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Provide a context or background for the study (i.e., the nature of the problem and its significance). State the specific purpose or research objective of, or hypothesis tested by, the study or observation; the research objective is often more sharply focused when stated as a question. Both the main and secondary objectives should be made clear, and any pre-specified subgroup analyses should be described. Give only strictly pertinent references and do not include data or conclusions from the work being reported.

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Do not repeat in the text all the data in the tables or illustrations; emphasize or summarize only important observations. When data are summarized in the results section, give numeric results not only as derivatives (for example, percentages) but also as the absolute numbers from which the derivatives were calculated, and specify the statistical methods used to analyze them. Table font should be 10 and caption should be below table and figure.

Data should not be duplicated in both figures and tables. The maximum limit of tables and figures should not exceed more than 4. Mention the findings of the study in paragraph, while mentioning figure and table number in text in sequential order.

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CONCLUSION(S)

Conclusion should elucidate how the results communicate to the theory presented as the basis of the study and provide a concise explanation of the allegation of the findings.

ACKNOWLEDGEMENT

Provide the list of individuals who contributed in the work and grant details where applicable

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THE THERAPIST

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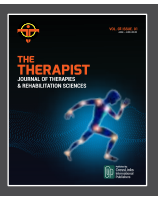

Communication and Language Challenges in Autism Spectrum Disorder

OPEN ACCESS

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Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that is marked by a lifelong struggle with social communication, interaction, and the occurrence of limited or repetitive behaviors [1]. A broad spectrum of speech and language impairments that may be mild, moderate, or severe in nature and manifestation is one of the most obvious features of this disorder. These communication issues should also be comprehended during diagnosis as well as in the formulation of effective therapeutic interventions [2].

The language development of children with ASD is very heterogeneous. There are those who exhibit age-related or even outstanding language skills and there are those that demonstrate a gross delay or are barely verbal. These variations are seen in various areas of language such as semantics, pragmatics, phonology and morphosyntax. As an illustration, semantic problems can interfere with abstract thinking, word use and word classification, but pragmatic problems are commonly represented by inappropriate conversational behavior, literal language interpretation, echolalia or pedantic speech. Phonological and morphosyntactic difficulties also increase the difficulty in communication, especially when they are accompanied by developmental language disorders or intellectual disabilities [3].

ASD also has a diverse speech production. Most children have disordered prosody, abnormal rhythm or intonation, and motor planning impairments of articulation and fluency. Oral motor impairments are often associated with delays in expressive language, whereas receptive language can be comparatively intact. Dysfluency, such as stuttering, cluttering, and unusual pauses in speech, can also hinder communication, and is usually indicative of cognitive or working memory limitations [4].

The acknowledgment of the heterogeneity of ASD language profiles has prompted researchers to introduce categorizations that can be used to inform clinical practice. One of the approaches distinguishes between children with primary pragmatic problems and those with comorbid language or speech problems, between those with delays due to intellectual disability and where limited language develops as a secondary result of limited social interaction or environmental influences. These frameworks underline that intervention must be based on the individual child profile, and it must be focused on social communication, speech motor skills, and language comprehension simultaneously [5].

Early identification and targeted therapy are critical. Supporting social engagement, fostering language-rich interactions, and addressing motor and phonological skills can help mitigate delays and improve long-term outcomes. Clinicians, educators, and caregivers must work together to recognize individual strengths and challenges, ensuring interventions are personalized and contextually relevant. Speech and language difficulties in ASD are multifaceted, ranging from subtle pragmatic challenges to profound expressive deficits. A careful understanding of these profiles allows for more precise diagnoses and interventions, ultimately enhancing communication, social integration, and quality of life for individuals on the autism spectrum.

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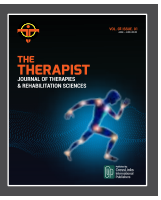

Original Article

OPEN ACCESS

Depression, Anxiety, and Stress in Undergraduate Allied Health Students: A Cross-Sectional Study from Multan, Pakistan

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ABSTRACT

Mental health problems like depression, anxiety, and stress become more widespread in university students all over the world. The involvement of academic pressure, social pressure, and transitional life stages is one of the factors that build psychological distress that may affect academic performance and general well-being. **Objectives:** To determine the prevalence and severity of depression, anxiety, and stress among undergraduate students of allied health sciences pursuing their undergraduate degrees at Laeeque Rafique Institute of Health Sciences, Multan, Pakistan. **Methods:** A cross-sectional study was conducted from January 15 to April 20, 2024, including all students of LRIHS. Participants completed a two-part questionnaire comprising socio-demographic details and the standardized DASS-21 scale. Data were analyzed using SPSS version 26.0 to calculate frequencies, percentages, means, and standard deviations. **Results:** Depression prevalence was 3.43% extremely severe, 8.57% severe, 22.57% moderate, 18.29% mild, and 47.14% normal. Anxiety levels were 15.43% extremely severe, 8.57% severe, 23.43% moderate, 7.71% mild, and 44.86% normal. Stress was reported as 2.57% extremely severe, 10.86% severe, 15.71% moderate, 19.71% mild, and 51.14% normal. Female students showed higher stress levels, while male students had relatively higher rates of depression and anxiety. **Conclusions:** The results suggest that undergraduate allied health sciences students experience considerable psychological distress. These findings point to the necessity to invest in specific mental health support, screening, and intervention in academic institutions.

