Association between Physical Activity and Mental Health among University Students in Bangladesh: A Cross Sectional Study

Miss Sanjida Sultana

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By	Miss Sanjida Sultana
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Thesis Advisor	Nuchanad Hounnaklang, Ph.D.

Accepted by the COLLEGE OF PUBLIC HEALTH SCIENCES, Chulalongkorn University in Partial Fulfillment of the Requirement for the Master of Public Health

..... Dean of the COLLEGE OF PUBLIC HEALTH SCIENCES

(Professor SATHIRAKORN PONGPANICH, Ph.D.)

THESIS COMMITTEE

..... Chairman

(Associate Professor NUTTA TANEEPANICHSKUL, Ph.D.)

..... Thesis Advisor

(Nuchanad Hounnaklang, Ph.D.)

..... External Examiner

(Nanta Auamkul, M.D., M.P.H.)

ชานจิดา ชัลทานา : ความสัมพันธ์ระหว่างกิจกรรมทางกายและสุขภาพจิตของนักศึกษามหาวิทยาลัยในบังคลาเทศ: การศึกษาภาคตัดขวาง. (*Association between Physical Activity and Mental Health among University Students in Bangladesh: A Cross Sectional Study*) อ.ที่ปรึกษาหลัก : นุชนาฏ หวนนากลางPh.D

สุขภาพจิตนับได้ว่าเป็นเรื่องสาคัญอย่างยิ่งเรื่องหนึ่งทางด้านสาธารณสุขเนื่องจากส่วนที่จะทาให้เกิดการบูรณาการที่จะนาไปสู่ชีวิตที่มีความสุข นักศึกษาเป็นกลุ่มที่มีความเปราะบางกลุ่มหนึ่งที่ได้รับผลกระทบจากความเบี่ยงเบนทางด้านสุขภาพจิตเนื่องจากการเปลี่ยนแปลงที่เกิดขึ้นในชีวิตและแรงกดดันทางสังคม รการปรับเปลี่ยนรูปแบบการดาเนินชีวิตเช่นกิจกรรมทางกายเป็นวิธีหนึ่งที่สามารถทาให้รับมือกับปัญหาทางสุขภาพจิตได้ถึงแม้ว่าจะมีงานวิจัยจานวนมากที่ศึกษาเกี่ยวกับผลกระทบจากการออกกาลังกายต่อสุขภาพจิตแต่ก็อาจจะยังไม่ทันสถานการณ์โดยเฉพาะอย่างยิ่งการศึกษาในช่วงการระบาดของโรคโควิด19การระบาดทาให้คนไม่มีกิจกรรมทางกายหรืออยู่นิ่งๆโดยไม่มีการเคลื่อนไหวร่างกายซึ่งเป็นปัจจัยนาไปสู่ปัญหาสุขภาพจิต

วัตถุประสงค์ของการศึกษานี้คือ1)เพื่อหาความชุกของสุขภาพจิต(ภาวะซึมเศร่าวิตกกังวลและความเครียด)และความชุกของกิจกรรมทางการในช่วงการระบาดของโรคโควิด19และ2)เพื่อหาความสัมพันธ์ระหว่างสุขภาพจิต(ภาวะซึมเศร่าวิตกกังวลและความเครียด) และกิจกรรมทางกายของนักศึกษาระเบียบวิธีวิจัยการศึกษานี้เป็นการศึกษาแบบภาคตัดขวางโดยมีวัตถุประสงค์ซึ่งท าการศึกษาในระหว่าง วันที่ 23 พฤษภาคม-15มิถุนายน ณ มหาวิทยาลัย BRAC ประเทศบังคลาเทศ เก็บข้อมูลโดยใช้แบบสอบถามผ่านกูเกิลฟอร์มไปยังสื่อสังคมออนไลน์ต่างๆการสุ่มกลุ่มตัวอย่างใช้การสุ่มแบบสะดวกมีกลุ่มตัวอย่างทั้งหมด413คน

ผลการศึกษาพบว่า ความชุกของภาวะความซึมเศร้าเท่ากับร้อยละ 67.1 ความวิตกกังวลร้อยละ 68.0 และ ความเครียดร้อยละ 59.8 และพบว่า เพศ การนอนหลับ สัมพันธภาพในครอบครัว เพื่อน ความเหงาและความเข้มแข็งทางจิตใจการวิเคราะห์การถดถอยโลจิสติกแบบพหุพบว่าพฤติกรรมการอยู่นิ่งมีความสัมพันธ์กับภาวะซึมเศร้าอย่างมี นัยสาคัญทางสถิติ (OR 1.97, 95%CI 1.08-3.58) และการออกก าลังกายอย่างหนักและพฤติกรรมการอยู่นิ่งมี ความสัมพันธ์กับความเครียด (OR 1.89, 95%CI 1.25 - 2.86 and OR 1.85, 95%CI 1.15 – 2.99) ตามลาดับ

จากการศึกษาแสดงให้เห็นว่านักศึกษาจานวนมากที่มีภาวะซึมเศร้าวิตกกังวลและเครียด นอกจากนี้ยังพว่าสัดส่วนของนักศึกษาที่ไม่ออกกาลังกายตามที่องค์การอนามัยโลกแนะนาจานวนมากควรมีการให้การสนับสนุนทางจิตวิทยากและการให้การปรึกษาให้กับนักศึกษาเพื่อช่วยเหลือทางสุขภาพจิตมหาวิทยาลัยควรมีข้อกาหนดเพื่อส่งเสริมให้นักศึกษามีกิจกรรมกรรมทางการ และการอยู่นิ่งๆ

สาขาวิชา	สาธารณสุขศาสตร์	ลายมือชื่อนิสิต .....
ปีการศึกษา	2564	ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

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Sanjida Sultana : *Association between Physical Activity and Mental Health among University Students in Bangladesh: A Cross Sectional Study* . Advisor: Nuchanad Hounnaklang, Ph.D.

Introduction: Mental health is considered one of the most significant topics of public health as it makes up an integral part of a person's ability to lead a fulfilling life. University students are one of the most vulnerable groups to be affected by mental health disorders due to a change in their life and societal pressure. Lifestyle modifications like physical activity can be one way to combat these Mental Health problems. Although a lot of research has been carried out to analyze the health impact of Physical exercise, impact of it on Mental Health still lags, especially during the Covid-19 pandemic. The pandemic has caused people to live a sedentary lifestyle which could be a risk factor for Poor Mental Health among the population during this time. Objective: This study aimed 1) to identify the prevalence of Mental Health (Depression, Anxiety and Stress) and Physical activity during the pandemic time and 2) to assess the association between mental health (Depression, Stress, and Anxiety) and physical activity among Bangladeshi University Students. Method: This cross-sectional study was conducted between 23rd May to 15 June at BRAC University, Bangladesh. The questionnaire was in google form which was shared to several social media groups. Participants were selected through convenience sampling, totaling 413 students Results: The prevalence of Depression was 67.1%, Anxiety was 68.0%and stress was 59.8%. It was found that Gender, Sleep, Relationship with family, Having toxic friends and family members, loneliness and resilience were associated with Mental Health (Depression, Stress and Anxiety). The multivariable logistic regression analysis showed that the sedentary behavior was significantly associated with depression (OR 1.97, 95%CI 1.08 - 3.58). It was also found that vigorous PA and sedentary behavior were associated with stress (OR 1.89, 95%CI 1.25 - 2.86 and OR 1.85, 95%CI 1.15 – 2.99), respectively. Discussion: The findings of the survey illustrated that a significantly high number of University students have symptoms related to Mental Health Disorders such as Depression, Anxiety and Stress. Additionally, a significant proportion of the population is also not involved in recommended Physical Activity by WHO. Psychosocial support and counseling sessions should be provided by the University to help the status of these students. Additionally, the university should introduce compulsory Physical Activity to boost students PA status and lower Sedentary behavior.

Field of Study:	Public Health	Student's Signature .....
Academic Year:	2021	Advisor's Signature .....

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CHAPTER 1: INTRODUCTION

1.1 Background and Rationale

Mental Health wellness is considered of the most significant topics of Public Health as it makes up an integral part of a person's ability to lead a fulfilling life, including the ability to form relationships, study, work or pursue leisure interests, as well as to make day-to-day decisions and choices (1). However, in most countries of the world, mental health disorders still carry more stigma that any other disorders. More so in low- mid income countries like Bangladesh. This is why mental health challenges are still unmet in this country (2). Mental health disorders create a detrimental impact on the effected individuals as well as their family as a result, the disease burden of mental health disorders is very high, not only in Bangladesh, but globally. Mental disorders are a major public health problem which contributes to 13% of the global burden of disease measured as disability adjusted life and when present with comorbidity, serious mental health disorder can reduce life expectancy by about twenty years (3, 4). However, Mental health research is so few in Bangladesh that there has been no rigid data published stating the burden of disease among general population of Bangladesh (3).

University students are one of the most vulnerable groups to be affected by mental health disorders. After finishing high school, students step into the university life for their undergraduate studies which is considered as a big transition in a person's

life. In this time, some students move away to another city in search of a better education leaving their family and loved one's behind. During this time, students need to meet the increasing burden of academic pressure as well as social expectations like getting a well paid job and participating in social events. It is during this time that they explore their autonomous self and creates self-identity. The pressure causes common mental health problems (MHP) to become prevalent in this population. Some studies suggests that 12 -50% of the College students meet the criteria for one or more than one common MHP which are depression, anxiety and stress (5-8). The stressors can include Sociodemographic factors such as gender, age, living conditions, monthly income as well as other factors including but not limited to academic dissatisfaction, strained relationships, family and peer pressure, sleep deprivation, future worries, loneliness, more time using internet, toxic psychological environment, academic pressure and workload (9-13). The global prevalence of moderate to extreme symptoms is 60.8% for depression, 73% for anxiety, and 62.4% for stress among university students. In Bangladesh, the prevalence of depression is reported to be 54.3%, prevalence of anxiety is 64.8% and stress is 59.0% for the same group (14)

Lifestyle modifications can be one way to combat these MHP. An essential way to modify lifestyle is to be physically active and reduce sedentary behavior as much as possible. WHO defines physical activity (PA) as any bodily movement produced by skeletal muscles that requires energy expenditure –including activities undertaken while working, playing, carrying out household chores, travelling, and engaging in

recreational pursuits. Only exercise is not referred to as physical activity, it is a subcategory of physical activity. Regular physical activity of moderate intensity – such as walking, cycling, or doing sports has significant benefits for health. On the other hand, there might be drop in physical activity which can be due to inaction during leisure time and sedentary behavior on the job and at home together with an increase in the use of "passive" modes of transportation which can also contribute to insufficient physical activity and sedentary lifestyle (15). Sedentary behavior (SB) involves all activities with low levels of metabolic energy expenditure which includes 'too much sitting' as an important sedentary behavior leading to differing health hazards on metabolism, in relation to the lack of exercise (≤1.5 metabolic equivalents (METs)). The term physical inactivity is described as performing insufficient amounts of physical activity, that is, not meeting specified physical activity guidelines provided by the WHO (16). Although a neglected intervention in mental health care, there is evidence that physical activity such as exercise and playing sports is beneficial for mental health (17-19). It is found that these physical activities have proved to reduce anxiety and depression as well as stress.

The Coronavirus pandemic that hit the world 2019 has significantly cause a disruption in physical activity of the people. This can be attributed to the fact that most of the nations in the world have opted to the more disease friendly way of working through the "work from home" method. Moreover, several lockdowns have been imposed in the nations at different times in addition to maintaining social

distancing that are altering people's routine and enabling them to lead a more sedentary lifestyle. During the pre-covid times, people would go to malls, go out for recreation, work, jog etc. which would require physical movement. However, with an increase in restrictions of people movement outside, physical inactivity and sedentary lifestyle is more common (20, 21). According to research conducted in Thailand, the prevalence of sufficient Moderate to vigorous physical activity decreased from 74.6% to 54.7% when compared the prevalence between pre pandemic and during pandemic period (20). Not only in Thailand, but also in another research conducted in Brazil, there was a significant decline in physical activity during the pandemic period when compared to the non-pandemic period (21). Although physical inactivity has always been a concern, it is now much so in a bigger scale as it puts people to the risk of cardiovascular diseases, Diabetes, hypertension and other comorbidities associated with physical activity which has the potential to worsen the impact of Covid-19 prognosis. In addition to a decrease in Physical Activity, an increase in the prevalence of depression and anxiety is also increasing due to isolation and unpredictability which may negatively impact the mental health of the population at a large scale (21). Evidence suggests that even with the relaxation of measures regarding social isolation and lockdowns in some countries, the physical activity of the population have not yet reached the pre-pandemic level. The factors that affect the transition of PA performed during this period of time includes Gender, Age, Socioeconomic status, Health status, educational background and field (22, 23).

Although several studies have been conducted analyzing different stressors in University students of Bangladesh, to our knowledge research on impact of Physical activity on mental health during the Covid-19 pandemic is limited. Studies based in Bangladesh tend to focus more on the benefits of physical activity on the physical health due to the stigmatization of mental health topics. To reduce the burden of mental health disorder, it is significant that the population is made aware of mental health disorders and interventions is made readily available. One such intervention is physical activity. The unprecedented times due to Covid-19 has caused a detrimental impact on mental health of the population due to social isolation, trauma and uncertainty. With closures of schools and entertainment centers for over 2 years, the impact on the youth can be considered significant. It is vital to study the impact of physical activity on mental health during this pandemic period on sample based in Bangladesh to be able to generalize the findings to the targeted population as stressors in different countries can be different.

In this paper, we determined the prevalence of stress, anxiety and depression and explore if involving in physical activities such as exercise impact the mental health of University students in Bangladesh during this stressful time of Covid-19. We have chosen BRAC university to collect our sample because it is one of the best universities in Bangladesh where people from all over the country come to study in search of better education. The University has about 10,000 Undergraduate students and seven departments which are department of Architecture, Computer Science and

Engineering, Economics and Social Science, Electrical and Electronic Engineering, English and Humanities, Mathematics and natural Science and Pharmacy.

Figure 1 Showing Location of Dhaka in Bangladesh Map (24)

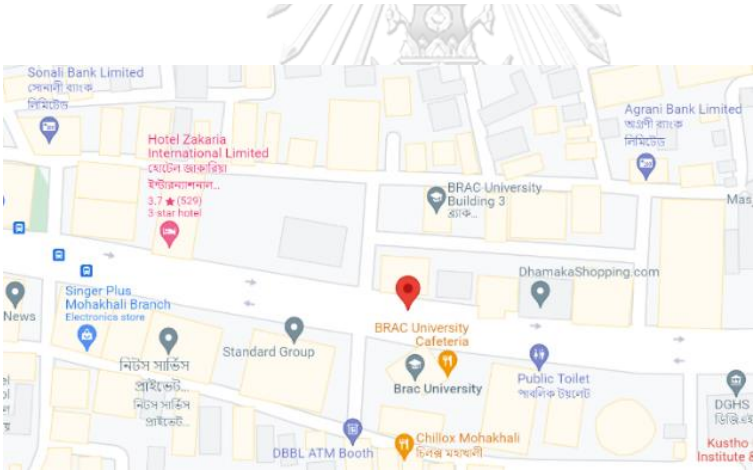


Figure 2. Location of BRAC university on Map of Dhaka (25)

1.2 Research Questions

a) What is the prevalence of mental health (Depression, Stress, and Anxiety) among Bangladeshi University Students during Covid-19?

b) Is there an association between mental health (Depression, Stress, and Anxiety) and physical activity among Bangladeshi University Students?

