A Longitudinal Case Study of Depression, Anxiety and Stress among Science Students at University Using DASS-21

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(2024)

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A thesis submitted to the National University of Sciences and Technology, Islamabad,

in partial fulfillment of the requirements for the degree of

Master of Science in

Statistics

Supervisor: Dr. Zamir Hussain

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Islamabad, Pakistan

(2024)

THESIS ACCEPTANCE CERTIFICATE

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Date: 29.8.2024

FORM TH-4

National University of Sciences & Technology

MS THESIS WORK

We hereby recommend that the dissertation prepared under our supervision by: Hafiza Fasiha Binte Mudassir, Regn No. 00000402983, Titled A longitudinal Case Study of Depression, Anxiety and Stress Among Science Students at University Level Using DASS-21 be Accepted in partial fulfillment of the requirements for the award of MS degree.

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DEDICATION

I dedicate this thesis to my beloved brothers, who acted as my backbone and supported me at every step of the way.

ACKNOWLEDGEMENTS

I would like to acknowledge Dr. Zamir Hussain and Dr. Tahir Mehmood, who supported me professionally and morally; without both I would not have been able to complete my thesis.

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LIST OF SYMBOLS, ABBREVIATIONS AND ACRONYMS

DASS: Depression Anxiety Stress Scale
s1-s7: the question of Stress Subscale in DASS-21
a1-a7: the question of Anxiety Subscale in DASS-21
d1-d7: the question of Depression Subscale in DASS-21
CFI: Comparative Fit Index
TLI: Tucker-Lewis Index
RMSEA: Root Mean Square Error of Approximation
SRMR: Standardized Root Mean Square Residual

Abstract

This thesis investigates the levels of depression, anxiety and stress among university students at the School of Natural Sciences, National University of Sciences and Technology (SNS NUST) Islamabad, using the Depression Anxiety Stress Scales-21 (DASS-21). The study aims to assess the reliability of DASS-21 as a measurement tool and to identify any significant changes in students' mental health across different time points. Data were collected in two phases, with the initial phase serving as a pilot study. The tool's internal consistency was validated using reliability analysis, which yielded a Cronbach's alpha value of 0.915. The DASS-21's factor structure was verified via confirmatory factor analysis (CFA). Comparative analysis of the mental health data revealed no significant differences between two key time points; however, hierarchical clustering highlighted slight elevations in stress and depression before the End-Semester Exams (ESEs) and increased anxiety during the sports gala. These findings suggest that while overall mental health remained stable, specific academic and extracurricular pressures can impact students' well-being. This study highlights how important it is to evaluate mental health conditions continuously and put supportive measures in place to assist students in managing stress and anxiety during stressful times.

Keywords: Mental Health; DASS-21; Stress; Anxiety; Depression; Comparative Analysis; Longitudinal Study

Chapter 1

Introduction

One of the most important aspects of a person's total wellbeing is their mental health. It clearly affects how well they operate socially, physically, and emotionally. Mental health diseases encompass a wide spectrum of problems, from stress, anxiety, and depression to more serious disorders like bipolar disorder and schizophrenia. Like physical disorders, mental health disorders affect both the brain and the body. The variation in prevalence of mental health disorders across different continents is influenced by cultural, economic, and social factors. For example, in some cultures there are specific attitudes towards mental health illnesses that can affect the recognition and stigma associated with them, which make it difficult to diagnose and treat.The accessibility and quality of mental health services are significantly influenced by economic considerations, including healthcare access and income levels. Social factors like education, employment status, and social support networks contribute to the inconsistency observed in mental health outcomes across regions. To develop effective mental health

interventions and support systems tailored to specific populations' unique needs it is important to understand the variations. This includes identifying the region, culture, social and economic factors to address mental health issues.

1.1 Background of the Study

1.1.1 Structural Changes in Brain Due to Chronic Stress Anxiety and Depression

Stress, anxiety, and depression affect individuals physically through complex interactions between the brain, hormones, and various bodily systems. Key mechanisms include hormonal responses, such as the activation of the hypothalamic-pituitary-adrenal (HPA) axis, leading to cortisol release [1][2]. Elevated cortisol levels can suppress the immune system and cause metabolic changes like weight gain. Neurotransmitter imbalances involving serotonin, norepinephrine, and dopamine play crucial roles in mood regulation, with low serotonin linked to depression and increased norepinephrine contributing to anxiety[3]. Chronic stress can also lead to structural and functional changes in the brain, including reduced hippocampus volume and hyperactivity in the amygdala, impacting memory, emotional regulation, and anxiety [4]. Increased inflammation associated with stress and mood disorders can contribute to physical health issues, such as cardiovascular disease[5].Chronic stress can also result in dysregulation of the autonomic nervous system, which can contribute to persistent tension and anxiety by prolonging the activation of the sympathetic nervous system (SNS) and inhibiting the

parasympathetic nervous system (PNS).

1.1.2 Physical Manifestations of Stress Anxiety and Depression

Stress often manifests physically as headaches, muscle tension, or pain. It can cause chest pain and rapid heartbeat, leading to fatigue and sleep problems[6]. Gastrointestinal issues such as an upset stomach, nausea, and diarrhea are common, along with changes in appetite, resulting in either loss of appetite or overeating[7]. Stress can also trigger anxiety, irritability, depression, social withdrawal, and poor concentration.

Abdominal pain, lightheadedness, dizziness, and fast breathing or heart rate are some of the physical effects of anxiety. People may suffer from headaches, exhaustion, insomnia, indigestion, chest pain, and a compromised immune system. Additionally, anxiety can make asthma symptoms worse. [8].

Depression's physical symptoms include sleep problems, whether too much or too little sleep, and fatigue with a lack of energy. Sufferers may experience unexplained aches and pains, digestive issues like nausea, diarrhea, or constipation, and significant appetite changes, leading to weight loss or gain. Depression can also cause irritability, loss of interest in sex, and other physical discomforts [9].

The coexistence of chronic pain and depression can lead to a cycle of worsening symptoms.Depression is substantially more common in patients with chronic pain, and vice versa. For instance, individuals with chronic pain conditions like migraines or back

pain are at higher risk of developing depression, with the severity and duration of pain correlating with the severity of depressive symptoms. This interaction involves complex neurobiological mechanisms, with significant alterations in the ACC, amygdala, hippocampus, PFC, insula, and thalamus[10].

Patients with depression and chronic pain often have dysfunction in the dorsolateral prefrontal cortex (DLPFC), a region of the prefrontal cortex that affects higher cognitive skills and emotional control.[11][12]. The insular cortex integrates sensory and emotional information and shows alterations in both conditions. Finally, the Thalamus, a relay station for sensory information, is implicated in both pain processing and mood regulation, with changes in activity noted in individuals with chronic pain and depression[13].

1.1.3 Global Mental Health Overview

In Africa, mental health disorders are prevalent, with approximately 13 percent of the population affected. Access to services for mental health, however, is very restricted. In low- and middle-income nations, more than 75 percent of people do not receive treatment for illnesses like depression.[14]. The challenges in Africa include stigma, limited resources, and the impact of conflict and poverty, which exacerbate mental health issues and impose a significant economic burden on these nations.

Asia presents a diverse mental health landscape. Countries like Vietnam and Taiwan

report some of the lowest prevalence rates of mental disorders, while regions in South Asia face high rates of anxiety and depression [15]. With a range of 41–44 percent, South Korea, Malaysia, and Japan have the largest percentage of workers at higher risk of mental health problems. In contrast, Vietnam, Taiwan, and Indonesia report lower rates, with 35 percent, 35 percent, and 17 percent of employees, respectively. However, the prevalence of mental disorders remains significant across Asia, with 82 percent of employees having elevated risk of developing issues[16]. The cultural stigma associated with mental illness continues to be a major obstacle to getting treatment. The situation surrounding mental health is further complicated by the fact that access to mental health care is sometimes restricted, especially in rural areas.

Europe has a high prevalence of mental health disorders, with about 19 percent of the population affected[17]. Despite better access to mental health services in high-income countries, significant gaps remain, especially in Eastern Europe. Stigma and discrimination continue to affect treatment-seeking behavior, underscoring the need for improved mental health awareness and resources.

North America, particularly the United States, has one of the highest rates of mental health disorders, with 20 percent of adults experiencing conditions like anxiety and depression[18].Furthermore, mental health issues, including anxiety and depression, are quite prevalent in Australia, with Indigenous groups experiencing even higher rates of these conditions. There are differences in access to mental health care, particularly

for rural and Indigenous groups, even if it is better than in many other places. Tailoring strategies that take geographic and cultural characteristics into account is necessary to address these differences.

1.2 Mental Health of People in Pakistan

In Pakistan, mental health disorders are a significant concern, with approximately 24 million people (about the population of Texas) requiring mental healthcare[19]. Up to 10 percent of the population, or around 20 million people, are thought to be affected by mental illnesses nationwide. This is roughly equivalent to the population of New York. Anxiety, schizophrenia, and depression are common mental health conditions. Depression alone affects 17 million individuals, or roughly the population of New York.[20]. These issues are exacerbated by factors such as poverty and social isolation. Despite the high prevalence, only about 10 percent of individuals with mental illness receive any form of treatment due to barriers like stigma, lack of awareness, inadequate resources, and limited access to mental health services, especially in rural areas.

It is concerning how few mental health specialists there are in Pakistan. There is one psychiatrist accessible for every half a million individuals, as there are only about 400 trained psychiatrists and about 500 psychologists.[21]. This shortage significantly impacts the availability and quality of mental health care. The lack of professionals per capita creates a massive treatment gap, leaving over 90 percent of people with

common mental disorders untreated. Additionally, mental disorders contribute significantly to the overall disease burden in Pakistan, with depression being the leading cause of disability-adjusted life years (DALYs). The burden has increased from 1990 to 2019, particularly among young and middle-aged adults.

Estimates of the prevalence of common mental diseases in Pakistan vary greatly; for females, they range from 25 percent in urban regions to 72 percent in rural areas, and for males, they range from 10 percent in urban areas to 44 percent in rural areas.[22]. Mental health disorders are associated with a significant economic burden, affecting productivity and quality of life. Financial difficulties faced by families often hinder the management and treatment of these disorders. The barriers to accessing mental health care include societal stigma, which discourages people from seeking help, and limited treatment facilities and trained professionals [23]. There is also an inadequate mental health budget, with less than 1 percent of the total health budget dedicated to mental health issues.

Several successful mental health awareness programs in Pakistan aim to improve understanding and reduce stigma associated with mental health issues. The Pakistan Association for Mental Health (PAMH) provides mental health services and works to reduce stigma. Through community-based mental health services, school mental health programs, and awareness campaigns, the British Asian Trust has been actively changing the mental health landscape. The President's Initiative for Mental Health in

Schools, launched in 2019, promotes mental health in schools by training teachers to recognize and manage mental health problems among students. Additionally, Mental Health Awareness Month in May provides an opportunity for various organizations to raise awareness and promote mental health resources.