INTRODUCTION

Mental health in undergraduate students is a major concern in terms of public health globally. Academic and family demands on university students put significant pressure on them, and thus, they experience psychological stress, which can later transform into more severe mental health problems, including depression and anxiety. As a result, their physical well-being, academic performance, and overall mental health may deteriorate over the course of their academic journey, often going unnoticed until an advanced stage. This assumption is supported by evidence showing that without timely support, students' mental health tends to worsen across academic years, with first- and second-year students being particularly vulnerable [1, 2]. The WHO emphasizes that mental health is fundamental to overall health. Mental disorders are now the leading cause of disability worldwide, largely due to their chronic progression, therapeutic challenges, and rising prevalence [3]. The WHO reported that in 2001, approximately 450 million people globally suffered from a mental disorder, and that one in four individuals meets diagnostic criteria for a mental illness at some point in their life [4]. Depression is among the most common mental disorders that is characterized by persistent sadness, deficits of interest or pleasure, and other emotional and physical signs. The

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incidence of depression is similar between boys and girls before puberty, but it becomes significantly more prevalent among females after puberty [5]. Anxiety refers to a group of emotional states characterized by excessive worry, tension, and physical changes such as increased heart rate. It can occur even in the absence of an identifiable trigger. In 2013, one in nine people globally was affected by an anxiety disorder [6]. Stress, as defined by the WHO (2023), is a state of mental strain resulting from challenging circumstances. It arises when the demands placed on an individual exceed their capacity to cope. When stress becomes chronic, it can contribute to the development and worsening of depression, anxiety, and burnout [7]. The vulnerability of university students to mental health problems is especially caused by one of the two shifts: a developmental shift between adolescence and adulthood, and a life shift between home or school and a new institutional setting [8]. The competitive nature of higher education further exacerbates academic stress, increasing the risk of mental health disorders. Literature indicates that students enrolled in health science programs are especially prone to psychological distress, including anxiety, depression, and suicidal ideation [9]. In Pakistan, multiple studies have highlighted rising rates of psychological distress among medical and health sciences students, with prevalence estimates ranging from 40–70%, underscoring the urgent need for localized evidence [10-12]. These mental health challenges can impair students' social relationships, vocational goals, and academic functioning. Those suffering from depression may experience difficulties concentrating, reduced academic motivation, and a general disinterest in studies. In the United States, nearly 10% of university students were diagnosed and treated for depression within 12 months [13]. This study was therefore designed to assess the prevalence and severity of depression, anxiety, and stress among BS students at Laeeque Rafiq Institute of Health Sciences (LRIHS), Multan, Pakistan. Specifically, the study aimed to explore gender and year-wise differences to identify high-risk subgroups. The Depression, Anxiety, and Stress Scale-21 (DASS-21), previously validated and applied in Pakistani student populations, was used in this study as it provides a reliable and culturally appropriate measure for assessing psychological distress [14, 15].

This study aimed to provide actionable evidence for the design of targeted mental health screening and intervention programs for Pakistani undergraduate students.

METHODS

An analytical cross-sectional study was conducted from January 15 to April 20, 2024, to assess the prevalence of depression, anxiety, and stress. And stress among BS students at Laeeque Rafiq Institute of Health Sciences (LRIHS). A total of 350 students were recruited through convenience sampling. This represented a census of all available undergraduate allied health students at LRIHS during the study period, which justifies the sample size. The DASS-21 was used to measure psychological distress. This is a self-reported questionnaire that was administered in person during classroom sessions, under the supervision of the research team. The DASS-21 is widely validated across multiple populations, including South Asian contexts, with Cronbach's alpha values ranging from 0.82 to 0.90 for its subscales, ensuring strong internal consistency and reliability. Its previous use in Pakistani student populations further supports its cultural relevance and validity. In the methodology, the DASS-21 also serves as the operational definition for depression, anxiety, and stress in this study. Scores were categorized according to standard cutoff values provided in the DASS manual. Data were analyzed using SPSS version 26.0. Descriptive statistics were calculated to determine prevalence rates, while inferential analyses were performed to explore associations between demographic variables and mental health outcomes. The IRB of LRIHS gave ethical approval. All the participants were informed before collecting data and giving their informed consent, which was done in accordance with the ethical principles of the Declaration of Helsinki. They were informed in detail about the purpose of the study, their free will to take part, the confidentiality of the information, and the option of discontinuing participation at any point. Anonymity was upheld in the study.

RESULTS

Out of the total participants, 294 (84%) were female and 56 (16%) were male. The age of students ranged from 17 to 24 years, with a mean age of 19.59 years. Student distribution was as follows in academic years: 31.71 in the 1st year, 32.86 in the 2nd year, 30.86 in the 3rd year, and 4.57 in the 4th year. On the body mass index (BMI), 38.86% of the students were underweight, 52.27% were normal, and only 8.57% were overweight, as shown in table 1.