1.3 General Objectives:

a) To find out the prevalence of mental health (Depression, Stress, and Anxiety) among Bangladeshi University Students during Covid-19.

b) To find out the association between mental health (Depression, Stress, and Anxiety) and physical activity among Bangladeshi University Students.

1.4 Specific Objectives

a) To assess the status of mental health i.e., Depression, Stress, and Anxiety among Bangladeshi University Students.

b) To find out the status of physical activity among Bangladeshi University Students.

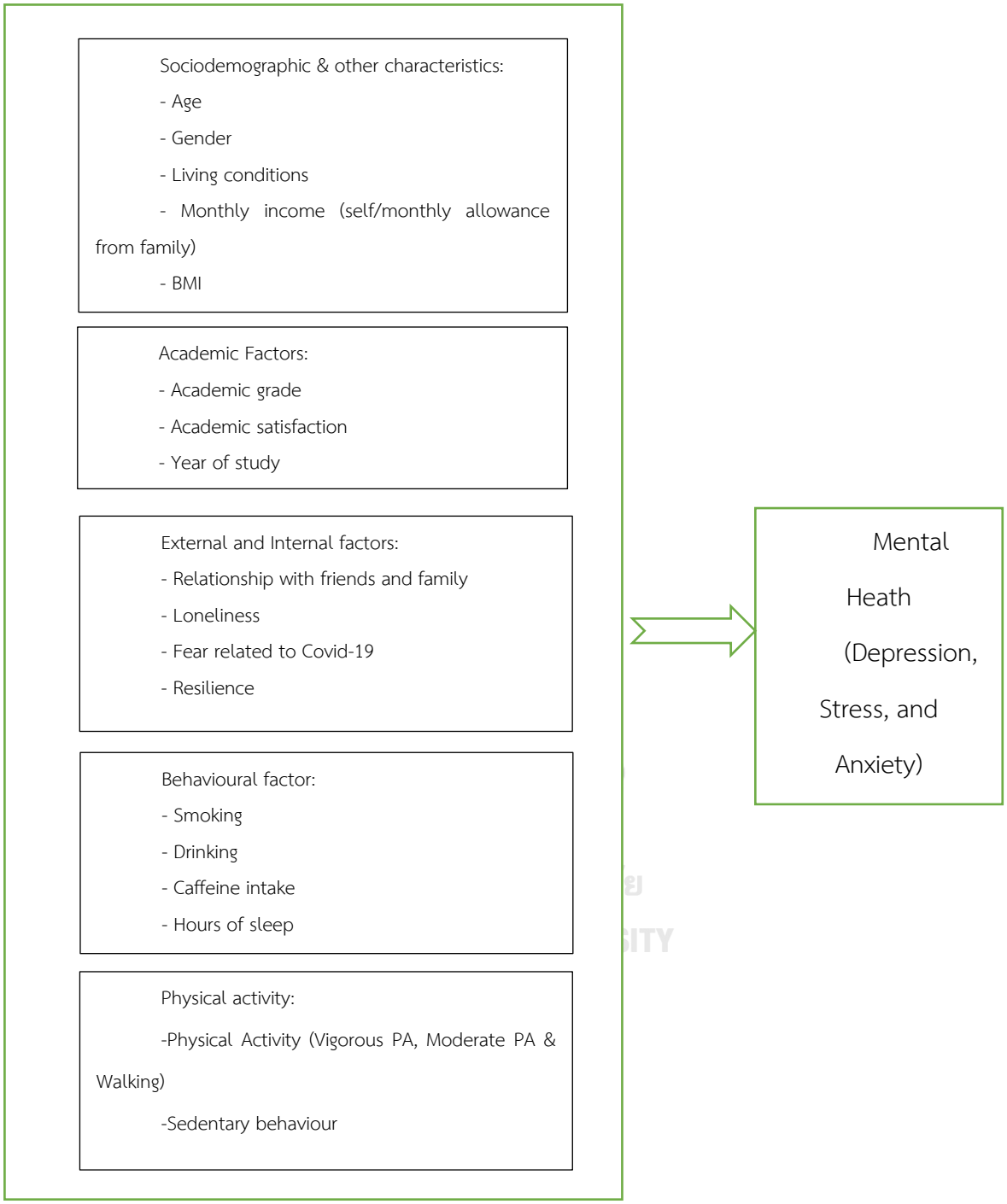
c) To evaluate association between mental health and physical activity among Bangladeshi University Students.

1.5 Research Hypothesis

a) H_0 = There is no association between mental health (Depression, Stress, and Anxiety) and physical activity among Bangladeshi University Students.

B) H_1= There is an association between mental health (Depression, Stress, and Anxiety) and physical activity among Bangladeshi University Students.

1.6 Conceptual Framework:



1.7 Operational Definition

	Term	Operational Definition
1	Mental Health	Mental health is one's emotional, social & psychological wellbeing which we will be measuring by symptoms of depression, anxiety and stress using DASS 21.
2	Mental Health Disorder	Mental illness, also called mental health disorders, refers to a wide range of mental health conditions — disorders that affect one's mood, thinking and behavior. In this study, we will look at some common mental health disorders which are Depression, Anxiety and Stress which we will identify using the DASS 21.
3	Physical Activity	Any bodily movement produced by skeletal muscles that requires energy expenditure including activities undertaken while working, playing, carrying out household chores, travelling, and engaging in recreational pursuits. This can be categorized into moderate or vigorous physical activity. Moderate Physical Activity refers to Physical Activity that will

		need around 3.0 to 6.0 METs, 3.5 to 7 kcal/min energy expenditure. Vigorous physical activity refers to activities that spend greater than 6.0 METs and more than 7 kcal/min. At least 75 min vigorous or 150 min moderate activity should be performed per week according to WHO (15). We will measure this using our derived version of IPAQ-SF. We will categorize PA into physically active and inactive following WHO guideline and Sedentary behavior into ≥8 hours or <8 hours.
4	Sedentary Behavior	Any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents (METs). WHO recommends not spending more than 8 hours in this. (15)
5	Sociodemographic factor	A combination of social and demographic factors that define people in a specific group or population including age, gender, living arrangement, income, education.
6	Relationship with friends and family	Dynamics of relationship in the person's life, how would they rate their relationship with family,

		whether or not they have toxic family members and friends and how they will describe their romantic relationship if they have any.
7	Toxic relationship	Relationship that causes one's wellbeing-physical or emotional to be threatened. It's a relationship that can make one feel attacked, demotivated, demeaned and unsupported including physical or verbal abuse.
12	Loneliness	Feeling of being alone and not having anyone to share feelings with. This will be measure suing the UCLA 3 Items loneliness scale.
13	Fear related to Covid-19	Exploring the fears of the subject that are additional due to the pandemic going on in the world currently to analyze the impact on mental health. Fears can be due to social isolation, over share of news, fake news, family member, loved ones or self being affected by Covid-19 or passing away from the infection.
14	Resilience	Ability to cope with the adversities of life. The 10 items CD-RISC scale will be used to measure this.

CHAPTER 2: LITERATURE REVIEW

2.1 Mental Health

Mental health focuses on one's wellbeing based on emotional, social & psychological wellbeing. One's mental health effects how he thinks and perceive different stimulus as well as their actions and feelings. Both mental health and physical health are very essential components of one's overall health. A person's mental health can change overtime. Many factors can contribute to poot mental health or mental health illnesses. One demand exceeds a person's resources his mental health could be affected (26). The global prevalence of moderate to extreme level is 60.8% for depression, 73% for anxiety, and 62.4% for stress. In Bangladesh, the prevalence of depression is reported to be 54.3%, prevalence of anxiety is 64.8% and stress is 59.0% (14).

University students are one of the most vulnerable group in terms of mental health. As this is a time when many things in their life changes, for example friends, living situation, study and work pressure etc. According to a study conducted at a University in Bangladesh, the prevalence of moderate to the severe levels of depression was 52.2%, anxiety was 58.1%, and stress was 24.9% (27). Another study that looked at mental health disorder among college students in 21 countries including high, low- and middle-income countries based on reports from WHO showed that 20.3% of the college students had 12 months DSM-IV disorder (28)

2.2 Mental health and the society

Although mental health disorders are a growing public health concern and it contributes to about 13% of the global burden of disease as reported by few studies (3, 4) there is still a lot of stigmas associated with it which makes it harder for the sufferers. The impact of stigma can be divided into two types- public stigma, which is the negative reaction that people have towards the sufferers and self-stigma which the sufferer has towards himself. It can be because of either or both these stigmas that people suffering from mental health related problems do not seek help from professionals (29). Many studies have showed that stigmas associated with mental health are widely endorsed by the western society (30-37). Not only in western countries but even in Asia, there is a widespread discrimination and stigmatization towards people with mental health related disorders. People with severe mental health disorders are not only considered dangerous but also supernatural. Instead of seeking help from professionals, a large portion of the population believes is religious, magical & supernatural approach to combat the problems (38). This attitude can be attributed to the lack of knowledge and mental health literacy including information about mental health related disorders, symptoms, and treatments around the world (39-42). In Bangladesh, even today, people are unaware of mental health and the problems associated with it and the topic is stigmatized to an extent that people

would not even talk about it, a lack of literature or research about mental health related knowledge based in Bangladesh is a proof of this.

2.3 Mental Health problems and comorbidity

Comorbidity is the presence of two or more diseases together, where the presence two or more diseases will worsen the prognosis of all the diseases that are present and lead to more severe complications, hence making treatment difficult. Over the years, comorbidity in mental health has been an increasing concern globally. Besides older people, comorbid mental & physical conditions are increasing even at a younger age which is reducing quality of life of the youth (43). A study conducted in France showed that 6% of the total sample population had psychiatric co-morbidity where more than one mental health disorder/problem was present in the sample. The most common co-morbidities were between MDD, Anxiety disorder and substance use disorder (7). However, comorbid conditions are not only limited to having two or more mental health problems at the same time, presence of other physical health conditions together with mental health disorders or problems are also comorbid conditions. Over the last few years, comorbid mental and physical condition have increased to a great length. Several studies have found out comorbidities between different mental health disorders and chronic physical illness. Association between mental disorders like depression, anxiety, schizophrenia and bipolar disorders and chronic physical diseases such as cancer, heart disease, stroke, diabetes, obesity and

chronic obstructive pulmonary disease (COPD) have been reported in several studies (44-48)

2.4 Determinants of Common Mental Health Problems

There are several factors that act as risk factors for Mental health disorders. These factors vary according to the sample being looked; the countries they belong in as stressors can vary across different cultures and geographical regions. As we are interested in the mental health of university students of Bangladesh, we explored the determinants of the common mental health among this population.

Sociodemographic factors such as gender, socioeconomic status, parent's educational level and type of accommodation they live in are some determinants of common mental health disorders among university students in Bangladesh. Prevalence of these disorders are higher in students who are males, have lower SES, have parents who are illiterate or with a low level of education and students who live with their family instead of alone or with friends. (9). BMI was found to be strongly associated with the presence of common mental disorders as well which was also predicted by gender and age. Younger women had a higher probability of having a mental health disorder as BMI increased, whereas in younger men, the probabilities were higher for both underweight and obese men (49).

Academic satisfaction and grade are another risk factor of common mental health disorders among Bangladeshi students. Prevalence of these disorders are lower

in students with a higher grade and higher academic satisfaction. In addition, these students tend to have higher level of happiness (10).

Human behaviors impact mental health to a great extent as well. Using social media or Facebook for prolonged hours can contribute to these mental health disorders. Students who use Facebook or social media for long hours (more than 5 hours every day) tend to have symptoms of depression. Predictors of Facebook addiction are reported to be being single, lack of physical activity, sleep disturbances (12). Other human behaviors that are risk factors of the common mental health disorders are having no or inadequate physical activities, sleeping less or more than normal hours & smoking (14). A study conducted in Chittagong; Bangladesh found that sleep deprived students showed greater level of anxiety than sleep non- deprived students. Significant correlations were found among sleeping hour and mental health (50). Higher doses of caffeine intake have also been particularly associated with mental health disorders like anxiety, depression and panic disorder in several studies. It is found that higher level of caffeine intake increases anxiety and reduces sleep which in fact impacts the health-related quality of life indirectly (51-53) . A number of studies have found out that a hazardous level of alcohol consumption is associated with increased mental health problems such as depression and stress among university students as well as general population (54-57) .

There are several other well researched risk factors affecting mental health of university students. A research conducted on university students in Bangladesh also

found positive correlations between loneliness and depressive symptoms in the students (58). Relationship in a person's life also affect their mental health. People with toxic relationships with family members, friends or partners have a higher tendency to suffer from symptoms of depression. In fact, several studies have found that good relationship with friends, family and partner act as a protective factor against depression (59-61). Fear related to Covid-19 also positively associates with mental health disorders like depression, anxiety and stress. One reason can be due to fear of contracting the virus, individuals isolate themselves which impacts their psychological status negatively. The fear might take over them and affect their work productivity which in turn causes stress and anxiety and depressive symptoms. Constant worrying, anxiety, stress and depressive symptoms can be common in individuals when they cannot reach their family members or in case any of their family members get infected. Rumors and overexaggerated information can also contribute to rising fear levels causing individuals to become more stressed and anxious (62). Resilience is another factor that impacts mental health largely. Resilience is a form of defense mechanism that enables a person to spring back in times of adversity. A higher resilience allows a person to function normally despite of the negative or unprecedented events (63, 64). Number of studies have been conducted in order to explore the association between mental health and resilience. It has been found that a higher level of resilience is negatively correlated to symptoms of stress, anxiety and depression (65-67).