1.3 Mental Health of Students in Pakistan

Due to a number of socioeconomic issues and the COVID-19 pandemic, student mental health in Pakistan has become a critical concern. Recent studies indicate that a sizable portion of students in Pakistan experience mental health issues, with 39 percent reporting low mood, 36 percent experiencing anxiety, and 25 percent facing depression. Medical students are particularly affected, with anxiety rates reported as high as 74.2 percent[24]. Factors contributing to these challenges include intense academic competition, societal expectations, and familial pressures to achieve high grades, creating a competitive environment that can lead to stress, anxiety, and even suicidal behaviors among students.

The consequences of untreated mental health issues can be severe. In the short term, students may experience diminished interest in social activities and academic performance. Long-term effects can include substance abuse and self-destructive behaviors, with reports indicating that approximately 13,000 suicides occurred in Pakistan in 2012, many linked to untreated mental health conditions[25]. Additionally, research

indicates that, due to societal expectations and cultural norms, female students may experience higher levels of stress and anxiety than their male counterparts. In one study, female medical students exhibited higher anxiety and depression rates, highlighting the need for gender-sensitive mental health interventions[26].

Addressing these challenges requires systemic changes and comprehensive mental health frameworks tailored to the needs of Pakistani students. This includes promoting digital mental health services, increasing awareness, and providing counseling resources within educational institutions. Shifting the focus from competition to collaboration in learning environments could help alleviate stress and improve overall mental well-being among students. Ensuring access to mental health services and fostering a culture of support are crucial steps in addressing these issues.

Students' mental health problems can be both exacerbated and mitigated by parents and teachers. Students' mental health issues can be greatly exacerbated by a variety of factors, including a lack of knowledge, high expectations, poor communication, stigmatizing attitudes, and a lack of support from parents and instructors. On the other hand, students can be empowered to effectively manage their mental health through modeling healthy coping mechanisms, encouraging open communication, cultivating supportive connections, educating themselves about mental health issues, and advocating for better mental health resources.

Training teachers to better identify early signs of mental health issues in students is

essential for fostering a supportive educational environment. Comprehensive training programs should focus on early identification of mental health issues, including recognizing behavioral changes, emotional distress, and academic performance declines. Incorporating mental health first aid training into teacher education can equip educators with the skills to respond effectively to students in crisis. Practical strategies such as observation and documentation, enhanced communication skills, and collaboration with mental health professionals are vital.

Creating a mental health culture within schools, providing access to resources, and offering ongoing professional development opportunities for teachers can further support their efforts in addressing students' mental health challenges. In order to mitigate mental health difficulties among their pupils and promote general well-being, educators can play a crucial role by providing thorough training programs, facilitating open dialogues, and creating a friendly school atmosphere.

1.4 The DASS-21

The Depression Anxiety Stress Scales-21, or DASS-21 for short, are a trio of self-report measures created by Lovibond, S.H. and Lovibond, P.F. (1995) to gauge the negative emotional states of stress, anxiety, and depression. [27]. It is a condensed version of the 42-item original DASS questionnaire, with 21 items total—7 items for each scale. Higher scores indicate more severe levels of stress, anxiety, or depression. Each item

is rated from 0 (did not apply to me at all) to 3 (applied to me very much, or most of the time). The final score for each scale is determined by adding the points for all pertinent elements, and this process is repeated for each scale. This process reflects the DASS-21's shorter length than the original edition. The severity labels for each scale—normal, mild, moderate, severe, and extremely severe—are used to interpret these scores.

The DASS-21 is a commonly employed screening instrument that evaluates symptoms of stress, anxiety, and depression in order to help identify people who are experiencing severe emotional distress. It is particularly useful for tracking changes in symptoms over time, such as before and after treatment [11].It is crucial to remember that DASS-21 is a screening tool rather than a diagnostic one. Scores should be interpreted within the context of a clinical interview and other relevant information. The scales are not specific to disorders and may not distinguish between diverse types of anxiety or depression, underscoring the necessity for comprehensive clinical evaluation.

It has been demonstrated that the DASS-21 possesses significant psychometric qualities, such as convergent validity and good internal consistency.[28]. It has been validated across various populations, including clinical and non-clinical samples, and has been translated into multiple languages, ensuring its applicability in diverse settings[29]. Additionally, the DASS-21 has demonstrated sensitivity to change in mental health symptoms over time, making it effective for assessing the impact of interventions and

tracking changes in depression, anxiety, and stress levels. Studies have also found the DASS-21 to have good test-retest reliability, indicating that it provides consistent results when administered at different time points, supporting its use for longitudinal assessment of mental health[30].

The shorter DASS-21 is comparable to the original 42-item DASS in factor structure, reliability, and validity. A thorough assessment of stress, anxiety, and depression can still be obtained by using the shortened version, which can lessen participant burden. It is important to understand the limitations of DASS-21 notwithstanding its usefulness. As a screening measure, it should not be used as the sole basis for diagnosis. Scores should consider the specific context and population being assessed to ensure accurate and meaningful use of the tool.

1.4.0.1 Psychometric Properties of the DASS-21

The DASS-21 (Depression Anxiety Stress Scales - 21 items) is recognized for its strong psychometric properties, contributing to its reliability and effectiveness as a mental health assessment tool. One of its key strengths is high internal consistency across its three subscales—depression, anxiety, and stress. Research indicates that the Cronbach's alpha coefficients for these subscales typically range from 0.78 to 0.91, demonstrating good reliability[31]. High internal consistency means that the items within each subscale effectively measure the same underlying construct, ensuring the scale's

reliability in various contexts. It also boasts a clear factor structure, with three distinct subscales corresponding to depression, anxiety, and stress. This structure allows for meaningful interpretations of scores across different populations. The DASS-21 is a useful tool for monitoring treatment outcomes and the efficacy of therapies since it has also shown sensitivity to changes in mental health status over time. Because of this sensitivity, medical professionals and researchers are able to track patients' development and make well-informed treatment plan selections.

Moreover, the DASS-21's cultural adaptability enhances its utility as a global tool for assessing mental health. It has been successfully adapted and validated in various cultural contexts, ensuring its applicability across different populations. The ease of use of the DASS-21 also contributes to its popularity; as a brief self-report questionnaire, it can be completed quickly, making it suitable for clinical and research settings without placing a significant burden on respondents[32].

1.4.0.2 Comparison to Longer Version DASS-42

The DASS-21 (Depression Anxiety Stress Scales - 21 items) and its longer counterpart, the DASS-42, both exhibit strong psychometric properties, though there are some differences worth noting in their internal consistency. The three subscales of the DASS-21 exhibit strong internal consistency, with Cronbach's alpha values often falling between 0.78 and 0.94. In particular, the anxiety subscale runs from 0.78 to 0.92, the stress

subscale from 0.79 to 0.90, and the depression subscale often has values between 0.81 and 0.94.[33].

Standardized cutoff scores for each subscale are provided in both versions, classifying findings as normal, mild, moderate, severe, or extremely severe. This uniformity facilitates simple result interpretation and comparison between various patients and environments. Additionally, the DASS-21 has proven versatile, being successfully used across various age groups and cultural contexts, which enhances its applicability in diverse clinical populations. While the DASS-42 may offer slightly higher reliability due to its longer format, the DASS-21 offers significant advantages in terms of time efficiency and ease of use without compromising on psychometric robustness. Because of this, the DASS-21 is a highly recommended option in numerous clinical and research contexts, offering a dependable and useful instrument for evaluating stress, anxiety, and depression.

1.5 Problem Statement

Even though mental health problems are common, there are not many long-term research that look at the Depression Anxiety Stress Scales-21's (DASS-21) consistency and reliability over time. Clinicians and academics can benefit greatly from knowing how mental health states vary over time and how reliably the DASS-21 captures these changes.

Up until the COVID-19 outbreak, university students' mental health assessments in Pakistan have not received much attention from researchers. Unprecedented stressors brought on by the epidemic underscored the significance of mental health, prompting a boom in research on the subject. Nevertheless, there is a dearth of pre-pandemic literature available, and the majority of this research is focused on the COVID-19 era. This emphasizes the necessity of continuing research to comprehend overall population patterns in mental health outside of the pandemic environment.

In order to close these gaps, DASS-21 data that were gathered at three distinct times points were compared in this study. Through an analysis of the mental health status of students at SNS NUST (National University of Sciences and Technology) Islamabad, this study attempts to offer a thorough grasp of mental health patterns and the validity of the DASS-21 as a measure of these patterns over an extended period of time in Pakistan.

1.6 Objectives of the Study

The following are the study's objectives:

1. **Assess the Consistency and Reliability of the DASS-21:** to assess the Depression Anxiety Stress Scales-21's (DASS-21) reliability and consistency when used to measure Pakistani university students' mental health at three distinct intervals.

2. **Evaluate the Consistency of DASS-21 Scores Across Three Time Points:** to evaluate the DASS-21 scores' consistency at three different time points in order to confirm the tool's long-term dependability.

3. **Analyze Longitudinal Changes in Mental Health:** to look into the long-term changes in stress, anxiety, and depression levels among SNS NUST Islamabad university students over the given time periods.

4. **Compare the Total Scores of Each Factor Over Time:** To compare the total scores of each factor (depression, anxiety, and stress) over time, identifying patterns and trends in mental health states.

5. **Determine Notable Shifts in Mental Health Status:** to pinpoint any noteworthy alterations in the participants' mental health condition over the course of the three time points, emphasizing pivotal moments or elements impacting these modifications.

1.7 Research Questions

The following research questions are the focus of this investigation:

1. How consistent and reliable is the DASS-21 in measuring mental health states over two different time points among university students in Pakistan?

2. Do the DASS-21 scores show consistency over two different time periods, suggesting that the tool is reliable over an extended period of time?

3. What are the longitudinal changes in depression, anxiety, and stress levels among university students at SNS NUST Islamabad, and are there significant patterns or trends in these changes over time?

1.8 Significance of the Study

1. **Enhanced Understanding of Mental Health Trends:** This study offers a deeper knowledge of how mental health states—specifically, depression, anxiety, and stress—evolve over time among Pakistani university students by performing a longitudinal analysis of the DASS-21 scores. This is essential for determining the key times when pupils might be more vulnerable to mental health problems.

2. **Validation of the DASS-21 Tool:**The DASS-21 is a popular tool for mental health assessments, and the study evaluates its reliability and consistency throughout a number of time periods. By demonstrating this tool's dependability in a Pakistani setting, researchers and clinicians can utilize it with confidence for upcoming mental health assessments and interventions.

3. **Addressing a Research Gap:**There has not been much research on mental health in Pakistan, especially longitudinal studies. With few pre-pandemic data

available, the majority of studies currently in existence concentrate on the effects of the COVID-19 pandemic. By offering a more comprehensive temporal perspective on student mental health, both within and outside of the pandemic context, our study helps close this gap.

