Care Units
IFAD	International Fund for Agricultural Development

ILO	International Labour Organization
LMO	Liquid Medical Oxygen
OR	Odds Ratio
PHEIC	Public Health Emergency of International Concern
PHQ-9	Patient Health Questionnaire-9
SARS	Severe Acute Respiratory Syndrome
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
SD	Standard Deviation
STAI	State-Trait Anxiety Inventory
UCLA	University of California, Los Angeles
WHO	World Health Organization
WHO-5	World Health Organization Wellbeing Index-5
WOAH	World Organization for Animal Health

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Chapter 1: Introduction

1.1 Background

1.1.1. COVID-19

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the seventh coronavirus that has infected the human population [1]. The Chinese health authorities confirmed in January 2020 that the cluster of pneumonia cases of unknown origin discovered in Wuhan, Hubei province of Central China were caused by the novel coronavirus, SARS-CoV-2 [2]. The International Committee on Taxonomy of Viruses (ICTV) named the novel coronavirus as 'SARS-CoV-2' because it was genetically linked with the coronavirus that caused the 2003 SARS outbreak [3]. Following the guidelines provided by the World Organization for Animal Health (WOAH) and the Food and Agriculture Organization (FAO) of the United Nations, on 11 February 2020, World Health Organization (WHO) named the disease caused by SARS-CoV-2 as 'COVID-19' [3]. By the end of January 2020, the novel coronavirus had 9826 confirmed cases with 213 deaths from 19 countries [4]. As a result, this outbreak of novel coronavirus was designated as Public Health Emergency of International Concern (PHEIC) by the WHO in January 2020 [5]. Before March 2020, 53 countries outside of China were affected by the novel coronavirus [6]. In response to the alarming levels of infection spread and severity, WHO Director-General made the announcement that COVID-19 disease could be identified as a pandemic [7].

COVID-19 is an infectious disease that can cause mild to moderate respiratory illness in the infected human body [8]. Even though most of the patients do not require special treatment for COVID-19, older people and those who have underlying comorbidities (e.g., cardiovascular disease, chronic respiratory disease, cancer, diabetes) can become seriously ill and require special medical attention [8]. According to WHO, the most common symptoms of COVID-19

includes, fever, cough, tiredness, and sore throat. [8]. Loss of taste or smell, headache, aches and joint pains, diarrhea, skin rash, fatigue, insomnia, palpitations etc. are identified as less common symptoms [8, 9]. Many patients who were hospitalized due to COVID-19, reported different symptoms (e.g., fatigue, muscle weakness, anxiety, depression, sleep difficulties, myalgia) within 6 months following the infection [10]. WHO suggested seeking immediate medical attention if the patient feels difficulty breathing or shortness of breath, loss of speech or mobility, and chest pain [8]. These later symptoms are known as serious symptoms of COVID-19 [8].

SARS-CoV-2 can be transmitted through both direct and indirect means [11]. Person-to-person transmission of SARS-CoV-2 happens predominantly by respiratory droplets and dense aerosols [11]. Respiratory droplets are produced when an infected patient coughs, sneezes, talks or sings [11]. According to WHO, globally more than 500 million confirmed COVID-19 cases were identified and this disease claimed the lives of 6,261,708 individuals till 13th May 2022 [12]. The consequences of COVID-19 pandemic are not limited only to tragic loss of human lives [13]. A joint statement by the International Labour Organization (ILO), Food and Agricultural Organization (FAO), International Fund for Agricultural Development (IFAD), and WHO, identified that the pandemic imposed severe disruption on the economy, public health, and food systems all over the world [13]. With lockdowns, border closures and travel restrictions, agricultural workers had limited access to markets which threatened the food security of millions of people [13].

1.1.2. COVID-19 in Bangladesh

Bangladesh is a country of South-Asia with 7 divisions comprised of 64 districts [14]. With a population density of 1265 per square km and a total population over 160 million, Bangladesh is one of the most densely populated countries of the world [15]. Majority of its population is 15 to

64 years of age (almost 60%) and about 5% are over the age of 65 years [16]. 38% of the total population of Bangladesh reside in urban areas [17]. Initially, studies suggested that population density, air pollution, temperature, and humidity can affect the spread of SARS-CoV-2 virus [18, 19]. Considering all these, an infectious disease like COVID-19 with the R_0 ranging from 1.5 to 6.9 could become a catastrophe [20].

The airport authority of Hazrat Shah Zalal International Airport, Dhaka and Shah Amanat International Airport, Chittagong started to screen all incoming passengers from China for COVID-19 after 53 days of first identification of the virus [21]. Using a special flight operated by Bangladesh Biman, on 1st February 2020, the government of Bangladesh brought back 312 students from the epicenter of COVID-19, Wuhan, China [22]. All of them were quarantined at Ashkona Hajj Camp and none of them were tested positive for COVID-19 [22]. However, in 2019, more than 700,000 Bangladeshi expatriates were working in many European and Middle-eastern countries [23]. Since the epicenter of COVID-19 shifted to Europe from China, many of these expatriates started to come back to Bangladesh [24]. Bangladesh started screening all the incoming airline passengers from 8th March 2020, and confirmed its first three COVID-19 cases which included 2 individuals who returned from Europe [15,25]. Since then, the number of infected started to increase daily and on 18th March 2020, the first official death from COVID-19 was announced by the Government of Bangladesh [15]. Initially the number of laboratories to conduct RT-PCR tests was inadequate in Bangladesh [14]. On top of that, there were only 5.3 physicians and 3 nurses per 10,000 Bangladesh population, 0.7 ICU beds and 1.1 ventilators for 100,000 people in Bangladesh [26]. However, after the first identification of COVID-19 case, the government gradually started to set up labs to detect COVID-19 cases [14]. In order to stop

the virus from spreading, the government shut down all educational institutions in the country on 16th March 2020 [14].

Bangladesh Government announced the National Preparedness and Response Plan on March 18, 2020 consisting a total cost of 29,550,000 million US dollar [14, 25, 27]. The first lockdown was announced at Shibchar of Madaripur district on 19th March, 2020 and the subsequent country-wide first phase lockdown was announced from 26th March to 4th April, 2020 [14, 25, 28]. However, the national lockdown was regarded as general holidays and it was extended to 30th May, 2020 [14, 25]. During this phase, the government of Bangladesh completely locked down the country except hospitals, grocery and drug stores, and emergency services in the last two weeks of March 2020 to the end of April 2020 [29]. After 31st May, the government announced that the lockdown measures would be lifted conditionally [14]. Complying with the directions provided by government/semi-government/autonomous institutions were suggested to keep open to a limited extent [14]. All domestic and international flights were resumed from 1st June 2020 and 21st June 2020 respectively [30, 31]. Closure of all educational institutions was announced to continue till 31st of October 2020 [31]. By the end of 2020, the government of Bangladesh established 99 labs all over the country for COVID-19 testing, recruited 2000 physicians, 6000 nurses to bolster the fight against the pandemic [14]. However, the number of tests per million population in Bangladesh (80,192 per million) was lower than India, Sri Lanka, Nepal, and Pakistan [32].

During the period of lockdown, the death rate was not high, but immediately after the lockdown was relaxed, the death toll started to increase [31]. From March to September 2020, 5272 infected individuals died [31]. During the first wave, male patients infected with SARS-CoV-2 outnumbered female patients considering both the number of cases and the number of deaths

[31]. From June to August 2020, the COVID-19 test-positivity rate was over 20% [31]. However, the rate was much lower when lockdown was active in Bangladesh (below 15%) [31]. The case fatality rate in Bangladesh during the first wave was 1.5 per 100 cases [31]. Bangladesh saw a test-positivity rate less than 5% in January 2021 which continued till the middle of March 2021 [33]. Within a month, all COVID-19 dedicated hospitals in Dhaka and other major cities of Bangladesh were full with patients and the death toll started to increase again [33]. COVID-19 infected patients who were above 50 years of age contributed to more than 80% of the deaths during this period [33]. The second wave of COVID-19 in Bangladesh was caused by the Delta variant which originated in neighboring India [34]. The South African variant, which is 50 percent more transmissible than wild-type SARS-CoV-2, is thought to be the cause of the third wave in Bangladesh [33, 35, 36]. First coinfection case of COVID-19 and mucormycosis, caused by a black fungus was reported on 8th May 2021 with another subsequent case on 23rd May 2021 [37].

When there was no available pharmacological treatment of COVID-19, the most practical solution to prevent the disease was to limit in-person social activities [38]. The World Bank approved 100 million USD to aid Bangladesh during the crisis which was utilized to establish Liquid Medical Oxygen (LMO) systems, increase the number of ventilators and hospital beds, and ensure access to Personal Protective Equipment [39]. After the initial phase of lockdown, the government made the use of face masks mandatory in all public and private office spaces, banks, public transports, prayer halls, shopping malls etc. [33]. Even though Bangladesh struggled with the increasing number of COVID-19 patients and death toll, it showed significant success in vaccine rollout [40]. Bangladesh started to vaccinate frontline workers and people over 40 years of age from 7th February 2021 with the Oxford AstraZeneca vaccine AZD1222 [41]. By mid-

April 2021, Bangladesh was able to vaccinate about 5.73 million people with at least one dose of COVID-19 vaccine and 1.51 million people had two doses of vaccines [33]. Bangladesh was able to ensure at least one dose of COVID-19 vaccination to 25.1% of its population by October 2021 and completed the full vaccination protocol of 71.4% population by May 2022 [42]. Studies found that vaccines against COVID-19 were well accepted within the Bangladeshi population which is also represented by the numbers of the vaccinated population [42–45].

1.1.3. Loneliness

Humans, being a social creature, need a safe, secure social environment in order to survive [46]. Loneliness heightens emotions of vulnerability and increases vigilance for threats, while simultaneously increasing the urge to reconnect [46]. Loneliness is one of the most important measures of social wellbeing [47]. According to the American Psychological Association (APA), Loneliness can be defined as "Affective and cognitive discomfort or uneasiness from being or perceiving oneself to be alone or otherwise solitary" [48]. The Centers for Disease Control and Prevention (CDC) defined loneliness as "the feeling of being alone, regardless of the amount of social contact" [49]. Some other ways to define loneliness are "a state of solitude or being alone" or "a subjective, negative feeling related to the deficient social relations" [50]. According to Weiss, loneliness is a natural occurrence, a (personal) emotion that can occur at any time in one's life and afflict anyone, regardless of gender, age, or other socio-demographic factors [51]. Weiss further added that loneliness is sometimes perceived as a sign of weakness or self-pity, and as something that a person should be able to overcome because it is not a physical condition [51]. Other authors have described loneliness in other ways, such as "a negative psychological response to a discrepancy between the social relationships one desires (expectations) and the relationships one actually has (objective, real ones)" or as "an individual feeling characterized by

an unpleasant or inadmissible lack of quality in certain social relationships that can occur either because one has fewer social contacts than one wishes to have, or because the level of intimacy hoped for in relationships is not there" [52]. While describing loneliness, APA also added that it may be perceived as an inescapable, unpleasant component of the human experience by existential or humanistic psychologists, but it may also contribute to enhanced self-awareness and regeneration [48]. Sometimes loneliness can be compared with physical pain [52]. In the same way that physical pain originates to protect us from physical hazards, loneliness arises to protect us from the risk of being lonely [52]. Loneliness may be classified into three types based on the reason of its origin [50].

- *Situational loneliness*: Situational loneliness is influenced by socioeconomic and cultural factors, such as, a disparity between his/her requirements and social connections, population movement, inter-personal disputes, accidents, disasters, or emptiness syndrome, and so on [50, 53].
- *Developmental loneliness*: Developmental loneliness mostly occurs when a person is unable to appropriately balance between the requirements of being connected to others and recognizing the necessity of some isolation for individual growth [50]. Personal shortcomings, developmental deficiencies, substantial separations, social marginalization, poverty, housing conditions, and physical/psychological disability are all factors that contribute to developmental loneliness [50].
- *Internal loneliness*: It is not solitude that results in loneliness. Rather, loneliness is caused by a person's sense of being alone [50]. Personality traits, locus of control, mental anguish, low self-esteem, sense of shame or worthlessness, and poor coping skills with events are all variables that contribute to internal loneliness [50].

Apart from the above classification, Weiss et al. classified loneliness into emotional and social loneliness [51]. Where emotional loneliness can be considered as the lack of an emotional bond and social loneliness is the lack of a group of people that enables a person to feel the sense of companionship [52].

Loneliness is associated with the loss of wellbeing, increased sadness, suicidal behavior, disturbances in sleep pattern, and change in appetite [50]. Loneliness can also result in severe anxiety, loss of self-esteem, high level of stress and depression [54, 55]. Previously a scientific study also found that lonely individuals may perceive daily events as more stressful than those who are not lonely [56]. Suicidal ideation and suicide attempts are also associated with loneliness among the older adults [57]. Apart from the mental health effects of loneliness, it can seriously affect the health behaviors and physical health of an individual. As a psychological coping mechanism, lonely people may be more prone to engage in risky health behaviors such as smoking, excessive alcohol use, overeating, or transitory sexual interactions [58]. A related literature also suggests that loneliness can contribute to obesity [59]. Again, loneliness and social isolation may lead to less engagement and more reliance on online sources of guidance, and potentially result in poor treatment adherence [60]. Even though evidence has been insufficient to establish an association between loneliness and sleep duration, loneliness has been found to be associated with poor sleep quality [47]. Moreover, loneliness and social isolation can also result in hypertension, poor cardiovascular function [61, 62]. The study conducted by Hawkley and colleagues established an association between loneliness and increased Total Peripheral Resistance of blood vessels which is a determinant of high blood pressure [61]. Loneliness can also be associated with poor immune function [58]. Loneliness has been found to be associated with increased all-cause mortality [58].

Loneliness has been measured by a number of scales, notably:

- University of California, Los Angeles (UCLA) Loneliness Scale [63],
- Revised UCLA Loneliness Scale [64],
- Three-items Loneliness Scale [65],
- De Jong Gierveld Loneliness Scale [66].

The UCLA loneliness scale and the revised UCLA loneliness scale are both 20-items scales which seek to measure an individual's subjective feelings of loneliness [63, 64]. The Three-item Loneliness Scale measures three dimensions of loneliness [65]; participants rate each item on a scale of 1 to 3 where 1 stands for "Hardly ever" and 3 stands for "Often" [65]. There is no reverse scoring in this scale. The De Jong Gierveld Loneliness Scale is comprised of 6 items where three items are to determine the emotional loneliness of the participant and three items are to identify the social loneliness among the participants [66]. The measurement of loneliness is crucial for the development and evaluation of practical efforts to alleviate loneliness.

During the pandemic, when no pharmaceutical interventions were available, governments around the world implemented strict public health measures to reduce face-to-face social interactions [67]. Not only the educational institutions and public and private establishments were closed, but also restaurants, non-essential shops, cultural events, and sports facilities [67]. A number of studies have found an association between loneliness and anxiety, depression, and addictive behaviors [68–70]. As a social being, the human population is not "designed" to handle segregation for lengthy periods of time, despite the fact that it is vital to control the spread of the illness [71]. Long-term isolation can have a negative impact on physical and mental health, disrupting sleep and dietary cycles and limiting opportunities for mobility [72]. Furthermore,

initially face-to-face contact was being observed as a threat to the health and wellbeing for oneself and for his loved ones [71]. Extended social isolation, which is marked by a reduction in social relationships and interaction, causes deep detachment among individuals [71]. As a result, the imposed social isolation and loneliness due to the pandemic can have a significant impact on the society. The population of Bangladesh can also face a similar phenomenon.

1.1.4. Anxiety

According to APA, “Anxiety is an emotion characterized by feelings of tension, worried thoughts and physical changes like increased blood pressure” [73]. Anxiety disorders are characterized by excessive fear and anxiety, as well as accompanying behavioral problems where anxiety is the emotional reaction to a future threat [74]. Anxiety is a universal emotion that acts as a biological warning system which is triggered when there is a threat or can happen when inner desires clash with external demands or when opposing value systems collide [75]. The multifaceted condition of anxiety can manifest in psychological, physiological, behavioral, and cognitive ways [76]. This universal aspect of the human experience becomes abnormal when its intensity gets out of proportion, or when it happens without an imminent danger [76]. Historical description of anxiety can be traced back to the third millennium BC and it was also described in Greek and Latin Literature [76], [77]. The word anxiety originated from the Latin noun *angor* and the accompanying verb *ango* [77]. Cicero (106 BC to 43 BC) described anxiety as a disorder in Tusculan disputations within the concept of the similarity of a disturbed mind and diseased body [77]. Cicero made a clear distinction between the anxious emotion and sadness, and in medical textbooks, he referred anxiety as a form of sickness [77]. Cicero’s distinction between the state of anxiety and the trait of anxiety predates Cattell and Schleier's work, who are credited with coining the words "state" and "trait" anxiety [77, 78]. The diverse emotion of anxiety

includes psychosomatic expressions as well as hyperarousal [75]. Tension, fear, anticipation of catastrophe, fear of being unable to cope with situations, fear of acquiring anxiety, and full-fledged panic in extreme situations are all examples of psychic manifestations [75]. The somatic expressions of anxiety can be classified into muscular and autonomic signs [75]. The muscular feelings can range from barely perceptible tension to tremor, spasms, muscle weakening in rare cases, increased head, neck, and shoulder muscle activity which can result in discomfort and pain in those areas [75]. In severe anxiety, autonomic symptoms are widespread, although they vary in nature and intensity. Some people may feel palpitations, flushing, heat, sweat, clammy hands, dry lips, tightness in the chest, fast breathing, shortness of breath, butterflies in the stomach, and nausea as autonomic responses of anxiety [75]. Obviously, no single system can be held accountable for the psychobiology of all anxiety symptoms [75]. It must be viewed as the result of interactions between brain stem nuclei, limbic system, prefrontal cortex, cerebellar systems, and also the neurotransmitters [75]. Worrying too much reduces an individual's capacity to do tasks quickly and effectively and this impairment is a result of the time and effort required for worrying [79]. Anxiety is also associated with alcohol and drug dependence and major depressive disorder is one of the most frequent complications of it [80]. In this study, the focus will be on general anxiety symptoms of the respondents.