Table 1: Socio-Demographic Characteristics of Study Participants (n=350)

Variables	Category	n (%)	Mean ± SD
Age	<20	138 (39.43%)	18.52 ± 0.59
	≥20	212 (60.57%)	20.84 ± 0.53
BMI	Underweight	136 (38.8%)	16.51 ± 1.41
	Normal	184 (52.5%)	20.76 ± 1.65
	Overweight	30 (8.5%)	28.48 ± 2.19
Gender	Male	56 (16%)	–
	Female	294 (84%)	

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Year	1st Year	111 (31.7%)	-
	2nd Year	115 (32.8%)	
	3rd Year	108 (30.8%)	
	4th Year	16 (4.5%)	
Department	BS MLT	73 (20.8%)	
	BS HND	47 (13.4%)	
	BS OTT	53 (15.4%)	
	BS RIT	86 (24.5%)	
	BS MICRO	8 (2.2%)	
	DPT	83 (23.7%)	

Overall, the prevalence of depression among students was as follows: 3.43% had extremely severe, 8.57% severe, 22.57% moderate, 18.29% mild, and 47.14% were within normal limits. For anxiety, 15.43% experienced extremely severe anxiety, 8.57% severe, 23.43% moderate, 7.71% mild, and 44.86% were normal. Stress levels were distributed as follows: 2.57% extremely severe, 10.86% severe, 15.71% moderate, 19.71% mild, and 51.14% normal. These prevalence rates are summarized. Among the male students (n=56), none experienced extremely severe depression; 14.29% reported severe depression, 23.21% moderate, 21.43% mild, and 41.07% had normal levels. For anxiety, 10.71% of males reported extremely severe anxiety, 3.57% severe, 19.64% moderate, 1.78% mild, and 64.28% were normal. In terms of stress, 1.79% experienced extremely severe stress, 7.14% severe, 17.86% moderate, 8.93% mild, and 64.29% were within normal levels. Among female students (n=294), 4.08% had extremely severe depression, 7.48% severe, 22.45% moderate, 17.69% mild, and 48.30% were normal. Regarding anxiety, 16.32% experienced extremely severe anxiety, 9.52% severe, 24.14% moderate, 8.84% mild, and 41.1% were normal. Stress levels in females were as follows: 2.72% extremely severe, 11.56% severe, 15.31% moderate, 21.77% mild, and 48.64% normal. Depression and anxiety were more prevalent among male, whereas stress levels were slightly higher in female. Gender-specific prevalence data are provided in table 2.

Table 2: Prevalence of Depression, Anxiety, and Stress by Severity and Gender among Study Participants (n=350)

Variables	Category	Depression	Anxiety	Stress
Total (n=350)	Normal	165 (47.1%)	157 (44.9%)	179 (51.1%)
	Mild	64 (18.2%)	27 (7.7%)	69 (19.7%)
	Moderate	79 (22.5%)	82 (23.4%)	55 (15.7%)
	Severe	30 (8.5%)	30 (8.5%)	38 (10.8%)
	Extremely Severe	12 (3.4%)	54 (15.4%)	9 (2.5%)
Male (n=56)	Normal	23 (41%)	36 (64.2%)	36 (64.3%)
	Mild	12 (21.4%)	1 (1.78%)	5 (8.9%)
	Moderate	13 (23.2%)	11 (19.64%)	10 (17.8%)
	Severe	8 (14.2%)	2 (3.57%)	4 (7.1%)
	Extremely Severe	0	6 (10.71%)	1 (1.8%)
Female (n=294)	Normal	142 (48.3%)	121 (41.1%)	143 (48.6%)
	Mild	52 (17.7%)	26 (8.8%)	64 (21.7%)
	Moderate	66 (22.4%)	71 (24.1%)	45 (15.3%)
	Severe	22 (7.5%)	28 (9.5%)	34 (11.5%)
	Extremely Severe	12 (4.1%)	48 (16%)	8 (2.7%)

The prevalence of mental health concerns also differed by academic year. In first-year students, depression, anxiety, and stress were reported at rates of 60.4%, 55.9%, and 49.6%, respectively. Second-year students showed 57.4% depression, 54.8% anxiety, and 52.3% stress. Third-year students had a depression rate of 52%, anxiety of 62%, and stress of 47.3%. In contrast, fourth-year students had significantly lower rates: 31.25% for depression, 6.25% for anxiety, and 18.75% for stress. These findings suggest that first-year students experienced the highest depression rates, third-year students the highest anxiety levels, and second-year students the most stress. Detailed year-wise data is presented in table 3.

