

Full-Length Research Article

Interplay Between Depression, Anxiety, and Working Memory Among Students in the College of Medical Sciences, Ahmadu Bello University, Zaria, Nigeria

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Summary: University life presents a mix of academic and social challenges that often contribute to stress and mental health issues. Chronic stress, particularly in university students, is a well-known risk factor for depression and anxiety, which can lead to cognitive impairments such as deficits in working memory. This study explored the prevalence of depression and anxiety among students at the College of Medical Sciences, Ahmadu Bello University, Zaria, Nigeria, and examined their impact on working memory. A cross-sectional approach was used, involving undergraduate students from different levels and departments within the college. Participants completed the Beck Depression Inventory (BDI) and Generalized Anxiety Disorder-7 (GAD-7) scale to assess symptoms of depression and anxiety, while the 2-back task evaluated working memory performance. Findings revealed a high prevalence of depressive (47.84%) and anxiety (65.12%) symptoms among students. However, no significant relationship was found between these symptoms and working memory performance ($p > 0.05$). Notably, students experiencing anxiety were 12 times more likely to develop depression, highlighting the strong co-occurrence of these conditions ($p = 0.00$). Age did not significantly influence these outcomes. Although depressive and anxiety symptoms were common among students, their presence did not significantly affect working memory performance. However, the strong association between anxiety and depression underscores the tendency for these conditions to co-occur in this population. These findings suggest the importance of proactive mental health screening and support services within universities to address psychological distress and promote students’ overall well-being.

Keywords: Depression, anxiety, cognition, working memory, and medical students

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Manuscript received: August 2025; Accepted: November 2025

DOI: <https://doi.org/10.54548/njps.v40i2.5>

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INTRODUCTION

The university life is a critical time of transition from adolescence to adulthood, moreover, the demands of establishing a sense of identity, achieving strong academic performance, planning for a future career, and, in some cases, living away from family can contribute to significant stress for many students, whereas the overall response to this stress might lead to depression (Adewuya, 2006; Abdulwali et al., 2022). University students exhibit significantly higher rates of depression compared to the general population (Ibrahim et al., 2013; Othieno et al., 2014). Unfavourable conditions, such as excessive internet use, predispose university students to psychological disorders like depression and anxiety, particularly in first-year students, which not only affect their personal lives but also pose significant challenges to their academic performance (Islam et al., 2022). A multi-school study by Goebert et al. (2009) reported that 12% of individuals exhibited probable major

depression, while 9.2% showed signs of probable mild to moderate depression. Significant differences were noted based on trainee level, with a higher prevalence among medical students, and by gender, with women being more affected. Globally, studies have indicated that a significant proportion of first-year medical students experience moderate to severe or extremely severe mental health issues, with depression affecting 63.6% and anxiety impacting 78.4% of this population (Islam et al., 2022). A review by Coentre and Góis (2018) confirmed that suicidal ideation remains a pressing concern among medical students, and additionally, the findings emphasised the need for future research to focus on developing preventive and treatment programs that address the identified risk factors linked to suicidal ideation in this population.

Depression is a complex psychiatric disorder characterised by pervasive feelings of sadness, loss of interest, and cognitive impairments, including deficits in

working memory. Depression and anxiety are causative factors for impairment in the allocation of attention and all other elements of working memory (Christopher & MacDonald 2005). In light of this, individuals experiencing depression exhibit widespread impairments in executive functioning, including working memory deficits, which place a considerable burden on daily cognitive processes (Songco et al., 2023). Working memory is an executive function fundamental to human cognitive functioning. It involves retaining information temporarily and manipulating it mentally. A commonly used tool for assessing working memory function is the n-back task, in which participants monitor a sequence of stimuli and respond when a stimulus matches one presented n trials earlier (Meule, 2017; Frost et al., 2021; Yeung & Han, 2023). The most common variations are the 2-back and 3-back tasks, where participants must identify stimuli that appeared two or three trials prior, respectively (Meule, 2017).