There are several tools to measure anxiety. Some of these tools are clinician measures and some are self-report measures. The Hamilton Anxiety Rating Scale (HAM-A) is one of the clinician-rated scales to measure anxiety [81]. State-Trait Anxiety Inventory (STAI), Beck Anxiety Inventory (BAI), Hospital Anxiety and Depression Scale-Anxiety (HADS-A), and Generalized Anxiety Disorder-7 (GAD-7) are some of the self-reported scales to measure anxiety [82–85]. Among the self-rated scales, STAI has 40 items (20 items in S-Anxiety and 20 items T-Anxiety

subscales), BAI has 21 items, HADS-A has 7 items, and GAD-7 has 7 items [82–85]. STAI intends to evaluate the ongoing state of anxiety as well as the "anxiety proneness" using the two subscales [86]. However, the T-Anxiety subscale is often criticized for its poor validity in differentiating anxiety from depression [86]. The BAI scale is intended to differentiate between anxiety and depression by giving special attention to the somatic symptoms of anxiety [86]. The HADS was designed to evaluate medically sick individuals for clinically significant anxiety [86]. GAD-7 scale was developed with a view to screening the probable cases of GAD in primary care settings [85].

Pandemics can have serious psychological impacts and anxiety is one of them. Previous evidence from Hong Kong showed that 18% of the patients who recovered from SARS (2003 outbreak) showed symptoms of anxiety in later life [87]. The existing COVID-19 outbreak poses unprecedented physical and financial difficulties. Uncertainty, infection dread, moral discomfort, and sadness can reduce the coping abilities of an individual which may result in anxiety [88]. A significant change in the teaching/learning process, financial insecurities, unemployment, gender differentiation in anxiety prevalence, and fear of being infected by COVID-19 had a significant toll on the level of anxiety of the general population [89].

1.1.5. Wellbeing

The concept of wellbeing is not modern, rather it was addressed by Plato, Socrates, and Aristotle thousands of years ago [90]. Wellbeing has been defined as "the state of being comfortable, healthy, or happy" by the Oxford English Dictionary [91]. This definition of wellbeing echoes the definition of health provided by WHO which is "a state of complete physical, mental, and

social well-being and not merely the absence of disease or infirmity" [91]. However, while there isn't a universally accepted definition of what constitutes well-being, it is generally acknowledged that it at the very least includes the presence of positive emotions and moods (such as contentment and happiness), the absence of negative emotions (such as depression and anxiety), fulfillment with one's life, contentment, and positive functioning [92], [93]. The second meeting of the expert group on 'Measurement of and target-setting for well-being: an initiative by the WHO Regional Office for Europe' which was held in Paris, France, proposed the following definition for wellbeing [91],

"Well-being exists in two dimensions, subjective and objective. It comprises an individual's experience of their life as well as a comparison of life circumstances with social norms and values."

This definition focuses on the concept that health and wellbeing are interactively connected with each other [91]. Higher educational attainment, safe surroundings, economic sufficiency and stability, as well as other factors, frequently correlate with elevated levels of objective well-being [94]. A person's general sense of wellbeing, psychological health, and emotional states are all examples of subjective experiences [91]. The components of wellbeing in modern research is underpinned by two broad philosophies: the hedonist philosophy and the eudemonic philosophy [95]. The hedonic approach emphasizes happiness and defines well-being in terms of obtaining pleasure and averting misery [96]. On the other end, the eudemonic approach stresses meaning and self-realization, and it perceives health as a person's overall functioning [97]. Subjective wellbeing of an individual can be expressed through the hedonic approach which consists of an emotional component defined by the predominance of pleasant feelings as opposed to negative emotions [96].

A more comprehensive approach to illness prevention and health promotion results from the integration of mental health (mind) and physical health (body) which is apparently known as wellbeing [98]. According to research, subjective wellbeing is advantageous for health and lifespan, enabling social connections, citizenship, job satisfaction, and resilience [99, 100]. This study will focus on the subjective wellbeing of the participants. There are a number of scales to measure the wellbeing of subjects. Among them most often/widely used scales in subjective wellbeing literature are: General Health Questionnaire (GHQ-12), Patient Health Questionnaire (PHQ-9), Center for Epidemiological Studies Depression Scale (CES-D), and WHO-5 Wellbeing scale [101–104]. The GHQ-12 was originally developed as a 60 items tool and later condensed to 30 and 12- items questionnaires [101]. CES-D is a 20 items scale which focuses on an individual's personal experience of emotional states in the previous week [103]. The WHO-5 is a 5-items scale which was derived from the shorter version (WHO-10) of a 28-items rating scale [105]. This concise rating scale is used to measure subjective wellbeing of the participants [106].

Due to the pandemic, income, job quality and work environment, work-life balance, mental and physical health, civil engagement and social connections were hampered at a large scale. All these can eventually impact the subjective wellbeing of individuals. Closure of physical workplaces resulted in job uncertainty. Teleworking or work from home during the pandemic protected the jobs particularly for those who were highly skilled/already well-paid [107]. Data from 11 countries showed that the workers in the lowest earning quartiles are twice as likely to lose jobs during the pandemic and unemployed people are considerably more likely to feel excluded from society [107]. Connectedness with friends and family members, quality of social relations, prosocial behaviors, social media use, regular participation in daily activities (such as

sports, outdoor activities etc.) were found to be associated with wellbeing during the period of COVID-19 [108]. Again, seeking COVID-19 related information from social media/digital news media can increase the fear and mental distress among individuals [108]. It is crucial to continue attentively and routinely examining the reasons, antecedents, and effects of variations in well-being and social connectedness in a densely populated country like Bangladesh as the epidemic progresses.

1.2 Research Objectives

International Citizen Project COVID-19 (ICPcovid) is a global effort to evaluate public health measures' and their effects on the COVID-19 epidemic [109]. Under this initiative 'Personal and Family Coping with Covid-19 in the Global South' is a large study including 12 consortium member countries. Bangladesh is one of the member countries of this study. While the goal of this survey was to gather information on how individuals and families were handling the COVID-19 problem, the questionnaire also collected data on loneliness, anxiety, and wellbeing of the Bangladeshi population. The present study will use collected data of the Bangladesh chapter from 'Personal and Family Coping with COVID-19 in the Global South' to understand the impact of COVID-19 on loneliness, anxiety, and wellbeing of the Bangladeshi population. Hence, this study offers an opportunity to understand the impact of COVID-19 pandemic on mental health and wellbeing among Bangladeshi population. Although the circumstance at the time the data was obtained and the current or future scenario associated to COVID-19 differ, we must remember that the effects of any crisis on mental health will not go away immediately. The factors that influence loneliness, anxiety, and wellbeing among the study participants will assist mental health professionals and decision-makers in designing strategies that could respond to the

real needs felt by the people. The general objective and the specific objectives of this study are as follows,

General Objective: To investigate self-reported loneliness, anxiety, wellbeing, and associated factors before and during COVID-19 in Bangladesh.

Specific Objectives:

- To investigate a potential difference between participants' loneliness, anxiety, and wellbeing before and during COVID-19 in Bangladesh.
- To explore an association between loneliness and anxiety, and loneliness and wellbeing among the participants during COVID-19.

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Chapter 2: Literature Review

2.1. Introduction

When an outbreak develops, it frequently provokes panic in the population and changes the fundamental way that medicine is practiced [1]. The COVID-19 pandemic, one of the most significant worldwide catastrophes in centuries, has had significant and far-reaching effects on health systems, economics, and civilizations [2]. Fever, chills, cough, sore throat, myalgia, nausea, vomiting, and diarrhea are common physical symptoms of coronavirus infection. However, in severe cases, the infection can lead to acute respiratory syndrome or even death [3], [4]. Numerous individuals have lost their dear ones, communities and families have become stressed and fractured, companies have gone bankrupt, and millions of individuals started to live in poverty [2]. Social, professional, and economic disruptions due to the pandemic can impact the mental health of populations across the globe considerably. Even after the strict lockdown measures, the mental health impact of COVID-19 continues to persist, and the effects are not negligible. This viral pandemic has harmful psychological impact at both individual and community levels. Prior to the COVID-19 pandemic, Ebola and SARS epidemics showed a detrimental impact on the mental health of the survivors in the long run [5, 6]. Compared with Ebola and SARS epidemic, COVID-19 had severe psychological distress on millions of individuals all over the globe on a larger scale. This literature review aimed to establish familiarity with scientific studies that have already been conducted to assess loneliness, anxiety symptoms, and wellbeing among different populations. Understanding the psychological effects of various populations and nations would provide a theoretical foundation for identifying high-risk individuals, designing interventions, allocating resources, and enforcing national and governmental policies—all of which are crucial and have global public health implications [7].

2.2. Loneliness in COVID-19

Loneliness is considered a crucial indicator of health. American Psychological Association (APA), defined Loneliness as "Affective and cognitive discomfort or uneasiness from being or perceiving oneself to be alone or otherwise solitary" [8]. Physical and mental health can be seriously threatened by loneliness. Social connections gently round us with the comfort of affirmation and are essential to our capacity for emotional fulfilment. Like few other occurrences, disruption or the absence of strong social interactions has a profound impact on our bodies and cognition [9]. During a mean follow-up of 7 years, a meta-analysis of 70 cohort studies conducted in 2015 found that lonely people had a 26% higher risk of non-suicide mortality [10]. Despite the fact that the presence of a causal relationship is still unknown, large cross-sectional studies have found an association between loneliness and greater rates of anxiety, depression, and suicidal thoughts [11]. The lack of social contact that is prevalent during the present pandemic is usually linked to the feeling of loneliness [12].

During the first phase of the pandemic, several nations implemented travel restrictions, stay-at-home orders, and physical separation policies [13]. To mitigate and control infection, people started working and studying remotely. As a result, for the first time in their lives, many people were going through an unpleasant and protracted separation from a crucial and profoundly human component of their existence [14]. Additionally, a previous scientific study conducted during the SARS epidemic in 2003 showed that quarantine and other self-isolation measurements to prevent viral transmission could increase loneliness [15]. However, relatively fewer studies have investigated the prevalence of loneliness among the general population. While comparing loneliness before and during COVID-19, increased loneliness among the general population was identified in studies from the United Kingdom (UK), Germany, USA, and Netherlands [16–20].

Among the scales that were used to measure loneliness in the pandemic, University of California Los Angeles (UCLA) 3- items questionnaire (also known as Three-item Loneliness Scale) , UCLA loneliness scale version-3, and 8-item UCLA loneliness scale (ULS-8) are considered as the most frequently used loneliness scales [9, 21, 22]. Even though the UCLA 3-items Questionnaire is well validated and reliable, the psychometric assessment of the UCLA 3-item questionnaire was not found for Bangladeshi settings [23]. However, the UCLA 3-item questionnaire was developed from a previous version of UCLA Loneliness Scale Version-3, Revise UCLA Loneliness Scale [9, 24]. Psychometric assessment of UCLA Loneliness Scale Version-3 is validated and showed reliable internal consistency [24]. UCLA 3-itmes questionnaire was also valid and reliable for the Spanish, Japanese, and Taiwanese populations [25–27]. In this study, loneliness was assessed using 'UCLA 3-item Questionnaire'. Based on score (scores 3-5 as "Not lonely" and 6-9 as "Lonely"), the outcome variable was dichotomized as "Lonely" and "Not Lonely."

Brief findings of the literature that assessed prevalence of loneliness during the pandemic period are presented in the table below.

Table 1: Prevalence of loneliness during COVID-19 in different countries.

Author (Year)	Country and Data Collection Period	Research Design and Instrument Used	Target Population and Sample Size	Major Findings
Xu et al. (2021)	China. February 2020.	Online cross-sectional. UCLA Loneliness Scale (UCLA-3).	Adult general population	Among the participants, 38.7% were screened positive for loneliness [28]

Author (Year)	Country and Data Collection Period	Research Design and Instrument Used	Target Population and Sample Size	Major Findings
Killgore et al. (2020)	United States of America. April 2020.	Nationwide, Cross-sectional. UCLA Loneliness Scale (UCLA-3).	English-speaking adult U.S. population	Mean loneliness score in the sample is significantly higher than it was reported in previous works as well as 43% respondents exceeded the cutoff score (≥47) of high loneliness [14].
Groarke et al. (2020)	United Kingdom. March to April 2020.	Online cross-sectional. UCLA Loneliness Scale (UCLA-3).	Adult UK residents	Among the adult UK population, the prevalence of loneliness was 27% [29].
Al Omari et al. (2021)	Oman, United Arab Emirates, Saudi Arabia, Iraq, Jordan, and Egypt. March to April 2020	Online cross-sectional. UCLA Loneliness Scale	Adult general population	The study observed that 40.8% of the respondents were experiencing moderately high to a very high level of loneliness during the period of the pandemic [30].
Das et al. (2021)	Bangladesh. April to May 2020.	Online cross-sectional. UCLA Loneliness Scale-8 (UCLA-8)	Adult Bangladeshi population	The prevalence of loneliness was estimated at 71% among the participants [31].
Idzik et al. (2021)	Poland. October 2020.	Online cross-sectional. Revised UCLA Loneliness Scale (R-UCLA).	Adult women	Among the participants, 62.5% were experiencing moderate to a very high level of loneliness [12].
Stickley & Ueda (2022)	Japan. April to December 2020.	Online cross-sectional. UCLA Loneliness Scale (UCLA-3).	Adult Japanese population	During the study period, 41.1% of the participants were screened as lonely (cut-off value ≥6) [32].

Considering the socio-demographic characteristics, a higher level of loneliness was associated with decreased age of the respondents during COVID-19 [12, 16, 29, 32–36]. Researchers have also found that women are at more risk of developing loneliness than their male counterparts in

different populations all over the globe [16, 32–37]. In addition, unmarried and separated/divorced participants had a higher risk of being lonely than married participants during the pandemic [28, 29, 35, 36]. Among the other socio-demographic variables, lower socioeconomic status [16, 32], living in an urban area [16], being a student [16], working from home [12], presence of a chronic disease or comorbid health conditions [12, 28], and having COVID-19 symptoms [34] were the most prominent factors. Studies also identified that increased loneliness is associated with increased anxiety during the pandemic [30, 32, 36, 38, 39].

2.3 Anxiety in COVID-19

Anxiety has been identified as one of the major contributors of the global mental health burden prior to the pandemic [40]. In light of this, the COVID-19 pandemic's appearance in 2020 has prompted several effects on mental health, both in terms of its immediate and long-term psychological impacts [41]. The definition of anxiety provided by the American Psychological Association (APA), according to which "anxiety is an emotion characterized by feelings of tension, worried thoughts and physical changes like increased blood pressure" will be applied in the current study. Various scales were frequently used to assess anxiety among the general population during the pandemic period. Among those scales Generalized Anxiety Disorder-7 (GAD-7) [42–47], Depression Anxiety and Stress Scale (DASS) [48–54], Hospital Anxiety and Depression Scale (HADS) [55–57], Beck Anxiety Inventory (BAI) [58, 59], Hamilton Anxiety Rating Scale (HARS) [60, 61] were used widely for assessment of anxiety. The GAD-7 scale showed good validity and internal consistency in different settings [62–64]. In addition, Faisal and colleagues explored the psychometric properties of the Bengali version of GAD-7, and

acceptable validity and reliability of the scale were found in the assessment in Bangladeshi settings as well [65, 66]. The current study has used GAD-7 scale to assess the anxiety symptoms among Bangladeshi population.

Relatively higher number of studies attempted to assess anxiety symptoms of general population in the pandemic period than loneliness. Brief findings of those literature are tabulated below.

Table 2: Prevalence of anxiety symptoms during COVID-19 in different countries.

Authors	Country and Data Collection Period	Research Design and Instrument Used	Target Population and Sample Size	Major Findings
Wang et al. (2020)	China. First survey: End of January 2020. Second survey: End of February 2020.	Online longitudinal study. DASS-21.	Adult general population living in mainland China, n= 1304 for the first survey and n=861 for the second survey.	Moderate to severe anxiety symptoms were prevalent among 28.8% of the participants in the first survey. The anxiety symptoms did not reduce between the two compared time points – during the initial outbreak and the peak of the epidemic [67].
M. Z. Ahmed et al. (2020)	China. February 2020.	Online cross-sectional. BAI (Cutoff score ≥8).	Adult Chinese population, majority from Hubei province. n=1074.	The study identified that 29% of the participants were suffering from mild to severe forms of anxiety in February 2020 [58].
Casagrande et al. (2020)	Italy. March to April 2020.	Online cross-sectional. GAD-7 (cut-off ≥10).	Adult Italian population, n= 2291	Among the respondents, 32.1% showed moderate to severe anxiety during the first wave of COVID-19 [42].
Bäuerle et al. (2020)	Germany. March to May 2020.	Online cross-sectional. GAD-7.	Adult German population, n= 15037	Among the study participants 44.7% showed mild to severe anxiety symptoms during the study period [43].
Georgieva et al. (2021)	11 countries (UK, Belgium, Netherlands, Bulgaria,	Online cross-sectional. GAD-2 (cut-off score≥3).	Adult general population, n= 9543 (UK 659, Belgium 384, Netherlands 867,	Average prevalence of anxiety was 28.6%. the prevalence of anxiety was 28.4% in the UK, 35.2% in Belgium, 27.2% in

Authors	Country and Data Collection Period	Research Design and Instrument Used	Target Population and Sample Size	Major Findings
	Czech Republic, Finland, India, Latvia, Poland, Romania, and Sweden). August to November 2020.		Bulgaria 1862, Czech Republic 725, Finland 543, India 780, Latvia 635, Poland 996, Romania, 1502, and Sweden, 590)	Netherlands, 25.0% in Bulgaria, 31.3% in Czech Republic, 25.8% in Finland, 31.9% in India, 25.8% in Latvia, 34.8% in Poland, 28.2% in Romania, and 25.6% in Sweden [47].
Caycho-Rodríguez et al. (2021)	Seven Latin American Countries (Argentina, Colombia, Ecuador, El Salvador, Mexico, Paraguay, and Uruguay). June to September 2020.	Online cross-sectional. GAD-7.	Adult general population, n= 4881 (Argentina 1719, Colombia 324, Ecuador 790, El Salvador 354, Mexico 986, Paraguay 272, and Uruguay 436)	Mild to severe anxiety was observed among 71.8% participant from Argentina, 61.1% from Colombia, 78.3% from Ecuador, 65.2% from El Salvador, 65.8% from Mexico, 76.1% from Paraguay, and 55.8% from Uruguay [45].
Turna et al. (2021)	USA and Canada. April to June 2020.	Online cross-sectional. GAD-7 (cut-off score ≥10).	General population from USA and Canada aged more or equal to 16 years, n= 632. (USA 195, Canada 437)	Moderate to severe anxiety symptoms were observed among 31% of the respondents [44].
El Desouky et al. (2021)	Egypt. April 2020	Online cross-sectional. GAD-7 (cut-off score ≥10).	Adult general population, n= 1040	Among the respondent 56.2% showed moderate to severe anxiety symptoms [68].
Msherghi et al. (2021)	Libya. May to June 2020	Online cross-sectional. GAD-7 (cut-	Adult general population from 20 cities of Libya, n=8084	Severe anxiety symptoms were present among 14.2% of the respondents [46].

