



Common mental health problems among different populations in Bangladesh– A systematic review

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Abstract

Introduction: Mental disorders are a significant global public health issue, particularly prevalent in low and middle-income nations. The burden of mental diseases is substantial in Bangladesh, but a generally unrecognized and under-researched field from the very beginning; however, it has been getting researchers' attention in recent years. The number of systematic reviews on the mental health state of Bangladesh is scarce. However, no study focused on mental disorders in different populations.

Materials and Methods: The review paper examines mental disorders in seven different populations, including younger, older, medical students, university students, vulnerable, Indigenous, and general people, and investigates the four most prevalent mental disorders in Bangladesh: depression, anxiety, stress, and suicide.

Results: Initially, we screened 71 papers using exclusion and inclusion criteria and then selected 24 papers for further analysis following the PRISMA procedures. This paper reviews studies published from August 2021 to July 2023. Overall, the study found that females are more suffer mental health problems than men do. The findings of this paper suggest that adolescents and vulnerable people suffer more than any other population, and the two most prevalent diseases are anxiety and depression.

Conclusion: We need effective preventive actions against future pandemics to reduce long-term consequences.

Keywords: Anxiety, Depression, Mental health, Stress, Suicide

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Introduction

Mental disorders constitute a major public health problem and contribute to 13% of the global burden of disease measured as disability-

adjusted life years (1). According to the Global Burden of Disease Study (GBD) 2016, an estimated 1.1 billion people globally were affected by mental disorders (2). Additionally,

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low and middle-income countries have a higher burden of mental disorders than economically developed countries (3,4). According to a WHO report, 80% of people with mental disorders are from low- and middle-income countries (LMICs) (5). Almost 170 million people live in Bangladesh, a highly populated nation with little access to medical logistics and healthcare resources. Mental healthcare in Bangladesh is enormously inadequate owing to a lack of public mental health facilities, scarcity of skilled mental health professionals, insufficient financial resource distribution, and societal stigma. These shortcomings are sustained by the absence of effective stewardship to execute adequate mental health policies (6).

People frequently ignore mental health issues as a priority for physical health. As a result, the delicate balance of psychological elements, including anxiety, stress, and depression, is severely affected. These mental health issues can even cause suicidal thoughts in certain people. They additionally foster panic attacks, sleeplessness, trauma, Post Traumatic Stress Disorder (PTSD), and abnormal behaviors (7,8). A meta-analysis reported that the total prevalence of mental disorders in Bangladesh, the prevalence of mental disorders varied from 6.5% to 31.0% among adults (9). However, the information available regarding the prevalence of Mental Disorders in Bangladesh is scant.

Further, the COVID-19 pandemic has exacerbated mental health issues, with studies showing increased rates of depression, anxiety, and stress among the Bangladeshi population, particularly affecting females and individuals with physical illnesses (10) and the prevalence increased to 38%-73% after the pandemic (11).

Mental health problems have increased significantly in the past decades (9). In Bangladesh, the prevalence of mental health problems also increased (12). There are several studies in Bangladesh that have found which focused on mental health problems such as depression (13), anxiety (14), stress (15), and suicide (16).

Also, a few systemic reviews were conducted on the Bangladeshi population focused on mental health issues (9,17), but they did not pay special attention to the mental health problems of different populations. Numerous studies focused on mental health problems found that the prevalence of different populations is different such as older people (81.6%), university students (55.6%), medical students

(58.6%), vulnerable people (69.2%), tribal people (58.8%), and general people (66.34%). So, this systematic review acknowledged this knowledge gap and aimed to understand the prevailing trends of mental disorders among different populations in Bangladesh (18-23).

Materials and Methods

Search strategy and techniques

We searched two electronic databases, (i) Google Scholar and (ii) Pub Med, and used the local journal of Bangladesh and a shadow library called Z-library. The keywords used for this review paper were: "anxiety," "stress," "depression," "suicide," "COVID-19," and Bangladesh. These keywords were repeatedly utilized to select the desired academic articles by using Boolean operators. They got 71 papers to see the impacts of COVID-19 on mental health on seven different populations such as younger people, older people, university students, medical students, vulnerable people, tribal people, indigenous communities, general People, and the four most prevalent mental disorders such as anxiety, stress, depression, and suicide in Bangladesh. This study was registered in the International Prospective Register of Systematic Reviews (PROSPERO ID: CRD42024546856).