2.5 Physical Activity & Mental Health

WHO defines physical activities as any bodily movement that is produced by skeletal muscles that requires energy expenditure and all movement including during leisure time, for transport to get to and from places or as part of a person's work. Physical activity does not only mean exercise but also include playing sports, walking, cycling, active recreation. There are several benefits of performing regular physical activities on both physical and mental health. There are several guidelines published by the WHO which recommends the physical activity that should be performed specified by different age groups. Adults aged 18–64 years should do at least 150–300 minutes of moderate-intensity aerobic physical activity or at least 75–150 minutes of vigorous-intensity aerobic physical activity per week. They can increase the duration of the activities performed for additional health benefits. According to report from WHO, 28% of adults in the category mentioned above were not active enough in 2016, which means they did not meet the guideline by WHO (15). In accordance with CDC and ACSM guidelines, moderate and vigorous physical activity is classified through the energy expenditure. A moderate PA will need around 3.0 to 6.0 METs, 3.5 to 7 kcal/min energy expenditure. Examples of moderate physical activity includes walking, dancing, yoga, gymnastics, jumping on a trampoline, weight training, gardening, boxing (punching bags), table tennis, golf etc. Activities that spend greater than 6.0 METs and more than 7 kcal/min are vigorous physical activities. Examples include racewalking, running,

jogging, bicycling more than 10mph, push-ups, pull-ups, jumping jacks, karate, boxing (in the ring) and wresting, competitive sports (basketball, soccer, football, tennis, lacrosse), squash, canoe/kayak etc (68). Lifestyle modifications such as performing physical activities is one of the most effective ways to reduce symptoms of mental health disorders. Aerobic exercises like swimming, gardening, walking have been reported to reduce stress and anxiety (69). Exercise also helps to improve self- image, social skills and cognitive functioning which contributes to overall mental health wellness. (70, 71). There are several models used to explain this effect. The physiological or biological explanation of this is proposed to be caused by an increase in blood circulation to the brain which is induced by exercise and by an influence on the hypothalamic-pituitary-adrenal (HPA) axis through release of monoamines (dopamine, serotonin and Noradrenaline) and endorphins, thus, on the physiologic reactivity to stress by binding to their specific receptors at the nerve terminals resulting in an uplifted or happy mood (69). It is also hypothesized that this physiologic reaction is mediated by the communication of the HPA axis with several regions of the brain, including the limbic system which functions to control motivation and mood; the amygdala, which generates fear in response to stress and the hippocampus, which plays an important part in memory formation as well as in mood and motivation (72). There are other hypotheses that explain how exercise or other physical activity can benefit a person's mental health from a psychological perspective. One such hypothesis is the distraction hypothesis that suggests that redirecting attention from

disturbing stimuli through exercise leads to an improved mood. The self- efficacy hypothesis says that since exercising can be a challenging activity for some, being able to do it provides a sense of accomplishment and hence contribute to self- confidence and improved mood (73). There is no consensus reached regarding how physical activity including exercise improves mental health but a psychobiological model combining all of them seems the most plausible (74).

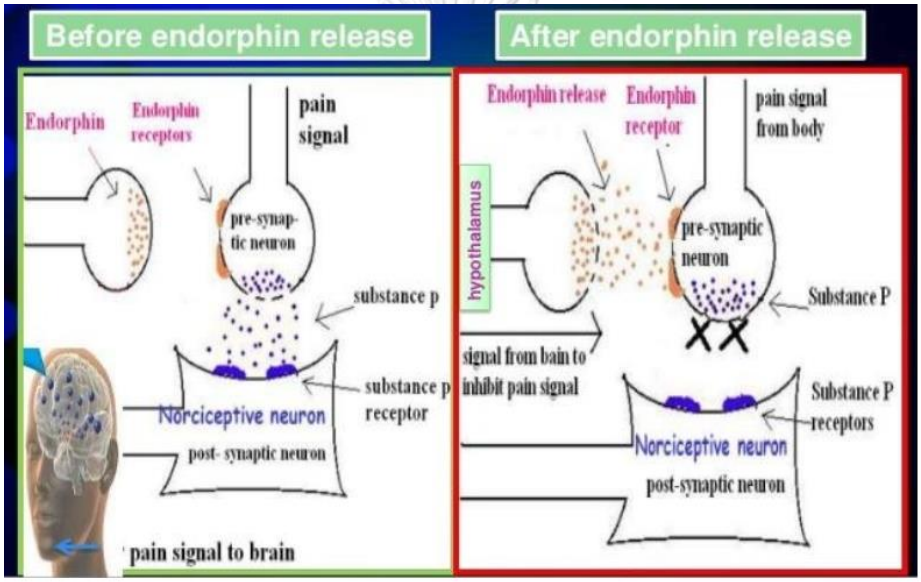


Figure 3. Pathway of Endorphins Release Before and After Exercise

In this diagram, substance P is stress hormone Cortisol (75). Not just in improved mental health, regular physical activity has numerous benefits like preventing and managing non-communicable diseases such as Cardiovascular diseases, cancer, diabetes. Besides, it also enhances one's ability to think and learn and judge. People who are insufficiently active are at 20-30% higher risk than active people. Yet, 80% of the world's adolescent population globally was inactive according to the WHO report

in 2020 (15). A study conducted in Bangladesh in 2016 reported that only the overall country wise prevalence of low PA was about 34.5% with women being the more inactive group (76). Another study by Islam published in the International Journal of Environmental Research and Public health in 2021 explored the pattern of PA in patients with high blood pressure in Bangladesh where it found that only 1% of PA was recreational for women and 3% for men. Most routine PA was work-related. This study also concluded that PA in women was much less than in men (77).

2.6 The Covid-19 Pandemic in Bangladesh and its impact on Mental Health & Physical Activity

The Covid-19 Pandemic that hit us towards the end of December 2019 has changed our lives in many ways. Several measures have been taken to curb the spread of the virus. One such measure that has impacted human physical and mental health is social distancing and lockdown. Although the Covid-19 pandemic is becoming normalized in many countries now, almost all the countries had taken extreme measures to curb the spread of the virus at some point of the pandemic and more than once. In Bangladesh, the first case of Covid-19 was reported to be on March 8, 2020, after which the first nationwide lockdown was imposed from 26 March to 4 April which was named as “General Holidays”. It was then extended to May 31, 2020, after 66 days. A second lockdown was imposed on April 5, 2021 and until April 21, 2021 but

was extended until August 11, 2021. However, the educational institutions has never been fully opened ever since the pandemic (78). This means that more people spent "lazy days" with lesser movement at home during work-from home leading to a higher sedentary lifestyle.

The Covid-19 Pandemic has also led to negative consequences among the university students. Although the Covid-19 pandemic has resulted in the educational institutes to rapidly change their system to online platform, it has been especially hard for the students to adapt to these new changes. A study published in January 2022 in the International Journal of Environmental Research and Public health explored the "Impacts of COVID-19 on the Education, Life and Mental Health of Students in Bangladesh". This study has found out that 13.7% of the students reported to be unable to focus on their studies during these times up from 1.2% pre Covid-19. It was also reported that 54% of the sample spent more time on social media than before (79). The same study also reported that 45% of the sample had severe to moderate level depression using the PHQ-9 scale, 48.6% of students were suffering from severe to moderate level anxiety which was measured using the GAD-7 scale. Out of the total sample, only 26.1% of the population had no symptoms of depression. Only 21.8% of the total study sample had minimal anxiety symptoms Significant factors that had been found to be associated with the mental health of the students were students' focus on their study, their social media usage and overall internet usage, sleep time, personal care time, and changes in future plans (79). Another article published in the

Journal of Affective Disorders in August 2020 analyzed the impact of Covid-19 Pandemic on the Mental Health of University and College students using the DASS 21 and IES scale. The study found out that 28.5 % of the respondents suffered from stress, 33.3% from anxiety, 46.92% mild to extremely severe depression according to DASS 21 and 69.31% had event-specific distress from mild to severe in terms of severity according to IES. The same study also analyzed factors associated with the mental health of these students. This study also stated absence of physical activity as a significant factor causing detrimental impact on the students' Mental Health (80).

2.7 Other Related studies

The impact of physical activity on Mental health has been studied for a long time around the world. Several research papers have been published regarding this topic. However, the impact of PA on Mental health during the Covid-19 Pandemic has been studied at a limited scale. It is well known the Covid-19 pandemic has changed our lives in many ways, social distancing and lockdowns as well as constant fear of the virus has not only compromised Mental health of the populations but also their motivation to be physically active. Especially with work from home and schools being online, Sedentary lifestyle is becoming the norm in many nations. There are several factors that could contribute to the PA and Mental health in these times for example SES, gender, health conditions etc. A limited number of research have been done to explore the relationship between PA and mental health.

A paper titled “The relationship between physical activity and mental health in a sample of the UK public: A cross-sectional study during the implementation of COVID-19 social distancing measures” published by Elsevier explored the association between physical activity and mental health in the UK public during Covid-19 pandemic. The study used a pre-planned interim data from a cross sectional epidemiological study which was administered through an online survey. The Two variables of the study, PA was self-reported and mental health was measured using Beck Anxiety and Depression Inventory and the Short Warwick–Edinburgh Mental Well-being Scale (SWEMWBS). The covariates which were analyzed were sex, age, marital status, employment and annual household income, smoking and alcohol status and multimorbidity. Associations between moderate-to-vigorous physical activity per day in hours (independent variable) and several mental health outcomes (poor mental health, moderate-to-severe anxiety symptoms, moderate-to-severe depressive symptoms, and poor mental wellbeing; dependent variables) were analyzed using regression models which were adjusted for sex, age, marital status, employment, income, current smoking, current alcohol consumption, and the number of chronic physical conditions with significance set at p-value < 0.05 using R 3.6.2. The results showed that prevalence of poor mental health, moderate to severe anxiety symptoms and moderate to severe anxiety symptoms were all negatively associated with PA (OR<1, 0 < CI <1) when controlled for the confounding factors (81).

Another paper named “The role of physical activity on mental health and quality of life during COVID-19 outbreak: A cross-sectional study” published in the European Journal of Integrative Medicine in 2020 studied the effects of physical activity on quality of life, depression and anxiety levels during the COVID-19 outbreak in Turkey. This study used googles forms to collect data by virtual snowball sampling method. The study sampled people from 20-75 years old and had a sample size of 2301. Physical activity was measured through IPAQ and divided into Physically Inactive (<600 MET-min/week), Minimal active (600–3000 MET- min/week) and Active (>3000 MET-min/week). Becks Depression and anxiety inventory was used to measure depression and anxiety. Quality of Life was measured using WHO QOL scale. Sociodemographic factors and data related to Covid-19 were analyzed as confounding factors. Multivariate analysis was used to analyze the data. A significantly positive relationship was found between Quality of Life and Level of PA and negative relationship was found between Becks Depression and Anxiety inventory scale and level of PA ($p < 0.05$). The study found out that level of PA in the population was high and Depression and Anxiety was high (82).

A similar study was conducted in the United Kingdom (UK), Ireland, New Zealand and Australia in 2021 which was published in the Journal of Science and Medicine in Sport titled “Physical activity, mental health and well-being of adults during initial COVID-19 containment strategies: A multi-country cross-sectional analysis”. This study also used an online survey to collect data. This was a self-reported questionnaire

which asked questions about sociodemographic factors, Status of physical activity as measured through IPAQ-SF, Exercise behavior change by Stages of Change scale, Mental health (Depression Anxiety and Stress) by using DASS-9, Well-being using WHO -5 Well-being Index and description of weekly exercise by using free-text responses. For WHO-5, DASS-9 and IPAQ-SF, multivariable linear regression obtained the independent effect of each characteristic on the outcome. Age, gender and ethnicity were included as covariates to control for their independent effects in the multinomial logistic regression and multivariable linear regression. Spearman's correlation coefficient was used to quantify association between PA with mental health and well-being. All tests were done using STATA. Results reported that fewer women met the PA guidelines by WHO even before the pandemic, there was no statistical difference between PA among the countries and for all countries, women engaged in lower high intensity PA. The study found out that PA was negatively correlated with depression, anxiety and stress ($p<0.001$) and positively correlated with well-being ($p<0.001$).

2.8 Measurement Tools

We have reviewed several measurement tools to select the best suited tools for out setting and sample. The most important variable of this study is measuring the physical activity and mental health.

The scale we are using to measure Mental Health is is the DASS-21 scale. There are several other scales that can be used for example Beck's Anxiety Inventory and

Beck's Depression Inventory. However, compared to these scales, DASS-21 is more suitable for our study. First of all, compared to BDI and BMI, DASS-21 has greater separation in factor loading (83). Moreover, BDI and BMI each contains 21 questions and does not cover stress which makes it unsuitable for use in our study. In Bangladesh, a lot of previous research has been made using DASS-21 scale which has been proved reliable for population of the country. The DASS-21 scales identify dysphoric symptoms. This is a standardized tools used in many countries by researchers including Bangladesh as the scale has been converted into 45 different languages including Bangla that allowed this to be tested on a wide range of population in the world including Bangladesh (84). The scale has also been tested for reliability and validity across several countries. The Cronbach internal consistency of the entire scale is 0.89 and Test- retest and split-half reliability coefficient scores were 0.99 and 0.96 respectively showing that this scale is valid and reliable (85).

We are using a derived version of IPAQ-SF questionnaire to measure the physical activity. IPAQ is a widely used questionnaire for subjective measurement of Physical activity. Test-retest reliability for this is moderately high (rw = 0.74), also it is moderately-high for concurrent validity (rw = 0.72) (86). Validity of the IPAQ-SF has been assessed across 12 countries and showed that acceptable properties for use in many settings and in different languages. Another widely used measurement data for Physical Activity is the GPAQ (modified version of IPAQ), however, GPAQ is advised to be administered through interview, which is more difficult in the times today due to

the pandemic (87). Moreover, GPAQ has 16 questions which will make the questionnaire longer leading to loss of concentration of the participants.

CHAPTER 3: MATERIALS AND METHODOLOGY

3.1 Research Design

The study was approved by Public Health Foundation, Bangladesh (PHF Ethic Protocol PHF-SG-4001). A cross sectional study was conducted between 23rd May 2022 to 15th June 2022 where the online questionnaire was administered to the participants through social media. It had questions about sociodemographic factors, academic factors, Behavioral Factors, External & Internal factors, Physical Activity and Mental Health. This research was conducted on Undergraduate Level Students at BRAC University, DHAKA, Bangladesh. Participants were selected through convenience sampling. Anyone who were interested to participate and met the inclusion/exclusion criteria were welcomed to participate. There are a total of 10029 students currently studying at undergraduate studies in the institution.

Inclusion Criteria:

- Participants must be able to read and write in English, must be a student (of any department) of UG studies in BRAC University
- Participants must be part of social media (Facebook or WhatsApp)
- Participants should have ability to use google form
- Participants must be a Bangladeshi resident & Nationality
- Participants must be 18-25 years old and have already completed at least one semester at the university.

Exclusion Criteria

- Students with physical chronic diseases such as Cancer, CVD, Diabetes, CKD and diagnosed mental disease such as MDD, Schizophrenia, Bipolar Disorder.

Sample Size

Sample size in this study was calculated by the Cochran formula (88).

$$n = \frac{Z^2_{\alpha/2} p(1-p)}{d^2}$$

$Z^2_{\alpha/2}$ = 1.96 : Critical value for 95% confidence level

d = 0.05 : Absolute precision required

p = 0.54 : Prevalence of depression (89)

$$n = \frac{(1.96)^2\ 0.54(1-0.54)}{(0.05)^2}$$

$$n = 382$$

From above formula, the minimal participants were 382 people. 20% additional participants (77 people) are added to avoid person who refuse or not complete answering the questionnaires. So, the total sample size is 459 people.

3.2 Data Collection

The questionnaire was created in google forms and circulated through different BRAC university student groups in social media like Facebook. After scanning the QR code, the participants were directed to the screening questions based on the exclusion/inclusion criteria. After confirming that the participant has met all the criteria, they were then redirected to the to the questionnaire where they were asked to understand the information provided and agree to the informed consent. After clicking agree, the participants were able to proceed to the next page where they were asked to fill up the survey. The data collected was validated by setting the questionnaire to allow only BRAC University student using the institution email ID to response. To avoid duplication, the questionnaire was also set to allow only one response from each email ID.

3.3 Measurements & materials

The questionnaire consisted of six sections in total.