Authors	Country and Data Collection Period	Research Design and Instrument Used	Target Population and Sample Size	Major Findings
		off score ≥15).		
Janati Idrissi et al.	Morocco. April to May 2020	Online cross-sectional. Hamilton Anxiety Rating Scale (HARS) (cut-off score ≥14).	Adult general population, n=827	Among the respondents, 29.5% exhibited anxiety symptoms [60].
Naser et al. (2020)	Jordan. March 2020.	Online cross-sectional. GAD-7.	Adult general population, Healthcare workers, and university students, n= Total 4216 (general population 1798, healthcare professionals 1163, university students 1165)	Overall 67.7% of the respondents showed mild to severe anxiety symptoms (58% among general population, 70.8% among healthcare workers, 79.7% among university students) [69].
Bhowmick et al. (2021)	West Bengal, India. April to May 2020	Online cross-sectional. GAD-7.	Adult general population, n=355	Moderate to severe anxiety symptoms were present among 15.5% of the respondents [70].
Verma & Mishra (2020)	India. April 2020.	Online cross-sectional. DASS-21 (cut-off score ≥10).	Adult general population, n= 354	The prevalence of moderate to extremely severe anxiety symptoms was 28% among the participants [50].
Ullah et al. (2022)	Pakistan. May to July 2020.	Online cross-sectional. Hospital Anxiety and Depression Scale (HADS).	Adult general population, n=1047	Among the respondents, 57.7% were experiencing mild to severe symptoms of anxiety [55].
Ahmed et al. (2022)	Bangladesh. Data collection	Online cross-sectional. DASS-21.	Adult general population, n=500	Among the participants, 39.8% exhibited mild to

Authors	Country and Data Collection Period	Research Design and Instrument Used	Target Population and Sample Size	Major Findings
	period was not mentioned.			severe symptoms of anxiety [51].
Hossain et al. (2020)	Bangladesh. March to April 2020.	Online cross-sectional. GAD-7 (cut-off score ≥10).	Bangladeshi population aged more than 16 years, n=880	49.1% of participants had moderate to severe symptoms of anxiety [71].
Islam et al. (2020)	Bangladesh. May 2020.	Online cross-sectional. GAD-7.	University students aged at least 17 years, n= 476	Among the students, 87.7% had mild to severe anxiety symptoms [72].

Researchers have identified some important factors that are associated with anxiety during the period of COVID-19. Studies identified that female participants had higher anxiety than their male counterparts [40, 42, 46, 50, 51, 53, 55, 60, 68–70]. Younger age group, especially those under 30 years old, were more susceptible to experiencing anxiety symptoms than those in the older age groups [4, 40, 42, 44–46, 51, 53, 58, 60, 71, 73, 74]. Considering the marital status of general population, some studies found that married respondents expressed higher anxiety than single respondents [46, 71], and some studies showed that the separated/widowed population had anxiety symptoms more than the single population [49, 69, 75]. Regarding the other factors, individuals who followed reports news of COVID-19 [52, 53, 68], had COVID-19 symptoms [52, 75, 76], lost a family member with COVID symptoms [52, 53], was the financial supporter of the family [46], had low family income [48, 69], suffered from a chronic disease [60], lived in rural area [55, 60], and had social media and internet exposure [71] were at more risk of anxiety.

2.4. Wellbeing in COVID-19

The idea of wellness at the very least encompasses the existence of favorable feelings and moods (such as contentment and happiness), the absence of unfavorable emotions (such as depression and anxiety), fulfilment in one's life, contentment, and positive functioning [77, 78]. The World Health Organization expressed severe concerns about the potential impact of COVID-19 on the wellbeing of the world population in the early months of 2020 [79]. The COVID-19 pandemic's effects influence peoples' freedom to do things as well as their physical and emotional wellbeing [80]. Initiatives that were taken to minimize COVID-19 transmission had the potential to cause profound psychological changes in people, including decreased wellbeing, unpleasant feelings, anxiety, and even despair [81]. In addition, COVID-19 created economic meltdowns, raised unemployment rates, resulted in financial losses, and made travel difficult, which had a detrimental impact on people's mental wellbeing and has become a worldwide problem [82].

Among the various scales used to assess wellbeing during the pandemic, WHO-5 Wellbeing Index can be considered a versatile one. It has high construct validity and can be applied across various settings [83]. The Bangla version of the WHO-5 Wellbeing Index showed satisfactory internal consistency and good test-retest reliability [84]. When it comes to evaluating subjective well-being for the general adult population in Bangladesh, Bangla version of WHO-5 wellbeing Index is considered as psychometrically valid and reliable [84]. Researchers have identified that a cutoff score of ≤ 50 is indicative of reduced or impaired wellbeing [83, 85].

According to many scientific studies, COVID-19 had a negative impact on the overall subjective wellbeing of different populations all over the world. Findings from studies that used similar method are tabulated below.

Table 3: Prevalence of wellbeing during COVID-19 in different countries.

Authors	Country and Data Collection Period	Research Design and Instrument Used	Target Population and Sample Size	Major Findings
Simon et al. (2021)	Austria, May to June 2020	Online cross-sectional. WHO-5 Wellbeing Index.	Adult Austrian population, n= 848.	Among the participants 31% reported impaired wellbeing.
Beaglehole et al. (2022)	New Zealand, April 2020	Online cross-sectional. WHO-5 Wellbeing Index (cutoff <13).	Adult population of New Zealand, n= 3468	Impaired wellbeing was observed among 32.8% of the participants.
Every-Palmer et al. (2020)	New Zealand, April 2020.	Online cross-sectional. WHO-5 Wellbeing Index.	Adult population of New Zealand, n=2010	The prevalence of impaired wellbeing was 38.2%.
Liu et al. (2021)	Australia, May to December 2020.	Online cross-sectional. WHO-5 Wellbeing Index (cutoff <13).	Undergraduate and postgraduate students of Monash University, n=3973	Impaired wellbeing was prevalent among 66.3% of the students.
Kilani et al. (2020)	18 countries from Middle Eastern and North African Region. April 2020.	Online cross-sectional. WHO-5 Wellbeing Index (cutoff <13).	Adult Arab population, n=1723	Impaired wellbeing was reported by 32.6% of the participants in this study.
Bhowmick et al. (2021)	West Bengal, India. April to May 2020.	Online cross-sectional. WHO-5 Wellbeing Index (cutoff <12)	Adult general population, n=355	The study reported that 37.4% of the respondents had wellbeing score less than cutoff value.
Faruk et al. (2021)	Bangladesh. January to April 2021.	In-person survey, cross-sectional. WHO-5	Indigenous population living in the hill tracts areas of Rangamati,	Impaired wellbeing was observed among 50.9% of the participant.

Authors	Country and Data Collection Period	Research Design and Instrument Used	Target Population and Sample Size	Major Findings
		Wellbeing Index.	Khagrachori, and Bandarban, n=422	

Wilke and colleagues conducted a study including 14,975 adult participants from 14 countries (Australia, Austria, Argentina, Brazil, Chile, France, Germany, Italy, Netherlands, South Africa, Singapore, Switzerland, Spain, and United States) and reported that the mean score of WHO-5 wellbeing index score had statistically significantly reduced during the pandemic [86]. Another study from Germany that used WHO-5 scale, showed that the level of subjective wellbeing among the adult population decreased in the pandemic [87].

Reduced or impaired wellbeing was found to be highly associated with the gender of the participants: female respondents experienced poorer wellbeing than their male counterparts [70, 82, 86–92]. Besides, wellbeing score decreases with younger age [87, 88, 90, 91, 93] which represents that young adults are at more risk of impaired wellbeing. Apart from the above-mentioned factors, being unemployed [88, 91], belonging to low socioeconomic group [90, 91], being single or separated or divorced [90, 91], having an infected person among close friends and relatives [94], decreased physical activity [86, 90], and not being able to work from home [86] were discovered to be associated with impaired wellbeing during the pandemic. On the other hand, adequate rest was associated with good wellbeing scores [93]. Additionally, another study also found an association between impaired wellbeing and loneliness [95].

2.5 Conclusion

The literature review suggests that the pandemic has increased loneliness and anxiety symptoms among different populations and decreased subjective wellbeing globally. It also showed that there are study gaps regarding the assessment of loneliness among the general population in Bangladesh. Factors associated with the prevalence of loneliness among the Bangladeshi population also need to be assessed. On another note, overall subjective wellbeing and its associated factors were not investigated during this period. This study will try to address these gaps and also will try to find any association between loneliness and the other two constructs (anxiety and wellbeing). However, one crucial aspect of the literature review is that almost all of the studies included in the review were conducted using e-platforms or over phones. As conducting face-to-face interviews was not feasible during the pandemic, using the internet/phone was the most feasible way to conduct the studies. Nevertheless, this creates a chance of selection bias, recall bias, and information bias. Again, the samples may not always be the true representative of the underlying population. As a result, questions may arise about the generalizability of these studies.

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Chapter 3: Result

3.1 Introduction

Concerns regarding the COVID-19 pandemic's impact on mental health have been expressed since its early phases [1]. According to a research brief on COVID-19 and mental health published by World Health Organization (WHO) in March 2022, the prevalence of mental health problems in the general population has significantly increased [2]. The scientific brief also showed that younger age, being a woman, and having pre-existing medical issues were frequently cited as risk factors for mental health problems during this period [2]. The initial knowledge gap about the virus, its transmission, and the thoughts of being infected significantly contributed to increased mental health problems in Bangladesh [3]. However, mental health impacts of the pandemic can persist even when lockdown is no longer in the scenario and pharmacological interventions (i.e., vaccines) are present to prevent the disease. Researchers have suspected that the mental health impacts of the pandemic can stay for a prolonged period even after the pandemic ends [4]. For a vast portion of the population, the impact on mental health may be lessened by relaxing of control measures, but for some, the effects will still be there and may even worsen. In this light, this study aims to evaluate the magnitude of and the factors associated with loneliness, anxiety, and wellbeing of the adult Bangladeshi population and to find any potential difference in these constructs before and during COVID-19.

3.2 Method

3.2.1 Data Source

This study used already collected data from a large research project by International Citizen Project COVID-19 (ICPCOVID), Bangladesh chapter, (available from:

www.icpcovid.com/en/home) comprising 12 consortium members titled “Personal and Family Coping With COVID-19 in the Global South”. The original study aims to examine how family relationships, parental participation, and parent issue management during the COVID-19 crisis interact with the eventual lockdown measures in the Global South. To assess the coping strategies used by populations worldwide during the covid-19 crisis and the lockdown, the parenting practices and family relationships during COVID-19, and the boredom and stress levels of people during the COVID-19 crisis and lockdown, the parent questionnaire used 6 different tools: A Short Boredom Proneness Scale, University of California, Los Angeles (UCLA) 3-item Loneliness Questionnaire, The University of New Orleans Alabama Parenting Questionnaire APQ, Triple P – Positive Parenting Program Relationship Quality Index, Generalized Anxiety Disorder 7-item (GAD-7) scale, and WHO-5 Wellbeing Index were used. The present study used three tools (UCLA 3-item Loneliness Questionnaire, GAD-7, WHO-5 Wellbeing Index) from the above mentioned 6 tools to assess the loneliness, anxiety, and wellbeing of the Bangladeshi population and its associated factors during the pandemic. To compare before COVID-19 and during COVID-19 scenario, each item of the used tools in the survey asked the participants to respond for two time points: “two weeks before COVID-19 crisis” and “since the beginning of COVID-19 crisis” in Bangladesh. So, the participants had to recall their state-of-mind 2 weeks prior to the pandemic hit Bangladesh. The consortium co-investigator and country-lead of the parent study was reached to grant permission to use the dataset for the present study. The country consortium approved the request, and full access to the dataset of the Bangladesh chapter was provided on August 21, 2021.

3.2.2 Study Design

This primary study used an online survey design and provided individualized feedback and advice based on the scores people had on different questionnaires. A web-based cross-sectional design used convenience sampling technique to collect information on the participants for all the constructs pre-and-during-COVID-19. The study conducted an online survey using a survey link that was available from the ICPCOVID website (www.icpcovid.com/en/home). No data was collected through face-to-face interview. Information about the study was announced to potential participants via different communication means, e.g., social media, phone calls, email messages, and word of mouth. Invitations to participate were sent through different platforms, including social media (e.g., WhatsApp, Facebook, Messenger, Twitter, LinkedIn, email and messages). People self-selected to be part of the study. It was not possible to find out the exact number of people who were reached to participate in the study. Hence, response rate was not calculated. The participants answered items on the instruments in the survey regarding how things were or how they felt before the pandemic had spread to Bangladesh and after the pandemic had arrived in Bangladesh and the implementation of the subsequent national lockdown. As a result, the present study also followed a cross-sectional study design.

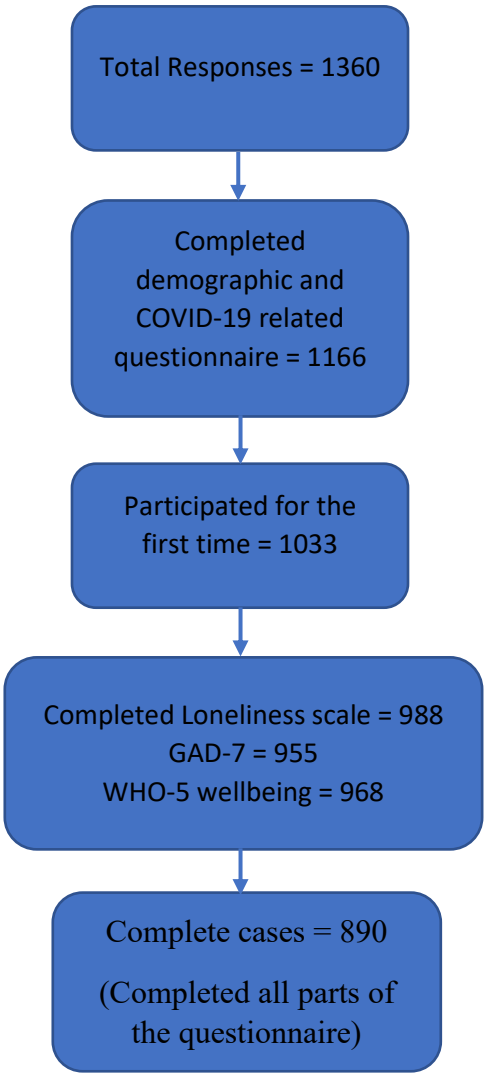
3.2.3 Study Period

In Bangladesh, data were collected from May to September 2020. The national lockdown ended on May 31, 2020, but restrictions related to public movement and travelling were still in place. Right after the national lockdown was over, physical attending in offices and industries was limited and educational institutions were closed. In addition to that, two-time points data, pre and during COVID, were collected at the same time during May to September 2020 because no data had been collected before the onset of the pandemic. Participants were asked to respond for two

time points for each item/question of the constructs under analysis in this study: “two weeks before COVID-19 crisis” and “since the beginning of COVID-19 crisis” in Bangladesh.

3.2.4 Study Population and Sample

The study included participants from Bangladesh aged 18 years and above. A total of 1360 individuals responded to the questionnaire using the link from the ICPCOVID website. Among them, 1166 participants answered all demographic and COVID-19-related questions.



Flowchart 1: Identification of cases who completed all parts of the questionnaire.

Before moving on to the main portion of the questionnaire, respondents were asked if they have participated in the study before. Data were collected if they were participating for the first/second/third/fourth/fifth/sixth/seventh time. However, there was no unique identifier which could be used to see if a first-time respondent is taking part in the study again. So, only the respondents (n=1033) who participated for the first time were included in the study. Of the 1033 participants, 890 completed all parts of the questionnaire considered in this study. The statistical analysis only considered individuals with no missing values for the relevant variables to conduct the complete case analysis. Any participant with missing data was disqualified. In the final analysis, 890 participants were included.