Inclusion criteria: We included articles that presented (i) quantitative research, (ii) Bangladeshi population, (iii) reported on the human participant, (iv) data were published between August 2021 and July 2023, (v) published in English, and (vi) mental health impacts of four attributes such as anxiety, stress, depression, suicide.

Exclusion criteria: We excluded articles that were (i) Qualitative studies, (ii) Not in English, (iii) Thesis papers, and (iv) Review or systematic review papers. We found 71 papers for initial screening using a search strategy and techniques. After disregarding 13 papers for time irrelevancy, we had 58 papers for further investigations.

Out of these 58 papers, the exclusion criteria involved three qualitative studies, two review studies, one place irrelevant studies, 14 irrelevant, three improper full-text articles, one inadequate data analysis, and 10 duplicate papers. After removing the 34 excluded papers from 58, 24 papers were finally added for review, followed by Prepared Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) (Figure 1).

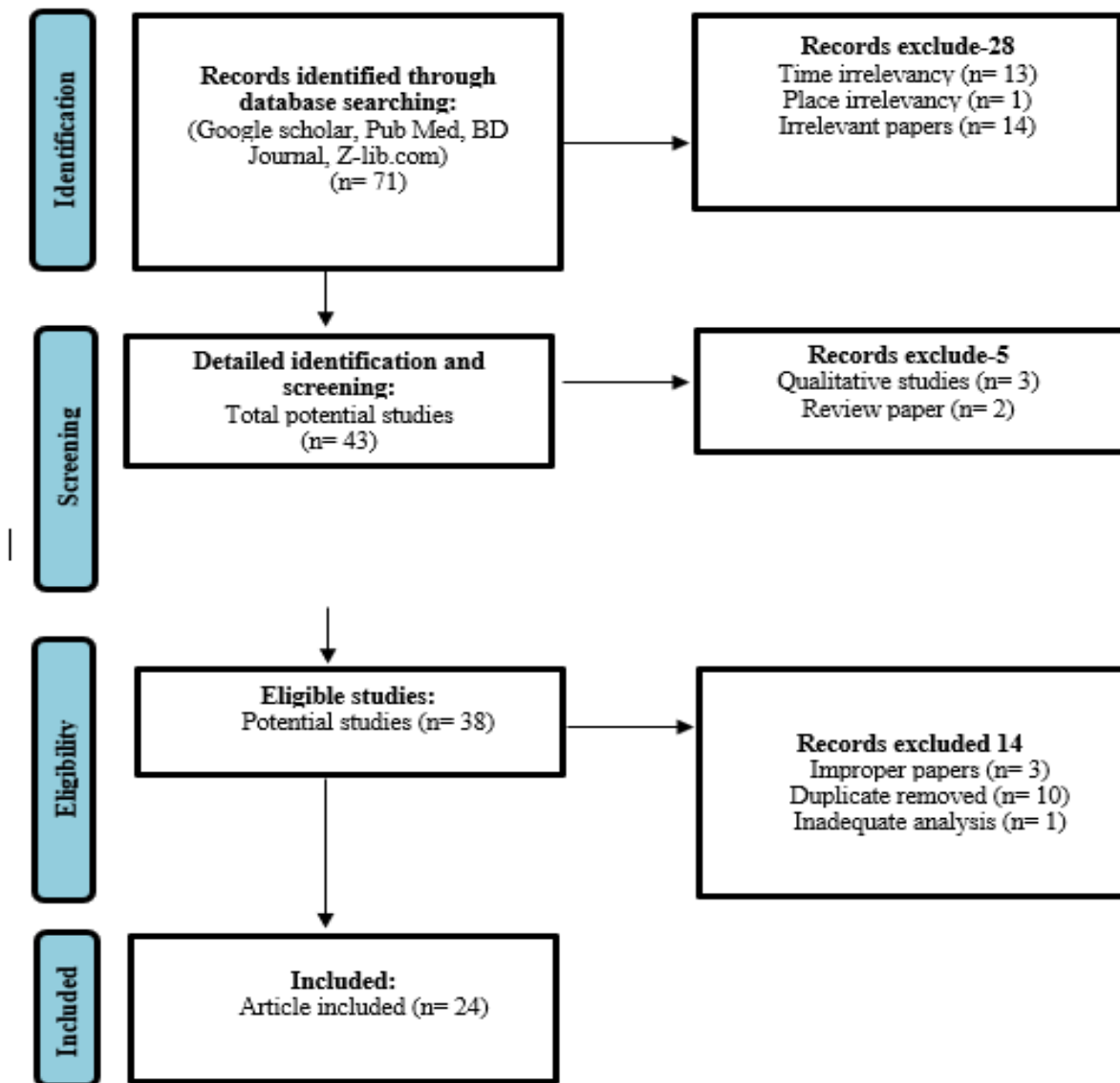


Figure 1. Process of searching, screening, and finalizing papers according to PRISMA

Results

Data analysis and result

Table 1 presents the summary information of papers and Table 2 details each study included in the current review paper, providing information about the time of the survey, key

areas, objectives, the size of the sample, target population, and approach methods.

In total of 24 papers were found, followed by Prepared Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA).

Table 1. Summary of selected paper on population characteristics

Sample population	Size of numbers	Key area
Younger people	4	Stress, anxiety, depression
Older people	2	Depression
University students	5	Suicide, anxiety, depression
Medical students	3	Anxiety, suicide, depression
Vulnerable people	5	Anxiety, depression
Tribal people, indigenous communities	1	Depression
General People	4	Stress, depression
N= 24		

Table 2. Result of literature search

Paper headline	Author	Date	Key area	Objectives	Method	Population	Sample size	Findings
Stress symptoms and associated factors among adolescents in Dhaka, Bangladesh: findings from a cross-sectional study	Affa Anjum Sahadat, Hossain M. Tasdik Hasan, et al.	21-January-2022	Stress	Prevalence of stress among adolescents	Two-stage cluster sampling	Younger people	2313	65% of adolescents experienced moderate stress symptoms. 9% experienced high-stress symptoms.