- Section one of the survey had questions exploring the sociodemographic factors and other characteristics. There were six questions in this section which asked about age, gender, height & weight, self-dependence, monthly income/allowance and living condition. BMI was calculated using height and weight using the formulae below and categorized into 4 groups:

$$BMI = Weight\ (kg) \div\ height\ (m^2)$$

where BMI,

>18.5= Underweight

18.5-24.9= Normal

15.0-29.9= Overweight

30.0+= Obese

- Section two consisted of three questions about academic factors (Academic year, academic satisfaction and CGPA)
- Section three explored various behavioral factors such as sleeping status, smoking status, alcohol consumption pattern and caffeine intake pattern. This section had six questions.
- Section four looked at External & Internal Factors such as relationship with friends and family, Relationship Status, loneliness, Fear related to Covid-19 and Resilience. Loneliness was measured through the UCLA 3 items loneliness scale. Scores for all 3 items for loneliness were added up and categorized into lonely or Not lonely. Participants who scored 3-5 were categorized as “Not lonely” whereas participants who scored 6-9 were categorized as lonely. Resilience was measured through the 10 item CD-RISC scale. The Cronbach alpha coefficient was 0.85 and the test-retest intraclass correlation coefficient was 0.71 for this scale (90). There was a total of twenty questions in this section.

Scores for all items were added up and converted to a binary outcome where Q4 was defined as Resilient group. This section had a total 20 questions.

- Section five of the questionnaire had questions about physical activity which is derived from the short version of IPAQ. Test-retest reliability for this is moderately high (rw = 0.74), also it is moderately-high for concurrent validity (rw = 0.72) (86). There were four questions in this section where the responses were in a four-point Likert scale from 0 (none)- 3 (High). WHO recommendation was used to for this categorization. For the final regression, The PA level for each category (vigorous PA, moderate PA and walking) was combined and categorized into physically active and inactive as guided by WHO recommendations. Participants who performed at least 75 minutes of vigorous PA and/ 150 min of moderate PA and/ 150 minutes of walking in previous week were defined as active and participants who did not meet this guideline were defined as inactive.

- Sedentary behavior was categorized into binary outcome being sedentary/not being sedentary using the WHO recommendation where 8 hours or more of SB is defined as being sedentary.
- Finally, the last section, section six asked questions to explore the subject's mental health, especially symptoms of depression, anxiety, stress using the DASS-21 scale. The Cronbach internal consistency of the entire scale is 0.89

and Test- retest and split-half reliability coefficient scores were 0.99 and 0.96 respectively showing that this scale is valid and reliable (85). The DASS-21 consists of twenty-one items with four-point Likert's Scale which are Did not apply to me at all coded as 0, Applied to me to some degree or some of the time coded as 1, Applied to me a considerable degree or a good part of time coded as 2, and Applied to me very much or most of the time coded as 3. The item for each disorder is added up. The scale can be measure as Normal, Mild, Moderate, Severe, and Extreme Severe. For this study, we coded the outcome for each Mental health Disorder as having the disorder (YES) for mild, moderate, severe and extremely severe symptoms. And not having the disorder (NO) for normal category. Cut off point for Depression was 4, Anxiety was 3 and Stress was 7.

3.4 Instrument Development

- We obtained permission for questionnaire distribution from authors of CD RISC Scale. The other 3 questionnaire used in the study which are UCLA 3 items loneliness scale, DASS-21 and IPAQ-SF are open to public and can be used without any permission.
- Attained the validity of measurements from 3 experts based on The Item-Objective Congruence (IOC) where all items were scored more than 0.5, indicating that the questionnaire was valid.

- To obtain reliability of measurements, the questionnaires were distributed to 30 undergraduate students at BRAC University, after that they were calculated to measure the reliability of measurements. The Cronbach's coefficient alpha was calculated. For the UCLA-3 items scale, it had a value of 0.724, for CDRISC Resilience, it had a value of 0.875, for derived version of IPAQ SF it was 0.706 and for DASS 21 it was 0.903.

3.5 Data Analysis

A total of 501 samples were obtained from which only 413 entered the final analysis after incomplete survey. Out of the 413, some variables contained invalid data which were excluded during analysis of those variables (BMI, Monthly income/allowance, CGPA) as shown in figure 4. Descriptive statistics like number and frequency was used to determine the percentage of each variable and summarize the obtained data. Bivariate Logistic Regression was used to analyze association between the predictor's variables and Mental Health. Bivariate & Multivariable Logistic regression was used to find out association between Physical Activity and Mental Health. Unadjusted OR and adjusted OR with 95% confidence interval was reported. Statistical significance was defined as $p < 0.05$ and analyzed using SPSS version 24.

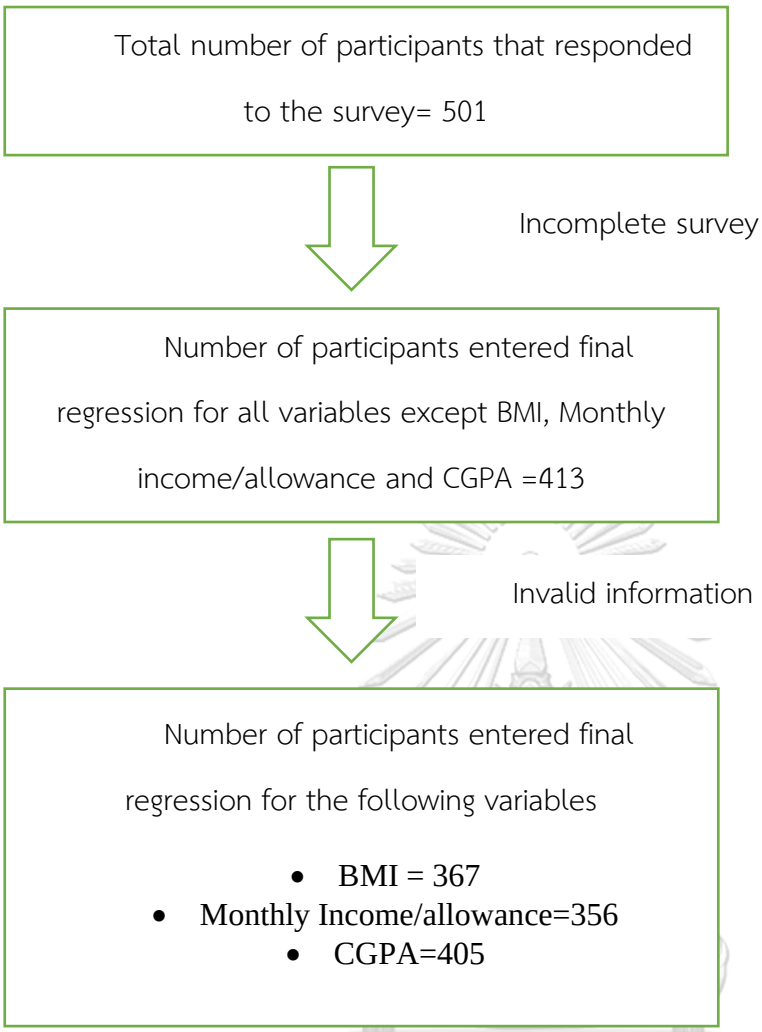


Figure 4: Flowchart showing participants for final analysis

CHAPTER 4: RESULTS

The purpose of this study was to determine the prevalence of Mental Health (Depression, Anxiety & Stress) among University students in Bangladesh during the Covid-19 pandemic and to explore whether there an association between physical activity and Mental Health (Depression, Stress, and Anxiety) among Bangladeshi University Students. A total of 501 questionnaires were collected out of which 413 entered the final analysis after excluding questionnaires that did not meet the inclusion/exclusion criteria and invalid data sets. Some of these 413 questionnaires were missing data for the questions on BMI, Monthly Income/Allowance and CGPA.

4.1 Characteristics of the Study Participants

Table 1 shows the Characteristics of the Study Participants from BRAC University, Bangladesh which are divided into Sociodemographic factors, Academic Factors, Behavioural factors and External & Internal Factors.

For the sociodemographic & other characteristics of the participants, participants age, gender, BMI, self-dependence, monthly income/allowance and living conditions were analysed. In this study, more than half of the participants were male (68.5%), not self-dependent (80.1%), living with immediate family (67.6%), followed by 19.6% living with friends. Only 5.8% of the participants reported to be living alone. Most of these participants were at least 22 years old (36.3%) followed by 20 years old (27.1%), 21 years old (22.5%). Only 14% of the participants belonged to the age group 19 years

old or less. Participants were seen to be almost equally distributed for monthly income/allowance. Most participants reported to have an income between 5000 to 9999 BDT (28.9%) followed by an income of less than 5000 BDT (25.8%). 24.4% of the participants reported to have an income of at least 15000 BDT. Only 20.8% of the participants reported an income between 10000-14999 BDT. As for BMI, most belonged to the normal category (55.6%), followed by overweight (28.6%) and obese (9.5%). Least number of people were categorized as underweight (6.3%).

As for academic factors, year of study, academic satisfaction and CGPA was considered. 63% of these participants were in their first year, 19.6% were in their fourth year. Least number of people reported to be sophomore (in second year) (5.1%). Most of these participants were academically satisfied (68%). Reporting their CGPA, 39% said that they had a CGPA of at least 3.50. Least number of participants reported to have a CGPA less than 3.0 (27.9%).

In terms of behavioral factors, smoking status, drinking pattern, coffee consumption pattern and sleeping pattern was analyzed. 71.7% of the participants reported to have never smoked whereas 23.5% reported to be smokers and only 4.8% reported to be ex-smokers. Reporting about drinking pattern, a large proportion of 89.1% said they have never drunk alcohol in the previous week, followed by 6.1% reporting they had more than 1 drinks and only 4.8% reporting to have 1 drink. For caffeine consumption pattern, only 12.3% reported that they have not drank any form of caffeine in the previous week. Most participants drank 1 cup of coffee/tea or (any

other for of caffeine) each time (53.0%), followed by 2 cups (20.1%) and more than 2 cups (14.5%). For Sleeping pattern, most participants reported a normal sleeping pattern of 6-8 hours per day on average in the previous week (69.5%), followed by less than 6 hours (22.0%). Least number of participants reported to have slept more than 8 hours in the previous week (8.5%).

For external and Internal factors, relationship with family, relationship status, toxic friends/family, loneliness status, resilience status and fear related to Covid-19 was analysed. For relationship with family, only 4.6% of participants said they have a bad relationship with their family. Most participants reported to have a good and very good relationship with family (37.5% & 35.1% respectively). As for relationship status, most of them reported to have no relationships (64.2%). 29.1% of the participants reported to be in a respecting and loving relationship. Only 6.8% said that they were in an abusive/unhappy relationship. In case of having toxic friends or family members, 66.1% said they had no toxic friends and similar trend was seen for toxic family members (68%). More than half of these participants reported to be lonely (64.9%) and not resilient (74.3%). When analysed characteristics related to Covid-19, most of the participants seemed to be doing well. 61.5% reported to have no fear of Covid-19 in the previous week. Only 7.7% of participants reported their immediate family member contracted Covid-19 in the previous month and 26.4% reported their loved ones/close person passed away from Covid-19 during the pandemic.

Table 1: Participants' characteristics

Sociodemographic & Other Characteristics	**n (%)**
Age (n=413)	
≤19	58 (14.0)
20	112 (27.1)
21	93 (22.5)
≥22	150 (36.3)
Gender (n=413)	
Male	283 (68.5)
Female	130 (31.5)
BMI (n=367)	
Underweight	23 (6.3)
Normal	204 (55.6)
Overweight	105 (28.6)
Obese	35 (9.5)
N/A	-
Self-dependence (n=413)	
Yes	82 (19.9)
No	331 (80.1)

Table 1: Continued

Monthly income/Allowance (in BDT where USD 1= 89 BDT approx.) (n=356)	
<5000	92 (25.8)
5000-9999	103 (28.9)
10000-14999	74 (20.8)
≥15000	87 (24.4)
N/A	-
Living Condition (n=413)	
Immediate family	279 (67.6)
Alone	24 (5.8)
Other relatives	29 (7.0)
Friends	81 (19.6)
Academic Factors	
Academic Year (n=413)	
First Year	260 (63.0)
Sophomore	21 (5.1)
Third Year	26 (6.3)
Fourth Year	81 (19.6)
More than year 4	25 (6.1)
Academic Satisfaction (n=413)	
Yes	281 (68.0)
No	132 (32.0)

Table 1: Continued

CGPA (n=405)	
<3.0	113 (27.9)
3.0-3.5	134 (33.1)
>3.5	158 (39.0)
N/A	-
Behavioral Factors	
Smoking Status (n=413)	
Never	296 (71.7)
Smoker	97 (23.5)
Ex-Smoker	20 (4.8)
Drinking Pattern in the previous week (n=413)	
Not applicable	368 (89.1)
1 drink	20 (4.8)
> 1 drink	25 (6.1)
Caffeine Consumption pattern in the previous week (n=413)	
Not applicable	51 (12.3)
1 cup	219 (53.0)
2 cups	83 (20.1)
> 2 cups	60 (14.5)

Table 1: Continued

Sleeping pattern (n=413)	
<6 hours	91 (22.0)
6-8 hours	287 (69.5)
>8 hours	35 (8.5)
External & Internal Factors	
Relationship with family (n=413)	
Bad	19 (4.6)
Neutral	94 (22.8)
Good	155 (37.5)
Very Good	145 (35.1)
Relationship Status (n=413)	
No relationship	265 (64.2)
In a respecting and loving relationship	120 (29.1)
In an abusive/unhappy relationship	28 (6.8)
Toxic Friend (n=413)	
Yes	140 (33.9)
No	273 (66.1)
Toxic Family (n=413)	
Yes	132 (32.0)
No	281 (68.0)

Table 1: Continued

Loneliness Status (n=413)	
Yes	268 (64.9)
No	145 (35.1)
Fear of Covid-19 (n=413)	
Never/ Rarely	254 (61.5)
Sometimes	101 (24.5)
Often/Always	58 (14.0)
Did you or your immediate family member contract Covid-19 in last month? (n=413)	
Yes	32 (7.7)
No	381 (92.3)
Did any of your loved or close person die due to Covid-19? (n=413)	
Yes	109 (26.4)
No	304 (73.6)
Resilience (n=413)	
Yes	106 (25.7)
No	307 (74.3)

4.2 Status of Physical Activity

Table 2 shows the status of Physical Activity among the sampled University students in Bangladesh. The frequency for each PA category as well as overall PA is represented in the table

More than half of these participants did not meet the Vigorous and Moderate Physical Activity Criteria set by the WHO. Only 29.8% of the participants performed more than 75 min of vigorous PA and 32.2% had done Moderate PA for more than or equal to 150 minutes in the previous week. Most of the participants had met the criteria for walking at least 150 minutes the previous week (68.3%) and Sedentary Behaviour for not more than 8 hours in the previous week (65.4%). When analyzed for combined PA (Vigorous PA, Moderate PA and Walking) to see if these participants could be categorized into Physically active or inactive, it is seen that about 73% of the population falls in the category of physically active.