3.2.5 Research Instruments

Demographic and COVID-19-related questionnaire: The first section of the questionnaire collected respondents' sociodemographic information, which included location (rural/urban), age group, sex, relationship status, number of children, the highest level of education, and occupation. Participants were asked how they did perceive their socioeconomic status. The following section collected information regarding the infection status of the participants, their family members, and close friends and relatives. Other COVID-19-related factors included participants' health concerns, if they have any pre-existing chronic disease or comorbidities, if they were concerned about supporting their families financially during COVID-19, how difficult they found it to switch away from pandemic-related news, if their lives have changed after the pandemic, their perception about how COVID-19 was being controlled in Bangladesh, and how well they were coping with COVID-19.

The questionnaire also tried to get the respondents' perceptions regarding their time spending patterns during the pandemic. This portion asked about the following activities: watching TV,

using the internet, and social media, working from home, doing household chores, participating in sports, talking with friends and family members, praying, resting, and sleeping. The options included “Less than before COVID-19”, “Same as before COVID-19”, “More than before COVID-19,” and “Prefer not to say” for this section.

UCLA 3-Item Questionnaire: UCLA-3 Item Questionnaire is considered as ‘a short scale for measuring loneliness in large surveys’, and also known as the ‘Three-Item Loneliness Scale [5]. Psychometric assessment of the UCLA 3-Item Questionnaire showed satisfactory reliability, concurrent validity, and discriminant validity [5]. Initially developed from the Revised UCLA Loneliness Scale (R-UCLA), this questionnaire has the following 3 items: “How often do you feel that you lack companionship?”, “How often do you feel left out”, and “How often do you feel isolated from others?” [5]. In this study each question has three possible responses (1 = Hardly ever, 2 = Some of the time, and 3 = Often) for two different time points (two weeks before COVID-19 crisis and since the beginning of COVID-19 crisis in Bangladesh) [5]. Higher score represents more loneliness among participants [5]. Researchers in past have grouped people who score 3-5 as “Not lonely” and 6-9 as “Lonely” [6]. This study used loneliness as a dichotomized outcome, “Not lonely” and “Lonely”. For the present study, the UCLA 3-Item Questionnaire showed good internal consistency with Cronbach’s Alpha 0.84 (two weeks before COVID-19 crisis in Bangladesh) and 0.86 (since the beginning of COVID-19 crisis in Bangladesh).

Generalized Anxiety Disorder-7: The Generalized Anxiety Disorder-7 was developed by Spitzer and colleagues which showed excellent internal consistency (Cronbach $\alpha = 0.92$), test-retest reliability (intraclass correlation = 0.83), and good convergent validity with 2 anxiety scales: the Beck Anxiety Inventory ($r = 0.72$) and the anxiety subscale of the Symptom

Checklist-90 (r = 0.74) [7]. The scale showed satisfactory internal consistency (Cronbach's α 0.895), construct validity (KMO coefficient 0.915), convergent validity with Patient Health Questionnaire-9 (PHQ-9) and in Bangladeshi settings [8]. For the present study, GAD-7 showed good internal consistency with Cronbach's Alpha 0.86 (two weeks before COVID-19 crisis in Bangladesh) and 0.90 (since the beginning of COVID-19 crisis in Bangladesh). The respondents had to answer 7 items with four options, 0 = Not at all, 1 = Several days, 2 = More than half the days, and 3 = Nearly every day for two different time points (two weeks before COVID-19 crisis and since the beginning of COVID-19 crisis in Bangladesh) [7].

The 7 items are as follows:

1. Feeling nervous, anxious, or on edge
2. Not being able to stop or control worrying
3. Worrying too much about different things
4. Trouble relaxing
5. Being so restless that it is hard to sit still
6. Becoming easily annoyed or irritable
7. Feeling afraid, as if something awful might happen

The total GAD-7 scale has the score range from 0 to 21 [7]. Anxiety scores were then dichotomized based on a threshold score of 4 [9]. Participants with a GAD score less than or equal to 4 were deemed to have experienced no anxiety whilst the rest were considered to have experienced mild to severe levels of anxiety [9]. In this study, anxiety is used as a dichotomized outcome, "No anxiety (GAD-7, 0-4)" and "Yes anxiety (GAD-7, 5-21)". Severity of the GAD-7 scale has also been identified as no or minimal anxiety (0-4), mild anxiety (5-9), moderate anxiety (10-14), and severe anxiety (15-21) [10].

WHO-5 Wellbeing Index: The WHO-5 is a brief survey with 5 straightforward, non-intrusive questions that focuses on the respondents' subjective well-being [11]. The WHO-5 has been widely applied around the world, Topp and colleagues found that this scale has high psychometric validity as well as the scale's construct validity revealed that it was a unidimensional scale, with each item contributing unique information regarding the degree of wellbeing [11, 12]. In Bangladeshi settings, the WHO-5 wellbeing scale demonstrated acceptable internal consistency (Chronbach's $\alpha = 0.754$) and test-retest reliability ($r = 0.713$, $p<0.01$), divergent validity ($r = -0.443$, $p<0.01$, with the Bangla version of Perceived Stress Scale-10) and convergent validity ($r = 0.542$, $p<0.01$, with the Bangla version of the Warwick-Edinburgh Mental Well-being Scale). [11 12]. In the present study, WHO-5 Wellbeing Index showed good internal consistency with Cronbach's Alpha 0.87 (2 weeks before COVID-19 crisis in Bangladesh) and 0.86 (since the beginning of COVID-19 crisis in Bangladesh). The WHO-5 wellbeing scale has 5 items with 6 options to answer. The options are 0 = At no time, 1 = Some of the time, 2 = Less than half the time, 3 = More than half the time, 4 = Most of the time, and 5 = All of the time.

The 5 questions are as follows:

1. I have felt cheerful in good spirits.
2. I have felt calm and relaxed.
3. I have felt active and vigorous.
4. I woke up feeling fresh and rested.
5. My daily life has been filled with things that interest me.

The respondents had to answer the above-mentioned 5 questions twice: one for two weeks before COVID-19 crisis in Bangladesh and another for since the beginning of COVID-19 crisis in

Bangladesh. The raw score ranges from 0 to 25, 0 representing worst possible and 25 representing best possible quality of life. The raw score is then multiplied by 4 to get a score in 100. According to a systematic review on WHO-5 wellbeing scale, a cut-off score of ≤50 can be used to identify those with impaired wellbeing [11]. Accordingly, in this study the outcome variable is dichotomized by WHO-5 wellbeing score ≤50 as impaired wellbeing and >50 as optimal wellbeing.

3.2.6 Data Collection

Information about the study was announced to potential participants via different communication means, such as social media, phone calls, email messages, and word of mouth. Data was collected using a survey available at the website address: www.icpcovid.com/en/home. A reminder and new invitation were sent out every other week through different communication channels of the country consortium to ensure that the invitation could reach as many participants as possible. Participants were allowed to skip any question they liked apart from some basic demographic data.

3.2.7 Data Analysis

The primary outcomes of this study were loneliness, anxiety, and wellbeing of the participants before and during the pandemic. Sociodemographic variables, COVID-19-related questions, and time spending patterns during COVID-19 were considered covariates. Characteristics of the sample, including covariates and outcomes variables were summarized using descriptive statistics. Categorical variables were reported as frequencies and percentages, continuous measures were reported as means with standard deviations (SD). To examine the presence and magnitude of the change before COVID-19 and after COVID-19, all three outcome variables

mean scores were compared using a paired sample t-test. The outcome variables were also categorized according to previously conducted scientific studies, and the difference between the "two weeks before COVID-19 crisis" and "since the beginning of COVID-19 crisis" outcome groups were assessed using McNemar's test. Chi-square test was done to see the association between the dichotomized outcome variables and independent variables.

To see the associated factors with the outcome variables, backward elimination stepwise multivariable logistic regression was conducted. Variables that have a p-value < 0.2 in the bivariate analysis were included in the first multivariable model. Then the full model was run and variables with the highest p-values ≥ 0.05 were removed one at a time from the model. If a variable was removed from the model due to statistical non-significance, the confounding effect on other predictors was checked. The examination of confounders was primarily based on the change in odds ratio (OR). If the change is greater than 10%, the variable was considered a potential confounder. Whenever a confounder was confirmed between any two variables, both were retained in the model. Then the variable with the next highest statistically insignificant p-value was considered for elimination. This iterative process of variable elimination and retention persisted until the best main effects model was obtained. No significant interactions were found among variables of the main effects models.

Association between covariates and the outcomes loneliness, anxiety, and wellbeing were demonstrated by odds ratio (OR) with 95% confidence interval (CI). Similarly, to identify any interaction between loneliness and the other two constructs (anxiety and wellbeing) during the pandemic, loneliness was added to the final model of anxiety and wellbeing after seeing a statistically significant association in bivariate analysis. All applicable statistical tests were 2-tailed. Raw data were cleaned and sorted using Microsoft Excel 2019. All statistical analysis was

done using STATA MP (developed by STATA Corp.) version 13.0. A p-value<0.05 was considered statistically significant.

3.2.8 Ethical Consideration

Participants were informed about the study through various means of communication, and at the start of the questionnaire a 'letter of information' was provided to inform participants on the study purpose and design. There was also an informed consent, with all necessary explanations, that needed to be accepted before they could start with the survey. No incentives or compensations were given to the participants. Consortium data was shared via email, and all data were stored in a password protected computer. The questionnaire was completed anonymously, and no unique identifier/name/email address was shared with the researcher through which any participant could be identified. For the main research, ethical approval was obtained from Biosafety, Biosecurity & Ethical Committee of Faculty of Biological Sciences, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh (approval reference number: BBEC, JU/M-2020(6)1/RG/Bangladesh). To conduct the thesis, ethical approval was obtained from Alberta Research Information Services (ARISE) of University of Alberta (Research Ethics Board 2; ID: Pro00117900).

3.3 Results

3.3.1 Loneliness, anxiety, and wellbeing before and during COVID-19

The participants' demographic distribution shows that the majority of the respondents were from the urban area of Bangladesh (75.3%). Most of the participants (70.3%) were less than 25 years old and were single (78.7%). More than half of the participants' highest level of education was a Bachelor's degree (54.9%). Almost two-thirds of the respondents were students (68.9%). The characteristics of study participants are presented in Table 4.

Table 4: Demographic distribution and responses to the COVID-19 related questions of the participants (n=890)

Variables	n (%)
Location	
Rural	206 (23.2)
Urban	670 (75.3)
Prefer not to say	14 (1.6)
Age in years	
Less than 25	626 (70.3)
25-44	208 (23.4)
45 and more	48 (5.4)
Prefer not to say	8 (0.9)
Sex	
Female	423 (47.5)
Male	455 (51.1)
Prefer not to say	12 (1.4)
Current relationship status	
Single	700 (78.7)
Married	169 (19.0)
Widowed/Separated/Divorced	12 (1.4)
Prefer not to say	9 (1.0)
Number of children	
No children	757 (85.1)
One	46 (5.2)
Two	44 (4.9)
More than two	31 (3.5)
Prefer not to say	12 (1.4)
Highest level of education	

Variables	n (%)
Secondary or below	77 (8.7)
Diploma/Certificate Degree	152 (16.8)
Graduation	480 (54.9)
Post-graduation	163 (17.1)
Prefer not to say	18 (2.1)
Occupation	
Unemployed	107 (12.0)
Employed	175 (19.7)
Student	597 (67.1)
Prefer not to say	11 (1.2)
Socioeconomic Status	
Low income	155 (17.4)
Lower Middle income	404 (45.4)
Higher middle income	287 (32.3)
High income	44 (4.9)
Himself/ Herself infected by the COVID-19	
Yes	25 (2.8)
No	754 (84.7)
Not sure	111 (12.5)
Household member infected by COVID-19	
Yes	110 (12.4)
No	720 (80.9)
Not sure	60 (6.7)
Close friend or relative infected by COVID-19	
Yes	395 (44.4)
No	438 (49.2)
Not sure	57 (6.4)
Close friend or relative died from COVID-19 symptoms	
Yes	128 (14.4)
No	725 (81.5)
Not sure	37 (4.2)
Concern about health of own and family members	
Not at all concerned	27 (3.0)
Somewhat concerned	278 (31.2)
Moderately concerned	392 (44.0)
Extremely concerned	193 (21.7)
Presence of a pre-existing disease or condition that can aggravate symptoms if infected by COVID-19	
Yes	178 (20.0)
No	571 (64.2)
Not sure	141 (15.8)
Concerned about supporting family financially	

Variables	n (%)
Yes	352 (39.6)
No	421 (47.3)
Not sure	117 (13.2)
Feeling difficulties to avoid COVID-19 related news from media (electronic/print/social)	
Difficult	257 (28.9)
Neither easy nor difficult	462 (51.9)
Easy	171 (19.2)
How their lives have changed during COVID-19	
Worse	648 (72.8)
About the same	177 (19.9)
Better	65 (7.3)
How well COVID situation is controlled in Bangladesh	
Not well controlled	470 (52.8)
Neutral	205 (23.0)
Well controlled	215 (24.2)
How well they are coping with COVID-19	
Not well	143 (16.1)
Average	612 (68.8)
Well	135 (15.2)
Activities at home since COVID-19 arrived	
Watching TV	
Less than before Covid-19	204 (22.9)
Same as before Covid-19	346 (38.9)
More than before Covid-19	249 (28.0)
Prefer not to say	91 (10.2)
Internet Use	
Less than before Covid-19	48 (5.4)
Same as before Covid-19	175 (19.7)
More than before Covid-19	641 (72.0)
Prefer not to say	26 (2.9)
Social Media Use	
Less than before Covid-19	83 (9.3)
Same as before Covid-19	202 (22.7)
More than before Covid-19	565 (63.5)
Prefer not to say	40 (4.5)
Work from Home	
Less than before Covid-19	228 (25.6)
Same as before Covid-19	228 (25.6)
More than before Covid-19	244 (27.4)
Prefer not to say	190 (21.4)
Household Chores	

Variables	n (%)
Less than before Covid-19	77 (8.7)
Same as before Covid-19	288 (32.4)
More than before Covid-19	435 (48.9)
Prefer not to say	90 (10.1)
Sports	
Less than before Covid-19	380 (42.7)
Same as before Covid-19	263 (29.6)
More than before Covid-19	177 (19.9)
Prefer not to say	70 (7.9)
Talking with friends and family members	
Less than before Covid-19	143 (16.1)
Same as before Covid-19	346 (38.9)
More than before Covid-19	374 (42.0)
Prefer not to say	27 (3.0)
Praying	
Less than before Covid-19	36 (4.0)
Same as before Covid-19	376 (42.3)
More than before Covid-19	430 (48.3)
Prefer not to say	48 (5.4)
Resting	
Less than before Covid-19	53 (6.0)
Same as before Covid-19	183 (20.6)
More than before Covid-19	636 (71.5)
Prefer not to say	18 (2.0)
Sleeping	
Less than before Covid-19	86 (9.7)
Same as before Covid-19	266 (30.0)
More than before Covid-19	524 (58.9)
Prefer not to say	14 (1.6)

Even though COVID-19 infected a small portion of the participants and their family members during data collection (2.8% and 12.4%, respectively), almost 44.4% of the respondents had someone from their close friends or relatives who were infected. However, in responses to the questions regarding the COVID-19 infection, the ‘Not sure’ category is not negligible. This might reflect the initial testing capacity in Bangladesh. More than 60% of respondents were either moderately or extremely concerned about the health of their own and their family

members during the pandemic. A pre-existing disease or condition that can aggravate symptoms if infected by COVID-19 was present among 20% of the respondents. These pre-existing conditions included cancer, chronic lung diseases (Chronic Obstructive Pulmonary Disease, asthma, bronchiectasis, pulmonary fibrosis etc.), cystic fibrosis, diabetes, heart disease, and immunocompromised conditions. More than 70% of participants thought that their life had become worse since the beginning of COVID-19.

Since the arrival of the pandemic, majority of the participants' internet use (72.0%) and social media use (63.5%) have increased. Almost half of the participants (48.9%) perceived that their participation in household chores have increased after the pandemic started. Participation in sports was thought to be decreased by 42.7% of the respondents. Most of the participants identified that their time for rest (71.5%) and sleep (58.9%) had increased after the pandemic hit.

Mean scores of the three scales (UCLA 3-item Questionnaire, GAD-7, and WHO-5 Wellbeing Index) were calculated. Then paired t-test was used to find out any statistically significant difference in the mean scores of each scale two weeks before and since the onset of COVID-19 among the participants.

Table 5: Difference in scores of loneliness, anxiety, and wellbeing over the 2 weeks before onset of COVID epidemic (as recalled) and since the beginning of the crisis in Bangladesh (n=890)

Score	Mean ± SD		p-value
	Two weeks before COVID-19	Since the onset of COVID-19	
Loneliness	5.2 ± 1.8	6.0 ± 2.1	<0.001
Anxiety	3.7 ± 4.6	8.7 ± 6.6	<0.001
Wellbeing	53.2 ± 26.8	32.5 ± 23.7	<0.001

From Table 5, we can see that the loneliness score increased over the period since the onset of COVID-19 ($p<0.001$). GAD-7 scale also demonstrated an increase in anxiety among the participants ($p<0.001$). Similar pattern is also showed on the WHO-5 wellbeing scale, where we can see significantly lower wellbeing score since onset of COVID-19 epidemic than as recalled for the 2 weeks before onset ($p<0.001$).

According to the cut-off scores for each of the scales, loneliness, anxiety, and wellbeing of the participants were categorized and presented in Table 6.