4. **Informed Interventions and Policies:** The creation of focused mental health therapies and support services for college students can be guided by the study's conclusions. Legislators and academic institutions can create more efficient mental health programs that cater to the individual requirements of students by recognizing notable shifts and patterns in mental health over time.

5. **Contribution to Global Literature:** This study contributes to the worldwide body of knowledge on mental health by offering perspectives from the setting of a poor nation. Comparing the findings with comparable research from other areas can help us better understand how cultural and environmental influences affect mental health.

6. **Promoting Mental Health Awareness:** This study can contribute to increasing awareness about the necessity of routine mental health examinations and support networks inside Pakistani educational institutions by highlighting the significance of mental health among university students. This may result in a less stigmatized approach to mental health care and encourage students to get

treatment when they need it.

1.9 Scope and Limitations

1.9.1 Scope of the Study

1. **Longitudinal Analysis:**The research employs a longitudinal examination of DASS-21 scores to assess alterations in stress, anxiety, and depression at two distinct intervals. This method offers a dynamic perspective on the state of university students' mental health.

2. **Tool Validation:** The study adds to the validation of this mental health assessment instrument in the Pakistani setting by evaluating the DASS-21's consistency and reliability. This may improve how it is used in next studies and therapeutic settings.

3. **Comparative Analysis:** The study compares mental health scores across three time points, offering insights into how mental health states evolve over time. This helps identify critical periods and trends that are essential for developing effective interventions.

4. **Focus on University Students:** The research focuses on university students at SNS NUST Islamabad, providing specific insights into the mental health challenges faced by this demographic. These findings can inform targeted mental

health support programs within educational institutions.

5. **Contribution to Pakistani Mental Health Research:** This study addresses a major gap in the literature by addressing the paucity of mental health studies conducted in Pakistan prior to the COVID-19 pandemic. It offers a starting point for further research on trends in mental health and the efficacy of therapies in the Pakistani setting.

6. **Policy and Intervention Development:** The study's findings can guide policymakers and educational institutions in designing and implementing mental health programs tailored to the needs of university students. This can lead to more effective strategies for promoting mental well-being and academic success.

1.9.2 Limitations of the Study

1. **Sample Size and Generalizability:** The study's sample size is restricted to SNS NUST Islamabad university students, who might not be entirely representative of Pakistan's university population. As a result, it is possible that the results cannot be applied to different age or student populations.

2. **Self-Report Bias:** Self-reported data, which the DASS-21 depends on, is prone to biases such social desirability or false self-evaluation. The accuracy of the results may be impacted by participants' overreporting or underreporting of their symptoms.

3. **Attrition Rates:** Participant retention in longitudinal studies is frequently problematic over time. Later in the study, attrition may result in a lower sample size, which could have an impact on the validity and reliability of the findings.

4. **External Influences:**Various external factors, such as academic pressure, personal issues, or socio-economic changes, could influence participants' mental health states over time. These factors might not be fully accounted for, impacting the interpretation of the results.

5. **Limited Temporal Scope:** The study's period might not be sufficient to capture long-term trends and changes in mental health. Longer follow-up periods could provide more comprehensive insights into mental health trajectories.

Chapter 2

Literature Review

2.1 Introduction

The impact of mental health problems on students' academic performance and general well-being is a developing concern. This chapter examines the body of research on student mental health, with a focus on healthcare disciplines, as well as the instruments available for mental health assessments. An overview of the Depression Anxiety Stress Scales-21 (DASS-21) and its use in multiple studies is given in this chapter. The goal is to create a thorough grasp of the DASS-21's importance in these evaluations as well as the prevalence, evaluation, and consequences of mental health problems among healthcare students.

2.2 Mental Health and Its Importance

A person's mental health has a significant impact on their general well-being and affects their thoughts, feelings, and social interactions. It affects everyday functioning and

quality of life severely and includes emotional, psychological, and social elements. The significance of mental health in many settings has been emphasized by recent research, underscoring the necessity of continuous investigations to guide public health policies and interventions.

2.2.1 Importance of Mental Health

1. **Impact on Daily Life:** Good mental health enables individuals to cope with stress, build relationships, and achieve personal goals. Poor mental health can lead to difficulties in these areas, affecting overall life satisfaction.

   - Coping with Stress: Trauma has a significant impact on marital dynamics, as demonstrated by a study looking at how posttraumatic stress disorder (PTSD) affected spouse relationships among victims of natural disasters. Sustaining mental well-being cultivates resilience, empowering people to proficiently handle stress. [34].

   - Relationships: Social ties are essential for mental health, according to research on social anxiety levels among college students before, during, and after the COVID-19 epidemic. Students also reported higher levels of social anxiety. An individual's ability to establish and sustain healthy relationships may be hampered by poor mental health.[35].

   - Personal Goals: Early intervention for first-episode psychotic mania in bipo-

lar disorder patients highlights the significance of prompt treatment to enhance outcomes. Setting and pursuing personal goals is made possible by good mental health, which enhances life happiness in general.

2. **Connection to Physical Health:** Mental health is linked to physical health. Conditions like anxiety and depression can exacerbate physical health issues, while chronic illnesses can worsen mental health.

   - Multimorbidity in Severe Mental Illness: According to a recent BMJ Mental Health study, multimorbidity—the term for the combination of several physical health conditions—is twice as common in people who suffer from severe mental illness. This study examined data from more than 194,000 mental health patients and found that many of these people had respiratory problems, metabolic illnesses, and hypertension. The results highlight the necessity of integrated healthcare strategies that concurrently treat physical and mental health.[36].

   - Impact of Chronic Illness on Mental Health: Research indicates that chronic physical conditions can lead to mental health issues. For instance, individuals with chronic diseases like diabetes or heart disease often experience higher rates of depression and anxiety. This reciprocal relationship suggests that managing physical health is crucial for maintaining mental well-

being[37].

- Physical Health's Influence on Mental Well-being: A study from Australia demonstrated that physical health significantly impacts mental health outcomes. The research found that improvements in physical health scores were associated with corresponding improvements in mental health scores. Specifically, a one-point improvement in physical health was linked to a 0.43-point increase in mental health scores, illustrating the direct influence of physical health on mental well-being[38].
- Barriers to Healthcare Access: Access to healthcare for people with mental health disorders is frequently impeded, which can exacerbate their physical health. According to a survey, individuals with mental health disorders are less likely to get regular medical care, which increases the risk of untreated or undetected physical health ailments. The cycle of poor mental health causing poor physical health and vice versa may be exacerbated by this lack of availability.
- Effects of Mental Health on Chronic Disease Management: Mental health conditions can complicate the management of chronic diseases. For example, depression is associated with poorer adherence to treatment regimens for chronic illnesses, resulting in worse health outcomes. This highlights

the importance of addressing mental health when treating physical health conditions to improve overall health outcomes [39] [40].

3. **Social and Economic Costs:** There is a substantial global burden of mental health issues, affecting about 450 million individuals. According to World Health Organization (WHO) projections, depression is expected to rank among the primary causes of disease burden in the upcoming years, underscoring the importance of developing efficacious interventions for mental health promotion and treatment.

   - Prevalence and Burden: The World Health Organization (WHO) estimates that mental health illnesses impact more than 450 million individuals worldwide [41]. These illnesses carry a heavy burden; in 2010, mental and drug use disorders accounted for 10.4 percent of the world's disease burden and were the primary cause of years spent disabled across all disease categories.[42].
   - Economic Costs: The financial toll that mental health illnesses take is enormous. According to a research that was published in eClinicalMedicine, a division of The Lancet Discovery Science, the economic cost of mental illness in 2019 was anticipated to be around USD 5 trillion. On a regional scale, these losses might make up 4 percent of Eastern sub-Saharan Africa's GDP and 8 percent of High-income North America's GDP. Crucially, estimates

indicate that these expenses would rise at an exponential rate over the next 15 years, reaching 2.5 trillion USD in 2010 (or around 3 trillion USD in 2019) by 2030.[43].

- Impact on Economic Growth: Because they reduce the availability of capital and labor, mental illnesses can have a substantial negative effect on economic growth by lowering economic output. A vicious cycle of poverty and disease can be created at the home level by the burden of mental illness.
- Need for Effective Interventions: Effective mental health promotion and treatment methods are desperately needed, as the World Health Organization (WHO) estimates that depression will rank among the main causes of disease burden in the years to come (WHO, 2022). Purchasing mental health support systems can result in several positive effects, such as increased worker wellbeing, less absenteeism, and increased productivity.

4. **Stigma and Access to Care:** Stigma surrounding mental health can prevent individuals from seeking help. Research indicates that barriers such as fear of judgment, cost, and cultural insensitivity hinder access to mental health services[44].

2.2.2 Recent Research Findings

1. **Posttraumatic Stress Disorder and Relationships:** A longitudinal study examined the effects of PTSD on spousal relationships among natural disaster victims, revealing significant relational dynamics influenced by trauma[45].

2. **Social Anxiety in University Students:** A study assessing social anxiety levels during and after the COVID-19 pandemic found that social connections are vital for mental well-being, with increased social anxiety reported among students. The research highlighted barriers to accessing mental health services, including cultural stigmas[46].

3. **Early Intervention in Psychosis:**Early intervention is crucial for improving outcomes in first-episode psychotic mania in bipolar disorder patients, according to research on the subject.[47].

4. **Smoking Cessation Interventions:**A study explored the role of social networks in smoking cessation among individuals with serious mental illness, suggesting that these networks could be leveraged for effective interventions[48].

5. **Mental Health and Surgical Outcomes:** A systematic review indicated that mental health comorbidities, particularly depression, negatively impact postoperative outcomes in patients undergoing total ankle arthroplasty, underscoring

the need for integrated healthcare approaches[49].

2.3 Tools for Mental Health Assessment

Mental health assessment tools are essential for clinicians to evaluate and monitor the mental health of their patients effectively. These tools range from standardized questionnaires to structured interviews, each designed to assess various mental health conditions and symptoms. Below is an overview of some commonly used mental health assessment tools categorized by their primary focus.

2.3.1 General Categories of Mental Health Assessment Tools

Anxiety Assessment Tools

The common mental health illness known as generalized anxiety disorder (GAD) has a substantial negative influence on people's everyday functioning and quality of life. To quantify symptom intensity, diagnose GAD, and gauge anxiety levels, numerous instruments and scales have been devised.[50]. The Generalized Anxiety Disorder-7 (GAD-7) scale, created by Spitzer R. L. in 2006, is one of the most well-known instruments. It is a quick and effective self-report tool for determining whether a person has GAD and evaluating the severity of their symptoms. The DSM-IV symptom criteria for GAD were included in the item pool that was initially developed. It was then refined to a 7-item scale based on the item that had the highest association with the total score of the 13-item scale. The GAD-7 showed outstanding test-retest reliability (intraclass

correlation = 0.83) and great internal consistency (Cronbach alpha =.92).[51].