Table 2: Status of Physical Activity

Type of Physical Activity	n (%)
Vigorous physical Activity (n=413)	
≥75 minutes	123 (29.8)
<75 minutes	290 (70.2)
Moderate Physical Activity (n=413)	
≥ 150 minutes	133 (32.2)
<150 minutes	280 (67.8)
Walking (n=413)	
≥ 150 minutes	282 (68.3)
<150 minutes	131 (31.7)
PA (Vigorous/moderate/walking activity) (n=413)	
Active	303 (73.4)
Inactive	110 (26.6)
Sedentary behavior (n=413)	
≥8 hours	143 (34.6)
< 8 hours	270 (65.4)

4.3 Status of Mental Health

In this section we explored the Mental Health status among the University Students of Bangladesh during the Covid-19 Pandemic. We analyzed status of Mental health by identifying prevalence of Depression, Anxiety and Stress among the participants. Out of the 413 participants, 67.1% were found to have depression symptoms and 68% were found to have symptoms of anxiety. Less than half (59.8%) of the participants were found to be stressed. All these data were derived from the questionnaire based on DASS 21 Scale.

Table 3: Prevalence of Mental Health (Depression, Anxiety & Stress) among participants

Mental health Status		n (%)
Depression (n=413)		
	Yes	277 (67.1)
	No	136 (32.9)
Anxiety (n=413)		
	Yes	281 (68.0)
	No	132 (32.0)
Stress (n=413)		
	Yes	166 (40.2)
	No	247 (59.8)

4.4 Factors affecting Mental Health

In this research, several factors including Sociodemographic, Academic, Behavioural, External & Internal factors were analysed using Bivariate Logistic Regression to see if they were associated with Mental Health particularly with Depression, Anxiety & Stress. It was found that gender, sleep pattern, relationship with family, having toxic friends, having toxic family, loneliness and resilience were common factors associated with depression, anxiety and stress.

a) Predictor variables associated with depression

Table 4 shows the association between the predictor variables and depression. Analysing the sociodemographic factors, the crude logistic analysis found that females were more likely to have depression symptoms than males (OR=2.39, 95%CI=1.46-3.88). Participants who earned less than 5000 BDT were more likely to have the symptoms of depression compared to those who earned at least 15000 BDT (OR=1.92,

95%CI=1.01-3.64). For the academic factors, those who were not academically satisfied were also more likely to manifest symptoms of depression (OR=1.64, 95%CI=1.03-2.60). For association between depression and the behavioral factors, participants who drank more one drink every time they drank the previous week were seen to be 3.77 times more likely to have reported symptoms of depression compared to participants who did not drink at all (OR=3.77, 95%CI=1.10-12.84). Similar trend was observed for caffeine consumption pattern. Participants drinking more than 2 cups of coffee each time manifested symptoms of depression more than those who did not drink any coffee (OR=2.83, 95%CI=1.13-7.08). For external and internal factors, being in an abusive relationship was also found to be associated with depressive symptoms when compared to being in a respecting and loving relationship (OR= 4.16, 95%CI=1.18-14.63) as well as less than 6 hours of sleep compared to 6-8 hours of sleep daily on average in the previous week (OR: 2.74, 95%CI: 1.52-4.95). Type of relationship with family was found to be a significant predictor of symptoms related to depression. Likelihood of depressive symptoms increased with decreasing quality of relationship with family. Having a bad relationship with immediate family increased chances of depressive symptoms by 15.8 times (OR: 15.8, 95% CI: 2.06-122.24). Having neutral relationship with family increased chances of depressive symptoms by 4 times and good relationship increased chances of depression symptoms by 1.85 times compared to having a very good relationship with family (OR=4.00, 95%CI=2.15-7.42 and OR=1.85, 95%CI= 1.16-2.96 respectively). Having a toxic friend increased chances of suffering

from Depression by 86% (OR: 0.86, 95%CI: 1.77-2.93). Similarly, having a toxic family member increased chances of suffering from the symptoms of depression (OR: 3.41, 95%CI: 2.03-5.71) Participants that identified to be lonely were times more likely to suffer from depression related symptoms (OR: 5.43, 95%CI: 3.47-8.48). Not being Resilient was associated with depression by increasing chances of manifesting the symptoms (OR: 3.54, 95%CI: 2.23-5.62).

Table 4: Predictors associated with depression analyzed using bivariate logistic regression.

Predictor variables	Depression		Unadjusted OR (95% CI)	p-value
	Yes n (%)	No n (%)		
Sociodemographic Characteristics				
Age (n=413)				
≤19	37 (63.8)	21(36.2)	Ref	
20	80 (71.4)	32 (28.6)	1.41 (0.72-2.78)	0.309
21	60 (64.5)	33 (35.5)	1.03 (0.52-2.04)	0.928
≥22	100 (66.7)	50 (33.3)	1.135 (0.60-2.14)	0.695
Gender (n=413)				
Female	103 (79.2)	27 (20.8)	Ref	
Male	174 (61.5)	109 (38.5)	2.39 (1.46-3.88)	<0.001*
BMI (n=367)				
Normal	138 (67.6)	66 (32.4)	Ref	
Underweight	15 (65.2)	8 (38.4)	0.89 (0.36- 2.22)	0.814
Overweight	72 (68.6)	33 (31.4)	1.04 (0.62 - 1.73)	0.869
Obese	24 (68.6)	11 (31.4)	1.04 (0.48- 2.25)	0.914
N/A			-	
Self-dependence (n=413)				
Yes	59 (72.0)	23 (28.0)	1.33 (0.78- 2.26)	0.294
No	218 (65.9)	113 (34.1)	Ref	
Monthly Income/Allowance in TAKA (in BDT where USD 1= 89 BDT approx.) (n=356)				
<5000	69 (75.0)	23 (25.0)	1.92 (1.01 - 3.64)	0.045*
5000-9999	73 (70.9)	30 (29.1)	1.56 (0.85- 2.85)	0.149
10000-14999	43 (58.1)	31 (41.9)	0.89 (0.47 - 1.67)	0.717
≥15000	53 (60.9)	34 (39.1)	Ref	
N/A			-	

Table 4 Continued

Living Condition (n=413)				
Immediate Family	194 (69.5)	85 (30.5)	1.14 (0.47 - 2.76)	0.770
Living alone	16 (66.7)	8 (33.3)	Ref	
Other Relatives	16 (55.2)	13 (44.8)	0.61 (0.20 - 1.88)	0.396
Friends	51 (63.0)	30 (37.0)	0.85 (0.32- 2.22)	0.740
Academic Factors				
Academic Year (n=413)				
First Year	169 (65.0)	91 (35.0)	0.87 (0.36- 2.10)	0.764
Sophomore	18 (85.7)	3 (14.3)	2.82 (0.64-12.44)	0.170
Third Year	23 (88.5)	3 (11.5)	3.60 (0.83-15.65)	0.087
Fourth Year	50 (61.7)	31 (38.3)	0.75 (0.29 -1.96)	0.570
More than 4	17 (68.0)	8 (32.0)	Ref	
Academic Satisfaction (n=413)				
Yes	179 (63.7)	102 (36.3)	Ref	
No	98 (74.2)	34 (25.8)	1.64 (1.03 -2.60)	0.034*
CGPA (n=405)				
≤3.0	81 (71.7)	32 (28.3)	Ref	
3.0-3.5	90 (67.2)	44 (32.8)	0.80 (0.46 -1.39)	0.444
>3.5	101 (63.9)	57 (36.1)	0.70 (0.41-1.180)	0.181
N/A			-	

Table 4 Continued

Behavioral Factors				
Smoking Status (n=413)				
Never	193	103	Ref	
Smoker	68	29	1.25 (0.76 -2.05)	0.376
Ex-Smoker	16	4	2.13 (0.69 - 6.55)	0.185
Drinking Pattern in previous week (n=413)				
Never	243	125	Ref	
1 drink	12	8	0.77 (0.30-1.93)	0.581
> 1 drink	22	3	3.77 (1.10-12.84)	0.034*
Caffeine Consumption pattern in previous week (n=413)				
Never	78	13	Ref	
1 cup	96	30	0.88 (0.46-1.68)	0.713
2 cups	66	46	0.83 (0.40- 1.74)	0.638
> 2 cups	37	47	2.83 (1.13 -7.08)	0.026*
Sleeping pattern in previous week				
6-8 hours	181	106	Ref	
<6 hours	75	16	2.74 (1.52-4.95)	<0.001*
>8 hours	21	14	0.87 (0.42- 1.80)	0.723
External & Internal Factors				
Relationship with family				
Bad	18 (94.7)	1 (5.3)	15.8 (2.06-122.2)	0.008*
Neutral	17 (18.1)	77 (81.9)	4.00 (2.15- 7.42)	<0.001*
Good	50 (32.3)	105 (67.7)	1.85 (1.16-2.96)	0.010*
Very Good	68 (46.9)	77 (53.1)	Ref	
Relationship Status				
No relationship	172 (64.9)	93 (35.1)	0.92 (0.58- 1.45)	0.736
In a respecting and loving relationship	80 (66.7)	40 (33.3)	Ref	
In an abusive/unhappy relationship	25 (89.3)	3 (10.7)	4.16 (1.18-14.63)	0.026*

Table 4: Continued

Toxic Friend				
Yes	106 (75.7)	34 (24.3)	1.86 (1.177-2.93)	0.008*
No	171 (62.6)	102 (37.4)	Ref	
Toxic Family				
Yes	110 (83.3)	22 (16.7)	3.41 (2.03- 5.71)	<0.001*
No	167 (59.4)	114 (40.6)	Ref	
Loneliness Status				
Yes	215 (80.2)	53 (19.8)	5.43 (3.47- 8.48)	<0.001*
No	62 (42.8)	136 (32.9)	Ref	
Fear of Covid-19				
Never/Rarely	163 (64.2)	91 (35.8)	Ref	
Sometimes	70 (69.3)	31 (30.7)	1.26 (0.76 - 2.06)	0.359
Often/Always	44 (75.9)	14 (24.1)	1.75 (0.91- 3.37)	0.092
Did you or your immediate family member contract Covid-19 in last month?				
Yes	22 (68.8)	10 (31.3)	1.08 (0.50 - 2.36)	0.833
No	255 (66.9)	126 (33.1)	Ref	
Did any of your loved or close person die due to Covid-19?				
Yes	73 (67.0)	36 (33.0)	0.99 (0.62- 1.58)	0.980
No	204 (67.1)	100 (32.9)	Ref	
Resilience				
Yes	48 (45.3)	58 (54.7)	Ref	
No	229 (74.6)	78 (25.4)	3.54 (2.23- 5.62)	<0.001*

b) Predictor variables associated with Anxiety

Table 5 shows predictor variables that are associated with Anxiety. Analysing sociodemographic factors, being a male was seen to be a protective factor for anxiety symptoms compared to female (OR=0.53, 95%CI=0.33-0.85). None of the academic factors showed significant associations. As for behavioural factors, sleeping less than 6 hours on average in the previous week was also associated with anxiety symptoms compared to those who slept 6-8 hours (OR=2.10, 95%CI=1.18-3.72). Relationship with family was also significantly associated with anxiety symptoms. For external and internal factors, participants who reported to have neutral and bad relationship exhibited more symptoms of anxiety than those who reported to have very good relationship with family (OR=2.24, 95%CI=1.25-4.01 and OR=5.83, 95%CI=1.29-26.19 respectively). Having a toxic friend as well as toxic family members increased likelihood of manifestation of anxiety symptoms than those who did not have any toxic friend or family member (OR=2.96, 95%CI=1.80-4.86 and OR=2.80, 95%CI=1.69-4.64 respectively). Participants who reported to be lonely were more vulnerable to anxiety than those who were not (OR=3.77, 95% CI=2.43-5.83). Fear of Covid-19 had significant association with anxiety. Participants who reported to be often/always afraid about the virus in the previous week had more anxiety symptoms than those who never/rarely had any fears (OR=3.61, 95%CI= 1.64-7.94). Participants who were not resilient manifested more anxiety symptoms than those who were resilient (OR=2.58, 95%CI=1.63-4.08)

Table 5: Predictors associated with Anxiety analyzed using bivariate logistic regression.

Predictor variables	**Anxiety**		**Unadjusted OR (95% CI)**	**p-value**
	Yes n (%)	**No n (%)**		
Sociodemographic factors				
Age (n=413)				
≤19	41 (70.7)	17 (29.3)		
20	77 (68.8)	35 (31.3)	0.91 (0.45-1.82)	0.795
21	60 (64.5)	33 (35.5)	0.75 (0.37-1.52)	0.434
≥22	103 (68.7)	47 (31.3)	0.90 (0.46-1.76)	0.777
Gender (n=413)				
Female	100 (76.9)	30 (23.1)	Ref	
Male	181 (64.0)	102 (36.0)	0.53 (0.33 - 0.85)	0.009*
BMI (n=367)				
Normal	16 (69.6)	7 (30.4)	Ref	
Underweight	141 (69.1)	63 (30.9)	1.02 (0.40-2.60)	0.965
Overweight	72 (68.6)	33 (31.4)	0.97 (0.58-1.62)	0.922
Obese	21 (60.0)	14 (40.0)	0.67 (0.32-1.40)	0.288
N/A			-	
Self-dependence (n=413)				
Yes	56 (68.3)	26 (31.7)	1.01(0.60 -1.70)	0.956
No	225 (68.0)	106 (32.0)	Ref	

Table 5 Continued

Monthly Income/Allowance in TAKA (in BDT where USD 1= 89 BDT approx.) (n=356)				
<5000	68 (73.9)	24 (26.1)	1.34 (0.70-2.56)	0.370
5000-9999	69 (67.0)	34 (33.0)	0.96 (0.52-1.77)	0.904
10000-14999	49 (66.2)	25 (33.8)	0.93 (0.48-1.79)	0.830
≥15000	59 (67.8)	28 (32.2)	Ref	
N/A			-	
Living Condition (n=413)				
Immediate family	190 (68.1)	89 (31.9)	0.71 (0.27-1.85)	0.486
Alone	18 (75.0)	6 (25.0)	Ref	
Other relatives	17 (58.6)	12 (41.4)	0.47 (0.14-1.54)	0.214
Friends	56 (69.1)	25 (30.9)	0.74 (0.26-2.10)	0.581
Academic Factors				
Academic Year (n=413)				
First Year	173 (66.5)	87 (33.5)	1.11 (0.47-2.63)	0.798
Sophomore	16 (76.2)	5 (23.8)	1.80 (0.49-6.56)	0.373
Third Year	20 (76.9)	6 (23.1)	1.87 (0.55-6.37)	0.314
Fourth Year	56 (69.1)	25 (30.9)	1.26 (0.49-3.23)	0.631
More than year 4	16 (64.0)	9 (36.0)	Ref	
Academic Satisfaction (n=413)				
Yes	189 (67.3)	92 (32.7)	Ref	
No	92 (69.7)	40 (30.3)	1.12 (0.71-1.75)	0.620
CGPA (n=405)				
≤3.0	81 (71.7)	32 (28.3)	Ref	
3.0-3.5	87 (64.9)	47 (35.1)	0.73 (0.42-1.25)	0.257
>3.5	110 (69.6)	48 (30.4)	0.90 (0.53-1.54)	0.714
N/A			-	
Behavioral Factors				
Smoking Status (n=413)				
Never	199 (67.2)	97 (32.8)	Ref	
Smoker	67 (69.1)	30 (30.9)	1.08 (0.66-1.78)	0.736
Ex-Smoker	15 (75.0)	5 (25.0)	1.46- (0.51-4.14)	0.474