Table 6: Severity of loneliness, anxiety, and wellbeing among the participants 2 weeks before COVID-19 crisis (as recalled) and since the beginning of COVID-19 crisis in Bangladesh (n=890)

	n (%)	
Variables	**Two weeks before COVID-19 crisis**	**Since the beginning of COVID-19 crisis**
Location		
Lonely	386 (43.4)	509 (57.2)
Not lonely	504 (56.6)	381 (42.8)
Anxiety		
Minimal	593 (66.6)	278 (31.2)
Mild	205 (23.0)	238 (26.7)
Moderate	53 (6.0)	175 (19.7)
Severe	39 (4.4)	199 (22.4)
Wellbeing		
Impaired	376 (42.2)	708 (79.6)
Optimal	514 (57.8)	182 (20.4)

From Table 6, we can see that, 43.4% of the respondents were found to be lonely before COVID-19 (as recalled) but since the beginning of the pandemic, 57.2% of them were assessed as lonely. Similarly, almost two-third (68.8%) were experiencing mild to severe level of anxiety symptoms since the beginning of COVID-19 , where only one-third of them (33.4%) were experiencing so before COVID-19 as they recalled. Furthermore, impaired wellbeing was found in 79.6% of the

respondents since the beginning of COVID-19, where before COVID-19, 42.2% of them recalled experiencing impaired wellbeing.

To determine any statistically significant difference between the groups under the three scales before and since the beginning of COVID-19, McNemar chi-square test was done. For the purpose of analysis, mild to severe anxiety were categorized as positive for anxiety symptoms and minimal/no anxiety was categorized as negative for anxiety symptoms.

Table 7: Difference in loneliness 2 weeks before and since the beginning of COVID-19 (n=890)

Loneliness 2 weeks Before COVID-19	**Loneliness Since the Beginning of COVID-19**		
	Positive	Negative	Total
Positive	41.2%	2.1%	43.3%
Negative	16.0%	40.7%	56.7%
Total	57.2%	42.8%	100%

p<0.001

From Table 7, we can see that, the proportion of lonely participants was different since the beginning of COVID-19 than 2 weeks before COVID-19 ($p<0.001$) as recalled by the participants.

Table 8: Difference in anxiety 2 weeks before COVID-19 and since the beginning of COVID-19 (n=890)

Symptoms of Anxiety 2 weeks Before COVID-19	**Symptoms of Anxiety Since the Beginning of COVID-19**		
	Positive	Negative	Total
Positive	31.7%	1.7%	33.4%
Negative	37.0%	29.6%	66.6%
Total	68.7%	31.3%	100%

p<0.001

Again, the McNemar test from Table 8 shows that, the proportion of participants who were experiencing mild to severe anxiety are different since the beginning of COVID-19 than 2 weeks before the pandemic ($p<0.001$) as recalled.

Table 9: Difference in wellbeing 2 weeks before COVID-19 and since the onset of COVID-19 (n=890).

Impaired wellbeing 2 weeks before COVID-19	**Impaired wellbeing since the onset of COVID-19**		
	Positive	Negative	Total
Positive	39.8%	2.5%	42.3%
Negative	39.7%	18.0%	57.7%
Total	79.5%	20.5%	100%

p<0.001

The results from this Table 9 also represents that the proportion of respondents who were facing impaired wellbeing were different since the beginning of COVID-19 than 2 weeks before the pandemic ($p<0.001$).

3.3.2 Associated factors that influence participants' loneliness, anxiety, and well-being before and during COVID-19.

At first chi-squared test was done to see the association between the constructs and independent variables (demographic variables and COVID-19 related questions) among the participants. The variables that have a p-value less than 0.2 in the bivariate analysis were considered potential covariates for developing a final multivariable logistic regression.

Table 10: Association (chi-squared test) between loneliness with demographic variables and COVID-19 related questions among the participants (Percentages are prevalence of loneliness within categories).

	Loneliness			
	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
Variables	**%**	**p-value**	**%**	**p-value**
Location				
Rural	35.4	0.03	55.3	0.73
Urban	45.8		57.8	
Prefer not to say	42.9		57.1	
Age in years				
Less than 25	46.2	0.05	61.0	0.001
25-44	37.5		49.5	
More than 45	31.3		37.5	
Prefer not to say	50.0		75.0	
Sex				
Female	49.7	0.001	64.3	<0.001
Male	37.4		50.6	
Prefer not to say	50.0		58.3	
Current relationship status				
Single	45.7	0.001	60.6	<0.001
Married	30.8		40.2	
Widowed/Separated/Divorced	66.7		91.7	
Prefer not to say	66.7		66.7	
Number of children				
No children	44.3	0.18	58.8	0.04
One	39.1		56.5	
Two	34.1		40.9	
More than two	32.3		38.7	
Prefer not to say	66.7		66.7	
Highest level of education				
Secondary or below	40.3	0.60	50.7	0.12
Diploma/Certificate/Degree	40.1		60.5	
Graduation	45.0		59.4	
Post-graduation	41.7		49.7	
Prefer not to say	55.6		66.7	
Occupation				
Unemployed	49.5	0.43	57.9	0.04
Employed	39.4		47.4	
Student	43.4		59.8	
Prefer not to say	45.5		63.6	
Socioeconomic Status				

Variables	Loneliness			
	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
	%	p-value	%	p-value
Low income	49.0		61.3	
Lower Middle income	41.1	0.40	55.5	0.63
Higher middle income	43.2		57.8	
High income	45.5		54.6	
Himself/ Herself infected by the COVID-19				
No	42.3		57.3	
Yes	48.0	0.32	48.0	0.62
Not sure	49.6		58.6	
Household member infected by COVID-19				
No	41.9		57.5	
Yes	46.4	0.12	57.3	0.82
Not sure	55.0		53.3	
Close friend or relative infected by COVID-19				
No	39.5		55.9	
Yes	46.8	0.07	58.7	0.71
Not sure	49.1		56.1	
Close friend or relatives died from COVID-19 symptoms				
No	41.4		55.6	
Yes	47.7		62.5	
Not sure	67.6	0.004	70.3	0.09
Concern about health of own and family				
Not at all concerned	37.0		40.7	
Somewhat concerned	40.7	0.60	53.2	0.09
Moderately concerned	44.9		60.0	
Extremely concerned	45.1		60.0	
Presence of a pre-existing disease or condition that can aggravate symptoms if infected by				
No	42.4		54.5	
Yes	43.8	0.63	64.0	0.07
Not sure	46.8		59.6	
Concerned about supporting family financially				
No	43.7		59.6	
Yes	41.5	0.47	54.0	0.28
Not sure	47.9		58.1	
Feeling difficulties to avoid COVID-19 related news from media (electronic/print/social)				
Easy	49.7		54.4	

Variables	Loneliness			
	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
	%	p-value	%	p-value
Neither easy nor difficult	45.5	0.006	60.6	0.10
Difficult	35.4		52.9	
How their lives have changed during COVID-19				
Better	46.2	0.59	46.2	0.001
About the same	40.1		47.5	
Worse	44.0		61.0	
How well COVID situation is controlled in Bangladesh				
Well controlled	36.7	0.07	50.3	0.05
Neutral	43.9		61.5	
Not well controlled	46.2		58.5	
How well they are coping with COVID-19				
Well	39.3	0.03	45.9	<0.001
Average	42.0		56.2	
Not well	53.2		72.0	
Activities at home since COVID-19 arrived				
Watching TV				
Less than before Covid-19	43.1	0.05	59.8	0.48
Same as before Covid-19	46.5		54.1	
More than before Covid-19	36.6		59.4	
Prefer not to say	50.6		57.1	
Internet Use				
Less than before Covid-19	35.4	0.70	45.8	0.002
Same as before Covid-19	42.9		47.4	
More than before Covid-19	44.0		61.2	
Prefer not to say	46.2		46.2	
Social Media Use				
Less than before Covid-19	38.6	0.39	50.6	<0.001
Same as before Covid-19	39.6		48.0	
More than before Covid-19	45.5		62.5	
Prefer not to say	42.5		42.5	
Work from Home				
Less than before Covid-19	41.2	0.54	60.1	0.11
Same as before Covid-19	41.2		51.3	
More than before Covid-19	44.3		56.2	
Prefer not to say	47.4		62.1	
Household Chores				

	Loneliness			
	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
Variables	**%**	**p-value**	**%**	**p-value**
Less than before Covid-19	41.6		55.8	
Same as before Covid-19	45.5	0.75	56.9	0.99
More than before Covid-19	41.8		57.7	
Prefer not to say	45.6		56.7	
Sports				
Less than before Covid-19	44.0		60.0	
Same as before Covid-19	43.0	0.71	54.8	0.47
More than before Covid-19	40.7		54.2	
Prefer not to say	48.6		58.6	
Talking with friends and family members				
Less than before Covid-19	49.0		62.9	
Same as before Covid-19	43.4	0.10	54.1	0.15
More than before Covid-19	40.1		57.0	
Prefer not to say	59.3		70.4	
Praying				
Less than before Covid-19	55.6		63.9	
Same as before Covid-19	44.2	0.04	59.0	0.28
More than before Covid-19	40.0		54.2	
Prefer not to say	58.3		64.6	
Resting				
Less than before Covid-19	49.1		58.5	
Same as before Covid-19	42.1	0.58	50.8	0.28
More than before Covid-19	42.9		58.8	
Prefer not to say	55.6		61.1	
Sleeping				
Less than before Covid-19	59.3		74.4	
Same as before Covid-19	36.5	0.002	47.7	<0.001
More than before Covid-19	43.9		60.0	
Prefer not to say	57.1		64.3	

Age and number of children of the participants were not significantly associated with loneliness but were included in the model for before COVID-19 because of their association with loneliness. While checking for confounders, no variable showed more than 10% change in the OR for both models. No variables in the model showed high correlation with any other variable.

Table 11: Multivariable logistic regression analysis of loneliness two weeks before pandemic and since the beginning of pandemic with demographic variables and COVID-19 related questions.

	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
Variables	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**
Location				
Rural	Reference			
Urban	1.5 (1.1, 2.2)	0.02		
Prefer not to say	0.8 (0.2, 3.3)	0.81		
Age in years				
Less than 25	Reference		Reference	
25-44	0.8 (0.5, 1.2)	0.28	0.6 (0.3, 1.1)	0.09
More than 45	0.5 (0.2, 1.6)	0.25	0.2 (0.1, 0.8)	0.02
Prefer not to say	0.4 (0.04, 4.2)	0.47	2.3 (0.2, 21.5)	0.47
Sex				
Female	Reference		Reference	
Male	0.6 (0.5, 0.8)	0.002	0.6 (0.5, 0.9)	0.003
Prefer not to say	0.4 (0.1, 2.2)	0.33	0.5 (0.1, 2.3)	0.34
Current relationship status				
Single	Reference		Reference	
Married	0.5 (0.2, 0.9)	0.02	0.4 (0.2, 0.7)	0.003
Widowed/Separated/Divorced	3.1 (0.6, 15.3)	0.16	19.2 (1.6, 223.9)	0.02
Prefer not to say	3.8 (0.5, 26.3)	0.18	1.1 (0.1, 8.8)	0.93
Number of children				
No children	Reference		Reference	
One	1.5 (0.7, 3.6)	0.32	2.1 (0.9, 5.2)	0.09
Two	1.9 (0.7, 5.2)	0.20	2.3 (0.8, 6.2)	0.12
More than two	1.6 (0.5, 4.8)	0.44	1.6 (0.5, 5.1)	0.46
Prefer not to say	2.6 (0.6, 11.4)	0.22	1.0 (0.2, 4.2)	0.95
Occupation				
Unemployed			Reference	
Employed			1.4 (0.7, 2.6)	0.35
Student			0.8 (0.4, 1.3)	0.34
Prefer not to say			1.3 (0.2, 7.8)	0.79
Household member infected by COVID-19				
No	Reference			
Yes	1.0 (0.6, 1.6)	0.93		
Not sure	1.3 (0.7, 2.5)	0.36		
Close friend or relative infected by COVID-19				
No	Reference			

Variables	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Yes	1.2 (0.9, 1.6)	0.32		
Not sure	0.8 (0.4, 1.7)	0.60		
Close friend or relative died from COVID-19 symptoms				
No	Reference		Reference	
Yes	1.1 (0.7, 1.8)	0.57	1.4 (0.9, 2.2)	0.10
Not sure	2.3 (1.0, 5.4)	0.05	2.1 (0.9, 4.8)	0.09
Concern about health of own and family members				
Not at all concerned			Reference	
Somewhat concerned			1.7 (0.6, 4.3)	0.29
Moderately concerned			1.9 (0.7, 5.0)	0.19
Extremely concerned			1.6 (0.6, 4.4)	0.32
Presence of a pre-existing disease or condition that can aggravate symptoms if infected by COVID-				
No			Reference	
Yes			1.5 (1.03, 2.3)	0.04
Not sure			1.1 (0.7, 1.7)	0.74
Feeling difficulties to avoid COVID-19 related news from media (electronic/print/social)				
Easy	Reference		Reference	
Neither easy nor difficult	0.8 (0.6, 1.2)	0.40	1.2 (0.8, 1.8)	0.42
Difficult	0.7 (0.4, 1.0)	0.07	0.9 (0.5, 1.4)	0.52
How their lives have changed during COVID-19				
Better			Reference	
About the same			1.0 (0.5, 1.9)	0.94
Worse			1.8 (1.0, 3.2)	0.05
How well COVID situation is controlled in Bangladesh				
Well controlled	Reference		Reference	
Neutral	1.3 (0.8, 2.0)	0.27	1.7 (1.1, 2.7)	0.01
Not well controlled	1.5 (1.04, 2.1)	0.03	1.3 (0.9, 1.9)	0.16
How well they are coping with COVID-19				
Well	Reference		Reference	
Average	1.1 (0.7, 1.7)	0.66	1.1 (0.7, 1.6)	0.74

Variables	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Not well	1.5 (0.9, 2.5)	0.12	2.0 (1.1, 3.4)	0.02
Activities at home since COVID-19 arrived				
Watching TV				
Less than before Covid-19	Reference			
Same as before Covid-19	1.3 (0.9, 1.9)	0.18		
More than before Covid-19	0.8 (0.6, 1.3)	0.41		
Prefer not to say	1.3 (0.7, 2.2)	0.40		
Internet Use				
Less than before Covid-19			Reference	
Same as before Covid-19			1.3 (0.6, 2.8)	0.53
More than before Covid-19			1.3 (0.6, 2.7)	0.56
Prefer not to say			1.3 (0.3, 6.1)	0.78
Social Media Use				
Less than before Covid-19			Reference	
Same as before Covid-19			0.9 (0.5, 1.7)	0.73
More than before Covid-19			1.4 (0.7, 2.6)	0.30
Prefer not to say			0.5 (0.1, 1.6)	0.24
Talking with friends and family members				
Less than before Covid-19	Reference		Reference	
Same as before Covid-19	0.8 (0.5, 1.3)	0.37	0.8 (0.5, 1.3)	0.40
More than before Covid-19	0.8 (0.5, 1.2)	0.24	0.8 (0.5, 1.3)	0.45
Prefer not to say	0.9 (0.3, 2.5)	0.82	1.3 (0.4, 4.3)	0.62
Praying				
Less than before Covid-19	Reference			
Same as before Covid-19	0.8 (0.4, 1.6)	0.50		
More than before Covid-19	0.7 (0.3, 1.5)	0.33		
Prefer not to say	1.3 (0.5, 3.5)	0.62		
Sleeping				
Less than before Covid-19	Reference		Reference	
Same as before Covid-19	0.4 (0.2, 0.7)	0.001	0.3 (0.2, 0.6)	<0.001
More than before Covid-19	0.5 (0.3, 0.9)	0.02	0.4 (0.2, 0.7)	0.002
Prefer not to say	0.5 (0.1, 2.2)	0.35	0.7 (0.1, 3.3)	0.65

From the multivariable logistic regression analysis in Table 11, we can see that, during the period of 2 weeks before COVID-19 in Bangladesh, urban population had 1.5 times higher odds

of being lonely than the rural population (95% CI: 1.1, 2.2, p=0.02) (as recalled). The male participants had 40% lower odds of being lonely than their female counterparts (95% CI: 0.5, 0.8, p=0.002). After adjusting for all other variables, married participants showed lower odds of being lonely. Compared to single participants, those who were married had 0.5 times the odds of being lonely (95% CI: 0.2, 0.9, p=0.02). Those who were either widowed/separated/divorced had 3.1 times higher odds of being lonely (95% CI: 0.6, 15.3, p=0.16) than those who were single. Those who identified it difficult to avoid COVID-19 related news from media (electronic/print/social) during COVID-19 had 0.7 times the odds of being lonely before COVID-19 than those who identified it as easy (95% CI: 0.4, 1.0, p=0.07). The participants who experienced more sleep during COVID-19 had 0.5 times the odds of being lonely than those who experienced less sleep before COVID-19 appeared in Bangladesh (95% CI: 0.3, 0.9, p=0.02).

From the multivariable logistic regression analysis (Table 11) of the participants' loneliness since the beginning of COVID-19 crisis, we can see that loneliness showed a decreasing trend with the increase of age. Those who were aged between 25-44 years had 40% decreased odds of being lonely (95% CI: 0.3, 1.1 p=0.09) but the association was not statistically significant. Respondents who were more than 45 years of age had 80% decreased odds of being lonely than those who were less than 25 years (95% CI: 0.1, 0.8 p=0.02). Moreover, during the pandemic, male participants still had the lower odds of being lonely than their female counterparts (OR: 0.6, 95% CI: 0.5, 0.9, p=0.003). The married participants also showed lower odds of being lonely than the participants who were single (OR: 0.4, 95% CI: 0.2, 0.7, p=0.003). Even though the participants who were widowed/separated/divorced had 19.2 times the odds of being lonely than

those who were single (95% CI: 1.6, 223.9 , p=0.02), the 95% CI is larger due to small sample size in this group, and high prevalence of loneliness 91.7% (11 out of 12).