The n-back task, widely used to assess working memory, offers several advantages over other measures. Its electronic delivery enables precise tracking of response latencies and accuracy while also allowing simultaneous neuroimaging of brain activity related to working memory processes, such as through electroencephalography (EEG) and functional magnetic resonance imaging (fMRI). Moreover, studies using this task generally report impaired performance, characterized by reduced accuracy and slower response times, although these deficits are not always consistently observed (Lamichhane et al., 2020).

Research consistently highlights that depression negatively affects working memory performance. Levens and Gotlib (2010) demonstrated that individuals with depression exhibit difficulty removing irrelevant negative information from working memory, suggesting that this impairment contributes to the persistence of negative thoughts. This difficulty in updating and clearing working memory may underlie rumination, a hallmark cognitive symptom of depression, as also posited by Songco et al. (2023), that cognitive impairments are frequently observed in individuals with depression and often persist even after remission. Anxiety and depression often co-occur, yet their cognitive impacts can differ significantly. Zhang et al. (2022) explored these differences, revealing that depression predominantly impairs the processing of negative emotional content in working memory, while anxiety tends to disrupt overall cognitive flexibility. Our study was aimed at investigating the prevalence of depressive and anxiety symptoms among medical students and exploring their relationship with working memory performance using validated assessment tools. Furthermore, we hypothesised that depressive-like symptoms are not associated with working memory performance among students of the College of Medical Sciences, Ahmadu Bello University, Zaria.

MATERIALS AND METHOD

Materials

The Beck Depression Inventory (BDI) and Generalised Anxiety Disorder Scale (GAD-7) were administered to assess the level of depression and anxiety among the study participants. The n-back task (2-back) was performed

according to the methods of Kirchner (1958) as adopted by Yusha'u et al. (2019). The assessment instruments, including the consent form (with the demographic details section), BDI, and GAD-7 and n-back scoring sheet, were included in a booklet used for each participant.

Equipment

HP and Dell Laptops with a 1366 x 768 landscape resolution were used in the study of working memory.

Methodology

Study location and population: The study was conducted at the College of Medical Sciences, Ahmadu Bello University, Zaria, Kaduna State, Nigeria. Furthermore, College of Medical Sciences ABU Zaria has 4 Faculties (i.e Basic Medical Sciences, Allied Health Sciences, Dental Surgery and Clinical Sciences), and 7 Departments with undergraduate students (i.e Human Physiology, Human Anatomy, Basic Dental Surgery, Bachelor of Medicine Bachelor of Surgery, Nursing Science, Medical Lab Science and Medical Radiography) at various levels. A stratified random sampling method was employed to recruit an equal number of participants (undergraduate students only) from 100 – 400 level in all departments.

Study design: The study was a cross-sectional study. The study employed the use of questionnaires and aforementioned equipment to assess the study variables that included some demographic details (age, level and program of study), depressive and anxiety-like symptoms, and working memory parameters (accuracy and reaction time).

Inclusion Criteria: Undergraduate students of the College of Medical Sciences ABU Zaria who gave consent volunteered for the study. Participants who volunteered were undergraduates of the Departments of Human Physiology, Human Anatomy, Dental Surgery, Bachelor of Medicine, Bachelor of Surgery, Nursing Science, Medical Laboratory Science and Medical Radiography.

Exclusion Criteria: Those receiving treatment for any psychiatric disorder or who declined to give consent were excluded.

Participants' consent: Written informed consent was obtained from participants after verbally and in writing explaining the procedures before administering the questionnaires. Ensuring confidentiality and protecting research participants from harm, privacy violations, and distress were prioritised, along with providing both emotional and practical support.

Ethical approval: Ethical approval was sought from the Ethics and Research Committee of Ahmadu Bello University Zaria and was granted with the approval number ABUCUHSR/2024/013.