Table 5 Continued

Drinking Pattern in last week (n=413)				
Not applicable	199 (67.2)	97 (32.8)	Ref	
1 drink	67 (69.1)	30 (30.9)	0.87 (0.34-2.25)	0.785
> 1 drink	15 (75.0)	5 (25.0)	1.21 (0.49-2.98)	0.673
Caffeine Consumption pattern in last week (n=413)				
Not applicable	32 (62.7)	19 (37.3)	Ref	
1 cup	142 (64.8)	77 (35.2)	1.02 (0.61-1.70)	0.931
2 cups	58 (69.9)	25 (30.1)	1.01 (0.57-1.77)	0.967
> 2 cups	49 (81.7)	11 (18.3)	1.79 (0.83-3.85)	0.134
Sleeping pattern (n=413)				
6-8 hours	189 (65.9)	98 (34.1)	Ref	
<6 hours	73 (80.2)	18 (19.8)	2.10 (1.18-3.72)	0.011*
>8 hours	19 (54.3)	16 (45.7)	0.61 (0.30-1.25)	0.180
External & Internal Factors				
Relationship with family (n=413)				
Bad	17 (89.5)	2 (10.5)	5.83 (1.29-26.19)	0.021*
Neutral	72 (76.6)	22 (23.4)	2.24 (1.25-4.01)	0.006*
Good	106 (68.4)	49 (31.6)	1.48 (0.92-2.38)	0.102
Very Good	86 (59.3)	59 (40.7)	Ref	

Table 5 Continued

Relationship Status (n=413)				
No relationship	174 (65.7)	91 (34.3)	0.85 (0.53-1.35)	0.499
In a respecting and loving relationship	83 (69.2)	37 (30.8)	Ref	
In an abusive/unhappy relationship	24 (85.7)	4 (14.3)	2.67 (0.86-8.25)	0.087
Toxic Friend (n=413)				
Yes	166 (60.8)	25 (17.9)	2.96 (1.80-4.86)	<0.001*
No	115 (82.1)	107 (39.2)	Ref	
Toxic Family (n=413)				
Yes	108 (81.8)	24 (18.2)	2.80 (1.69-4.64)	<0.001*
No	173 (61.6)	108 (38.4)	Ref	
Loneliness Status (n=413)				
Yes	210 (78.4)	58 (21.6)	3.77 (2.43-5.83)	<0.001*
No	71 (49.0)	74 (51.0)	Ref	
Fear of Covid-19 (n=413)				
Never/Rarely	161 (63.4)	93 (36.6)	Ref	
Sometimes	70 (69.3)	31 (30.7)	1.30 (0.79-2.13)	0.292
Often/Always	50 (86.2)	8 (13.8)	3.61 (1.64-7.94)	<0.001*
Did you or your immediate family member contract Covid-19 in last month? (n=413)				
Yes	24 (75.0)	8 (25.0)	1.44 (0.63-3.31)	0.382
No	257 (67.5)	124 (32.5)	Ref	
Did any of your loved or close person die due to Covid-19? (n=413)				
Yes	77 (70.6)	32 (29.4)	1.18 (0.73-1.90)	0.497
No	204 (67.1)	100 (32.9)	Ref	
Resilience (n=413)				
Yes	55 (51.9)	51 (48.1)	Ref	
No	226 (73.6)	81 (26.4)	2.58 (1.63-4.08)	<0.001*

c) Predictor variables associated with Stress

Table 6 shows the predictor variables associated with stress. For sociodemographic factor, age was a significant predictor for stress. Participants being more than or 22 years were more stressed than those who were 19 or below (OR=2.16,

95%CI=1.13-4.15). Gender was also associated with stress. Males were seen to be less stressed than females (OR=0.46, 95%CI=0.30-0.70). None of the academic factors were associated with stress. As for behavioural factors, participants having more than one drink per time when drinking in the previous week was more at risk of stress than those who never had any (OR=2.36, 95%CI= 1.03-5.39). Similar trend was seen for caffeine consumption pattern. Participants having more than two cups of coffee per time in the previous week had more stress than those who never consumed any coffee (OR=2.32, 95%CI= 1.08-4.98). Participants who slept less than 6 hours daily on average in the previous week suffered from stress more than whose who slept 6-8 hours (OR=2.17, 95%CI=1.34-3.51). Analysing external and internal relationships, relationship with family was associated with stress where it was seen that lower level of relationship was associated with more stress in participants. Participants who rated their relationship with family to be neutral and bad suffered from stress more compared to those who rated their relationship with family to be good (OR=2.37, 95%CI=1.38-4.06 and OR=5.14, 95%CI=1.83-14.40). Being in an abusive/unhappy relationship was also associated with having more stress compared to being in a respecting and loving relationship (OR=3.27, 95%CI=1.36-7.85). Fear related to Covid-19 was also found to be a significant factor associated with stress. Having toxic friend and family was also seen to increase stress in participants (OR=2.20, 95%CI=1.45-3.34 and OR=3.66, 95%CI= 2.37-5.64). Participants who reported to be lonely were more likely to suffer from stress than those who did not (OR=3.73, 95%CI=2.34-5.93). Participants who were often/always having fears

related to Covid-19 in the previous week had more stress than who rarely or never had any fears (OR=2.17, 95%CI= 1.21-3.87). Resilience was found to be significantly associated with stress where participants who were not resilient were more likely to suffer from stress (OR=2.57, 95%CI= 1.57-4.23)

Table 6 : Predictors associated with Stress analyzed using bivariate logistic regression.

Predictor variables	Stress		Unadjusted OR (95% CI)	p-value
	Yes (%)	No (%)		
Sociodemographic Characteristics				
Age (n=413)				
≤19	17 (29.3)	41 (70.7)	Ref	
20	41 (36.6)	71 (63.4)	1.39 (0.70-2.75)	0.342
21	37 (39.8)	56 (60.2)	1.59 (0.79-3.21)	0.193
≥22	71 (47.3)	79 (52.7)	2.16 (1.13-4.15)	0.020
Gender (n=413)				
Female	69 (53.1)	61 (46.9)	Ref	
Male	97 (34.3)	186 (65.7)	0.46 (0.30-0.70)	<0.001*
BMI (n=367)				
Normal	10 (43.5)	13 (56.5)	Ref	
Underweight	81 (39.7)	123 (60.3)	1.16 (0.48-2.79)	0.720
Overweight	42 (40.0)	63 (60.0)	1.01 (0.626-1.63)	0.960
Obese	15 (42.9)	20 (57.1)	1.13 (0.55- 2.35)	0.725
N/A			-	
Self-dependence (n=413)				
Yes	36 (43.9)	46 (56.1)	1.21 (0.74-1.97)	0.445
No	130 (39.3)	201 (60.7)	Ref	

Table 6 Continued

Monthly Income/Allowance in TAKA (in BDT where USD 1= 89 BDT approx.) (n=356)				
<5000	44 (47.8)	48 (52.2)	1.42 (0.78-2.58)	0.239
5000-9999	40 (38.8)	63 (61.2)	0.99 (0.55-1.77)	0.972
10000-14999	29 (39.2)	45 (60.8)	1.00 (0.53-1.89)	0.989
>15000	34 (39.1)	53 (60.9)	Ref	
N/A			-	
Living Condition (n=413)				
Immediate family	9 (37.5)	165 (59.1)	1.15 (0.48-2.72)	0.748
Alone	114 (40.9)	15 (62.5)	Ref	
Other relatives	12 (41.4)	17 (58.6)	1.17 (0.38-3.56)	0.774
Friends	31 (38.3)	50 (61.7)	1.03 (0.40-2.64)	0.945
Academic Factors				
Academic Year (n=413)				
First Year	95 (36.5)	165 (63.5)	0.53 (0.23-1.21)	0.133
Sophomore	8 (38.1)	13 (61.9)	0.56 (0.17-1.84)	0.347
Third Year	12 (46.2)	14 (53.8)	0.79 (0.26-2.37)	0.676
Fourth Year	38 (46.9)	43 (53.1)	0.81 (0.33-2.00)	0.657
More than year 4	13 (52.0)	12 (48.0)	Ref	
Academic Satisfaction (n=413)				
Yes	105 (37.4)	176 (62.6)	Ref	
No	61 (46.2)	71 (53.8)	1.44 (0.94-2.18)	0.088
CGPA (n=405)				
≤3.0	43 (38.1)	70 (61.9)	Ref	
3.0-3.5	53 (39.6)	81 (60.4)	1.06 (0.63-1.78)	0.810
>3.5	69 (43.7)	89 (56.3)	1.26 (0.77-2.06)	0.355
N/A	43 (38.1)	70 (61.9)	-	
Behavioral Factors				
Smoking Status (n=413)				
Never	114 (38.5)	182 (61.5)	Ref	
Smoker	43 (44.3)	54 (55.7)	1.27 (0.79-2.02)	0.311
Ex-Smoker	9 (45.0)	11 (55.0)	1.30 (0.52-3.25)	0.566

Table 6 Continued

Drinking Pattern in last week (n=413)				
Not applicable	143 (38.9)	225 (61.1)	Ref	
1 drink	8 (40.0)	12 (60.0)	1.04 (0.41-2.62)	0.919
> 1 drink	15 (60.0)	10 (40.0)	2.36 (1.03-5.39)	0.042*
Caffeine Consumption pattern in last week (n=413)				
Not applicable	20 (39.2)	31 (60.8)	Ref	
1 cup	81 (37.0)	138 (63.0)	0.91 (0.48-1.70)	0.767
2 cups	29 (34.9)	54 (65.1)	0.83 (0.40-1.71)	0.618
> 2 cups	36 (60.0)	24 (40.0)	2.32 (1.08-4.98)	0.030*
Sleeping pattern				
6-8 hours	106 (36.9)	181 (63.1)	Ref	
<6 hours	51 (56.0)	40 (44.0)	2.17 (1.34-3.51)	<0.001*
>8 hours	9 (25.7)	26 (74.3)	0.59 (0.26-1.30)	0.195
External & Internal Factors				
Relationship with family				
Bad	13 (68.4)	6 (31.6)	5.14 (1.83-14.4)	0.002*
Neutral	47 (50.0)	47 (50.0)	2.37 (1.38-4.06)	0.002*
Good	63 (40.6)	92 (59.4)	1.62 (1.00-2.62)	0.047*
Very Good	43 (29.7)	102 (70.3)	Ref	
Relationship Status				
No relationship	100 (37.7)	165 (62.3)	0.94 (0.60-1.46)	0.789
In a respecting and loving relationship	47 (39.2)	73 (60.8)	Ref	
In an abusive/unhappy relationship	19 (67.9)	9 (32.1)	3.27 (1.36-7.85)	0.008*
Toxic Friend				
Yes	74 (52.9)	66 (47.1)	2.20 (1.45-3.34)	<0.001*
No	92 (33.7)	181 (66.3)	Ref	
Toxic Family				
Yes	81 (61.4)	51 (38.6)	3.66 (2.37-5.64)	<0.001*
No	85 (30.2)	196 (69.8)	Ref	
Loneliness Status				
Yes	135 (50.4)	133 (49.6)	3.73 (2.34-5.93)	<0.001*
No	31 (21.4)	114 (78.6)	Ref	

Table 6 Continued

Fear of Covid-19				
Never/Rarely	96 (37.8)	158 (62.2)	Ref	
Sometimes	37 (36.6)	64 (63.4)	3.73 (2.34-5.93)	<0.001*
Often/Always	33 (56.9)	25 (43.1)	2.17 (1.21-3.87)	0.009*
Did you or your immediate family member contract Covid-19 in last month?				
Yes	13 (40.6)	19 (59.4)	1.02 (0.48-2.12)	0.959
No	153 (40.2)	228 (59.8)	Ref	
Did any of your loved or close person die due to Covid-19?				
Yes	42 (38.5)	67 (61.5)	0.91 (0.58-1.42)	0.680
No	124 (40.8)	180 (59.2)	Ref	
Resilience				
Yes	26 (24.5)	80 (75.5)	Ref	
No	140 (45.6)	167 (54.4)	2.57 (1.57-4.23)	<0.001*

4.5 Association between Physical Activity and Mental Health

a) Association using Bivariate Logistic Regression (Unadjusted OR)

The primary objective of this study was to determine whether there is an association between Physical Activity and Mental Health. Physical Activity was divided into physically active or inactive based on WHO recommendation guidelines as described above. Table 7 shows the associations between PA and Mental Health. Sedentary Behavior was found to be a significant risk factor for both Depression and Stress where more than 8 hours of Sedentary Behavior increased likelihood of manifestation of depression symptoms and stress (OR= 2.05, 95%CI=1.29-3.25 and OR=1.89, 95%CI=1.25-2.86 respectively). For all these analyses, reference value was based on WHO Physical Activity Guidelines where it is recommended to perform at least 75 minutes of Vigorous PA and/ 150 minutes of moderate PA and/ 150 minutes

walking per week. WHO recommends not to spend more than 8 hours daily on any Sedentary Behaviour.

Table 7: Association between Physical Activity & Mental Health analyzed using bivariate logistic regression.

	Unadjusted OR (95% CI)	p-value
Depression (n=413)		
PA (Vigorous/moderate/walking activity)		
Active	Ref	
Inactive	1.13 (0.70-1.81)	0.599
Sedentary behavior		
≥8 hours	2.05 (1.29 - 3.25)	0.002*
< 8 hours	Ref	
Anxiety (n=413)		
PA (Vigorous/moderate/walking activity)		
Active	Ref	
Inactive	0.72 (0.45-1.14)	0.164
Sedentary behavior (n=413)		
≥8 hours	1.47 (0.94-2.30)	0.088
< 8 hours	Ref	
Stress (n=413)		
PA (Vigorous/moderate/walking activity)		
Active	Ref	
Inactive	0.84 (0.54-1.32)	0.466
Sedentary behavior		
≥8 hours	1.89 (1.25-2.86)	0.002*
< 8 hours	Ref	

b) Association using Multivariable Logistic Regression (Adjusted OR)

Similar trend was found when the data obtained were analyzed using Multivariable Logistic Regression. All predictors from the bivariable logistic regression with $p<0.05$ was included in multivariable logistic regression model.

Table 8 shows association between Physical activity and depression using multivariable logistic regression after adjusting with Gender, Monthly Income/Allowance in BDT, Academic Satisfaction, Drinking Pattern in last week, Caffeine Consumption pattern in last week, Sleeping Pattern, Relationship with family, Relationship Status, Toxic Friends, Toxic Family, Loneliness Status & Resilience. A total of 356 samples were used for analysis here as one of the significant factors for Depression, Monthly Income/Allowance had only 356 data. Sedentary behaviour was still found to be a significant factor where more than or equal to 8 hours of Sedentary Behaviour increased likelihood of suffering from depression 1.92 times more symptoms compared to those who had less than or equal to 8 hours (Adjusted OR=1.97, 95%CI=1.08-3.58).