Table 3: Prevalence of Depression, Anxiety, and Stress by Academic Year among Study Participants (n=350)

Years	Category	Depression	Anxiety	Stress
1st Year (n=111)	Normal	44 (39.6%)	49 (44.1%)	56 (50.5%)
	Mild	24 (21.6%)	26 (23.4%)	25 (22.5%)
	Moderate	29 (26.1%)	22 (19.8%)	14 (12.6%)
	Severe	9 (8.1%)	10 (9.0%)	11 (9.9%)
	Extremely Severe	5 (4.5%)	4 (3.6%)	5 (4.5%)
2nd Year (n=115)	Normal	49 (42.6%)	52 (45.2%)	53 (47.7%)
	Mild	21 (18.3%)	14 (12.2%)	26 (23.4%)
	Moderate	29 (25.2%)	25 (21.7%)	16 (14.4%)
	Severe	11 (9.6%)	10 (8.7%)	19 (17.1%)
	Extremely Severe	5 (4.3%)	14 (12.2%)	1 (0.9%)
3rd Year (n=108)	Normal	52 (48.1%)	41 (38.0%)	57 (52.8%)
	Mild	17 (15.7%)	14 (13.0%)	17 (15.7%)
	Moderate	28 (25.9%)	34 (31.5%)	23 (21.3%)
	Severe	9 (8.3%)	10 (9.3%)	8 (7.4%)
	Extremely Severe	2 (1.9%)	9 (8.3%)	3 (2.8%)
4th Year (n=16)	Normal	11 (68.8%)	15 (93.8%)	13 (81.3%)
	Mild	2 (12.5%)	0 (0%)	1 (6.3%)
	Moderate	2 (12.5%)	1 (6.3%)	2 (12.5%)
	Severe	1 (6.3%)	0 (0%)	0 (0%)
	Extremely Severe	0 (0%)	0 (0%)	0 (0%)

DISCUSSION

This study aimed to address a gap in the literature by examining the prevalence of depression, anxiety, and stress (DASS) among Bachelor of Science (BS) and Doctor of Physical Therapy (DPT) students at Laeeque Rafiq Institute of Health Sciences (LRIHS), using the DASS-21 questionnaire and considering socio-demographic factors. The results showed that the female students were more stressed compared to male students who were more

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depressed and anxious. The prevalence rates found in this study align with those reported in international and national research. For instance, a study from Fayoum University in Egypt found high levels of stress (62.4%), anxiety (64.3%), and depression (60.8%) among students, which are generally higher than the rates reported in our study [9]. Similarly, research conducted in Malaysian universities showed elevated levels of DASS, particularly among students aged 20 and above [10]. A study from Turkey reported prevalence rates of 27.1% for depression, 47.1% for anxiety, and 27% for stress [11], while a study in Punjab, Pakistan, showed depression at 52.8%, anxiety at 40.5%, and stress at 44.8% results that are comparable to those in our study [12]. Among Chilean students, depression, anxiety, and stress were reported at 42.3%, 53.5%, and 49.6%, respectively [13]. Saudi Arabian studies at Jazan and King Khalid Universities reported similar patterns, with rates often exceeding 50% across all three domains [14, 15]. In contrast, Indian research reported comparatively lower prevalence rates, especially for stress (4.2%), highlighting potential cultural, academic, and environmental differences influencing mental health [16]. A study from Women's Medical and Dental College, Abbottabad, reported strikingly high anxiety levels (85%), further emphasizing the variability in mental health outcomes across educational institutions and regions [17]. Year-wise analysis in our study revealed that first-year students had the highest depression rates, likely due to transition stress, adjustment to new academic demands, and reduced family support. Stress peaked in the second year, which may be linked to increasing academic workload, while anxiety was most prominent in the third year, possibly reflecting pressure from approaching clinical training and professional expectations. Final-year students showed the lowest rates, which may reflect better coping strategies and adaptation over time [18]. Cultural attitudes toward mental health, lower stress levels in Indian studies could reflect stronger family support systems and cultural resilience, while higher rates in Pakistan may be linked to academic competition, limited psychological support, and stigma around seeking help [19]. Gender differences observed in our study can also be interpreted in light of social and cultural factors. Female students often experience higher stress due to balancing academic, familial, and social expectations, while male students may be more prone to depression and anxiety due to financial pressure, societal expectations of responsibility, and reluctance to seek help [20].

CONCLUSIONS

This study identified that stress was more common in female and depression and anxiety higher in male. These findings emphasize the urgent need for institutions to establish regular mental health screenings, accessible counseling services, and resilience-building programs tailored to gender-specific needs. While limited to a single institution, this research highlights the importance of prioritizing student well-being in academic policies. Broader multi-institutional studies with diagnostic tools are essential to guide sustainable mental health interventions in Pakistani higher education.

Authors Contribution

Conceptualization: AA, SI, SS
Methodology: AA, MS, SI, KM, AS, IN
Formal analysis: MS, KM, AS, IN, SS
Writing review and editing: AA, MS, SI, KM

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

All the authors declare no conflict of interest.

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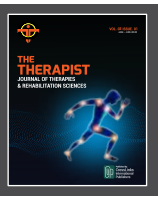

Original Article

OPEN ACCESS

Correlation of Serum Calcium with the Severity of Acute Ischemic Stroke Patients Presenting at Tertiary Care Hospital, Karachi