The respondents who were employed during the period of pandemic had 1.4 times the odds of being lonely than the unemployed participants (95% CI: 0.7, 2.6, p=0.35). But the association was not statistically significant. Those who had a pre-existing disease or condition that can aggravate the symptoms of COVID-19 had 50% higher odds of being lonely than those who did not have any comorbidities (95%CI: 1.03, 2.3, p=0.04). Respondents who perceived that they were not coping well with COVID-19 situation had 2.0 times the odds of being lonely that those who were coping well (95% CI: 1.1, 3.4, p=0.02). Participants who used social media more in the pandemic showed 40% higher odds of being lonely (95% CI: 0.7, 2.6, p=0.30) than those who were using social media less than before without a statistically significant association. Change in sleep pattern of the participants showed that those who were having sleep same as before the pandemic and those who were having more sleep in the same period had almost similar odds of being lonely, 0.3 and 0.4 respectively (95% CI: 0.2, 0.6, p<0.001 and 95% CI: 0.2, 0.7, p=0.002).

3.3.3 Associated factors that influence participants' anxiety two weeks before and since the onset of COVID-19.

At first chi-squared test was done to see the association between anxiety and independent variables (demographic variables and COVID-19 related questions) among the participants. The variables that have a p-value less than 0.2 in the bivariate analysis were considered potential covariates for developing a final multivariable logistic regression.

Table 12: Association (chi-squared test) between mild to severe anxiety with demographic variables and COVID-19 related questions among the participants (Percentages are prevalence of mild to severe anxiety within categories).

	Anxiety			
	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
Variables	**%**	**p-value**	**%**	**p-value**
Location				
Rural	33.5	0.93	70.1	0.51
Urban	33.4		68.4	
Prefer not to say	28.6		57.1	
Age in years				
Less than 25	32.8	0.90	69.3	0.44
25-44	34.1		69.2	
More than 45	37.5		58.3	
Prefer not to say	37.5		75.0	
Sex				
Female	34.3	0.43	73.5	0.01
Male	33.0		64.6	
Prefer not to say	16.7		58.3	
Current relationship status				
Single	33.9	0.90	70.0	0.26
Married	32.0		65.1	
Widowed/Separated/Divorced	25.0		66.7	
Prefer not to say	33.3		44.4	
Number of children				
No children	33.4	0.81	69.8	0.44
One	34.8		69.8	
Two	34.1		61.4	
More than two	35.5		58.1	
Prefer not to say	16.7		58.3	
Highest level of education				
Secondary or below	39.0	0.60	67.5	0.93
Diploma/Certificate/Degree	32.9		71.1	
Graduation	31.5		67.7	
Post-graduation	36.8		69.9	
Prefer not to say	33.30		72.2	
Occupation				
Unemployed	43.9	0.04	74.8	0.05
Employed	35.4		62.9	
Student	31.2		69.9	
Prefer not to say	18.2		45.5	

	Anxiety			
	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
Variables	**%**	**p-value**	**%**	**p-value**
Socioeconomic Status				
Low income	34.8		65.8	
Lower Middle income	33.2	0.93	69.1	0.76
Higher middle income	32.4		7.04	
High income	36.4		65.9	
Himself/ Herself infected by the COVID-19				
No	34.0		69.9	
Yes	40.0	0.35	64.0	0.23
Not sure	27.9		62.2	
Household member infected by COVID-19				
No	33.6		69.4	
Yes	35.5	0.49	70.0	0.20
Not sure	26.7		58.3	
Close friend or relative infected by COVID-19				
No	32.7		68.5	
Yes	33.9	0.89	70.6	0.15
Not sure	35.1		57.9	
Close friend or relative died from COVID-19 symptoms				
No	32.8		68.3	
Yes	34.4		71.9	0.71
Not sure	40.5	0.60	67.6	
Concern about health of own and family				
Not at all concerned	18.5		29.6	
Somewhat concerned	29.9	0.06	57.6	<0.001
Moderately concerned	33.9		74.5	
Extremely concerned	39.4		78.8	
Presence of a pre-existing disease or condition that can aggravate symptoms if infected by				
No	31.0		65.9	
Yes	36.0	0.10	78.1	0.009
Not sure	39.7		68.8	
Concerned about supporting family financially				
No	32.3		73.9	
Yes	35.8	0.41	64.2	0.008
Not sure	29.9		64.1	
Feeling difficulties to avoid COVID-19 related news from media (electronic/print/social)				

	Anxiety			
	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
Variables	**%**	**p-value**	**%**	**p-value**
Easy	29.8	0.18	53.2	<0.001
Neither easy nor difficult	32.3		70.1	
Difficult	37.7		76.7	
How their lives have changed during COVID-19				
Better	35.4	0.35	50.8	<0.001
About the same	28.8		50.9	
Worse	34.4		75.5	
How well COVID situation is controlled in Bangladesh				
Well controlled	31.6	0.51	67.9	0.01
Neutral	31.2		61.0	
Not well controlled	35.1		72.6	
How well they are coping with COVID-19				
Well	28.9	0.29	51.9	<0.001
Average	33.3		69.8	
Not well	37.8		80.4	
Activities at home since COVID-19 arrived				
Watching TV				
Less than before Covid-19	27.5	0.05	67.2	0.001
Same as before Covid-19	37.6		64.5	
More than before Covid-19	30.5		78.7	
Prefer not to say	38.5		61.5	
Internet Use				
Less than before Covid-19	27.1	0.79	64.6	0.001
Same as before Covid-19	34.3		57.1	
More than before Covid-19	33.7		72.7	
Prefer not to say	30.8		57.7	
Social Media Use				
Less than before Covid-19	32.5	0.80	60.2	<0.001
Same as before Covid-19	31.2		58.9	
More than before Covid-19	34.5		74.5	
Prefer not to say	30.0		55.0	
Work from Home				
Less than before Covid-19	34.7	0.20	79.0	<0.001
Same as before Covid-19	31.6		59.2	
More than before Covid-19	37.7		68.4	

	Anxiety			
	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
Variables	**%**	**p-value**	**%**	**p-value**
Prefer not to say	28.4		68.4	
Household Chores				
Less than before Covid-19	32.5		79.2	
Same as before Covid-19	32.6	0.98	63.9	0.002
More than before Covid-19	34.0		72.4	
Prefer not to say	33.3		57.8	
Sports				
Less than before Covid-19	36.1		77.1	
Same as before Covid-19	29.7	0.28	60.1	<0.001
More than before Covid-19	35.0		66.7	
Prefer not to say	28.6		61.4	
Talking with friends and family members				
Less than before Covid-19	35.0		76.2	
Same as before Covid-19	25.1	<0.001	58.4	<0.001
More than before Covid-19	40.1		75.4	
Prefer not to say	37.0		70.4	
Praying				
Less than before Covid-19	41.7		75.0	
Same as before Covid-19	33.0	0.44	66.0	0.03
More than before Covid-19	34.0		72.3	
Prefer not to say	25.0		54.2	
Resting				
Less than before Covid-19	32.1		69.8	
Same as before Covid-19	33.3	0.78	57.9	<0.001
More than before Covid-19	33.8		72.5	
Prefer not to say	22.2		44.4	
Sleeping				
Less than before Covid-19	44.2		77.9	
Same as before Covid-19	26.7	0.009	56.8	<0.001
More than before Covid-19	35.3		73.6	
Prefer not to say	21.4		57.1	

Two weeks before COVID-19 crisis, age and sex of the participants were not significantly associated with anxiety in the bivariate analysis (Table 12) but were included in the final model because of their previously found association with anxiety [13]. Relationship status of the

participants was identified as a confounder so it was added in the final model. During the pandemic period, age of the participants was not associated with anxiety in the bivariate analysis but was included in the final model because of its previously found association with anxiety [13]. Relationship status of the respondents was again found to be a confounder in during COVID-19 model, so it was included in the final model. No variables in the model showed high correlation with any other variable.

Table 13: Multivariable logistic regression analysis of anxiety two weeks before COVID-19 and since the onset of pandemic with demographic variables and COVID-19 related questions.

	Two weeks before COVID-19 crisis (as recalled)		**Since the beginning of COVID-19 crisis**	
Variables	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-**
Age in years				
Less than 25	Reference		Reference	
25-44	0.9 (0.5, 1.7)	0.85	1.2 (0.6, 2.3)	0.61
More than 45	1.4 (0.6, 3.7)	0.45	0.7 (0.2, 2.0)	0.51
Prefer not to say	2.2 (0.2, 18.9)	0.48	29.0 (0.8,	0.06
Sex				
Female	Reference		Reference	
Male	0.9 (0.7, 1.3)	0.60	0.7 (0.5, 0.9)	0.04
Prefer not to say	0.3 (0.03, 2.2)	0.21	1.2 (0.1, 9.2)	0.50
Current relationship status				
Single	Reference		Reference	
Married	0.5 (0.3, 0.8)	0.009	0.9 (0.5, 1.7)	0.70
Widowed/Separated/Divorced	0.3 (0.1, 1.4)	0.13	1.5 (0.3, 8.7)	0.66
Prefer not to say	1.1 (0.1, 10.0)	0.92	0.1 (0.0, 0.8)	0.04
Occupation				
Unemployed	Reference		Reference	
Employed	0.9 (0.5, 1.6)	0.73	0.6 (0.3, 1.2)	0.17
Student	0.4 (0.2, 0.7)	0.001	0.6 (0.3, 1.1)	0.10
Prefer not to say	0.3 (0.03, 2.2)	0.23	0.3 (0.04, 1.6)	0.15
Close friend or relative infected by COVID-19				
No			Reference	
Yes			1.0 (0.7, 1.4)	0.93
Not sure			0.9 (0.4, 1.9)	0.80

Variables	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
	OR (95% CI)	p-value	OR (95% CI)	p-
Concern about health of own and family members				
Not at all concerned	Reference		Reference	
Somewhat concerned	2.1 (0.7, 6.1)	0.16	3.5 (1.2, 9.7)	0.02
Moderately concerned	2.3 (0.8, 6.7)	0.11	4.9 (1.7, 13.7)	0.003
Extremely concerned	2.5 (0.9, 7.4)	0.09	5.7 (2.0, 16.6)	0.001
Presence of a pre-existing disease or condition that can aggravate symptoms if infected by COVID-				
No	Reference		Reference	
Yes	1.1 (0.7, 1.6)	0.68	1.7 (1.04, 2.7)	0.03
Not sure	1.5 (0.9, 2.3)	0.051	1.4 (0.9, 2.3)	0.18
Concerned about supporting family financially				
No			Reference	
Yes			0.7 (0.4, 0.9)	0.03
Not sure			0.6 (0.4, 1.1)	0.10
Feeling difficulties to avoid COVID-19 related news from media (electronic/print/social)				
Easy	Reference		Reference	
Neither easy or difficult	1.1 (0.8, 1.7)	0.56	1.9 (1.3, 3.0)	0.003
Difficult	1.6 (1.0, 2.5)	0.06	2.4 (1.4, 4.1)	0.001
How their lives have changed during COVID-19				
Better			Reference	
About the same			1.1 (0.6, 2.3)	0.70
Worse			2.3 (1.2, 4.3)	0.009
How well COVID situation is controlled in Bangladesh				
Well controlled			Reference	
Neutral			0.8 (0.5, 1.3)	0.45
Not well controlled			1.1 (0.7, 1.6)	0.72
How well they are coping with COVID-19				
Well			Reference	
Average			1.6 (1.0, 2.5)	0.06
Not well			2.7 (1.4, 5.2)	0.003

Variables	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
	OR (95% CI)	p-value	OR (95% CI)	p-
Activities at home since COVID-19 arrived				
Watching TV				
Less than before Covid-19	Reference		Reference	
Same as before Covid-19	1.8 (1.2, 2.7)	0.004	1.0 (0.7, 1.6)	0.84
More than before Covid-19	1.0 (0.7, 1.6)	0.92	1.3 (0.8, 2.2)	0.26
Prefer not to say	1.9 (1.1, 3.5)	0.02	0.8 (0.4, 1.6)	0.60
Internet Use				
Less than before Covid-19			Reference	
Same as before Covid-19			0.6 (0.3, 1.5)	0.28
More than before Covid-19			0.4 (0.2, 1.0)	0.06
Prefer not to say			0.7 (0.1, 4.1)	0.72
Social Media Use				
Less than before Covid-19			Reference	
Same as before Covid-19			1.8 (0.9, 3.6)	0.10
More than before Covid-19			3.1 (1.5, 6.2)	0.002
Prefer not to say			1.8 (0.5, 6.9)	0.38
Work from Home				
Less than before Covid-19			Reference	
Same as before Covid-19			0.6 (0.3, 0.9)	0.04
More than before Covid-19			0.7 (0.4, 1.1)	0.12
Prefer not to say			0.8 (0.5, 1.4)	0.49
Household Chores				
Less than before Covid-19			Reference	
Same as before Covid-19			0.9 (0.4, 1.9)	0.75
More than before Covid-19			1.0 (0.5,2.1)	0.90
Prefer not to say			0.7 (0.3, 1.7)	0.39
Sports				
Less than before Covid-19			Reference	
Same as before Covid-19			0.7 (0.4, 1.0)	0.06
More than before Covid-19			0.7 (0.5, 1.2)	0.20
Prefer not to say			0.7 (0.3, 1.5)	0.41
Talking with friends and family members				
Less than before Covid-19	Reference		Reference	
Same as before Covid-19	0.6 (0.4, 0.9)	0.02	0.5 (0.3, 0.9)	0.01
More than before Covid-19	1.3 (0.8, 2.0)	0.24	1.1 (0.6, 1.8)	0.80
Prefer not to say	1.1 (0.4, 3.3)	0.81	2.0 (0.5, 7.9)	0.34
Praying				

Variables	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
	OR (95% CI)	p-value	OR (95% CI)	p-
Less than before Covid-19			Reference	
Same as before Covid-19			0.6 (0.2, 1.5)	0.23
More than before Covid-19			0.6 (0.2, 1.6)	0.30
Prefer not to say			0.4 (0.1, 1.4)	0.14
Resting				
Less than before Covid-19			Reference	
Same as before Covid-19			1.3 (0.5, 3.1)	0.58
More than before Covid-19			1.1 (0.5, 2.5)	0.85
Prefer not to say			0.5 (0.1, 2.7)	0.38
Sleeping				
Less than before Covid-19	Reference		Reference	
Same as before Covid-19	0.4 (0.3, 0.7)	0.002	0.5 (0.3, 1.1)	0.08
More than before Covid-19	0.7 (0.4, 1.1)	0.10	0.8 (0.4, 1.7)	0.63
Prefer not to say	0.3 (0.1, 1.4)	0.12	1.4 (0.2, 11.2)	0.78

From the multivariable logistic regression analysis in Table 13, we can see that during the period of two weeks before COVID-19, there was no statistically significant difference between the level of anxiety (as recalled) between male and female participants (OR 0.9, 95%CI: 0.7, 1.3, p=0.60). Married participants had 0.5 times the odds of reporting anxiety than those who were single (95%CI: 0.3, 0.8, p=0.009). Participants who were student had lower odds of reporting mild to severe anxiety than those who were unemployed (OR 0.4, 95%CI: 0.2, 0.7, p=0.001). Participants with comorbidities had 50% higher odds of reporting mild to severe anxiety (95%CI: >1.0, 2.3, p=0.05) before COVID-19. Those who continued to watch TV same as before COVID-19 had 1.8 times the odds of reporting anxiety (95%CI: 1.2, 2.7, p=0.004) comparing to those who were watching less prior to the pandemic. Respondents who were able to keep in touch with their friends and family members during COVID-19 had lower odds for anxiety than those who could not (OR: 0.6, 95%CI: 0.4, 0.9, p=0.02) before the pandemic started.

From the multivariable logistic regression analysis in Table 13, we can see that over the period since the onset of COVID-19, male participants had 30% lower odds of reporting anxiety than their female counterparts (95%CI: 0.5, 0.9, p=0.04). Respondents who were somewhat concerned (OR: 3.5, 95%CI: 1.2, 9.7, p=0.02), moderately concerned (OR: 4.9, 95%CI: 1.7, 13.7, p=0.003), and extremely concerned (OR: 5.7, 95%CI: 2.0, 16.6, p-value 0.001) about the health of themselves and their family members during the pandemic showed higher odds of anxiety than those who were not concerned at all. Moreover, the participants who were suffering from any other disease or conditions that could aggravate the symptoms of COVID-19 had 70% higher odds of reporting anxiety than those who did not have any type of comorbidities (95%CI: 1.04, 2.7, p=0.03). However, those who were concerned about supporting family during the pandemic, showed lower odds of reporting anxiety than those who were not concerned (OR: 0.7, 95%CI: 0.4, 0.9, p=0.03).

The respondents who felt difficulties to avoid COVID-19 related news from electronic/print/ social media had 2.4 times the odds of having anxiety than those who found it easy (95%CI: 1.4, 4.1, p=0.001). Again, the participants who perceived that their lives have become worse since COVID-19 hit the country had 2.3 times the odds of reporting anxiety than those who found their lives being better (95%CI: 1.2, 4.3, p=0.009). Increased social media use was associated with higher level of anxiety as the participants, who identified that their social media use had higher odds of having mild to severe anxiety than those who were using social media less (OR:3.1, 95%CI: 1.5, 6.2, p=0.002). The respondents who were talking with their friends and family members same as they used to do before the pandemic had 50% less odds of reporting anxiety than those who were talking less after the pandemic hit (95%CI: 0.3, 0.9, p=0.01).

3.3.4 Associated factors that influence participants' wellbeing two weeks before and since the beginning of COVID-19 crisis in Bangladesh.

Chi-squared test was done to see the association between wellbeing and independent variables (demographic variables and COVID-19 related questions) among the participants. The variables that have a p-value less than 0.2 in the bivariate analyses were considered potential covariates for developing a final multivariable logistic regression.

Table 14: Association (chi-squared test) between impaired wellbeing with demographic variables and COVID-19 related questions among the participants (Percentages are prevalence of impaired wellbeing within categories).