Table 9 shows association between Physical activity and anxiety using multivariable logistic regression after adjusting with Gender, Sleeping Pattern, Relationship with family, Toxic Friends, Toxic Family, Loneliness Status, Fear of Covid-19 & Resilience. None of the Physical Activity was found to be associated significantly with Anxiety.

Table 10 shows association between Physical activity and stress using multivariable logistic regression after adjusting with Age, Gender, Drinking Pattern in last week, Caffeine Consumption pattern in last week, Sleeping Pattern, Relationship with family, Relationship Status, Toxic Friends, Toxic Family, Loneliness Status, Fear of Covid-19 & Resilience. Like the unadjusted data, Sedentary Behaviour was seen to be

significantly associated with Stress. Increase in Sedentary Behaviour for 8 hours or more increased Stress by 1.85 times compared to those with less than or equal to 8 hours (Adjusted OR= 1.85, 95%CI=1.15-2.99)

Table 8: Association between Physical Activity and Depression analyzed using Multivariable Logistic Regression

Physical Activity (n=356)	**Unadjusted OR (95% CI)**	**p-value**	***Adjusted OR (95% CI)**	**p-value**
PA (Vigorous/moderate/walking activity)				
Active	Ref		Ref	
Inactive	1.40 (0.67-2.90)	0.363	1.38 (0.57-3.36)	0.469
Sedentary Behavior				
≥8 hours	2.27 (1.38- 3.76)	0.010*	1.97 (1.08 - 3.58)	0.026*
< 8 hours	Ref		Ref	

[1]

Table 9: Association between Physical Activity and Anxiety analyzed using Multivariable Logistic Regression.

Physical Activity (n=413)	**Unadjusted OR (95% CI)**	**p-value**	***Adjusted OR (95% CI)**	**p-value**
PA (Vigorous/moderate/walking activity)				
Active	Ref		Ref	
Inactive	0.72 (0.45-1.14)	0.164	0.64 (0.37-1.09)	0.103
Sedentary Behavior				
≥8 hours	1.47 (0.94-2.30)	0.088	1.35 (0.81-2.25)	0.237
< 8 hours	Ref		Ref	

[2]

[1] Each OR is adjusted with Gender, Monthly Income/Allowance in TAKA, Academic Satisfaction, Drinking Pattern in last week, Caffeine Consumption pattern in last week, Sleeping Pattern, Relationship with family, Relationship Status, Toxic Friends, Toxic Family, Loneliness Status & Resilience

[2] Each OR is adjusted with Gender, Sleeping Pattern, Relationship with family, Toxic Friends, Toxic Family, Loneliness Status, Fear of Covid-19 & Resilience

Table 10: Association between Physical Activity and Stress analyzed using Multivariable Logistic Regression.

Status of Physical Activity (n=413)	**Unadjusted OR (95% CI)**	**p-value**	***Adjusted OR (95% CI)**	**p-value**
PA (Vigorous/moderate/walking activity)				
Active	Ref		Ref	
Inactive	0.84 (0.54-1.32)	0.466	0.88 (0.51-1.51)	0.654
Sedentary Behavior				
≥8 hours	1.89 (1.25-2.86)	0.002*	1.85 (1.15-2.99)	0.011*
< 8 hours	Ref		Ref	

[3]

[3] Each OR is adjusted with Age, Gender, Drinking Pattern in last week, Caffeine Consumption pattern in last week, Sleeping Pattern, Relationship with family, Relationship Status, Toxic Friends, Toxic Family, Loneliness Status, Fear of Covid-19 & Resilience

CHAPTER 5: DISCUSSION

5.1 Status of Mental Health in Bangladesh and it's predictors

The findings of the survey illustrated that a significantly high number of University students have symptoms related to Mental Health Disorders such as Depression, Anxiety and Stress. Prevalence of Depressive symptoms were reported to be 67.1%, Anxiety was 68% and Stress was 40.2%. This is expected as Undergraduate level students experience changes to their personal and academic lives and is in constant need to keep up with social expectations. This is consistent with the existing literature that says that higher level of education attainment is associated with having increased negative emotion (91).

This was also expected to be high given the Covid-19 pandemic that has caused the world to stop, Bangladesh not being any different. However, when this study was conducted the pandemic situation in Bangladesh was much better than previous times due to fast and efficient rollout of vaccination which is also evident by the fact that 61.5% of the study participants did not have any fear related to Covid-19 and only 14% has reported to be in constant fear of the pandemic. Between 1st May to 15 June, the daily infection toll of Covid-19 in Bangladesh was below 300 cases, death toll was below 5 people with most of the days having no deaths at all (92). This is consistent with the obtained data from this study where more than 90% of the participants reported that none of their loved or close person contracted Covid-19 in the previous

month. The study also found out that fear related Covid-19 is a significant risk factor for stress and anxiety. This is consistent with previous research. A study was conducted on Bangladeshi University students during the early Covid-19 pandemic from May-June 2020 which explored the Mental Health Outcomes among University students in Bangladesh during the Covid-19 pandemic using the DASS-21 scale. The study found out that negative perceptions about Covid-19 was significantly associated with worse Mental Health Outcome (depression, anxiety & stress). 84.2% of that study population believed that the worse of the pandemic is ahead of them (93). This fear of the virus is expected as the Covid-19 pandemic had just begun in the world at that time and little to nothing was known about the pandemic. Another research that studied the impact of Covid-19 Pandemic on Mental Health of Medical Students in Bangladesh between April to May 2020 found out that the students who were extremely concerned about being infected by the virus were 3.5 times more likely to suffer from symptoms of Anxiety and 2.7 times more likely to suffer from depressive symptoms. This research used the HADS anxiety and depression scale (94). Similar results were obtained for another study which also explored the impact of the Covid-19 pandemic on mental health & wellbeing among home-quarantined Bangladeshi students. This study was conducted using the DASS-21 and IES scale. It was found that perceived Covid-19 symptoms were significantly associated with Stress (OR = 3.71, 95% CI: 1.01 to 6.40), anxiety (OR = 3.95, 95% CI: 1.95 to 5.96) and depression subscale (OR = 3.82, 95% CI: 0.97 to 6.67). It was also found to have caused significant stress among the

participants as reflected by the significant IES scores (OR = 7.52, 95% CI: 3.58 to 11.45) (80). The Prevalence of Anxiety and depression was higher than Stress in the two studies which measured prevalence of Depression, Anxiety and Stress was also consistent with our findings (80, 93). Although the prevalence is different for all the studies and our study, all studies have found a considerably high prevalence of Mild to Severe level Depression, Anxiety and Stress.

Besides the Covid-19 pandemic, there are other risk factors which have been associated with symptoms of stress, anxiety and depression. Gender is a significant risk factor for Mental Health. Several studies have found that females suffer more from Anxiety and Stress symptoms compared to males (80, 93, 94). This is consistent with our finding where being male is a protective factor from anxiety and stress (OR= 0.53, 95%CI=0.33 to 0.85) A cross sectional study conducted in Isfahan among high school students between 2007-08 found out that girls had significantly higher level of anxiety symptoms compared to boys. The research also analyzed the cause of this trend using the metacognitive model of generalized anxiety disorder in their cross-sectional study. It was found out that girls the worry more about Health, has a higher metacognitive belief about worry believing that worry is uncontrollable and thought that worry could be useful compared to boys (95). Another potential reason of women being more vulnerable to stress and worry can be because they are a minority in student community making them more vulnerable. However, most studies suggest that female are more likely to have depressive symptoms than men which is inconsistent with our

findings. This may be due to the reasons like financial uncertainty or academic uncertainty due to Covid-19 Pandemic, given that in Bangladesh males are expected to take care of family financially when they grow up. Another reason why males could be more depressed than female maybe sue to the fact that they are expected to keep their feelings to themselves and not share it with others. Lack of attachment or people to share feelings with can also lead to these elevated depressive symptoms.

Sleeping less than 6 hours was found to be significantly associated with poor Mental health increasing symptoms of Depression, Anxiety and Stress. Adults require 6-8 hours of daily sleep to complete their sleep cycle, REM and Non-REM sleep. Enough sleep is important as it allows repairing of the bodies and consolidate memories. Having consistently poor sleep results in lack of concentration, agitation and irritability which has led to symptoms of stress, anxiety and depression. This is consistent with previous findings (96). A study conducted in the USA reported that participants who slept less than 6 hours per night were about 2.5 times more likely to have frequent mental health distress (CI, 2.32–2.73) than those who slept more than 6 hours (97).

Quality of Relationships with friends and family was also found to be a significant risk factor for all three Mental health indicators in this study.in all cases. Having a bad/very bad relationship with family increases symptoms of depression, anxiety and stress significantly. This is expected as family is a significant part of a person's external relationships. In Bangladesh, people live in close proximity with their family even after

they are independent and grown up and hence spend most of their lives with their family. Therefore, it is important to have good relationship with them and be able to share their feelings with their family. This is consistent with previous findings that showed the participants involved in less family conflicts had better mental health and displayed fewer symptoms of stress, anxiety and depression compared to people who had more family conflicts. The same study also found that having good friends is protective factor against these symptoms (61).

Loneliness was reported to be positively associated with increased symptoms of stress, anxiety and depression. This is expected as human beings are social creatures, they have an innate urge to socialize and live in social groups. Due to this biological need, loneliness can cause changes in mood causing symptoms of stress, anxiety and depression. About 65% of study population reported to be lonely although only 6% of these population reported to be living alone. This suggest that loneliness among the study population was not due to lack of relationships but due to lack of quality relationships or someone to share their feelings with. This could also be attributed to the lack of romantic relationship among most of this study population evident by the fact that almost 64% of the study population reported to not be in a relationship. This was consistent with previous finding. Research that studied the association between loneliness and depression found that loneliness was significantly predictive of MDD at follow-up (OR = 0.235, p = 0.001) (98)

Resilience was another important predictor of Mental Health among University students of Bangladesh. Lower resilience was associated with poorer Mental health and increased symptoms of Depression, Anxiety and Stress. This was expected. People with higher capability to cope with changes and have better ability to adapt have a better mental health as external stressors do not affect them. This is consistent with previous literature. A study conducted in 2020 on 314 college students in China reported that depression, anxiety, stress were negatively and significantly associated with resilience which means that people who were more resilient had better positive mental health and lower levels of Stress, Anxiety and depression symptoms (99).

5.2 Status of Physical Activity and its association with Mental Health

Prevalence of Vigorous and Moderate PA were significantly low among the study population when categorized within each type. Less than 30% of the population met the 75-minute threshold for vigorous PA as recommended by WHO, Only 32.2% met the guideline of 150 min threshold for moderate PA. Although more than half of the population met the recommended walking and sedentary behavior level, a still part of the population was still below threshold for walking (31.7%) and Sedentary Behavior (34.6%). This is expected as due to Covid-19, people have lost pace and still used to a more Sedentary lifestyle. Although the pandemic situation is much better now, prevalence of Physical Activity is still low. A study conducted on University students in Bangladesh during the early days of pandemic reported similar results

where only about 26% of the population reported to perform physical Activity (80). This is consistent to previous literatures that suggested that even though the world move towards post pandemic era, the level of PA among the population will still be low as the population has to focus on work & study more (22, 23). However, when the PA types are combined and categorized into active and inactive, its seen that more than 73% of the population are active. This may be attributed to the fact that most populations had higher walking scores than any other types of PA. Although walking more than 150 minutes is a recommendation of WHO, this contributes to lesser energy expenditure compared to Vigorous and Moderate PA (METs) therefore not meeting the energy expenditure criteria which is one of the limitations of this study design.

In both adjusted and unadjusted analysis, no significant association was found between Total PA with Depression, Anxiety. However, sedentary behavior was reported to be a significant risk factor for depression and stress. Spending more than 8 hours or more in sedentary behavior was reported to increase depressive symptoms by 2.27 times when unadjusted and 1.97 times when adjusted with other significant factors. Similarly, 8 or more hours of sedentary behavior increases symptoms of stress by 1.89 times when unadjusted and 1.85 times when adjusted. However Sedentary behavior is not found to be associated with Anxiety. This maybe because anxiety symptoms like palpitation and racing heartbeat maybe be alleviated by increased physical activity which is why people with these symptoms tend to lead a more sedentary lifestyle. Previous research conducted on University students in Bangladesh suggests that

physical activity is a protective factor of Mental Health. However, the study simply asked the question whether participants perform exercise not categorizing whether or not they perform the recommended level of PA (80). In all literatures, PA was reported to be significantly associated with a positive mental health. Our study similarly found that being physically active reduces both depressive and stress symptoms contributing to a more positive mental health.

5.3 Limitations of the study

Although this study will help to understand the status of physical activity and mental health among the Bangladeshi university students during the pandemic era being one of the first to do so based on Bangladesh, this study had some limitations. First of all, this is a self-administered questionnaire which means that the responses can be subjectively biased. This study is also subject to Other biases like Recall bias that can occur as participants were asked about activities over the last 1 week. Most importantly, this study was only conducted in one university, so the results are not generalizable to larger population. Another limitation of the study is in the design of PA data. In order to make it more feasible the questionnaire is converted into Likert scale which reduces its ability in ways such as able to covert PA into METs to obtain more accurate results for PA.

CHAPTER 6: CONCLUSION

The aim of this study was to explore the status of Physical Activity & Mental Health as well as analyse the association between these factors. In order to find this out, a cross sectional study was conducted between 23rd May to 15th June 2022 among BRAC University Undergraduate level students. The protocol was approved by Public health foundation, Bangladesh. Electronic inform consent was obtained from the participants before they could participate in this study. The data obtained was validated by setting the questionnaire to only considering students who could use BRAC university email ID to answer this survey. In additionally, the questionnaire was set in such a way that each email ID can response only one time. To analyze the data, SPSS 24 version was used. Associations between predictors and Mental health was measured using bivariate logistic regression. Associations between PA and mental health as well were measured using binary logistic regression and multivariable logistic regression. Each predictor that was found to be significant ($p<0.05$) entered the multivariable logistic regression model. The prevalence of Mental Health as well as PA was also reported in this study.

From the data analysis, it has been found that University students in Bangladesh have a high prevalence of depressive, anxiety and stress symptoms hence poor mental health. Additionally, about 25% of the population is found to be physically inactive as the population is not involved in recommended Physical Activity. About 73% of the population seems to be physically active when considered PA combined. A huge

population (about 35%) also spends more than 8 hours in sedentary activity which is detrimental to the health according to the WHO guideline.

Given the relationship between physical activity and mental health, spending more time in sedentary activities is likely to worsen student's mental health. Therefore, regular physical activity should be encouraged by the University authority. The university authority can introduce mandatory PA classes for the students to promote this. Additionally, counselling sessions and social interactive activities should be made available at the university so that the students can get professional as well as psychosocial help when required. This study could be used by researchers to conduct on a different setting like office, high school etc. to make the results more generalizable. Also, a larger study could be conducted using this study design in other universities in Bangladesh which will increase the generalizability of the results.

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APPENDIX A: Research Participant Information Sheet and Consent Form

Title of research project: Association between Physical Activity & Mental Health among University Students in Bangladesh: A Cross Sectional Study

Principal researcher's name: Sanjida Sultana **Position**: MPH (Candidate)

Office Address: College of Public Health Sciences, Chulalongkorn University, Institute Building 2-3, Soi Chulalongkorn 62, Phyathai Rd, Pathumwan, Bangkok 10330, Thailand

Telephone: +660981368471 **Email:** sanjida12.mahidol@gmail.com

Source of funding: Chulalongkorn University

You are being invited to take part in a research project. Before you decide to participate it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and do not hesitate to ask if anything is unclear or if you would like more information.