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ABSTRACT

Stroke is a significant chronic illness, death and disability in both developed and developing nations. The interrelation between the level of serum calcium and the processes of ischemic injury is not clear. **Objectives:** To identify the relationship between the level of serum calcium and the extent of acute ischemic stroke behavior in patients who reported to a tertiary care hospital in Karachi. **Methods:** The cross-sectional analytic study was done in the Neurology Department of Civil Hospital, Karachi. A total of 138 patients diagnosed with acute ischemic stroke, fulfilling the diagnostic criteria, were included after obtaining verbal consent. Serum calcium levels were measured within 24 hours of admission. Simple descriptive statistics (mean ± SD) were used for quantitative data, while qualitative variables were given in terms of frequencies and percentages. A p-value of less than 0.05 was taken as statistically significant. **Results:** Among 138 patients, the mean age was 51.14 ± 4.49 years, and the mean calcium level was 10.7 ± 1.32 mg/dl. Based on calcium quartiles, 28 (20.3%), 35 (25.4%), 54 (39.1%), and 21 (15.2%) patients fell into quartiles 1, 2, 3, and 4, respectively. Stroke severity (based on NIHSS scores) distribution was: mild (15.2%), moderate (29.7%), moderate to severe (20.3%), and severe (34.8%). Higher calcium levels were positively correlated with increased stroke severity ($p \leq 0.05$). **Conclusions:** Serum calcium levels measured within 24–48 hours of admission showed a strong correlation with both stroke severity and functional outcome. Therefore, calcium levels may serve as an indicator of disease severity in acute ischemic stroke patients.

INTRODUCTION

Stroke ranks third in developed nations and is the second most common cause of mortality worldwide [1]. It is the most common cause of disabilities among adults in the USA [2]. One stroke happens in the United Kingdom every three minutes and twenty-seven seconds. Asia is experiencing a rise in the prevalence of strokes, which is severely impacting individuals, family members, and the medical community in addition to causing a significant financial burden [3]. Every year, 16.3 million new instances of stroke are reported globally. The World Health Organization (WHO) predicts that between thirteen percent and twenty percent of acute ischemic stroke patients experience neurocognitive consequences [4]. The first week post-stroke is when individuals are particularly at risk of dying. Patients suffering a stroke are most vulnerable in the first few weeks after the event; in the initial thirty days, between twenty percent and fifty percent of patients pass away. Even for those who do make it through, there may still be mild, moderate, or severe disabilities, and substantial natural recovery may not occur for up to six months [5]. On

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the contrary hand, individuals who previously suffered a fatal stroke have a ten percent first-year chance and a five percent second-year probability of having a second stroke [6]. Sixty-five to eighty-three percent of stroke survivors are self-sufficient in their care after a year. One year following a stroke, between sixty percent and eighty-three percent of patients are independent in their ability to take care of themselves [7]. Cerebrovascular disorders remain a leading cause of death, according to cause-of-death statistics from the 1990s. It was projected that cardiovascular disorders, including stroke, would cause an estimated 5.5 million fatalities worldwide, or 9.6% of global deaths [8]. One of the major health problems in the UK is stroke. It was the cause of more than fifty-six thousand deaths in 1999, or eleven percent of total fatalities in the United Kingdom and Wales [9]. Out of the 135 diseases considered in the worldwide burden of disease research, ischemic stroke was one of the largest factors in mortality; cerebrovascular illnesses came in second [10]. Both the total number of stroke-related fatalities and the worldwide cost of stroke are high and rising [11]. According to Ashraf et al. there are no gender differences in the frequency of hemorrhagic strokes, while men are more likely to get ischemic strokes. Men have a twenty-five percent greater chance of suffering a stroke than women do, particularly if they are young [12]. Despite the extensive global research on stroke prevalence, mortality, and risk factors, there remains a limited understanding of the biochemical predictors that influence stroke severity, particularly serum calcium levels, in South Asian populations. Most existing studies have been conducted in Western countries, and regional variations in diet, genetics, and comorbidities may influence this association.

This study aimed to determine the correlation between serum calcium levels and the severity of acute ischemic stroke in patients.

METHODS

The analytical study was carried out as a cross-sectional study at the Neurology Department of Civil Hospital Karachi during the period of six months, that is, between 14 January and 14 July 2019, following the permission granted by the College of Physicians and Surgeons, Pakistan, and the local ethical review committee. The non-probability consecutive sampling was used to enroll 138 patients; the size of the sample was calculated based on the Pearson correlation coefficient ($r = -0.3$), 95% power, and 5% level of significance. The patients of the study were newly diagnosed patients who had their first stroke, of a non-contrast CT scan with the time frame not exceeding 24 hours after their symptoms began, aged between 30 and 60 years, and of either gender, and presenting with a clinical presentation of focal neurological deficits. Hemodynamically stable patients who could undergo serum calcium testing were included, while those with conditions such as thyroid or parathyroid disorders, SLE, CCF, chronic liver, renal, or lung diseases, neurological disorders, recent blood transfusions, or psychiatric illnesses were excluded. Verbal consent was obtained from all the participants. At the time of admission, demographic and clinical information were gathered, and ischemic stroke was diagnosed by a radiologist with more than five years' experience. The estimation of serum calcium was performed with the help of a 5 mL venous blood sample, and laboratory testing was carried out in a standard facility. The SPSS version 23.0 was used to analyze the data, and quantitative variables (age, calcium, lipid profile) were analyzed as the mean and SD, whereas the qualitative variables (gender, hypertension, diabetes, smoking, anemia) were analyzed as frequencies and percentages. Pearson correlation was used to establish a relationship between serum calcium levels and stroke severity (NIHSS score), whereas Chi-square tests were used to determine the relationship between categorical variables. The p-value was taken to be statistically significant when it was less than 0.05.