Perceived stress, eating behavior, and overweight and obesity among urban adolescents	S. K. Roy Khurshid Jahan, et al.	2021	Stress	Prevalence of perceive stress	Multistage sampling	Younger people	4609	61.5% of adolescents were in moderate-to-extremely-severe levels of stress.
English language anxiety of tertiary level learners in Bangladesh: Level and sources	Md. Abdullah Al Mamun	14-October-2021	Anxiety	English language anxiety	Accidentally , an online survey	Younger people	337	43.6% have high anxiety. 28.8% have moderately high anxiety. 11.6% have moderate anxiety. 5.6% have moderately low anxiety. 7.7% have very low anxiety.
Anxiety among urban, semi-urban, and rural school adolescents in Dhaka, Bangladesh: Investigating prevalence and associated factors	Afifa Anjum Sahadat Hossain, et al.	21-January-2022	Anxiety	Prevalence and associate factor	Two-stage cluster sampling	Younger people	2313	20.1% of adolescents were experiencing moderate to severe anxiety and women suffer more than men.
Health-related quality of life among older citizens in Bangladesh	Abdur Razzaque Sarker	5-October-2021	Depression	Depression on older people	Two-stage cluster sampling	Older people	585	81.6% of older people suffer from anxiety or depression.
Women outweighed men in life expectancy in Bangladesh: does it mean a better quality of life?	Md. Zakiul Alam	2021	Depression	Prevalence of depression in man and women	Systematic random sampling	Older people	200	Depression for women is 7.3 and for man, this is 6.1.
Suicidal behaviours among undergraduate medical students in Bangladesh	Miliva Mozaffor, Enayetur Raheem, et al,	30-July-22	Suicide	Suicidal behavior among medical students	Stratified random sampling	Medical students	583	A lifetime suicidal ideation was found in 23.8% of students.
Depression and suicidal ideation among medical students in a private medical college of Bangladesh. A cross-sectional web-based survey	Rifat Jahan Chomon	29-April-2022	Depression	Prevalence of depression in medical college student	Stratified random sampling	Medical students	237	58.6% of students have mild to severe depressive symptoms.
Risk factors for depression and anxiety disorders among Bangladeshi dental students: A cross-sectional survey study	Md. Omar Faruk, Mohammed A. Mamun, Abu Bakkar Siddique, Mark D. Griffiths	06-August-21	Anxiety	Prevalence and risk factors	Cross-sectional study, convenience sample	Medical students	468	The prevalence rates for moderate to severe depression and anxiety were 27.4% and 18.2%, respectively. The risk factors for depression and anxiety were being female, coming from city areas, having past-year psychological and physical suffering, having past-year traumatic events, and having a family history of mental illness, as well as a range of suicide-related behaviours.