	Impaired Wellbeing			
	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
Variables	**%**	**p-value**	**%**	**p-value**
Location				
Rural	41.8	0.24	82.0	0.47
Urban	41.9		79.0	
Prefer not to say	64.3		71.4	
Age in years				
Less than 25	41.9	0.56	78.6	0.01
25-44	41.4		84.6	
More than 45	47.9		66.7	
Prefer not to say	62.5		100.0	
Sex				
Female	42.3	0.22	83.2	0.04
Male	41.5		76.3	
Prefer not to say	66.7		75.0	
Current relationship status				
Single	41.7	0.04	79.7	0.28
Married	42.6		79.9	
Widowed/Separated/Divorced	33.3		58.3	
Prefer not to say	88.9		88.9	
Number of children				
No children	41.5	0.63	79.4	0.84
One	43.5		84.8	
Two	50.0		79.6	
More than two	41.9		74.2	

	Impaired Wellbeing			
	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
Variables	**%**	**p-value**	**%**	**p-value**
Prefer not to say	58.3		83.3	
Highest level of education				
Secondary or below	48.1		74.0	
Diploma/Certificate/Degree	39.5		83.6	
Graduation	40.6	0.15	79.8	0.16
Post-graduation	44.2		76.1	
Prefer not to say	66.7		94.4	
Occupation				
Unemployed	48.6		81.3	
Employed	44.6	0.14	80.0	0.90
Student	40.0		79.2	
Prefer not to say	63.6		72.7	
Socioeconomic Status				
Low income	45.8		81.3	
Lower Middle income	41.8	0.77	79.7	0.06
Higher middle income	41.5		80.8	
High income	38.6		63.6	
Himself/ Herself infected by the COVID-19				
No	41.6		79.3	
Yes	56.0	0.35	76.0	0.73
Not sure	43.2		82.0	
Household member infected by COVID-19				
No	40.8		78.8	
Yes	48.2	0.21	86.4	0.20
Not sure	48.3		76.7	
Someone from close friend or relatives infected by COVID-19				
No	40.9		79.2	
Yes	41.0	0.01	79.0	0.46
Not sure	61.4		86.0	
Someone from close friend or relatives died from COVID-19 symptoms				
No	41.0		79.0	
Yes	44.5	0.07	82.0	0.72
Not sure	59.5		81.1	
Concern about health of own and family				
Not at all concerned	48.2		59.3	
Somewhat concerned	48.2	0.08	75.6	0.005
Moderately concerned	39.3		83.2	

	Impaired Wellbeing			
	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
Variables	**%**	**p-value**	**%**	**p-value**
Extremely concerned	38.9		80.8	
Presence of a pre-existing disease or condition that can aggravate symptoms if infected by				
No	40.1	0.15	77.6	0.15
Yes	43.8		83.2	
Not sure	48.9		83.0	
Concerned about supporting family financially				
No	41.3	0.74	83.1	0.02
Yes	42.3		75.0	
Not sure	45.3		80.3	
Feeling difficulties to avoid COVID-19 related news from media (electronic/print/social)				
Easy	46.2	0.51	66.1	<0.001
Neither easy nor difficult	41.3		82.9	
Difficult	41.3		82.5	
How their lives have changed during COVID-19				
Better	53.9	0.009	58.5	<0.001
About the same	49.2		73.5	
Worse	39.2		83.3	
How well COVID situation is controlled in Bangladesh				
Well controlled	40.0	0.60	74.4	0.08
Neutral	44.9		79.5	
Not well controlled	42.1		81.9	
How well they are coping with COVID-19				
Well	32.6	0.004	63.7	<0.001
Average	42.0		80.4	
Not well	52.5		90.9	
Activities at home since COVID-19 arrived				
Watching TV				
Less than before Covid-19	43.1	0.02	79.9	0.76
Same as before Covid-19	46.0		78.6	
More than before Covid-19	34.1		81.5	
Prefer not to say	48.4		76.9	
Internet Use				
Less than before Covid-19	45.8		81.3	

	Impaired Wellbeing			
	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
Variables	**%**	**p-value**	**%**	**p-value**
Same as before Covid-19	46.3		70.9	0.01
More than before Covid-19	40.4	0.29	82.1	
Prefer not to say	53.9		73.1	
Social Media Use				
Less than before Covid-19	47.0		73.5	
Same as before Covid-19	41.6	0.27	73.8	0.02
More than before Covid-19	40.9		82.8	
Prefer not to say	55.0		75.0	
Work from Home				
Less than before Covid-19	44.7		88.2	
Same as before Covid-19	45.6	0.34	79.4	<0.001
More than before Covid-19	38.9		70.9	
Prefer not to say	39.5		80.5	
Household Chores				
Less than before Covid-19	44.2		89.6	
Same as before Covid-19	42.0	0.98	80.2	0.11
More than before Covid-19	41.8		77.5	
Prefer not to say	43.3		78.9	
Sports				
Less than before Covid-19	39.0		80.8	
Same as before Covid-19	42.6	0.27	80.2	0.48
More than before Covid-19	46.9		78.5	
Prefer not to say	47.1		72.9	
Talking with friends and family members				
Less than before Covid-19	40.6		79.0	
Same as before Covid-19	43.1	0.06	80.4	0.88
More than before Covid-19	40.4		79.4	
Prefer not to say	66.7		74.1	
Praying				
Less than before Covid-19	52.8		66.7	
Same as before Covid-19	42.6	0.14	83.0	0.02
More than before Covid-19	39.8		78.8	
Prefer not to say	54.2		68.8	
Resting				
Less than before Covid-19	41.5		77.4	
Same as before Covid-19	48.1	0.04	81.4	0.76
More than before Covid-19	39.9		79.4	
Prefer not to say	66.7		72.2	
Sleeping				

	Impaired Wellbeing			
	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
Variables	**%**	**p-value**	**%**	**p-value**
Less than before Covid-19	51.2		84.9	
Same as before Covid-19	37.6	0.04	75.9	0.10
More than before Covid-19	42.6		80.9	
Prefer not to say	64.3		64.3	

Two weeks before COVID-19, age and sex of the participants were not significantly associated with wellbeing in the bivariate analysis but were included in the final model because of their previously found association with wellbeing [14]. While checking for confounding, no variable which was dropped from the final model showed significant change (more than 10%) in the OR for before COVID-19 model. While checking for confounders in the during COVID-19 model, occupation of the participants changed the OR of the variable age groups of the participants more than 10%. So, the variable was included in the final model to adjust its effect. No variables in the models showed high correlation with any other variable.

Table 15: Multivariable logistic regression analysis of wellbeing 2 weeks before COVID-19 and since the onset of the pandemic with demographic variables and COVID-19 related questions.

	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
Variables	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**
Age in years				
Less than 25	Reference		Reference	
25-44	0.7 (0.4, 1.2)	0.19	2.7 (1.2, 5.6)	0.01
More than 45	1.0 (0.4, 2.6)	0.99	0.7 (0.2, 1.9)	0.46
Prefer not to say	0.3 (0.02, 3.5)	0.32	Small n	-
Sex				
Female	Reference		Reference	
Male	1.0 (0.7, 1.3)	0.74	0.7 (0.4, 1.0)	0.05
Prefer not to say	0.8 (0.1, 4.6)	0.80	0.2 (0.02, 1.1)	0.06

Variables	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Current relationship status				
Single	Reference			
Married	0.8 (0.4, 1.3)	0.34		
Widowed/Separated/Divorc	0.3 (0.1, 1.4)	0.14		
Prefer not to say	19.2 (1.1,	0.04		
Highest level of education				
Secondary or below	Reference		Reference	
Diploma/Certificate/Degree	0.6 (0.3, 1.1)	0.10	1.7 (0.8, 3.8)	0.16
Graduation	0.6 (0.4, 1.1)	0.08	1.0 (0.5, 2.0)	0.95
Post-graduation	0.9 (0.5, 1.7)	0.71	0.6 (0.3, 1.4)	0.24
Prefer not to say	1.4 (0.4, 4.7)	0.61	10.1 (0.6,	0.10
Occupation				
Unemployed	Reference		Reference	
Employed	1.1 (0.6, 2.1)	0.64	1.6 (0.7, 3.4)	0.26
Student	0.6 (0.4, 1.0)	0.07	0.9 (0.4, 1.8)	0.74
Prefer not to say	0.5 (0.1, 3.2)	0.50	0.2 (0.02, 1.0)	0.049
Socioeconomic Status				
Low income			Reference	
Lower Middle income			0.8 (0.5, 1.4)	0.42
Higher middle income			1.1 (0.6, 2.1)	0.74
High income			0.6 (0.2, 1.4)	0.23
Someone from close friend or relatives infected by COVID-19				
No	Reference			
Yes	1.0 (0.7, 1.3)	0.78		
Not sure	2.0 (1.0, 3.8)	0.048		
Someone from close friend or relatives died from COVID-19				
No	Reference			
Yes	1.1 (0.7, 1.8)	0.58		
Not sure	1.2 (0.5, 2.7)	0.67		
Concern about health of own and family members				
Not at all concerned	Reference		Reference	
Somewhat concerned	1.2 (0.5, 2.8)	0.75	3.0 (1.1, 8.5)	0.04
Moderately concerned	0.9 (0.4, 2.2)	0.80	3.4 (1.2, 9.5)	0.02
Extremely concerned	0.7 (0.3, 1.8)	0.50	2.4 (0.8, 7.1)	0.11
Presence of a pre-existing disease or condition that can aggravate symptoms if infected				

Variables	Two weeks before COVID-19 crisis (as recalled)		Since the beginning of COVID-19 crisis	
	OR (95% CI)	p-value	OR (95% CI)	p-value
No	Reference		Reference	
Yes	1.1 (0.8, 1.7)	0.47	1.3 (0.8, 2.2)	0.31
Not sure	1.0 (0.7, 1.6)	0.85	1.4 (0.8, 2.5)	0.28
Concerned about supporting family financially				
No			Reference	
Yes			0.6 (0.4, 0.9)	0.03
Not sure			0.7 (0.4, 1.3)	0.24
Feeling difficulties to avoid COVID-19 related news from media (electronic/print/social)				
Easy			Reference	
Neither easy nor difficult			2.4 (1.5, 3.9)	<0.001
Difficult			2.4 (1.4, 4.2)	0.002
How their lives have changed during COVID-19				
Better	Reference		Reference	
About the same	0.7 (0.4, 1.3)	0.26	1.9 (0.9, 3.8)	0.08
Worse	0.5 (0.3, 0.9)	0.03	2.7 (1.5, 5.2)	0.002
How well COVID situation is controlled in Bangladesh				
Well controlled			Reference	
Neutral			1.4 (0.8, 2.3)	0.17
Not well controlled			1.4 (0.9, 2.2)	0.13
How well they are coping with COVID-19				
Well	Reference		Reference	
Average	1.8 (1.2, 2.8)	0.008	1.4 (0.9, 2.3)	0.14
Not well	2.7 (1.6, 4.6)	<0.001	3.7 (1.7 ,7.9)	0.001
Activities at home since COVID-19 arrived				
Watching TV				
Less than before Covid-19	Reference			
Same as before Covid-19	1.1 (0.7, 1.5)	0.78		
More than before Covid-19	0.7 (0.5, 1.1)	0.09		
Prefer not to say	0.9 (0.5, 1.5)	0.57		
Internet Use				
Less than before Covid-19			Reference	
Same as before Covid-19			0.4 (0.1, 1.0)	0.06

Variables	Two weeks before COVID-19 crisis (as recalled) OR (95% CI)	p-value	Since the beginning of COVID-19 crisis OR (95% CI)	p-value
More than before Covid-19			0.4 (0.1, 1.1)	0.07
Prefer not to say			0.4 (0.1, 2.6)	0.34
Social Media Use				
Less than before Covid-19			Reference	
Same as before Covid-19			1.5 (0.7, 3.3)	0.27
More than before Covid-19			2.5 (1.2, 5.3)	0.02
Prefer not to say			1.5 (0.3, 6.3)	0.60
Work from Home				
Less than before Covid-19			Reference	
Same as before Covid-19			0.7 (0.4, 1.2)	0.21
More than before Covid-19			0.4 (0.2, 0.7)	0.001
Prefer not to say			0.7 (0.3, 1.3)	0.22
Household Chores				
Less than before Covid-19			Reference	
Same as before Covid-19			0.5 (0.2, 1.1)	0.09
More than before Covid-19			0.4 (0.2, 1.1)	0.07
Prefer not to say			0.7 (0.2, 2.1)	0.51
Talking with friends and family members				
Less than before Covid-19	Reference			
Same as before Covid-19	1.2 (0.8, 1.8)	0.50		
More than before Covid-19	1.2 (0.8, 1.8)	0.44		
Prefer not to say	2.4 (0.8, 7.1)	0.12		
Praying				
Less than before Covid-19	Reference		Reference	
Same as before Covid-19	0.7 (0.3, 1.4)	0.31	2.5 (1.0, 6.1)	0.05
More than before Covid-19	0.7 (0.3, 1.5)	0.36	1.8 (0.7, 4.4)	0.21
Prefer not to say	0.9 (0.3, 2.4)	0.80	1.5 (0.4, 5.0)	0.53
Resting				
Less than before Covid-19	Reference			
Same as before Covid-19	1.9 (0.9, 3.9)	0.10		
More than before Covid-19	1.1 (0.5, 2.2)	0.80		
Prefer not to say	3.2 (0.7, 15.4)	0.15		
Sleeping				
Less than before Covid-19	Reference		Reference	
Same as before Covid-19	0.4 (0.2, 0.8)	0.004	0.6 (0.3, 1.3)	0.17
More than before Covid-19	0.8 (0.5, 1.5)	0.53	0.8 (0.4, 1.7)	0.50
Prefer not to say	0.4 (0.1, 2.5)	0.33	0.6 (0.1, 3.4)	0.57

The multivariable logistic regression analysis in Table 15 shows that, over the two weeks preceding onset of the pandemic there was no difference between recalled wellbeing of male and female respondents (OR: 1.0, 95%CI: 0.7, 1.3, p=0.74). Employed respondents had essentially the same likelihood of recalling impaired wellbeing as unemployed respondents (OR: 1.1, 95%CI: 0.6, 2.1, p=0.64). Participants reporting that their lives have become worse since the pandemic hit, had 0.5 times the odds of reporting impaired wellbeing before COVID-19 (95%CI: 0.3, 0.9, p=0.03). Those reporting that they were failing to cope with COVID-19 had 2.7 times higher odds of impaired wellbeing over the 2-week interval before the pandemic (95%CI: 1.6, 4.6, p<0.001).

The multivariable logistic regression analysis (Table 15) shows that over the period since onset of the pandemic, participants aged 25-44 years, had 2.7 times the odds of impaired wellbeing compared to than those who were less than 25 (95%CI: 1.2, 5.6, p=0.01). There was a marginally statistically significant difference between the wellbeing of male and female respondents (OR: 0.7, 95%CI: 0.4, 1.0, p=0.05) during the period since onset of the pandemic. Respondents who were somewhat concerned (OR: 3.0, 95%CI: 1.1, 8.5, p=0.04), who were moderately concerned (OR: 3.4, 95%CI: 1.2, 9.5, p=0.02) and who were extremely concerned (OR: 2.4, 95%CI: 0.8, 7.1, p=0.11) about the health of their own and their family members had higher odds of impaired wellbeing than those who were not concerned at all. Moreover, COVID-19 related news from different media sources was associated with the wellbeing of the participants. Respondents who found it neither easy or difficult (OR: 2.4, 95%CI: 1.5, 3.9, p<0.001) and who found it difficult (OR: 2.4, 95%CI: 1.4, 4.2, p=0.002) had higher odds of impaired wellbeing than those who found it easy.

Participants who perceived that their lives have become worse since the beginning of the pandemic had 2.7 times the odds of impaired wellbeing than those who perceived their lives to be better (95%CI: 1.5, 5.2, p=0.002). Those who identified that they were not able to cope well during the pandemic had higher odds of experiencing impaired wellbeing than those who were coping well (OR: 3.7, 95%CI: 1.7, 7.9, p=0.001). More social media use was also associated with the wellbeing of the participants during the pandemic (OR: 2.5, 95%CI: 1.2, 5.3, p=0.02). Participants who were working from home more than before the pandemic had 60% decreased odds of impaired wellbeing than those who were not (95%CI: 0.2, 0.7, p=0.001).

3.3.5 Association between loneliness and anxiety among the participants over the period since the beginning of COVID-19 crisis in Bangladesh.

Initially, bivariate logistic regression was done to find out any statistically significant association between loneliness and anxiety over the period since the onset of COVID-19 in Bangladesh. As the bivariate analysis showed statistically significant association, loneliness was included in the final model for anxiety during COVID-19 to find out the adjusted OR. Statistical analysis did not find presence of any confounder and no variables in the model showed high correlation with any other variable.

Table 16: Bivariate and multivariable logistic regression analysis of anxiety symptoms of the participants with loneliness, after adjusting for all other variables, over the period since onset of COVID-19.

	Anxiety			
	Bivariate Analysis		Multivariable Analysis	
Variables	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**
Loneliness				
Not lonely	Reference		Reference	
Lonely	3.9 (2.9, 5.3)	<0.001	3.8 (2.6, 5.4)	<0.001

The bivariate analysis from Table 16 showed statistically significant association between loneliness and mild to severe anxiety symptoms during COVID-19. Before adjusting for all other variables, lonely respondents had 3.9 times the odds of reporting mild to severe anxiety symptoms than those who were not lonely (95% CI: 2.9, 5.3, p<0.001). In the multivariable logistic regression analysis (Table 16), the association continued to persist. The adjusted OR from the multivariable model showed that lonely individuals had 3.8 times higher odds of reporting anxiety compared to those who were not lonely (95% CI: 2.6, 5.4, p<0.001).

3.3.6 Association between loneliness and wellbeing among the participants over the period since the onset of COVID-19 in Bangladesh.

At first, bivariate logistic regression was carried out to see if there is any statistically significant association between loneliness and wellbeing of the participants during COVID-19. As the bivariate analysis showed statistically significant association, loneliness was included in the final model for wellbeing during COVID-19, to find out the adjusted OR. Statistical analysis did not find presence of any confounder and no variables in the model showed high correlation with any other variable.