RESULTS

The age of the patients ranged from 38 to 60 years, with a mean age of 51.14 ± 4.49 years. The mean age of the 138 patients was 38 years old, while the highest age was 60 years old. In our study, the average age was 51.14 years, with an SD of ± 4.49. In the present investigation, the average length of symptoms, height, weight, cholesterol, triglyceride, bad cholesterol (LDL), good cholesterol (HDL), SBP, DBP, calcium, and hemoglobin were 22 ± 7.21 hours, 161 ± 6.78 centimeters, 85.2 ± 8.54 kilograms, respectively (Table 1).

Table 1: Baseline Characteristics of Study Participants (n=138)

Variables	Mean ± SD	Min-Max
Age (Years)	51.14 ± 4.49	38-60
Duration of Symptoms (Hours)	22 ± 7.21	12-42
Height (cm)	161 ± 6.78	148-168
Weight (Kg)	85.2 ± 8.54	68-115
Cholesterol (mg/dl)	196.7 ± 12.88	180-225
Triglycerides (mg/dl)	144.7 ± 10.43	130-168
LDL (mg/dl)	123.8 ± 9.06	110-140
HDL (mg/dl)	41.61 ± 4.03	34-47
SBP (mmHg)	141 ± 9.81	138-178
DBP (mmHg)	92 ± 7.22	78-105
Calcium (mg/dl)	10.71 ± 1.32	9-12
Hemoglobin (mg/dl)	11.57 ± 2.88	9-13

According to stratification for the calcium quartile based on acute stroke severity, individuals in calcium quartile 1 reported moderate, mild, moderate-severe, and severe

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NIHS scores; accordingly, for 0 (0 percent), 14 (23.1%), 00 (00%), and 14 (29.5%) of the patients. A p-value (r = 0.05) was 0.17. On the other hand, the NIHS scores for patients in the calcium quartile 2 were 07 (33.3%), 21 (51.2%), 00 (00%), and 07 (14.6%), respectively. The p-value (r = 0.14) was 0.00. Additionally, among patients in the calcium quartile 3, 14 (66.7%), 06 (14.6%), 14 (50%), and 20 (41.6%) had moderate, mild, moderately-severe, and serious NIHS scores, respectively. 0.95 (r = 0.00) was the p-value. Lastly, the NIHS scores for those in the calcium quartile 4 were 0 (0%), 00 (00%), 14 (50%), and 07 (14.6%), respectively. These individuals had moderate, mild, moderate-severe, and severe scores. 0.01 was the 0-value (r = 0.08) (Table 2).

Table 2: Distribution of Acute Ischemic Stroke Severity Across Different Age Groups (n=138)

Age (Years)	Acute Ischemic Stroke				Total	Correlation Coeff (p-Value)
	Mild	Moderate	Moderate-Severe	Stress		
30-45	10 (47.6%)	14 (34.1%)	15 (53.6%)	22 (45.8%)	61 (44.2%)	0.496 (<0.0001)
46-60	11 (52.4%)	27 (65.9%)	13 (46.4%)	26 (54.2%)	77 (55.8%)	0.485 (<0.0001)
Total	21 (100%)	41 (100%)	28 (100%)	48 (100%)	138 (100%)	-

Stratification by comorbidities revealed distinct associations with stroke severity.

Hypertension and dyslipidemia showed statistically significant associations with higher NIHSS scores (p<0.0001 for both). For instance, over 90% of patients with mild stroke had hypertension, underscoring its role as a major risk factor. In contrast, the presence of Type 2 Diabetes Mellitus, smoking status, or anemia did not show a significant association with initial stroke severity in this cohort (p>0.05) (Table 3).

Table 2: Ischemic Stroke Severity with Hypertension, Diabetes Mellitus Type-II, Dyslipidemia, Smoking, and Anemia Status (n=138)

Variables	Acute Ischemic Stroke				Total	Correlation Coeff (p-Value)
	Mild	Moderate	Moderate-Severe	Stress		
Hypertension						
Yes	19 (90.5%)	28 (68.3%)	21 (75%)	33 (38.8%)	101 (73.2%)	0.39 (<0.0001)
No	02 (9.5%)	13 (31.7%)	07 (25%)	15 (31.2%)	37 (26.8%)	0.02 (0.18)
Total	21 (100%)	41 (100%)	28 (100%)	48 (100%)	138 (100%)	–
Diabetes Mellitus Type II Status						
Yes	07 (33.1%)	14 (34.10%)	11 (39.30%)	24 (50%)	56 (40.60%)	0.485 (<0.0001)
No	14 (66.7%)	27 (65.90%)	17 (60.70%)	24 (50%)	82 (59.40%)	0.031(0.81)
Total	21 (100%)	41 (100%)	28 (100%)	48 (100%)	138 (100%)	–
Dyslipidemia						
Yes	10 (47.6%)	17 (41.5%)	13 (46.4%)	21 (43.8%)	61 (44.2%)	0.49 (<0.0001)
No	11 (52.4%)	24 (58.5%)	15 (53.6%)	27 (56.2%)	77 (55.8%)	0.32 (0.05)
Total	21 (100%)	41 (100%)	28 (100%)	48 (100%)	138 (100%)	–
Smoking Status						
Yes	07 (33.3%)	21 (51.2%)	07 (25%)	21 (43.8%)	56 (40.6%)	0.37 (<0.001)
No	14 (66.7%)	20 (48.8%)	21 (75%)	27 (56.2%)	82 (59.4%)	-0.0036 (0.92)
Total	21 (100%)	41 (100%)	28 (100%)	48 (100%)	138 (100%)	–
Anemia Status						
Yes	04 (19%)	10 (24.4%)	06 (21.4%)	10 (20.8%)	30 (21.7%)	-0.0036 (0.92)
No	17 (81%)	31 (75.6%)	22 (78.6%)	38 (79.2%)	108 (78.3%)	-0.004 (0.91)
Total	21 (100%)	41 (100%)	28 (100%)	48 (100%)	138 (100%)	–