A criterion-standard study assessed the validity and reliability of the GAD-7 in fifteen US primary care clinics. A mental health expert conducted a telephone interview with 965 of the 2740 adult patients, enabling comparisons between self-report and independent diagnosis.[52]. At the determined cut point, the GAD-7 demonstrated strong construct, procedural, criteria, and specificity, scoring 89 percent and 82 percent, respectively. Significant functional impairment was connected with rising GAD-7 scores in a number of categories. Factor study verified that GAD and depression are separate dimensions with independent effects on functional impairment and disability, even though they frequently co-occur with depression. The GAD-7 demonstrated strong agreement across interviewer-administered and self-report forms, confirming its use in clinical practice and research.

The Hamilton Anxiety Rating Scale (HARS), which is a globally renowned instrument for assessing anxiety levels, is another often used evaluation tool. Its allowable factor structure is still flexible, though. Its psychometric qualities have been refined and validated by recent study. For example, normative anxiety prevalence rates were obtained in a study concentrating on a Persian sample, wherein 15.2 percent of respondents reported mild anxiety and 2.3 percent reported severe anxiety.[53].A two-factor model that distinguished between cognitive and physiological symptoms was found in the study, and it turned out to be both theoretically and statistically ad-

equate. This distinction facilitates comprehension of the efficacy of various therapy approaches. The two-factor paradigm offers a clearer understanding of anxiety as a general construct, and the Hamilton Anxiety Rating Scale remains a valuable tool for measuring anxiety.[54].

Another often used norm-referenced instrument for screening for anxiety disorders is Zung's Self-Rating Anxiety Scale (SAS). Nevertheless, Dunstan and Scott's (2018) recent study has called into question if the current cut-off is still a sufficient way to determine whether a disease is present. In both clinical and community samples, their study looked at sensitivity and specificity values in relation to diagnoses made with the Patient Health Questionnaire (PHQ). According to their research, the best cut-off point is somewhere in between Zung's original and current recommendations. The initial raw score cut-off of 40 would be more acceptable for research situations, they decided, even though the current cut-off of 36 might be appropriate for clinical screening. In order to balance the prevalence rates and potential expenses of false negative and false positive results, this adjustment

Depression Assessment Tools

According to a meta-analysis, the Patient Health Questionnaire-9 (PHQ-9) is a valid measure for identifying serious depression. A cut-off score of 10 maximizes combined sensitivity (0.88) and specificity (0.85) across a range of diagnostic interviews.[55].The PHQ-9 was further verified in a Chinese study involving patients with major depressive

disorder, showing strong internal consistency and good construct validity (Cronbach's alpha = 0.892).[56].

A Shanghai study conducted in response to COVID-19 assessed depression and anxiety in 2000 patients using the PHQ, the Generalized Anxiety Disorder Scale, and the Self-Rating Anxiety Scale in an effort to provide early psychological therapies.[57].

Among adults living with HIV in Kenya, the Generalized Anxiety Disorder-7 (GAD-7) scale demonstrated satisfactory test-retest reliability (ICC = 0.70) and strong internal consistency (alpha = 0.82). Its strong convergent validity with the PHQ-9 and unidimensional structure were verified.[58].

Effective screening instruments are the Zung Self-Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS). According to a study that compared the Zung scales to the Depression Anxiety Stress Scale (DASS), the DASS shown superior specificity, but the Zung scales had higher sensitivity (Dunstan, D. A., Scott, N., and Todd, A. K. 2017). The Zung cut-offs could be changed to improve accuracy. In order to balance false positives and negatives in research contexts, a different study recommended using a higher cut-off of 40 for the SAS. [59].

2.3.2 Importance of Mental Health Assessment Tools

Mental health assessment tools are crucial for effective evaluation and treatment, offering a structured method for clinicians to gather patient information, aiding diag-

nosis, treatment planning, and progress monitoring. These tools provide standardized measures for reliable and valid assessments across diverse populations and settings, facilitating consistent comparisons over time and among different patient groups.

They enhance communication between patients and clinicians by providing common language for discussing mental health issues, which improves understanding and strengthens therapeutic relationships. Regular use allows clinicians to monitor symptoms and treatment responses, track changes, adjust plans, and evaluate intervention effectiveness, essential for managing chronic conditions.

Validated assessment tools support evidence-based practice, informing clinical decisions with data grounded in research and best practices, leading to improved patient outcomes. Additionally, many tools help identify risks like suicidal ideation or self-harm, enabling timely interventions and ensuring patient safety.

2.4 The DASS-21

Developed by Lovibond and Lovibond (1995), the DASS-21 is intended to offer a thorough evaluation of stress, anxiety, and depression. There are seven items in all, one for each of the three subscales.

The DASS-21 has been validated across various populations and has shown strong reliability and validity [60]. It is particularly useful in settings where time constraints make longer assessments impractical. The tool has been used in numerous studies to assess

mental health in diverse groups, including healthcare students. Its ability to measure three dimensions of mental health simultaneously makes it a valuable instrument for comprehensive mental health assessments[22].

2.5 Previous Studies Using the DASS-21

The DASS-21 has been used in numerous research to evaluate healthcare students' mental health. For example, a study conducted at Qatar University with 1,378 medical students found that considerable amounts of stress, anxiety, and despair were present. The DASS-21 revealed that 34.7 percent of students exhibited symptoms of severe to extremely severe anxiety, 15.4 percent had symptoms of severe to extremely severe stress, and 21 percent had symptoms of severe to extremely severe depression.[61]. These findings highlight the high prevalence of mental health issues among healthcare students and underscore the importance of using reliable assessment tools like the DASS-21.

A high frequency of mental health issues was discovered in another study focusing on medical students in Qatar, with 10.4 percent reporting severe anxiety and 39.6 percent indicating psychological distress. [62]. Significant relationships between mental health problems and sociodemographic characteristics like parental education, academic achievement, and stigma associated with mental health were also found by the study. These results imply that larger societal variables as well as academic pressures

have an impact on mental health problems among medical students.

The connection between medical students' mental health and suicidal conduct has also been studied. In a study of 531 medical students, suicide behavior was detected in 19.6 percent of cases, with depression and inadequate coping mechanisms being important risk factors. [63].The study underlined how important it is to provide early assistance and intervention for mental health concerns in order to address suicide behavior in adolescents.

Innovative methods for classifying mental health have been created in addition to these research, such as the Multimodal and Multi-Teacher Knowledge Distillation model. [64]. This algorithm improves mental health classification by integrating many data sources, such as text and voice. These developments demonstrate how mental health assessments are developing and the possibility for more thorough and precise assessments.

2.6 Summary

This chapter elaborated on mental health issues faced by healthcare students, emphasizing the importance of mental health for overall well-being and academic performance. Mental health impacts daily life, stress management, relationships, and personal goals. It is linked to physical health, with poor mental health exacerbating physical conditions and vice versa. The social and economic costs of mental health disorders are

significant, highlighting the need for effective interventions.

Recent research findings highlight the profound impact of mental health on various aspects of life. Studies show the influence of mental health on relationships, social anxiety, early intervention in psychosis, smoking cessation, and surgical outcomes. For instance, research indicates that maintaining good mental health fosters resilience, enabling individuals to manage stress effectively and build healthy relationships. Furthermore, conditions like anxiety and depression can complicate the management of chronic diseases, underscoring the importance of addressing mental health in treatment plans.

The crucial function of mental health assessment tools is also covered in this chapter. These instruments offer standardized, organized assessments that support progress tracking, therapy planning, and diagnosis. The Zung Self-Rating Anxiety Scale (SAS), Hamilton Anxiety Rating Scale (HARS), Generalized Anxiety Disorder-7 (GAD-7), and Patient Health Questionnaire-9 (PHQ-9) are among the frequently utilized instruments. These tools promote evidence-based practice, permit continuous monitoring, and improve patient-clinician communication.

This chapter also discusses the vital role that mental health evaluation tools play. These tools provide structured, standardized examinations to aid in diagnosis, therapy planning, and progress monitoring. Among the often used tools are the Zung Self-Rating Anxiety Scale (SAS), Hamilton Anxiety Rating Scale (HARS), Generalized Anxiety

Disorder-7 (GAD-7), and Patient Health Questionnaire-9 (PHQ-9). These resources enhance patient-clinician contact, support evidence-based practice, and enable ongoing monitoring.

Chapter 3

Methodology

3.1 Research Design

Using a longitudinal research approach, this study gathers participant data on the Depression Anxiety Stress Scales-21 (DASS-21) at two distinct intervals. The DASS-21's consistency as a measurement tool and the assessment of changes in mental health over time are made possible by this design. Two separate phases of digitally created forms were used to gather data from students at the School of Natural Sciences (SNS), National University of Sciences and Technology (NUST), in Islamabad.

To evaluate the viability and dependability of the DASS-21 as a screening tool, the study first carried out a pilot study. The values of Chron Back's Alpha and Inter-Item Correlation were computed to assess the dependability. This stage functioned as a preliminary examination, guaranteeing the suitability of the instrument and improving the techniques for gathering data, laying the groundwork for the stages that followed. The pilot study also established the sample size needed for the comparative analysis

in phases one and two, guaranteeing that the research had sufficient power to identify noteworthy trends and changes.

Through repeated administration of the DASS-21, changes in the students' mental health condition throughout time were noted and assessed. A deeper understanding of the psychological difficulties faced by college students can be gained by using tests such as the independent t-test and hierarchal clustering to assess participant trends in stress, anxiety, and depression. These tests helped identify any significant changes or trends in mental health.

To summarize, the DASS-21 instrument was utilized in this longitudinal study at SNS NUST to collect data at two different stages: a pilot study, followed by two rounds of comparison analysis. The DASS-21's viability and dependability were examined in the pilot study, which also established the required sample size for later stages. The design of the study made it possible to thoroughly assess the reliability of the DASS-21 and gave insightful information about the trends in stress, anxiety, and depression among college students. This underscores the significance of continuing mental health monitoring and support in academic settings.

3.2 Participants

Students from the National University of Sciences and Technology's (NUST) School of Natural Sciences (SNS) participated in this investigation. Data were gathered at two

different time intervals: baseline, the sports gala, and the week before the End Semester Exams (ESEs), which yielded 209 sample points and 205 sample points, respectively. Students who took part at Time Point 1 were requested to return at Time Point 2, in order to enable a 1v1 comparison. This method made it possible to compare changes in each person's mental health across these particular time periods directly.

3.3 Data Collection

Data were collected using the DASS-21 questionnaire, which was administered in both paper and online formats to accommodate participants' preferences. Participants completed the questionnaire independently at each time point, ensuring that the responses were based on their subjective experiences and perceptions.