Prevalence of depression, anxiety, stress, and their associated factors among university students in Bangladesh	Md. Kamruzzaman, et al.	13-April-2022	Anxiety	Prevalence of anxiety	Randomly	University student	738	Private university students are more likely to suffer from depression, anxiety, and stress compared to the students at public universities.
Prevalence of anxiety, depression, and stress among students of Jahangirnagar University in Bangladesh	Md. Moyazzem Hossain, Md. Asraful Alam, Monirul Hasan Masum	06-Februrary-2022	Anxiety	Prevalence of anxiety	Stratified random sampling techniques	University student	351	The majority have a mild or moderate level of stress and it is associated with sex and residence (urban or rural). More than 40% of students have extremely severe anxiety.
Status of psychological health of students following the extended university closure in Bangladesh: Results from a web-based cross-sectional study	Md. Jamal Hossain Ahmed, et al.	31-March-2022	Depression	Mental health status	Simple snowball sampling	University student	568	55.6% student suffer from depression.
Escalated suicidal rate of the undergraduate students of Bangladesh – Social impact and recommendations to overcome	Mohammad Azizur Rahman, Md. Touhidul Islam Nabidur, Rahman Esrat Sultana, Md. Sohel Parvez, and Shaikh Mirja Nurunnubi	20-October-2021	Suicide	The prevalence of suicide among the university undergraduate students and the factors associated with suicide ideation among the university undergraduate students of Bangladesh	Classroom based convenience sampling method	University student	665	The female suicidal ideation is more in percentage than the male.
Suicidal behaviors and emotional distress among university students in Bangladesh: A cross-sectional study in Bangladesh	Abdul Mueyed Md. Mohsin Md. Badsha Alam, Sultan Mahmud Md. Nowshad Hossain Mst. Monira Khatun Nazratun Nayem Mamduda	02-June-2023	Suicide	Assess the suicidal risks and emotional distress among university students in Bangladesh	Convenience sampling technique	University student	620	The students who had depression, anxiety, stress, and insomnia symptoms had a higher prevalence of suicidal behaviors.
Antenatal depression among women with gestational diabetes mellitus: a pilot study	Sa'dia Tasnim Farzana Mahzabin Aun, et al.	2022	Depression	Antenatal depression	Purposive sampling	Vulnerable	105	Mild to severe antenatal depression was present in 36.2% of the subjects (i.e., 14.3%, 19%, and 2.9% for mild, moderate and severe depression, respectively).
Depression and anxiety symptom assessment in women with Polycystic Ovary Syndrome (PCOS), visiting tertiary level hospital of Bangladesh	Fariha Haseen, Shahjada Selim, Rezaul Karim Kazal, et al.	2022	Anxiety	Measure anxiety and depression on women with PCOS	Cross-sectional analysis	Vulnerable	200	74.5% have extremely severe anxiety, 14.4 have severe anxiety.
Depression, anxiety, and performance status among women with metastatic breast cancer receiving	Nashid Islam Jheelam Biswas, et al.	17-October-2022	Anxiety	Anxiety on women with metastatic breast	Purposive sampling	Vulnerable	95	Four out of ten (44.2%) patients had moderate to severe anxiety.