Sample size determination: The sample size determination for the study was calculated based on the prevalence of depression reported from initial studies in Ahmadu Bello University, Zaria by Dabana and Gobir (2018) using the following formulae;

Table 1:

Levels and severities of depression and anxiety among the students of College of Medical Sciences, Ahmadu Bello University Zaria

	Scoring Scales	F (n)	P (%)
Depression	1-10: Considered normal	169	52.16
	11-16: Mild mood disturbance	79	24.38
	17-20: Borderline clinical depression	30	9.26
	21-30: Moderate depression	34	10.49
	31-40: Severe depression	11	3.40
	over 40: Extreme depression	1	0.31
Total		324	100
Anxiety	0-4: Minimal anxiety	113	34.88
	5-9: Mild anxiety	98	30.25
	10-14: Moderate anxiety	74	22.84
	15-21: Severe anxiety	39	12.04
	Total	324	100

Descriptive statistics, n = 324 students.
F=Frequency; P = Percentage

Table 2:

Working memory parameters of the students of College of Medical Sciences Ahmadu Bello University Zaria

	Parameter	Mean ± SD
Working Memory	Accuracy (%)	85.9 ± 10.83
	Reaction Time (Sec)	1.04 ± 0.51

Descriptive statistics, n = 324 students.

Association Between Depression and Anxiety Statuses of College of Medical Sciences ABU Zaria Students: The result revealed a statistically significant association between the anxiety and depression statuses of the College undergraduate students, with a p-value of 0.001 ($p < 0.05$) in Fisher's Exact Test (Table 3). More so, the odds ratio value of the Risk Estimate showed that those with anxiety are 12x more likely to develop depression.

Table 4:

Comparison between depression and anxiety statuses with working memory of the students of College of Medical Sciences ABU Zaria.

Status	Accuracy (%) [Mean± SD]	p-Value	Reaction Time (Sec) [Mean± SD]	p-Value
Depressed	85.23±13.61	0.655	1.17±0.56	0.054
Normal (non-depressed)	86.00±10.33		1.02±0.50	
Anxiety	86.28±12.28	0.636	1.01±0.53	0.447
Normal (non-anxious)	85.69±10.00		1.06±0.51	

Independent samples t-test showed no statistically significant difference in working memory performance (accuracy and reaction time) between students with and without depression or anxiety ($p > 0.05$). n = 324; SPSS Version 23.

Table 5:

Correlation between age and WM among medical students at ABU Zaria.

Variables	Age (years)	Accuracy (%)	RT (sec)
Age (year)	Pearson Correlation	1	-0.069
	p-Value		0.217
Accuracy (%)	Pearson Correlation	-0.069	1
	p-Value	0.217	0.001**
RT (sec)	Pearson Correlation	0.095	-0.297
	p-Value	0.088	0.001**

Pearson Correlation Test. ** shows a statistically significant relationship between accuracy and reaction time ($p = 0.001$), no statistically significant relationship between age when compared with accuracy and reaction time (n = 324). SPSS Version 23. RT = Reaction Time

Table 3:

Association between depression and anxiety statuses of the students of the College of Medical Sciences, Ahmadu Bello University, Zaria.

		Depression Status	p-Value	Risk Estimate
		Depressed	Fisher's Exact Test	Value (odds Ratio)
		Normal		
Anxiety Status	Anxiety	38	0.001**	12.86
	Normal	8		
		203		

Chi-Square Test. ** shows a statistically significant relationship between anxiety and depression in college students ($p = 0.001$), (n = 324). SPSS Version 23

Comparison Between Depression and Anxiety Statuses with Working Memory of the Students of the College of Medical Sciences, Ahmadu Bello University, Zaria: The results of the comparison between depression and anxiety statuses and working memory of the College undergraduate students, using the Independent Sample-Test, revealed no statistical significance (Table 4). The results are presented as mean ± SD, with p-values of 0.655, 0.054, 0.636, and 0.447.

Correlation Between Age and Working Memory in the Students of College of Medical Sciences Ahmadu Bello University Zaria: The results of the correlation between Age and WM in the undergraduate students of the College using Pearson Correlation reveal a weak negative but statistically significant relationship between accuracy and RT ($p = 0.001$), whereas the correlation between age with accuracy and RT showed no statistically significant relationship with p-values 0.217 and 0.088 respectively (Table 5).