Table 17: Bivariate and multivariable logistic regression analysis of wellbeing of the participants with loneliness, after adjusting for all other variables, over the period since onset of COVID-19.

	Wellbeing			
	Bivariate Analysis		Multivariable Analysis	
Variables	**OR (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**
Loneliness				
Not lonely	Reference		Reference	
Lonely	2.1 (1.5, 3.0)	<0.001	1.8 (1.2, 2.6)	0.004

The bivariate analysis (Table 20) showed statistically significant association between loneliness and wellbeing of the participants during COVID-19. Before adjusting for all other variables, lonely respondents had 2.1 times the odds of reporting impaired wellbeing than those who were not lonely (95% CI: 1.5, 3.0, $p<0.001$). When adjusted for all other variables, OR from the multivariable logistic regression analysis (Table 20) showed that lonely individuals had 80% higher odds of reporting impaired wellbeing compared to those who were not lonely (95% CI: 1.2, 2.6, $p=0.004$).

3.4 Conclusion

The data analysis of this study showed how COVID-19 has affected loneliness, anxiety, and wellbeing of Bangladeshi population and what were the factors associated with the three outcome variables. It is prominent that, there is a significant change in the outcome variables before and during COVID-19. Some of the covariates were found to be associated with the outcome variables just as they were related before COVID-19 and some of them became associated during the pandemic. Anxiety and wellbeing of the participants were found to be correlated with the loneliness status of the participants. However, there are some limitations of this analysis. As the baseline time measure, respondents were asked to recall their state of mind over 2-week time interval just before onset of the COVID-19 pandemic. So, there was a difference in ascertainment of these mental health-related constructs, with the baseline assessed retrospectively and the more recent period assessed concurrently. Again, the convenience sampling and web surveys are vulnerable for sampling bias. Because, convenience sampling can reduce the generalizability of the study findings. Moreover, due to the web-based survey design, access to the study questionnaire was only available to those who use internet. Apart from the limitations, the data analysis showed that loneliness, anxiety, and wellbeing have changed since

the pandemic's onset from how participants recalled these before the pandemic. Besides, the multivariable logistic regression analyses showed demographic factors that are associated with loneliness, anxiety, and wellbeing two weeks before COVID-19 crisis (as recalled), and since the beginning of the COVID-19 crisis.

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Chapter 4. Discussion and Conclusion

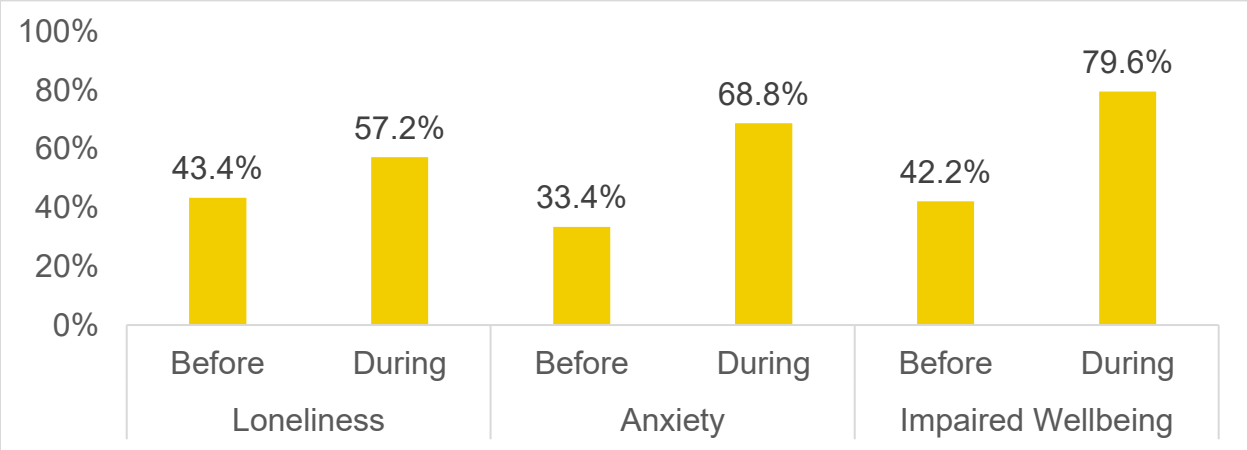
4.1 Summary of Findings

The COVID-19 pandemic caused a worldwide health catastrophe, forcing individuals to deal with stressful and unforeseen circumstances. People's actions altered as a result of the possibility of contamination and the sensation of social isolation, which had a significant influence on relationships, daily routines, and personal sentiments [1]. Researchers predicted that persons without pre-existing mental health disorders would have a considerable rise in anxiety and depression symptoms during the early stages of the pandemic [2]. Even many were at risk of developing post-traumatic stress disorder [2]. Furthermore, recurrent media depictions of gravely sick people, dead bodies, and coffins have intensified societal unrest and affected the general population's mental health [3]. The aim of this study was to assess the change in loneliness, anxiety, and wellbeing of Bangladeshi population and the associated factors 2 weeks before the pandemic and since the onset of COVID-19 in Bangladesh. During the data collection period, Bangladesh was progressing towards relaxation of lockdown from a strict lockdown phase [4]. Throughout the data collection period, educational institutions remained closed [5]. To evaluate before and during COVID-19 scenario, the participants were asked to respond to each item of the tools (University of California, Los Angeles 3-item Questionnaire, Generalized Anxiety Disorder-7, and World Health Organization-5 Wellbeing Index) on two different time points respectively: 2 weeks before the pandemic hit Bangladesh and since the beginning of the pandemic in Bangladesh.

Since the 1990s, web surveys have been utilized as a strategy to collect primary data [6]. During the pandemic, online surveys have gained popularity among researchers mostly because of their feasibility in the given circumstances, cost efficiency, and ease of implementation [6]. Except for

a study that targeted the wellbeing of the indigenous population of Bangladesh, all other studies conducted during the pandemic included in the literature review were done using online platforms (e.g., google forms, SurveyMonkey, website etc.) [7]. Web-based surveys are criticized mostly due to the chance of selection bias, the incapacity of the researchers to guarantee that the sample population is primarily from the intended group, the chance for a single internet user to answer the survey multiple times, and limited availability of internet connection [6, 8, 9]. Nevertheless, despite some methodological limitations of online surveys, it was the safest and most feasible way to collect data and create scientific evidence during the pandemic.

Figure 1. Difference between the prevalence of loneliness, mild to severe anxiety, and impaired wellbeing among the participants before (two weeks before the pandemic) and during (since the beginning of the pandemic) in Bangladesh.



The demographic distribution of the present study showed that the sample of this study mostly belong to urban areas, younger age group and are single considering relationship status. Findings from our study showed that the mean score of loneliness was higher during the period since the onset of the pandemic in Bangladesh than it was 2 weeks before pandemic as recalled by the respondents. Among the sample, loneliness symptoms were reported by 43.4% respondents 2

weeks before COVID-19 and 57.2% respondents since the onset of COVID-19. Similar phenomenon was observed among the studies conducted in the UK, Germany, USA, and Netherlands, where a considerable increase in loneliness was also seen [10–14]. Since the onset of the pandemic, loneliness was prevalent among 38.7% respondents in a study conducted in China, 43.0% respondents in a study conducted in the USA, 27.0% respondents in a study conducted in the UK, and 41.1% respondents in a study conducted in Japan [15–18]. Even though the prevalence of loneliness among the sample of our study is higher (57.2%) since the pandemic started, but these findings should not be compared because the studies took place in different time periods as well as the demographic distribution are not similar. Among the participants between the age group of 18-24, 61.0% were experiencing loneliness, which was higher than the prevalence evaluated by Al Omari and colleagues among the adult youths of 6 Middle Eastern countries [19].

Two weeks before COVID-19, the location of the participant (urban/rural) was found to be associated with participants' loneliness status but was not a significant predictor during COVID-19. Again, the age of the participants was not a significant predictor of loneliness before COVID-19 but became a significant one during the pandemic. Before COVID-19, studies from Southeast Asia found that loneliness increases with the age of participants and older adults are at more risk of developing loneliness than the younger population [20, 21]. However, in the present study, the odds of experiencing loneliness decreased with increasing age. This phenomenon is also found in many published literatures in different countries and settings [10, 17, 18, 22–26]. Like this study, women had a higher risk of loneliness than their male counterparts before the pandemic [21, 27]. During the pandemic, women respondents had higher odds of being lonely

than their male counterparts, and studies from different parts of the world showed a similar pattern [10, 18, 23–26, 28].

The relationship status of the participants was also associated with loneliness both before and during pandemic in this study. Being married was found to be a protective factor since the onset of COVID-19, and the finding is similar to studies conducted in China, the UK, Canada, and Norway [16, 17, 25, 26]. The participants' employment status or socioeconomic status was not associated with loneliness before and during COVID-19. Presence of a pre-existing disease was not associated with loneliness before the pandemic. Nonetheless, respondents with pre-existing diseases or conditions that could aggravate symptoms of COVID-19 had higher odds of being lonely during the pandemic. A similar association was also found in a systematic review, including 215,026 participants from 34 studies during the pandemic period [29].

During the pandemic, there was a 35.4% increase in anxiety among the sample population. Using the same tool (GAD-7), studies conducted during COVID-19 found that mild to severe anxiety symptoms was prevalent among 44.9% respondents from Germany, 61.1% respondents from Columbia, 68.1% respondents from El Salvador, 65.8% respondents from Mexico, 55.8% respondents from Uruguay, 71.8% respondents from Argentina, 72.8% respondents from Ecuador, and 76.1% respondents from Paraguay [30, 31]. In this thesis, the prevalence of mild to severe anxiety among the Bangladeshi respondents was found to be 68.8%. Islam and colleagues used the same instrument to assess anxiety symptoms among Bangladeshi university students in May 2020 [32]. Compared to that study, the student participants of this study showed a relatively lower prevalence of mild to severe anxiety symptoms during COVID-19.

Two weeks before the COVID-19 crisis in Bangladesh, there was no difference in anxiety symptoms between male and female participants in this study. Although, the same scenario is not

observed during COVID-19. In line with global research findings, female individuals had a higher likelihood of experiencing anxiety symptoms than their male counterparts [33–42]. Before the pandemic, married participants had 50% lower odds of experiencing mild to severe anxiety than the single participants. However, no such association was found between relationship status and anxiety since the beginning of the pandemic. Occupation was found to be a significant predictor for anxiety before the pandemic, but did not show any significant association with anxiety during the pandemic. No association was found with age in either before or during pandemic situation. Not being able to avoid COVID-19-related news was associated with anxiety, and similar findings were reported by studies conducted in Iran (March 2020) and Bangladesh (June 2020) [42, 43]. Social media became a crucial source of news and information related to COVID-19 [44]. As this study was conducted using a web-based survey, there is a chance that a significant portion of the sample is social media users. More social media use than before COVID-19 was found to be a significant predictor of anxiety in this study which was also observed by Hossain and colleagues [41]. Very few literatures were found where an association between loneliness and anxiety was explored during COVID-19. This study showed a strong association between loneliness and anxiety, similar to the studies conducted in Japan, Norway, and Israel [18, 26, 45].

This study discovered a 37.4% rise in participants' impaired wellbeing following the pandemic. A widely used tool to evaluate wellbeing was used in this study. Compared with the studies that used the WHO-5 wellbeing index in a similar period and used the same cut-off value, impaired wellbeing was more prevalent among the Bangladeshi sample than that of Austria (31%), New Zealand (38.2%), and India (37.7%) [46–48]. Impaired wellbeing was reported by 35.3% respondents in a study that included participants from 18 Middle Eastern and North African

countries. Another study that included only indigenous Bangladeshi population as sample reported impaired wellbeing among 50.9% of the respondents, but the later study was conducted from Jan to April 2021 [7].

Gender is an essential determinant for participant wellbeing throughout the epidemic, along with loneliness and anxiety. Similar findings across published literature from the same period indicated that women were more likely than males to have impaired wellbeing [49–56]. Although previous literature found an association between impaired wellbeing and decreasing age, no such association was found in this study [51, 53, 55–57]. Instead, those in the age group of 25-44 years showed higher odds of impaired wellbeing than those under 25 years. Relationship status, occupation, socioeconomic status, highest level of education of the participants were not found to be associated in both before and during the pandemic in Bangladesh. Perception of how the participants' lives have changed and how well they have been coping with the pandemic had strong association with impaired loneliness since the beginning of the pandemic. However, the findings suggest that working from home can be a protective factor for wellbeing of the participants. Working from home is a relatively new concept for the Bangladeshi population, and further research should be conducted to see if it is beneficial for the subjective wellbeing of the population in the long run.

4.2 Implications of Research

The life expectancy of those with mental health issues is lower than that of the general population [58]. This cross-sectional study examined the pre-COVID (two weeks before COVID-19) and during-COVID (since the onset of the pandemic) prevalence of three mental conditions, namely loneliness, anxiety, and wellbeing as well as their associated factors. The results from this study, along with previous research, could be cited as evidence to inform the

decisions and policymakers of Bangladesh as well as neighboring countries with similar settings. One of the key findings of this study is that loneliness, anxiety, and impaired wellbeing are more common in women during the pandemic. This finding emphasizes how important it is for future research to consider gender equality and inclusivity. Any countrywide initiative aimed at improving population mental health should be carefully tailored, keeping in mind the additional dangers women face. There have only been a few studies on loneliness undertaken in Bangladesh so far. This investigation can spark crucial research questions on loneliness for further analytical studies to fill the research gap in this area. Furthermore, it is a matter of consideration why loneliness is so common in a collectivistic society like Bangladesh, where reciprocity, hospitality, and harmony are core concepts [59].

In contrast to loneliness, the concept of anxiety is well-researched in Bangladesh. However, this study can serve as substantive evidence on the anxiety status of a nation following the COVID-19 pandemic. This information can be incorporated to seek practical solutions, as well as to instruct the healthcare professionals and disseminate the information to the general population. In the long run, this could help reduce the disease burden and healthcare costs on the health system.

Research on wellbeing is a complex web of information intertwined with one another. Success at personal, professional, and interpersonal levels is all related to wellbeing [60]. This study aims to evaluate the wellbeing status to understand the wellbeing status in order to how a person perceives being well in their life. These perceptions could lead to critical analysis of a number of mental conditions such as depression, mood disorder, borderline personality disorder, etc. In a nation of 162 million people, there are only 260 psychiatrists, 565 psychologists, and 700 nurses who are working in mental health care institutions [61]. The lack of human resource is already

making mental health care inaccessible to a large portion of the population. Further research is required to determine which populations are more likely to experience this complicated trifecta of mental health disorders because this study found a substantial correlation between loneliness and the other two constructs. It is crucial to take into account all of the information that is currently available to develop timely and effective therapies because Bangladesh barely allocates 0.44% of its overall health budget to mental health.

4.3 Strengths and Limitations

This study provided concerning findings regarding loneliness, anxiety, and wellbeing of the Bangladeshi population during and before COVID-19. However, the findings of this study should be interpreted in light of some specific limitations. The study design followed an online cross-sectional design and was limited to the individuals who had access to internet during the period of data collection. Although the large sample size in this study will provide good precision around the point estimates, researchers had very limited control over the selection of the sample. So, the sample may not be the best representation of the underlying population of interest. Altogether, these limit the generalizability of the findings of this study. Again, self-reported responses on the three constructs of this research could lead to response bias. So, the chance of overestimation or underestimation of the result cannot be overlooked. Due to the cross-sectional nature of the study, the data on the constructs before COVID-19 were collected during the time of pandemic. Thus, there is a possibility of recall bias. As the results are presented in adjusted odds ratio, we have to keep in mind that when the outcome is not rare, odds ratio can overestimate the relative risk in the underlying population. Apart from the above limitations, the study tried to assess the loneliness among the participants. Nevertheless, the

questionnaire did not include any questions that could assess whether the participants lived with their families or what sort of family structure they had (nuclear/joint).

Despite the limitations, the study provides some significant public health implications. The results demonstrated the increase in loneliness, anxiety, and impaired wellbeing of the Bangladeshi population, which represents the vulnerability of their mental health status during the pandemic. Besides, this is the first study that investigated and compared loneliness, anxiety, and wellbeing of general adult sample from Bangladesh before and during COVID-19. Despite the fact that there is some data on anxiety during COVID-19 in Bangladesh, loneliness and wellness are two topics that are remarkably understudied here. In addition, we cannot say for sure that the epidemic is finished just yet. In the post-pandemic era, economic recession and inflation can continue to distress the general population's mental health. Therefore, we cannot be optimistic that COVID-19's effects on mental health will be quickly reversed. In 2019, only 35 research articles were published from Bangladesh, focusing on mental health issues [62]. Thus, Bangladesh has a substantial research void in mental health. This study's findings about the prevalence and sociodemographic characteristics connected to the three study constructs will attempt to fill this knowledge gap. No other study examined the relationship between loneliness and the other two constructs in the Bangladeshi context. Decision and policymakers may use this study as proof to develop the best possible long-term interventions to tackle these mental health issues with the available resources. The significance of this work is therefore enormous.

4.4 Conclusion

In summary, this study identified real concerns by evaluating the prevalence and associated factors of a hidden mental health issues like loneliness, a ubiquitous problem like anxiety, and the subjective state of wellbeing of general Bangladeshi population before and during the

pandemic. The pandemic is not at the same place it was in the beginning, but the effects on mental health can be challenging to overcome. Considering the current state of mental healthcare in Bangladesh, significant attention should be given towards adequate mental health research, improved advocacy, training of lay workers, and adequate financial resource distribution. We hope that COVID-19 will be contained one day, but this is not the last disaster we are facing. This is the scope to address insufficient mental health resources in Bangladesh and prepare for any upcoming disaster utilizing evidence-based knowledge.

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