3.4 Data Pre-Processing

Data preprocessing involved the following steps:

1. Calculating the total scores for each factor (depression, anxiety, stress) by summing the relevant items on the DASS-21.

2. Identifying and removing any incomplete or inconsistent entries.

3. Removing four entries from Time Point 1 because those participants filled the form in both Time Point 1 and Time Point 2, to ensure the data's integrity and avoid duplication.

3.5 Statistical Analysis

Several statistical tests were run using SPSS, python, and RStudio to guarantee the accuracy and dependability of the data gathered for this investigation. The particular tests that were carried out and their objectives are described in the sections that follow.

3.5.1 Sample Size Generation

Software: RStudio

Purpose: Proper sample size calculation is crucial for the validity of statistical conclusions, as it influences the power of the study and the reliability of the results. The pilot study revealed that sample size of 46 was required for phases two and three to achieve meaningful comparative analysis, but 205 sample points were collected.

Sample Size Justification

Based on a proportion of students with low levels of stress, anxiety, and depression (p = 0.2453), a desired power of 0.95, and an alpha level of 0.05, preliminary calculations showed that a sample size of 46 participants was required. Adjustments were made for the limited number of roughly 700 pupils in this computation.

To enhance the precision and reliability of estimates, data was collected from 205 participants. This larger sample size provides several advantages:

1. **Increased Precision of Estimates:** With 205 participants, the standard error of estimates was reduced, resulting in narrower confidence intervals. This means

estimates of population parameters were more precise and reliable.

2. **Higher Statistical Power:** A higher sample size improved the study's power even though the original goal was for a power of 0.95, improving the capacity to identify real effects and lowering the possibility of Type II errors.

3. **Reduced Sampling Error:** A larger sample size decreased sampling errors, making results more representative of the population, and enhancing the generalizability of findings.

4. **Mitigating Non-Response Bias:** By collecting data from a larger sample, minimization of the potential impact of non-response bias was possible, ensuring that sample reflects the entire student population.

3.5.2 Validity and Reliability Tests

Software: SPSS

Purpose: Cronbach's Alpha and Inter-Item Correlation were computed to assess the DASS-21 instrument's internal consistency and reliability.

Cronbach's Alpha: By evaluating the internal consistency of the items, this test gauges the DASS-21's overall reliability. An elevated Cronbach's Alpha coefficient, typically beyond 0.7, signifies that the items on the scale are assessing the same fundamental construct.

Inter-Item Correlation: This test evaluates the degree to which items on the DASS-21 correlate with each other. High inter-item correlations i.e.,>0.8 indicate that the items are consistently reflecting the same construct, and low inter-item correlations i.e., <0.2 reflects the lack of same construct. So, the items with this correlation were excluded to avoid multicollinearity.

3.5.3 Descriptive Statistics

Software: SPSS

Purpose: The main characteristics of the data that were gathered were compiled and described using descriptive statistics. This involved computing metrics for each of the DASS-21's three subscales (stress, anxiety, and depression), including mean, standard deviation, lowest, and maximum values. In order to interpret the results of the ensuing studies, a fundamental comprehension of the data distribution and central tendencies is provided by descriptive statistics.

3.5.4 Confirmatory Factor Analysis

Software: RStudio

Purpose: To verify the DASS-21 factor structure, confirmatory factor analysis, or CFA, was performed. The purpose of this test is to determine if the data meet the anticipated three-factor model of stress, anxiety, and depression. CFA assists in verifying the instrument's theoretical framework and making sure that the items are correctly

categorized into the relevant categories.

3.5.5 Student's Independent t-Test

Software: SPSS

Purpose: Student's Independent t-Test was used to compare the mean scores of the depression, anxiety, and stress subscales of the DASS-21 between various time points. This assessment aids in detecting noteworthy variations in mental health conditions throughout the three stages of gathering information.

3.5.6 Hierarchal Clustering

Software: Python

Purpose: The DASS-21 score disparities between Time Points 1 and 2 were shown using hierarchical clustering, which shed light on how students' mental health has altered over time.

3.6 Ethical Considerations

The university's ethics committee granted the study ethical permission. The goal of the study, its methods, and the participants' unrestricted ability to discontinue participation at any moment were all explained to them. Every participant gave their informed consent, and the study's confidentially was upheld at all times.

Chapter 4

Data Analysis and Results

4.1 Inter-Item Correlation Matrix (SPSS)

Stress Subscale: In this matrix, s1 has non-significant correlation with s4 and zero correlation with s7 and s3 has non-significant correlation with s6 as well.

	s1	s2	s3	s4	s5	s6	s7
s1	1	0.396	0.287	0.074	0.35	0.251	0
s2	0.396	1	0.494	0.279	0.453	0.24	0.369
s3	0.287	0.494	1	0.311	0.373	0.142	0.277
s4	0.074	0.279	0.311	1	0.554	0.416	0.436
s5	0.35	0.453	0.373	0.554	1	0.606	0.244
s6	0.251	0.24	0.142	0.416	0.606	1	0.35
s7	0	0.369	0.277	0.436	0.244	0.35	1

Table 4.1. Inter-Item Correlation Matrix for Stress Subscale

Depression Subscale:

	d1	d2	d3	d4	d5	d6	d7
d1	1	0.484	0.435	0.457	0.544	0.516	0.364
d2	0.484	1	0.557	0.415	0.58	0.525	0.368
d3	0.435	0.557	1	0.513	0.747	0.682	0.704
d4	0.457	0.415	0.513	1	0.445	0.438	0.398
d5	0.544	0.58	0.747	0.445	1	0.767	0.68
d6	0.516	0.525	0.682	0.438	0.767	1	0.78
d7	0.364	0.368	0.704	0.398	0.68	0.78	1

Table 4.2. Inter-Item Correlation Matrix for Depression Subscale

In this matrix, all the items have significant correlation with each other

Anxiety Subscale:

	a1	a2	a3	a4	a5	a6	a7
a1	1	0.189	-0.027	0.15	-0.03	0.198	0.123
a2	0.189	1	0.333	0.255	0.533	0.31	0.077
a3	-0.027	0.333	1	0.236	0.218	0.247	0.315
a4	0.15	0.255	0.236	1	0.477	0.261	0.467
a5	-0.03	0.533	0.218	0.477	1	0.52	0.417
a6	0.198	0.31	0.247	0.261	0.52	1	0.512
a7	0.123	0.077	0.315	0.467	0.417	0.512	1

Table 4.3. Inter-Item Correlation Matrix of Anxiety Subscale

In this matrix, a1 has non-significant correlation with all other items and a2 has non-significant correlation with a7.

4.2 Reliability Analysis (SPSS)

Case	Sample Size	No. Of Items	Chron's Back Alpha
All items	53	21	0.915
Excluding "a1"	53	20	0.919

Table 4.4. Values of Chron's Back Alpha from Reliability Analysis

4.3 Confirmatory Factor Analysis (RStudio)

Interpretation of Fit Indices regarding CFA:

- CFI and TLI: For a satisfactory fit, both indices need to be over 0.90. Poor model fit is indicated by values close to 0.70.
- RMSEA: Good fit is indicated by values less than 0.06, mediocre fit is shown by values between 0.08 and 0.10, and bad fit is indicated by values greater than 0.10.
- SRMR: Values below 0.08 are considered good. A value of 0.120 indicates poor fit.

MODEL 1: All items included

The confirmatory factor analysis was applied on the dataset obtained in phase one i.e., which yield the following results:

CFI	TLI	RMSEA	SRMR
0.699	0.660	0.133	0.120

Table 4.5. Results of Model 1 from CFA

Comments: Not a good fit

MODEL 2: Excluding the items having no correlation

The results for the modified three-factor model after excluding non-significant correlations show some improvement over the initial model, but there are still areas of concern.

CFI	TLI	RMSEA	SRMR
0.729	0.683	0.147	0.119

Table 4.6. Results of Model 2 from CFA

Comments: Not a good fit

Latent Variables:

- Depression: All indicators (d1 to d7) have significant factor loadings, ranging from 0.565 to 0.936, suggesting they are good indicators of the latent construct Depression.
- Anxiety: Indicators (a2 to a6) have significant factor loadings, ranging from 0.357 to 0.697. However, a2 and a3 have lower loadings compared to others.
- Stress: Indicators (s2 to s6) have significant factor loadings, ranging from 0.454 to 0.767, suggesting they are good indicators of the latent construct Stress.

Covariances:

- Depression and Anxiety: 0.529 (significant)

- Depression and Stress: 0.801 (significant)
- Anxiety and Stress: 0.915 (significant)

The significant covariances suggest that there are meaningful relationships between these latent constructs.

MODEL 3: Data from phase two, Timepoint 1 for Comparative Analysis

The pilot study data had 53 sample points making the problem of fitting. The following results are CFA of dataset comprising 205 sample points, and all the items having no correlation were excluded:

CFI	TLI	RMSEA	SRMR
0.903	0.886	0.061	0.064

Table 4.7. Results of Model 3 from CFA

Latent Variables

- Depression: All items (d1 to d7) significantly load on the depression factor with standardized loadings ranging from 0.424 to 0.740.
- Anxiety: Items (a2 to a6) significantly load on the anxiety factor with standardized loadings ranging from 0.438 to 0.662.
- Stress: Items (s2 to s6) significantly load on the stress factor with standardized loadings ranging from 0.501 to 0.672.

Covariance

- Depression and Anxiety: 0.730 (significant)
- Depression and Stress: 0.852 (significant)
- Anxiety and Stress: 0.940 (significant)

Comments:

- The model fit indices suggest an improved and acceptable fit compared to the previous models.
- The factor loadings show that all remaining items significantly contribute to their respective factors.
- The covariances between latent factors are significant, indicating strong relationships between depression, anxiety, and stress.