palliative care in Bangladesh: A cross-sectional study				cancer receiving palliative care				
Assessment of depression and its associated factors among patients with type 2 diabetes	Akter N Latif Z. A	23-November-2021	Depression	Depression on type 2 diabetes patient	Purposively	Vulnerable	318	46.2% female and 17.9% male suffer from depression.
Anxiety and depressive symptoms among COVID-19 patients admitted to three isolation facilities in Bangladesh	Md Hafizur Rahman Goutom Banik, et al.	July-December-2021	Anxiety	Prevalence of anxiety and depression	Non-random sampling technique	Vulnerable	138	57.8% people have anxiety.
Anxiety and depression in two indigenous communities in Bangladesh	Md. Omar Faruk Rehnuma, Pervin Nijhum, et al.	2021	Depression	Prevalence of anxiety and depression in Marma and Chakma	Purposive, convenient sampling	Tribal people, indigenous communities	120 + 120	Marma people compared to Chakma people were more anxious (M= 59.49 v. 43.00, P<0.001) and more depressed (M= 86.78 v. 82.30, P< 0.001).
A machine learning approach for early detection of postpartum depression in Bangladesh	Jasiya Fairiz Raisa, M. Shamim Kaiser, et al.	August-2022	Depression	Develop a machine-learning model and prevalence of PPD	Interviewing , purposive sampling	General People	150	The prevalence of PPD in Bangladesh is 66.7%.
Machine learning approach to predict the depression in job sectors in Bangladesh	Nazmun Nessa Moon Asma Mariam, Shayla Sharmin, Mohammad Monirul Islam, et al.	November-2021	Depression	Prevalence of depression in Job	Accidental	General people	410	Percentage of depressed persons is 66.34% (272 persons) and satisfied persons are 33.66% (138 persons). the total female depression is 38.24% and total male depression is 61.76%.
A perception-based study to explore COVID-19 pandemic stress and its factors in Bangladesh	Sajid Amit Lumbini Barua Abdulla - Al Kafy	2021	Stress	Measure COVID-19 pandemic stress	Purposive sampling method	General people	750	83.56% (n ¼ 544) of the total respondents from the total sample reported being stressed due to the COVID-19 outbreak.
Workplace violence, bullying, burnout, job satisfaction and their correlation with depression among Bangladeshi nurses: A cross-sectional survey during the COVID-19 pandemic	Saifur Rahman Chowdhury, Humayun Kabir, et al.	22-September-2022	Depression	Correlation of depression	Purposive Sampling	General people	1264	Bangladeshi nurses' depression was correlated to workplace violence, bullying, burnout, and job satisfaction. In addition, the authority's insufficient professional support predicted nurses' depression.

Discussion

University students

University students are among the most sufferers among the six groups we classified in this paper. We have found five research studies in the targeted timeline. Random and snowball random sampling methods were used mostly as an instrument, the Depression Anxiety Stress Scale-21 (DASS-21). Prevalence and associate factors were the main targets. In several studies, it has been found that private university students suffer more from mental health problems like depression, anxiety, stress,

suicidal ideation, and other problems than public university students (22,24,25). Here is an example: There are two universities in Rajshahi, Bangladesh. Rajshahi University (RU) is a public institution, whereas Varendra University (VU) is private. 15.4% of VU students are depressed, while 14.50% of students of RU suffer from depression. Some factors like gender, resident, family type, birth order, and resident play an important role here. We can find some studies that tell us that female students are more depressed, more anxious, and have more suicidal ideation than male students

(14,24,25). However, why is this happening? According to Azizur Rahman et al., lower life satisfaction and more unpleasant life experiences may contribute to female students' poor mental health (24). Student residence is another factor that appears to influence mental health—a study by Md. Jamal Hossain et al. found that rural students and those living outside their families reported higher levels of depression (22). When it comes to family type, students from nuclear families had extremely severe levels of anxiety than students from joint families (14). However, this picture is the opposite for private university students. 22.8% of students from large families, 11.5% of students from extended families, and 15.9% of students from nuclear families suffer from depression (25). One shocking piece of information is that almost 20.2% of students have suicidal behavior. This prevalence is much higher in students with depression, anxiety, stress, and insomnia, at 33.3%, 29.53%, 41.95%, and 42.19% (16). A study by Azizur Rahman et al. identified several risk factors for suicidal ideation, including separation from a partner, social media addiction (specifically Facebook), and mental health struggles like depression, anxiety, and stress (24).