DISCUSSION

Stroke is a medical condition marked by rapidly increasing symptoms and/or evidence of focal decline in neurological function, sometimes worldwide (for individuals in coma), persisting over twenty-four hours or resulting in death from a cause that isn't of arterial origin [13-15]. Among the most prevalent and fatal conditions are cerebrovascular diseases, which also include cerebral malformations, including intracranial aneurysms and cerebrovascular defects, as well as ischemic and hemorrhaging strokes [16, 17]. Both the total number of predicted scores and the frequency of cerebrovascular illness rise with advancing age. Low haemoglobin levels, tobacco usage, high blood pressure, and diabetes are major contributors to risk. It is also recognized that there is an association with more recent risk factors such as uric acid, C-reactive protein (hs-CRP), homocysteine, and more. The levels of calcium and albumin are two of the more recent ones. An important part of the biochemical pathways leading to ischemic neuronal

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death and injury is played by serum calcium levels [18]. There were 138 individuals with an ischemic stroke diagnosis. In our study, the mean age was 51.14 ± 4.49 years, and the mean calcium level was 10.71 ± 1.32 mg/dl. There were forty-seven (33.3%) male and ninety-two (66.7%) male and female. Comparing people in lower calcium quartiles (Q1, Q2) with the people in higher calcium quartiles (Q3, Q4), Gupta et al. found that people in higher calcium quartiles (Q3, Q4) had much fewer severe strokes over the 24-48-hour period [9]. In particular, no less than 72.73 percent of the patients in Q3 and 42.86 percent of the patients in Q4 scored below the mild range of the NIH scale compared to 7.69 percent of patients in the Q2 range and 0 percent of patients in the Q1 range. Ca significantly correlated with NIHSS, BI, and IS (all patients) and BI, which was reported in solitary and lacunar strokes in all patients and both NIHSS (admission) and BI in lobar, anterior circulation, and bilateral cerebrovascular accidents [19]. CCa was closely related to IS and BI in all individuals, including those with anterior circulatory ischemic attacks. BI and NIHSS (admission) had a significant correlation with IS. High Ca (and CCa in part groups) is related to better survival and recovery after AIS (except in posterior circulatory strokes) and low IS with high Ca and CCa. A previous study on how blood calcium was measured within a period of 78 hours after the stroke had been experienced was tested, and the National Institute of Health Stroke score was used to estimate the extent of a stroke at the same time. Sixty-seven (48.5%) and 71 (51.4%) men out of 138 were cases. The mean age was thirty-four to one hundred years, with a mean of 61.1 ±11.93. Mean National Institute of Health Stroke 17.7/ + 7.73/ 2-35. The serum calcium of each patient was noted and corrected by the quantity of albumin in the patient. The concentration of calcium in the serum was 8.82 + 0.7 mg/dl (mean: 6.84, 10.48). In order to get further information on blood calcium and the National Institute of Health Stroke score, a bivariate correlation was performed [20]. The results of our research, nevertheless, suggest that in stroke patients with acute stroke, lower Ca levels may be associated with more acute stroke symptoms at admission. Moreover, the quartile-based stratification of serum calcium, although convenient in pointing out trends, might simplify the nature of the relationship between calcium levels and the severity of strokes, which is continuous in nature. This also implies that the cut-off values that are determined are also specific to our study population and cannot be generalized directly.

CONCLUSIONS

In conclusion, the researchers have shown that there is a high level of correlation between the level of serum calcium and the severity of acute ischemic stroke. The more calcium in the patients, the more severe the stroke was; this means that serum calcium could be an independent predictor of stroke severity and functional outcome. These results indicate that the amount of calcium may be a possible prognostic factor in the treatment of acute ischemic stroke.

Authors Contribution

Conceptualization: FH
Methodology: FH, MK, SGA, MS, AJ, WA
Formal analysis: FH, MK, SGA, MS, AJ, WA
Writing review and editing: FH, MK, SGA, MS, AJ, WA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

All the authors declare no conflict of interest.