1. **Background/rationale:** University students are one of the most vulnerable groups to be affected by mental health disorders as it is a period of transition in their lives from adolescent to adulthood. One way to combat these Mental health problems can be lifestyle modification. Several studies have shown benefits of exercise on physical health, however research on impact of physical activity on Mental Health is limited, more so in Bangladesh. Physical Activity has reduced significantly due to the Covid-19 pandemic which has affected Mental Health of the population as well. Limited research has been conducted on the pattern of Physical activity during Covid-19 pandemic and its impact on human health. The aim of this study is to explore the prevalence of mental health (Depression, Stress, and Anxiety) among Bangladeshi University Students during Covid-19 and study the association

between mental health (Depression, Stress, and Anxiety) and physical activity among Bangladeshi University Students.

1. **If you decide to take part in the research, the steps of research will be as follows:**

1. QR code will be provided that will direct you to the survey.
2. Screening questions to be able to participate in this research study.
3. Information about the research and informed consent that you need to agree to if you want to be a part of this
4. Read and understand the questions, fill out the survey.

3. Details of Participant

- **Number of participants needed to take part in the research**: 459 people
- **You are invited to take part in the research owing to**
    - Being a Bangladeshi resident & Nationality
    - Being an Undergraduate student at BRAC University
    - Being 18-25 years old
    - Having a stable internet connection & being able to use google form
    - Understanding English and being able to communicate in English
    - Must be able to use institution email address
    - Being a part of social media (Facebook or WhatsApp)

- **If you fall in one or more than one of these categories, you cannot participate in this research:**

    - If you have any known physical chronic diseases such as Cancer, Heart Disease, Diabetes, Kidney Disease and/or diagnosed mental disease

such as Depression, Schizophrenia, Bipolar Disorder, Borderline Personality disorder, Anxiety disorder etc.

4. Screening Process: The QR code provided will direct participants to the survey. The first section of the survey is screening participants based on inclusion/exclusion criteria. Participants who will meet these criteria will only be able to move to the next section which is the informed consent. Participants who will not meet the inclusion criteria cannot participate in this study. After clicking agree to the informed consent section, participants will be redirected to the research questions.

5. Procedure upon participants: The questionnaire will consist of 6 sections.

- Section one of the survey will be questions exploring the sociodemographic factors and other characteristics. There will be six questions in this section. It will take 2 minutes to complete this section.
- Section two will consist of three questions about academic factors. This section will take 1 minute to complete.
- Section three will explore various behavioral factors such as sleeping hours, smoking status, alcohol consumption and caffeine intake. This section will have six questions. This section will take about 2 minutes to complete.
- Section four will look at internal & external factors such as relationship with friends and family, loneliness, fear related to Covid-19 and resilience. There will be a total of twenty questions in this section. This section will take about 10 minutes to complete.
- Section five of the questionnaire will ask questions about physical activity. There will be four questions in this section. This section will take about 5 minutes to complete.

- Finally, the last section, section six will ask twenty-one questions to explore the subject's mental health, especially symptoms of depression, anxiety, stress. This section will take about 10 minutes to complete.
- The questionnaire will have a total of 60 questions in this survey. The total time will be about 30 minutes to complete this survey.

6. The risk that may occur when taking part in the research:

- Taking 30 minutes to complete the questionnaire.
- Sharing Confidential Information

7. **Expected benefits from the research**

- Benefit to individual participant/volunteer
    - Self-satisfaction and fulfilment as contributing for the welfare of the community.
- Benefit to profession as a whole
    - Help understand how much people are affected by mental health problems
    - Able to explore several benefits of physical activity, not limited to physical health but also mental health. The results can be used to promote Physical Activity in the community/universities by respective authorities.
    - This study can be used as a pilot study for a larger study based in Bangladesh with a higher and more diverse sample.
- Benefit to social welfare
    - Universities can make a policy of compulsory Physical Activity for their students- to promote Physical Activity and improve stress, anxiety and depression of students.
    - Government organizations can promote Physical Activity as a way to manage stress, anxiety, and depression.

8. Please be sure that all the information related directly to you will be kept confidential and will only be available to the research team. The questionnaire will not be shared with any other external sources. Results of the study will be reported as a total picture. Any information which could be able to identify you will not appear in the report.

9. If the questionnaire is to be used for future studies, separate consent form will be provided.

If you decide not to join the project, there will be no negative consequences to you.

If you have any inquiries regarding the research or if the unwanted side effect from the research occurs, you can contact

Sanjida Sultana, +660981368471 or email: sanjida12.mahidol@gmail.com

10. The compensation that the *participant*/volunteer will get when participating in the research: Upon completion of the survey, first 100 participants will get BD 100 in their bkash account within 24 working hours (9am to 5 pm).
Participants have to make sure to use their institution email address for this.

11. Participation in the study is voluntary and participants have the right to deny and/or withdraw from the study at any time, no need to give any reason, and there will be no bad impact upon that participant." (state explicitly e.g. still receive the same usual services).

12. If you have any questions or would like to obtain more information, the researcher can be reached at all times. If the researcher has new information

regarding benefit on risk/harm, participants will be informed as soon as possible."

13. If researcher does not perform upon participants as indicated in the participant information sheet and consent form, participants can report the incident to the:

Public Health Foundation, Bangladesh

54, Inner Circular Road, Scout Market (2nd Floor), Nayapaltan, Dhaka, Dhaka Division, Bangladesh

Email: phfbd.net@gmail.com

APPENDIX B: Questionnaire

Email:

Bkash Number:

Screening questions:

1. Will you be able to use your institution email address to complete this survey?

   ☐ Yes

   ☐ No

2. Are you a student of BRAC University?

   ☐ Yes

   ☐ No

3. Are you an Undergraduate Student?

   ☐ Yes

   ☐ No

4. Are you 18–25-year-old?

   ☐ Yes

   ☐ No

5. Are you a Bangladeshi national?

   ☐ Yes

   ☐ No

6. Are you a Bangladeshi resident?

   ☐ Yes

   ☐ No

7. Are you comfortable using English Language as a medium communication of this survey?

   ☐ Yes

☐ No

8. Do you have any physical chronic diseases such as Cancer, Heart Disease,
   Diabetes, Kidney Disease and/or diagnosed mental disease such as Depression, Schizophrenia, Bipolar Disorder, Borderline Personality disorder, Anxiety disorder etc?

   ☐ Yes

   ☐ No

9. Have you already completed at least one semester at the university?

   ☐ Yes

   ☐ No

Informed Consent: Informed Consent Read the participant information sheet carefully by clicking the link below, then answer the question: https://docs.google.com/document/d/10ppRNTrRNzKIV5ynjDbfInc6Gn-5CcqD8ne5Lxy0nE4/edit

I have been explained by researcher and understand all the details provided. And I voluntarily signed my name to enroll in this project and receive a copy of this document.

☐ Yes

☐ No

Section 1: Sociodemographic Characters

1. Age (Years)
2. Gender

   ☐ Male

   ☐ Female

3. Height (in cm) weight (in kgs)
4. Are you self-dependent?

   ☐ Yes

☐ No

5. Monthly income in Taka (if self-dependent) or monthly allowance from family?

☐ Yes

☐ No

6. Living conditions

☐ Living with family

☐ Living alone

☐ Living with other relatives

☐ Living with friends

Section 2: Academic factors

1. Year of Study

☐First Year

☐Sophomore

☐Third Year

☐Fourth Year

☐ More than 4 Year

2. CGPA:

3. I am satisfied with my academic learning and university facilities

☐ Yes

☐ No

Section 3: Behavioral Factors

1.Frequency of smoking in the last week?

☐0 (Never)

☐1 (Less than 15 cigarettes per week)

☐2 (About 15 cigarettes per week)

☐3 (More than 15 cigarettes per week)

☐4 (I am a chain smoker)

☐5 (Ex-Smoker)

2. Frequency of alcohol consumption in the last week

☐0 (Never)

☐1 (Occasionally)

☐2 (On weekend)

☐3 (Several times a week)

3. How many drinks did you consume each time?

☐1 drink

☐2- 3 drinks

☐More than 3 drinks

4. Frequency of caffeine intake in last week.

☐0 (Never)

☐1 (Occasionally)

☐2 (Once every day)

☐3 (Several times every day)

5. How many cups of coffee do you consume each time?

☐1 cup

☐2 cups

☐More than 2 cups

6. Average hours of sleep per day in the last week.

☐Less than 6 hours

☐6-8 hours

☐More than 8 hours

Section 4: External factors & Internal Factors

1. How would you rate your relationship with your family on a scale of 1-5, 1 being very bad to 5 being very good?

☐1 Very Bad

☐2 Bad

☐3 Neutral

☐4 Good

☐5 Very Good

2. Are you currently in a relationship? If yes, how would you categorize your relationship as? (Toxic refers to relationship that causes one's wellbeing-physical or emotional to be threatened. It's a relationship that can make one feel attacked, demotivated, demeaned and unsupported including physical or verbal abuse)

☐ Not in a relationship

☐ Yes, in a respecting and loving relationship

☐ Yes, in an abusive relationship

☐ Yes, in a toxic relationship

3. Do you have a toxic friend? (Toxic refers to relationship that causes one's wellbeing-physical or emotional to be threatened. It's a relationship that can make one feel attacked, demotivated, demeaned and unsupported including physical or verbal abuse)

☐ Yes

☐ No

4. 4. Do you have an immediate toxic family member? (Toxic refers to relationship that causes one's wellbeing-physical or emotional to be threatened. It's a relationship that can make one feel attacked, demotivated, demeaned and unsupported including physical or verbal abuse)

☐ Yes

☐ No

5. How often do you feel that you lack companionship: Hardly ever, some of the time, or often?

☐ Hardly Ever

☐ Sometimes

☐ Often

6. How often do you feel left out?

☐ Hardly Ever

☐ Sometimes

☐ Often

7. How often do you feel isolated from others?

☐ Hardly Ever

☐ Sometimes

☐ Often

8. On a scale of 1-5, how often did you have Covid-19 related fears in the last week? Fear of you or loved ones getting Covid-19 or dying because of it or Covid-19 infection getting high etc

☐1Never

☐2 Rarely

☐3 Sometimes

☐4 Often

☐5 Always

9. Did you or your immediate family member contract Covid-19 in last week?

☐ Yes

☐ No

10. Did any of your loved or close person die due to Covid-19?

☐ Yes

☐ No

11-20. Mark the following statements on your ability using the scale below:

	0 (Never)	1 (Rarely True)	2 (Sometimes True)	3 (Often True)	4 (Nearly True all time)
11.Able to adapt to change					

12.Can deal with whatever comes					
13. Tries to see humorous side of problems.					
14. Coping with stress can strengthen me					
15. Tends to bounce back after illness or hardship					
16. Can achieve goals despite obstacles					
17. Can stay focused under pressure					
18. Not easily discouraged by failure					
19. Thinks of self as strong person					
20. Can handle unpleasant feelings					

Section 5: Measuring Physical Activity

The following questions should be answered in terms of your physical activities performed in the last 7 days

	0- None	**1- Low**	**2- Moderate**	**3- High**
1. How much vigorous physical activities like heavy lifting, digging, aerobics, working out or fast bicycling did you conduct?	(No vigorous activity performed)	(less than 75 minutes per week)	(75 minutes per week)	(More than 75 minutes per week)
2. How much moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis did you perform? Do not include walking.	(No moderate physical activity)	(less than 150 min/week)	(150 min/ week)	(more than 150 min/week

(Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time)				
3. How much time did you spend walking? (for at least 10 minutes at a time) (This includes at work and at home, walking to travel from place to place, and any	(Did not walk more the 10 mins)	(less than 150 min/week)	(150 min/ week)	(more than 150 min/week

other walking that you have done solely for recreation, sport, exercise, or leisure)				
4. How much time did you spend sitting on a weekday? (Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television)	0: None	less than 6-8 hours everyday	6-8 hours everyday	more than 8 hours everyday

SECTION 6: MEASURING ANXIETY, STRESS AND DEPRESSION

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all

1 Applied to me to some degree, or some of the time

2 Applied to me to a considerable degree or a good part of time

3 Applied to me very much or most of the time

Statement	0	1	2	3
1 (s) I found it hard to wind down				
2 (a) I was aware of dryness of my mouth				
3 (d) I couldn't seem to experience any positive feeling at all				
4 (a) I experienced breathing difficulty (e.g. excessively rapid breathing,				
breathlessness in the absence of physical exertion)				
5 (d) I found it difficult to work up the initiative to do things				
6 (s) I tended to over-react to situations				
7 (a) I experienced trembling (e.g. in the hands)				
8 (s) I felt that I was using a lot of nervous energy				
9 (a) I was worried about situations in which I might panic and make a fool of myself				
10 (d) I felt that I had nothing to look forward to				
11 (s) I found myself getting agitated				
12 (s) I found it difficult to relax				
13 (d) I felt down-hearted and blue				
14 (s) I was intolerant of anything that kept me from getting on with what I was doing				
15 (a) I felt I was close to panic				
16 (d) I was unable to become enthusiastic about anything				
17 (d) I felt I wasn't worth much as a person				
18 (s) I felt that I was rather touchy				

19 (a) I was aware of the action of my heart in the absence of physical				
exertion (e.g. sense of heart rate increase, heart missing a beat)				
20 (a) I felt scared without any good reason				
21 (d) I felt that life was meaningless				

APPENDIX C: Information on the Research

1. Principal Investigator(s):

Name: Ms Sanjida Sultana

Qualification: MPH, candidate

Detail Address: Institute Building 2-3, Soi Chulalongkorn 62, Payathai Rd,

Pathumwan,

Bangkok 10330, Thailand

Telephone (Off./Res): +66981368471

e-mail: sanjida12.mahidol@gmail.com

2. Co-Investigator(s):

Name: Nuchanad Hounnaklang, Ph.D.

Qualification: Ph.D.

Detail Address: Institute Building 2-3, Soi Chulalongkorn 62, Payathai Rd,

Pathumwan,

Bangkok 10330, Thailand

Telephone (Off./Res): +662-218-8205

e-mail: Nuchanad.H@chula.ac.th

3. Place of the Study/Institution(s): BRAC University, Bangladesh

4. Title of Study: Association between Physical activity and Mental Health among University students in Bangladesh: A Cross Sectional Study

5. Type of Study: Cross Sectional Study

6. Duration of Study: 7 months

7. Total Cost: 20000 THB

8. Funding Agency: Chulalongkorn University

VITA

NAME	Sanjida Sultana
DATE OF BIRTH	12 June 1997
PLACE OF BIRTH	Bangladesh
INSTITUTIONS ATTENDED	Mahidol University
HOME ADDRESS	Salaya International House 64 Soi Sala Thammasop, Taweewathana Bangkok
PUBLICATION	Association between Loneliness and Related Factors among University Students during COVID-19 Pandemic in Bangladesh
AWARD RECEIVED	N/A