4.4 Descriptive Analysis (SPSS)

Timepoint 1	n	Mean	St. Deviation
Stress	205	16.98	7.900
Anxiety	205	16.45	8.860
Depression	205	15.72	9.190

Table 4.8. Descriptive Statistics of Timepoint 1

Timepoint 2	n	Mean	St. Deviation
Stress	205	17.44	9.041
Anxiety	205	16.23	9.533
Depression	205	16.88	10.648

Table 4.9. Descriptive Statistics of Timepoint 2

Stress Subscale:

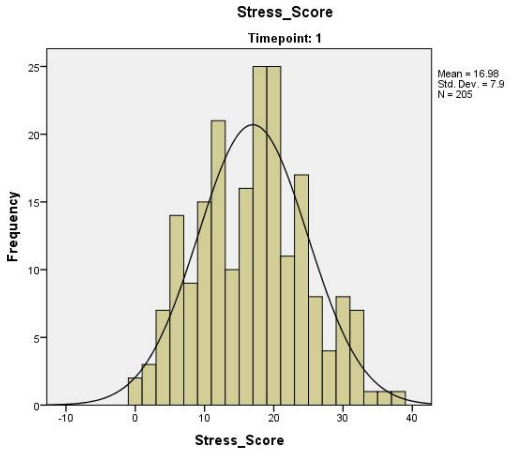

Figure 4.1: Frequency Visualization of Stress Subscale for Timepoint 1

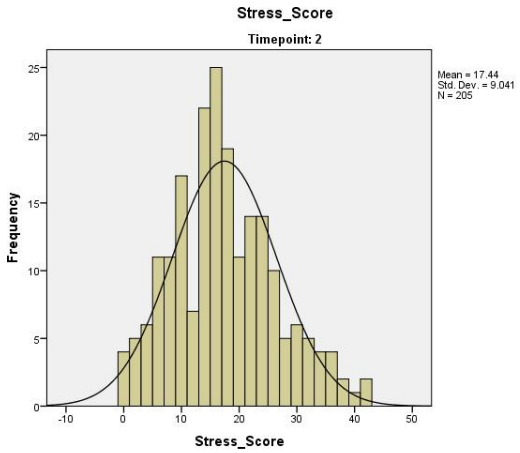

Figure 4.2: Frequency Visualization of Stress Subscale for Timepoint 2

Anxiety Subscale:

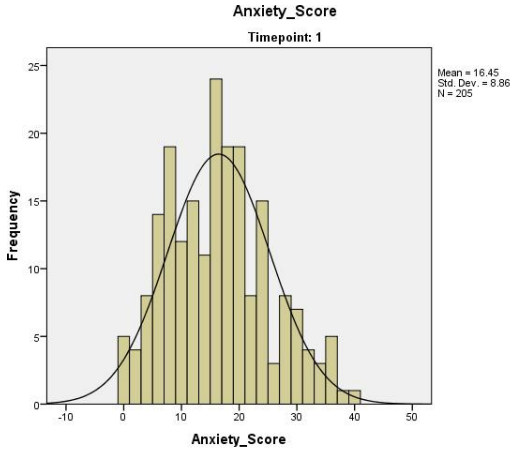

Figure 4.3: Frequency Visualization of Anxiety Subscale for Timepoint 1

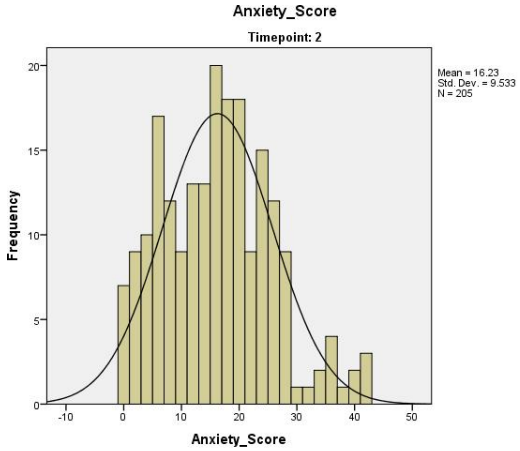

Figure 4.4: Frequency Visualization of Anxiety Subscale for Timepoint 2

Depression Subscale:

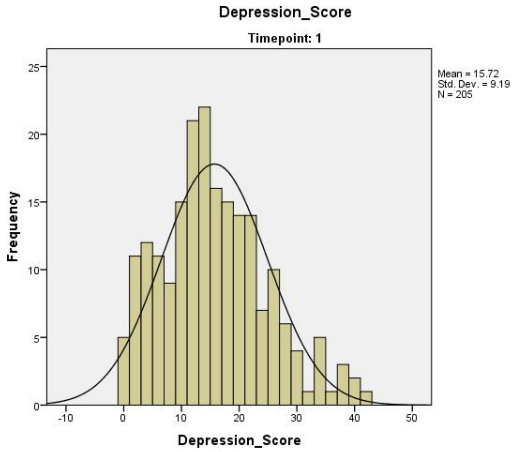

Figure 4.5: Frequency Visualization of Depression Subscale for Timepoint 1

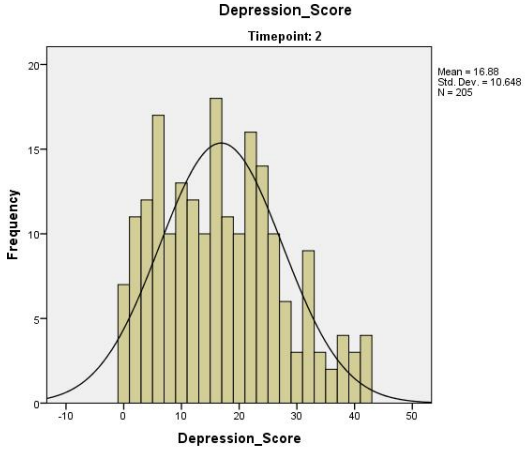

Figure 4.6: Frequency Visualization of Depression Subscale for Timepoint 2

4.5 Independent t-test (SPSS)

Stress Subscale:

- t-test for Equality of Means: t (408) = -0.558, p = .577
- Mean Difference: -0.468 (-2.117, 1.180)

- Interpretation: There is no significant difference in Stress scores between Time Point 1 and Time Point 2.

Anxiety Subscale:

- t-test for Equality of Means: t (408) = 0.236, p = .813
- Mean Difference: 0.215 (-1.572, 2.002)
- Interpretation: There is no significant difference in Anxiety scores between Time Point 1 and Time Point 2.

Depression Subscale:

- t-test for Equality of Means: t (399.456) = -1.182, p = .238
- Mean Difference: -1.161 (-3.092, 0.770)
- Interpretation: There is no significant difference in Depression scores between Time Point 1 and Time Point 2.

4.6 Hierarchal Clustering

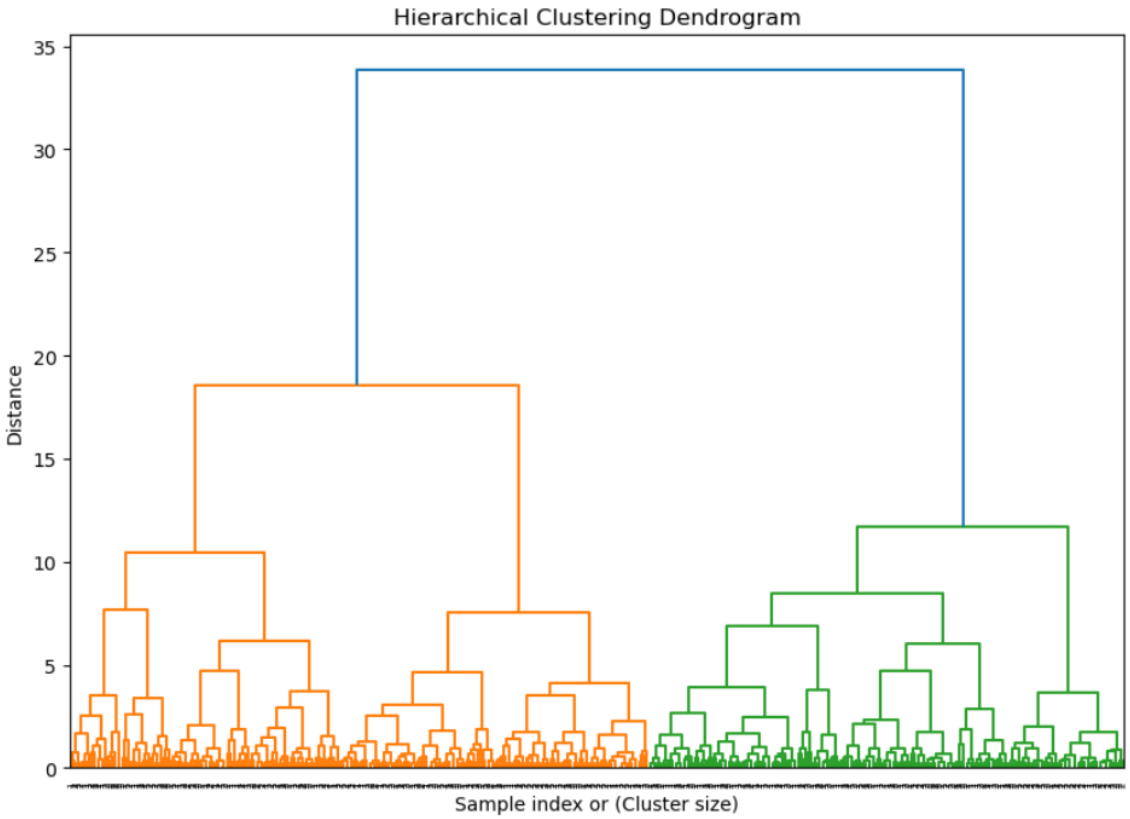

Figure 4.7: Visuals of Hierarchal Clustering to Check Difference between Timepoints

Primary Clusters: The dendrogram reveals two primary clusters, indicated by the large split at the top of the dendrogram. These clusters are differentiated by significant differences in their DASS-21 scores.

- Cluster 1 (Orange): This cluster primarily includes participants from Time Point 1. The sub-branches within this cluster indicate further subgroups with varying levels of stress, anxiety, and depression.

- Cluster 2 (Green): This cluster primarily includes participants from Time Point 2. The sub-branches here indicate variations within the cluster, suggesting different patterns in mental health status compared to Time Point 1.

Distance and Dissimilarity: There is a noticeable difference in the mental health state between the two time points, as indicated by the vertical distance between the orange and green clusters. This shows that over time, participants' levels of stress, anxiety, and depression may have changed noticeably.

Subgroup Analysis: Subgroups of participants with similar scores are highlighted by the intricate branching inside each central cluster. Subgroups inside the orange cluster, for instance, could represent different stress, anxiety, and depression levels at Time Point 1.

Shifts in Mental Health: There is a change in the participants' mental health state between Time Points 1 and 2, as can be shown by looking at the distribution of participants from each time point within the clusters. To learn more about the precise changes in stress, anxiety, and depression, this shift can be further examined.

4.7 Key Findings

4.7.1 Internal Consistency

1. Stress Subscale: The inter-item correlation matrix for the stress subscale shows that most items have significant correlations with each other, except for s1 with

s4 and s7, and s3 with s6.

2. Anxiety Subscale: The anxiety subscale shows that a1 has non-significant correlations with all other items, and a2 has non-significant correlation with a7.

3. Depression Subscale: All items in the depression subscale have significant correlations with each other, writing down strong internal consistency.

4. Overall Reliability: The overall Cronbach's Alpha for the DASS-21 is 0.915, showing high internal consistency. Excluding item a1 slightly increases the alpha to 0.919.

4.7.2 Factor Structure

Model 1 (All items included):

- CFI: 0.699, TLI: 0.660, RMSEA: 0.133, SRMR: 0.120
- These indices indicate a poor fit.