General people

Despite forming the majority of our country's population, this group is understudied in terms of mental health. There are 4 studies whose are about postpartum depression, COVID-19-related stress, job stress, and workplace stress and depression due to workload, bullying, and violence. The study by Amit et al. found results that showed us how much COVID-19 is horrible for our mental health. They found that almost 83% of people had COVID-19-related stress. In addition, they detected some factors that contributed to stress levels. These are fear and tension of self and family, concern for health treatment, students feeling stress because they could not attend their educational institution, and others (15). However, the study by Moon et al. and Fairiz Raisa found that postpartum depression and depression in the job sector are almost the same; the prevalence of postpartum depression is 66.7%, while job sector depression is 66.34% (19,26). The study also tells us that in the job sector, males are more satisfied and less depressed than females (19). Fairiz Raisa points out that some factors that affect PPD are relation to the husband, need for support, history of abuse, illness of the

newborn, and prior depression (26). One study on nurses has given us some valuable insight into the mental health status of healthcare providers, especially nurses. Nurses who are low educated, like diploma pass, have less depression than nurses who are highly educated. Some of the main sources that cause stress and depression are extended hours of workload, irregular salary, not getting any reward for good work, and, most importantly, no training for workplace violence (27).

There may be a need for more mental health services in Bangladesh. The studies suggest that many people who are struggling with depression are not getting the help they need.

Vulnerable people

Among the six population groups that we have classified, vulnerable people suffer most from mental health problems. It is presumably because people with chronic health diseases take high-power medicine doses regularly, they often have economic problems, and maybe they blame themselves for every unfortunate event that happens to them. Here, we have five research papers that abide by our desired framework. The researcher did their study on patients with five diseases. Among the five research papers, two are on diabetes patients; one is diabetes mellitus, and the other is gestational diabetes. One study is about patients with PCOS. One study is about patients with advanced breast cancer, and the last one is about COVID-19 patients.

Almost 63% patient of diabetes mellitus suffer from depression (23). The prevalence of depression is slightly less in patients with gestational diabetes mellitus, which is 36.2% (13). In both cases, the degree of depression is positively correlated with the time duration of the patient having diabetes. However, in the case of diabetes mellitus patients, female patients suffer more from depression than male patients do (13,23). Fariha Hassen conducted one study on adolescents and women with Polycystic Ovary Syndrome (PCOS), and Nashid Islam conducted another study on patients with advanced breast cancer. They have found some alarming results: 73.5% patient of PCOS have extremely severe anxiety, 63% of patients suffer from depression, 87% of patients have stress problems, where 47% have severe levels of stress, and 40% have moderate levels of stress problems. However, this situation is not very bad in the case of advanced breast cancer patients. Four out of ten patients,

44.2%, suffer from severe anxiety, and one-third of patients, 36.9%, suffer from moderate to severe depression (28,29). Moreover, patients with COVID-19 suffer from anxiety and depression, which is 57.2% and 52.2%. However, patients who possess low oxygen saturation levels have higher anxiety and depression. COVID-19 patients' mental health is highly associated with whether they have other comorbidities and physical illness, and there is no difference based on gender and other demographic factors (30).

Numerous studies focused on the need for more mental health services for women with medical conditions in Bangladesh. Many of the studies mention that the participants did not receive any mental health interventions even though they were experiencing symptoms of depression and anxiety.

Medical students

Medical students are the second most vulnerable communities for mental health problems among the six groups that we have classified. We found three studies on medical students according to the inclusion and exclusion criteria: one on depression and anxiety, one on depression and suicidal ideation, and the last one on suicidal behavior. However, no study has been conducted on stress. Researchers mainly focus on finding out the prevalence and associated factors of depression, anxiety, and suicidal behaviors. It is alarming for all of us that the future of our medical sector, the medical student, suffers from mental health problems at an astonishing rate. 58.6% of medical students suffer from depression, 27.4 students have suicidal ideation, which is higher than the global rate 18, and 18.2% of students suffer from anxiety (31). This is hardly the worst scenario, 9.8% of students express their idea about suicide, 8.7% of students made plans for suicide, and students with a family history of suicide or suicide attempt are six times more prone to suicidal ideation (32). Family history is also associated with depression and anxiety. Students with a family history of mental illness are more prone to depression and stress (31).

There is a significant impact of gender on mental health in medical students like university students. Female students are twice as likely at odds of ideation than men; also, female students are more prone to depression than males, but there is no association was found in terms of anxiety (31,32). Also, in the

medical student, research studies state that public medical college students suffer from suicidal ideation problems less than private medical college students (32).