DISCUSSION

This study investigated the co-existence of depressive and anxiety-like symptoms and their impact on working memory in undergraduate students at the College of Medical Sciences, Ahmadu Bello University Zaria.

Our analysis of depression and anxiety levels among medical students reveals that while over half of the students show no signs of depression, less than half experience minimal anxiety, and a considerable proportion present with mild anxiety. These findings highlight that a significant segment of the student population experiences some degree of depressive (14.2%) or anxiety-like symptoms (34.89%), aligning with global trends observed in similar studies (Goebert *et al.*, 2009; Isara *et al.*, 2022). Furthermore, our study identified a statistically significant relationship between anxiety and depression, with an odds ratio of 12.86. This suggests that students experiencing anxiety are 12 times more likely to develop depression. This strong co-occurrence of anxiety and depressive symptoms is well-documented in existing literature, which consistently reports their high comorbidity (Kessler *et al.*, 2005; Lamers *et al.*, 2011).

Furthermore, data from our 2-back Task indicated that the working memory (WM) parameters, including accuracy and reaction time, were within normal ranges. The mean accuracy and reaction time suggested good working memory (i.e. good cognitive performance) among the students. This finding aligns with our hypothesis that depressive-like symptoms do not impact working memory. The working memory parameters (accuracy and reaction time) identified indicate generally that the students have good working memory. These parameters further suggested that no difference exist between students with depression or anxiety and those without in terms of their working memory. This finding could support the thought that depressive-like symptoms do not reduce working memory among the student population. Although this finding contrasts with numerous studies suggesting that depression and anxiety can impair cognitive functions, including working memory (Rock *et al.*, 2014; Chen *et al.*, 2023), it is however, consistent with some studies showing no significant impact on working memory (Cousins *et al.*, 2011). Thus, the absence of difference in here might be because our work focuses on working memory, which is just one aspect of cognitive function, potentially overlooking other cognitive domains that might be affected by depressive and anxiety-like symptoms.

Moreover, information from this work suggested that age does not confound the observed working memory results. This is consistent with the understanding that cognitive functions like working memory are relatively stable during young adulthood (Salthouse, 2009). However, the observed significance of the relationship between accuracy and reaction time indicates an inverse relationship: an increase in one leads to a decrease in the other, and vice versa. There are also slight variations in working memory across programs, but they were not significantly different. This could be because medical students often employ coping strategies and resilience, which might explain the relatively stable cognitive performance observed despite high levels of mental health issues.

The strong association between depression and anxiety highlights the need for mental health interventions, even though these symptoms do not appear to impact working memory in this population. Future research could explore the mechanisms underlying the co-existence of depressive and anxiety-like symptoms and their potential long-term effects on working memory (i.e. cognitive performance).

In conclusion, this study underscores the high prevalence of depression and anxiety among medical students at Ahmadu Bello University, Zaria, with a strong co-existence between these conditions. However, despite high levels of psychological distress, working memory performance remained unaffected. These findings suggest that while depression and anxiety are common among students, their cognitive capacity, particularly working memory, may be preserved. The study underscores the importance of mental health awareness and intervention programs to support student well-being and academic success. Future research should explore other cognitive domains and long-term implications of mental health conditions in student populations.

Authors Contribution

Aliyu Muhammad Kabir conceptualized the study design. Aliyu Muhammad Kabir, Halimatu Mujittapha, and Farida Khalid Musa conducted the field work. Maryam B. Akor-Dewu and Yusuf Yusha'u supervised the study. Aliyu Muhammad Kabir drafted the initial manuscript, while Yusuf Yusha'u and Umar Muhammad Adam contributed to its refinement and assisted with statistical analyses. All authors contributed to and approved the final version of the manuscript.

Acknowledgments

Special thanks to the HOD and Lab Technicians of Human Physiology Department ABU Zaria.

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