Model 2 (Excluding non-significant items):

- CFI: 0.729, TLI: 0.683, RMSEA: 0.147, SRMR: 0.119
- Slight improvement but still a poor fit.

Model 3 (Data from phase two, Timepoint 1):

- CFI: 0.903, TLI: 0.886, RMSEA: 0.061, SRMR: 0.064
- Indicates an improved and acceptable fit.

Latent Variables:

- Depression: Significant factor loadings (0.424 to 0.740)
- Anxiety: Significant factor loadings (0.438 to 0.662)
- Stress: Significant factor loadings (0.501 to 0.672)

Covariances:

- Depression and Anxiety: 0.730
- Depression and Stress: 0.852
- Anxiety and Stress: 0.940

These significant covariances suggest strong relationships between the latent constructs.

4.7.3 Descriptive Insights

- Stress Subscale: Mean scores are 16.98 (TP1) and 17.44 (TP2) with standard deviations of 7.900 and 9.041, respectively.
- Anxiety Subscale: Mean scores are 16.45 (TP1) and 16.23 (TP2) with standard deviations of 8.860 and 9.533, respectively.

- Depression Subscale: Mean scores are 15.72 (TP1) and 16.88 (TP2) with standard deviations of 9.190 and 10.648, respectively.

These descriptive statistics suggest slight variations in scores between Time Point 1 and Time Point 2.

4.7.4 Comparative Analysis

Independent t-test Results:

- Stress Subscale: No significant difference between TP1 and TP2 (t (408) = -0.558, p = 0.577).
- Anxiety Subscale: No significant difference between TP1 and TP2 (t (408) = 0.236, p = 0.813).
- Depression Subscale: No significant difference between TP1 and TP2 (t (399.456) = -1.182, p = 0.238).

Hierarchical Clustering:

- Two primary clusters were identified: Cluster 1 (primarily TP1) and Cluster 2 (primarily TP2).
- The vertical distance between clusters indicates differences in DASS-21 scores, suggesting notable changes in mental health status over time.

- Subgroups within each cluster highlight varying levels of stress, anxiety, and depression.

4.7.5 Summary

1. The internal consistency of the DASS-21 subscales is high, with some items showing non-significant correlations.

2. The factor structure, as indicated by CFA, shows improvement in fit when non-significant items are excluded, but the best fit is achieved with the larger dataset from phase two.

3. Descriptive analysis reveals slight variations in stress, anxiety, and depression scores between TP1 and TP2, though these differences are not statistically significant according to t-tests.

4. Hierarchical clustering suggests distinct changes in mental health status between TP1 and TP2, highlighting significant differences that may not be captured by t-tests alone.

5. Overall, while the changes in mental health scores between time points are not statistically significant, the clustering analysis provides additional insights into the mental health trajectories of the participants.

Chapter 5

Discussion

5.1 Interpretation of Findings

First, the reliability test verifies that the DASS-21 is a useful instrument for assessing college students' mental health. The findings showed strong internal consistency, with a Cronbach's alpha score of 0.915, suggesting that the assessment tool measures the dimensions of stress, anxiety, and depression with reliability. The inclusion of every item in the comparison analysis was further confirmed by the correlation matrices. Furthermore, the validity of the instrument's construct was confirmed using Confirmatory Factor Analysis (CFA), which upheld the integrity of the factor structure.

There were no discernible changes in the students' mental health between the two time points, according to the compared analysis. Hierarchical clustering did, however, show some differences. At Time Point 2, one week prior to the End-Semester Exams (ESEs), there was a small increase in the levels of stress and despair. In contrast, anxiety levels were slightly higher at Time Point 2, coinciding with the period of the sports gala.

This increase in anxiety could be attributed to the performance pressure associated with the sports event. These findings highlight the nuanced changes in mental health status linked to specific academic and extracurricular pressures faced by students.

5.2 Implications for Mental Health Evaluation

The use of the DASS-21 in this study demonstrates its efficacy as a comprehensive tool for assessing depression, anxiety, and stress in healthcare students. The tool's ability to simultaneously measure these three dimensions of mental health makes it a valuable resource for both researchers and clinicians. The findings suggest that regular mental health evaluations using standardized tools like the DASS-21 can provide early detection of mental health issues, enabling timely interventions and support for students. Additionally, the study underscores the importance of integrating mental health assessments into the routine evaluation processes within educational institutions. By doing so, institutions can better monitor the well-being of their students and implement necessary support mechanisms to enhance their academic performance and overall well-being.

5.3 Limitations of the Study

This study contains a number of shortcomings in spite of its noteworthy contributions. First off, the sample size might not accurately reflect the diverse community of health-

care students, even though it was sufficient for the original study. To increase the generalizability of the results, larger and more varied sample sizes should be the goal of future research.

Second, because the study relied on self-reported data, it may have been influenced by response biases including recall or social desirability bias. Future studies could include other techniques, like clinical interviews or observational data, to validate the self-reported measurements in order to lessen these constraints.

Finally, the study's exclusive focus on a particular geographic and cultural context may have limited the findings' generalizability. Global comparisons of research across various regions and cultures would yield a more thorough understanding of mental health concerns among medical students.

Chapter 6

Conclusion and Recommendations

6.1 Summary of the Study

The Depression Anxiety Stress Scales-21 (DASS-21) was used in this study to assess university students' mental health and look for any notable changes in mental health status over time. Three stages of data collecting were included in the research, which was carried out at SNS NUST Islamabad. A pilot study was carried out in the first phase. The reliability test proved that the DASS-21 is a valid instrument for evaluating college students' mental health; its high Cronbach's alpha value of 0.915 indicates strong internal consistency. The applicability of DASS-21 for this study was confirmed by the correlation matrices and Confirmatory Factor Analysis (CFA), which verified the integrity of the factor structure.

Comparative analysis between the two time points showed no significant differences in students' mental health. However, hierarchical clustering indicated subtle variations in stress, depression, and anxiety levels. Notably, stress and depression levels were slightly

elevated during the week before the End-Semester Exams (ESEs), while anxiety levels were higher during the sports gala, due to performance pressure. These findings suggest that while there are no drastic changes in mental health over time, specific academic and extracurricular pressures can influence the mental well-being of students. This study underscores the importance of continuous mental health monitoring and the need for supportive measures to alleviate stress and anxiety during critical academic and extracurricular periods.

6.2 Recommendations for Practice

Drawing from the results and constraints of this investigation, multiple suggestions for subsequent research endeavors can be put forth:

1. Longitudinal Studies: To monitor changes in mental health over time and pinpoint the causes of improvements or declines in mental health, future research should make use of longitudinal designs.

2. Intervention Studies: Research on the efficacy of several interventions targeted at lowering stress, anxiety, and depression in students is required. Studies of this kind ought to evaluate educational and psychological therapies.

3. Greater Population: To improve the generalizability of the results, research should involve a larger and more varied sample of pupils. Incorporating students

from diverse geographic locations, educational backgrounds, and socioeconomic backgrounds can yield a more comprehensive understanding of the mental health difficulties that kids encounter.

4. Multimodal Assessment Tools: Future studies should explore the use of multimodal assessment tools that integrate various data sources, such as biometric data, to provide a more holistic assessment of mental health.

Bibliography

[1] J.A. Sheng, N.J. Bales, S.A. Myers, A.I. Bautista, M. Roueinfar, T.M. Hale, and R.J. Handa. The hypothalamic-pituitary-adrenal axis: development, programming actions of hormones, and maternal-fetal interactions. *Frontiers in Behavioral Neuroscience*, 14.

[2] M.A. Stephens and G. Wand. Stress and the hpa axis: role of glucocorticoids in alcohol dependence. *Alcohol research: current reviews*, 34(4):468–483.

[3] Y. Jiang, D. Zou, Y. Li, S. Gu, J. Dong, X. Ma, S. Xu, F. Wang, and J.H. Huang. Monoamine neurotransmitters control basic emotions and affect major depressive disorders. *Pharmaceuticals*, 15(10):1203.

[4] A. Starcevic, editor. *Chronic Stress and Its Effect on Brain Structure and Connectivity*. IGI Global.

[5] V. Maydych. The interplay between stress, inflammation, and emotional attention: Relevance for depression. *Frontiers in Neuroscience*, 13.

[6] K.S. Kumar and B.S. Akoijam. Depression, anxiety and stress among higher secondary school students of imphal. *Manipur. Indian journal of community medicine: official publication of Indian Association of Preventive and Social Medicine*, 42(2):94–96.

[7] K. Gudzune. Dietary and behavioral approaches in the management of obesity. *Gastroenterology clinics of North America*, 45(4):653–661.

[8] Caulfield J. I. Anxiety, depression, and asthma: New perspectives and approaches for psychoneuroimmunology research. *Brain, behavior, and immunity - health*, 18:100360.

[9] C.W. Tsao, A.W. Aday, Z.I. Almarzooq, C.A.M. Anderson, P. Arora, C.L. Avery, C.M. Baker-Smith, A.Z. Beaton, A.K. Boehme, A.E. Buxton, Y. Commodore-Mensah, M.S.V. Elkind, K.R. Evenson, C. Eze-Nliam, S. Fugar, G. Generoso, D.G. Heard, S. Hiremath, J.E. Ho, R. Kalani, D.S. Kazi, D. Ko, D.A. Levine, J. Liu, J. Ma, J.W. Magnani, E.D. Michos, M.E. Mussolino, S.D. Navaneethan, N.I. Parikh, R. Poudel, M. Rezk-Hanna, G.A. Roth, N.S. Shah, M.P. St-Onge, E.L. Thacker, S.S. Virani, J.H. Voeks, N.Y. Wang, N.D. Wong, S.S. Wong, K. Yaffe, and S.S. Martin. American heart association council on epidemiology and prevention statistics committee and stroke statistics subcommittee. heart disease and stroke

statistics-2023 update: A report from the american heart association. *Circulation*, 21;147(8:93– 621. Epub 2023 Jan 25. Erratum in: Circulation. 2023 Feb.

[10] A.O. Werneck and B. Stubbs. Bidirectional relationship between chronic pain and depressive symptoms in middle-aged and older adults. *Gen Hosp Psychiatry*, 89:49–54. Epub 2024 May 11. PMID: 38761582.

[11] M.U. Nadeem, S.J. Kulich, and I.H. Bokhari. The assessment and validation of the depression, anxiety, and stress scale (dass-21) among frontline doctors in pakistan during fifth wave of covid-19. *Frontiers in Public Health*, 11.

[12] D.A. Seminowicz and M. Moayedi. The dorsolateral prefrontal cortex in acute and chronic pain. *The journal of pain*, 18(9):1027–1035.

[13] C. Yang, K. Xiao, Y. Ao, Q. Cui, X. Jing, and Y. Wang. The thalamus is the causal hub of intervention in patients with major depressive disorder: Evidence from the granger causality analysis. *NeuroImage. Clinical*, 37:103295.