Our findings from the studies tell us that marriage is good for mental health. One such study conducted by Chomon found that single students are 2.35 times more prone to suicidal thinking than students who are married. She also found out the detrimental Impact of drug addiction on mental health. According to her, drug addicts and alcohol consumers are far more prone to suicidal ideation (18).

Younger people

From the studies conducted on them at our desired time frame, a significant portion of them suffer from different mental health problems. 20.1% of adolescents experience moderate to severe anxiety, and 28.4% of adolescents experience mild anxiety (33). 61.5% of adolescents suffer from moderate to extremely severe stress (34). Roy et al. mentioned some factors that may lead to severe stress; these are smoking habits, eating behavior, physical activity, and lifestyle (34). Afifa Anjum found and mentioned an important relationship between adolescent's anxiety and their resident area.

They found that 47.9% of urban, 33.9% of semi-urban, and 18.2% of rural students are sufferers of anxiety. However, they also mention an important fact of anxiety that social media use also has a significant impact on adolescent anxiety. They also found more anxiety in female students than males (35), but Roy et al. found contradictory results about stress; men suffer more than females (34). Al Mamun did another study on students at the tertiary level about English language anxiety. Around half of the students, 46.3% student, suffer from a high level of anxiety, 28.8% have moderately high anxiety, and this anxiety mainly comes from personal, classroom, or society (36).

Older people

Older people as a group did not have much priority for research; we have found only two research studies, and both are about depression. There is no research on anxiety, stress, or suicide. The research mainly focuses on health-related problems, and mental health is important to overall health. Abdur Razzaque Sarker researched Tangail, finding that health-related problems are higher in males than females (20).

Md. Zakir Alam added this statement about mental health; in his studies, he found that loneliness and depression are higher in women than in men. He also investigates life expectancy and quality of life in his study. Life expectancy and quality of life are both higher in males than females; it is not obvious, but one reason for loneliness may come from the fact that when 91% of men lived with their spouses then, only 31.5% of women lived with their spouses after their 60s (37). However, rural people live relatively better than urban people do in their older lives.

Tribal people and indigenous communities

Indigenous people are the most neglected population in mental health research. We found only one research study on this population, even though there are many tribal groups and a vast population living in our country. Md Omer Faruk et al. researched the Marma and Chakma populations and measured the prevalence and factors of acute stress and depressive syndrome. They found that 59.2% of all people suffer from acute stress, and 58.8% have depressive syndrome. This is so much higher than the average Bengali population. Between the two indigenous groups, the Marma people are more anxious and depressed than the Chakma people. One interesting result was found out. Although the females from the Marma people suffer more than the male population, it was similar to other population groups of our study in the case of the Chathe km population, which is different. Chakma males suffer more than females (21).

The cause of this deviation needs further investigation. It is worthwhile to address some of shortcomings of this study. The results from the selected study are not comparable due to variations in study settings (clinic vs. community-based), assessment techniques, and thresholds employed to diagnose mental diseases. As a result, the varied prevalence estimates provided could not accurately analyze the trend over time.

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Our review may have been influenced by publishing and selection bias because we could not gather unpublished studies or access any grey literature.

Conclusion

The study reveals a high prevalence of mental health issues in Bangladesh, particularly among university students, medical students, and vulnerable individuals with chronic illnesses. Females and those from private institutions are more vulnerable. Therefore, we should improve mental health services in private universities. The study also highlights the need for more research on older adults and indigenous communities. The findings highlight the need for improved mental health services and strengthening the support systems, couturier interventions for different population groups, and a society prioritizing mental well-being.

Conflict of Interests

The authors report no conflicts of interest.

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Ethical Considerations

This study was registered in the International Prospective Register of Systematic Reviews.

Code of Ethics

Prospero ID: CRD42024546856

Authors' Contributions

Masom Mia: Data curation, formal analysis, software, methodology, project administration, writing- original draft, writing- review and editing. Tafajjal Islam: Methodology, writing-original draft validation, visualization, software, project administration, writing-original draft, writing- review, and editing. Murshida Khatun: Discussed and approved the final version of the manuscript for publication. Md Burhan Uddin Zubair: Writing- original draft validation, visualization, software, writing- review, and editing.

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