[14] A. Jörns-Presentati, A. Napp, A.S. Dessauvagie, D.J. Stein, D. Jonker, E. Breet, W. Charles, R.L. Swart, M. Lahti, S. Suliman, R. Jansen, L.L. Den Heuvel, S. Seedat, and G. Groen. The prevalence of mental health problems in sub-saharan adolescents: A systematic review. *PLoS ONE*, 16(5):0251689.

[15] Ng C. H. Mental health and integration in asia pacific. *BJPsych international*, 15(4):76–79.

[16] G.C. Tong. *4 in 5 employees in Asia have moderate to high mental health risk, study shows*. CNBC.

[17] *Topic: Mental health in Europe*. Statista.

[18] *The state of mental health in America*. Mental Health America.

[19] M.H. Alvi, T. Ashraf, F. Naz, A. Sardar, A. Ullah, A. Patel, T. Kiran, A. Gumber, and N. Husain. Burden of mental disorders by gender in pakistan: analysis of global burden of disease study data for 1990–2019. *BJPsych Bulletin*, page 1–8.

[20] A. Javed, M.S. Khan, A. Nasar, and A. Rasheed. Mental healthcare in pakistan. *Taiwanese Journal of Psychiatry*, 34(1):6.

[21] O. Correspondents. Only 900 trained psychiatrists for millions of people facing mental health issues in pakistan: experts. *The News International*.

[22] Z. Husain, S.S. Datta, S. Ghosh, and M. Dutta. Change in mental health during the covid-19 pandemic: a longitudinal study of residents of indian metropolitan cities. *Journal of Mental Health*, 32(5):879–889.

[23] I. Ansari. *Mental Health Pakistan: Optimizing Brains*. OMICS International.

[24] M. Zafar, H. Zaidi, Zaidi T., N. H., M.W. Ahmed, S. Memon, F. Ahmed, A. Siddiqui, A. Fatima, A. Shahid, B. Hussain, and A. Salam. Attitude towards seeking professional help for mental health among medical students in karachi, pakistan. *Future science OA*, 10(1):916.

[25] Emhj. Integration of mental health into primary healthcare: perceptions of stakeholders in pakistan. world health organization - regional office for the eastern mediterranean.

[26] K. Mathias, S. Jain, R. Fraser, M. Davis, R. Kimijima–Dennemeyer, P. Pillai, S.N. Deshpande, and M. Wolters. Improving mental ill-health with psycho-social group interventions in south asia–a scoping review using a realist lens. *PLOS Global Public Health*, 3(8):0001736.

[27] B. Buchanan. *Depression Anxiety Stress Scales – Short Form (DASS-21.* NovoPsych.

[28] C. Cao, X. Liao, X. Jiang, X. Li, I. Chen, and C. Lin. Psychometric evaluation of the depression, anxiety, and stress scale-21 (dass-21) among chinese primary and middle school teachers. *BMC Psychology*, 11(1).

[29] Research portal.

[30] E. Moya, L.M. Larson, R.C. Stewart, J. Fisher, M.N. Mwangi, and K.S. Phiri. Reliability and validity of depression anxiety stress scale (dass)-21 in screening for common mental disorders among postpartum women in malawi. *BMC Psychiatry*, 22(1).

[31] C. Laranjeira, A. Querido, P. Sousa, and M.A. Dixe. Assessment and psychometric properties of the 21-item depression anxiety stress scale (dass-21) among portuguese higher education students during the covid-19 pandemic. *European journal of investigation in health, psychology, and education*, 13(11):2546–2560.

[32] D. Jun, V. Johnston, J.M. Kim, and S. O'Leary. Cross-cultural adaptation and validation of the depression, anxiety and stress scale-21 (dass-21) in the korean working population. *Work*, 59(1):93–102. PMID: 29439379.

[33] C. Pezirkianidis, E. Karakasidou, A. Lakioti, A. Stalikas, and M. Galanakis. Psychometric properties of the depression, anxiety, stress scales-21 (dass-21) in a greek sample. *Psychology*, 09(15):2933–2950.

[34] How does mental health impact our lives | st. mary's health care system.

[35] How does mental health impact our lives? - cura4u. n.d.). cura4u.com.

[36] D. Pizzol, M. Trott, L. Butler, Y. Barnett, T. Ford, S.A. Neufeld, A. Ragnhildstveit, C.N. Parris, B.R. Underwood, G.F.L. Sánchez, M. Fossey, C. Brayne,

E. Fernandez-Egea, G. Fond, L. Boyer, J.I. Shin, S. Pardhan, and L. Smith. Relationship between severe mental illness and physical multimorbidity: a meta-analysis and call for action. *BMJ Mental Health*, 26(1):300870.

[37] WebMD Editorial Contributor. How does mental health affect physical health? webmd.

[38] T. Doan, V. Ha, L. Strazdins, and D. Chateau. Healthy minds live in healthy bodies – effect of physical health on mental health: Evidence from australian longitudinal data. *Current Psychology*, 42(22):18702–18713.

[39] M. Mayer, D.B. Badesch, K.H. Nielsen, S. Kawut, T. Bull, J.J. Ryan, J. Sager, S. Mazimba, A. Hemnes, J. Klinger, J. Runo, J.W. McConnell, T. Marco, M.M. Chakinala, D. Yung, J. Elwing, A. Kaplan, R. Argula, R. Pomponio, and P. Hountras. Impact of the covid-19 pandemic on chronic disease management and patient reported outcomes in patients with pulmonary hypertension: The pulmonary hypertension association registry. *Pulmonary Circulation*, 13(2).

[40] N. Mahdi, I. Nadeem, M.U. Rasool, S.a U. Munamm, U.F. Khatana, F. Rashad, and A. Babu. Pulmonary hypertension, pulmonary embolism and covid-19: A district general hospital experience from the uk. *The Journal of the Royal College of Physicians of Edinburgh*, 53(1):9–12.

[41] Quantifying the global cost of mental disorders – center for health decision science.

[42] S. Trautmann, J. Rehm, and H.U. Wittchen. The economic costs of mental disorders: Do our societies react appropriately to the burden of mental disorders? *EMBO reports*, 17(9):1245–1249.

[43] D. Arias, S. Saxena, and S. Verguet. Quantifying the global burden of mental disorders and their economic value. *EClinicalMedicine*, 54:101675.

[44] A. Memon, K. Taylor, L.M. Mohebati, J. Sundin, M. Cooper, T. Scanlon, and R. Visser. Perceived barriers to accessing mental health services among black and minority ethnic (bme) communities: a qualitative study in southeast england. *BMJ open*, 6(11):012337.

[45] J. Huang, Z.Y. Liu, and X. Zhou. Posttraumatic stress disorder and spousal relationships in natural disaster victims: a longitudinal study. *J Ment Health*, 11:1–9. Epub ahead of print. PMID: 38602358.

[46] G. Russell and P. Topham. The impact of social anxiety on student learning and well-being in higher education. *Journal of Mental Health*, 21(4):375–385.

[47] J. Farr, J.E. Rhodes, E. Baruch, and J.A. Smith. Early intervention in psychosis for the first episode psychotic mania: the experience of people diagnosed with bipolar disorder. *J Ment Health*, 8:1–7. Epub ahead of print. PMID: 38588707.

[48] K.A. Aschbrenner, J.A. Naslund, L. Gill, T. Hughes, A.J. O'Malley, S.J. Bartels, and M.F. Brunette. Qualitative analysis of social network influences on quitting smoking among individuals with serious mental illness. *Journal of mental health*, 28(5):475–481.

[49] F. Elisa, T. Davide, S.M. Luisa, M. Martina, B. Tommaso, S. Luis, D. Barbara, F. Morena, and C. Giulio. Outcome analysis on individual health budgets in mental health: finding from the friuli venezia giulia region, italy. *Journal of Mental Health*, 33(2):159–168.

[50] T.A. Dhira, M.A. Rahman, A.R. Sarker, and J. Mehareen. Validity and reliability of the generalized anxiety disorder-7 (gad-7) among university students of bangladesh. *PloS one*, 16(12):0261590.

[51] Generalized anxiety disorder 7. n.d.).

[52] R.L. Spitzer, K. Kroenke, J.B. Williams, and B. Löwe. A brief measure for assessing generalized anxiety disorder: the gad-7. *Arch Intern Med*, 22;166(10):1092-7. PMID: 16717171.

[53] P.D.F. A study on hamilton anxiety rating scale among college students. ResearchGate.

[54] D.A. Dunstan and N. Scott. Norms for zung's self-rating anxiety scale. *BMC Psychiatry*, 20(1).

[55] Y. Sun, Z. Fu, Q. Bo, Z. Mao, X. Ma, and C. Wang. The reliability and validity of phq-9 in patients with major depressive disorder in psychiatric hospital. *BMC psychiatry*, 20(1):474.

[56] B. Levis, A. Benedetti, and B.D. Thombs. Accuracy of patient health questionnaire-9 (phq-9) for screening to detect major depression: individual participant data meta-analysis. *BMJ*, l1476.

[57] Y. Pu, W. Zhang, X. Xu, Y. Sun, C. Chen, S. Zhou, and B. Fang. A retrospective study investigating the anxiety and depression level of novel coronavirus omicron patients in 2022. *Medicine*, 101(51):32438.

[58] D.A. Dunstan, N. Scott, and A.K. Todd. Screening for anxiety and depression: reassessing the utility of the zung scales. *BMC psychiatry*, 17(1):329.

[59] E.P.R.O.V.I.D.E. *MAPI Research Trust*. Mapi Research Trust.

[60] P.M.Y. Lee, D. Wang, Y. Li, S. Wang, J.Y.C. Lau, S. Yang, T. Wu, H. Shen, S.Y.S. Wong, X. Ji, W. Chen, and L.A. Tse. Association of current income and reduction in income during the covid-19 pandemic with anxiety and depression among non-healthcare workers. *Journal of Mental Health*, 31(4):585–596.

[61] P.D.F. Evaluation of mental health of students in healthcare education programs. at Qatar University [version 1; peer review: 1 approved]. (n.d.). ResearchGate.

[62] Y. Mahgoub, S. Daher-Nashif, R. Al-Shebly, H.S. Wali, A. Khan, A. Almarkhi, M. Al-Motawa, G. AlObaidan, and Z. Al-Muhannadi. Prevalence and determinants of mental health problems and mental health stigma among medical students of different nationalities in qatar. *Advances in Medical Education and Practice*, 13:969–979.

[63] S. Garg, A. Chauhan, S. Singh, and K. Bansal. Epidemiological risk factors of suicidal behavior and effects of the components of coping strategies on suicidal behavior in medical students: A north-indian institution-based cross-sectional study. *Journal of neurosciences in rural practice*, 13(3):382–392.

[64] Multimodal multi-teacher knowledge distillation for mental health detection. n.d.). ResearchGate.