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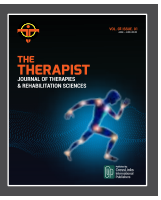

Original Article

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Beyond Sleep Hygiene: A Multidimensional Clinical Profile for Precision CBT-I in Distressed University Students

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ABSTRACT

Sleep disturbance is a core transdiagnostic factor in mental health, intricately linked to the onset and maintenance of depression. **Objectives:** To identify the underlying clinical dimensions of sleep disturbance in university students and explore their behavioral and cognitive predictors. **Methods:** This cross-sectional study of 151 students from the University of the Punjab was conducted using a comprehensive sleep questionnaire. Data were analyzed using exploratory factor analysis to identify latent constructs of sleep disturbance, with group differences examined via Mann-Whitney U and Kruskal-Wallis tests. Regression analyses identified key behavioral and cognitive predictors of adverse sleep outcomes. **Results:** Factor analysis revealed eight distinct clinical dimensions of sleep disturbance: Daytime Impairment, Clinical Sleep Disorders, Perceived Sleep Quality, Sleep Hygiene, Sleep Fragmentation, Pre-sleep Stimulation, Nocturnal Hyperarousal, and Autonomic Symptoms. Clinically significant group differences emerged: females reported greater daytime functional impairment ($p=0.009$), while males endorsed poorer perceived sleep quality ($p=0.027$). Lower family income was uniquely associated with increased sleep fragmentation ($p=0.034$). Critically, regression models identified pre-bed screen use as a significant predictor of reduced total sleep duration ($p=0.007$) and nocturnal cognitive hyperarousal (worry) as a predictor of prolonged sleep onset latency ($p=0.036$). **Conclusions:** Sleep disturbances in university students comprise multiple, co-occurring dimensions rather than a single deficit. Personalized strategies combining stimulus control and cognitive techniques can directly address the core drivers of sleep dysfunction in this population.

INTRODUCTION

Insomnia and depression frequently co-occur, forming a complex, bidirectional relationship that presents a major challenge in therapeutic settings, particularly among emerging adults. While insomnia is traditionally regarded as a secondary symptom of major depressive disorder, mounting evidence suggests that sleep disturbance is not merely a consequence but an active driver of depressive symptoms [1, 2]. Neurophysiological research has shown that fragmented sleep, altered REM patterns, and shortened slow-wave sleep can impair emotion regulation, increase negative cognitive bias, and elevate vulnerability to mood disorders [3]. Clinically, this means that treating insomnia may not only alleviate sleep complaints but also significantly reduce the severity and recurrence of depressive episodes [4]. This transdiagnostic relationship is especially pronounced in university students, who exhibit disproportionately high rates of both sleep problems and mood disorders compared to the general population [5, 6]. Academic stress, irregular schedules, social demands, and pervasive digital media use contribute to circadian misalignment and delayed sleep onset [7]. Students often normalize poor sleep patterns, such as inconsistent bedtimes and excessive pre-sleep screen exposure, which not only degrade sleep quality but also

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reinforce nocturnal cognitive arousal and emotional reactivity [8]. These risk factors interact to form a vicious cycle in which disturbed sleep heightens emotional dysregulation, thereby perpetuating the onset and maintenance of depressive symptoms. Despite the clinical significance of these patterns, most diagnostic frameworks and therapeutic formulations still treat sleep disturbance as a unitary phenomenon—typically labeled as "insomnia." This reductionist view overlooks the multidimensional nature of sleep dysfunction. For example, two individuals may both report "trouble sleeping," but one may suffer from sleep fragmentation due to physiological arousal, while the other may experience prolonged sleep latency driven by bedtime worry and screen use. Each of these patterns has a distinct etiology, clinical implications, and treatment pathways [9]. Previous literature has proposed several mechanistic contributors to student sleep dysfunction, including hyperarousal, maladaptive sleep hygiene, environmental disruptions, and autonomic dysregulation [10]. However, few studies have systematically categorized these elements into clinically meaningful dimensions within a student population. For therapists, this lack of nuance can hinder accurate assessment and reduce the efficacy of treatment planning, especially when using interventions such as Cognitive-Behavioral Therapy for Insomnia (CBT-I), which require precise targeting of maladaptive behaviors and cognitions. To address this gap, the present study aims to profile the multidimensional landscape of sleep disturbance in university students through factor analytic techniques. Using data from a comprehensive sleep questionnaire administered to students at the University of the Punjab, we seek to uncover latent structures underlying sleep complaints such as nocturnal hyperarousal, daytime impairment, and poor sleep hygiene and to explore their demographic and behavioral correlates. By clarifying these subtypes, this study provides clinicians with an empirically grounded framework to guide therapeutic assessment and intervention. Ultimately, we advocate for a shift away from generic sleep hygiene advice toward personalized, mechanism-specific treatment strategies for student populations at risk for depression.

This study aimed to identify the underlying clinical dimensions of sleep disturbance in university students and explore their behavioral and cognitive predictors

METHODS

This quantitative, cross-sectional study was conducted from March 2025 to June 2025 and investigated the associations between sleep patterns and depressive symptoms among a randomly selected sample of 151 students from the University of Punjab. Inclusion criteria included enrolled undergraduate students aged 18–25 years who provided informed consent, while exclusion criteria included students with diagnosed psychiatric disorders, current shift workers, or those on chronic sleep medications. A simple random sampling technique was employed, using a computer-based random number generator to select participants from the official university student registry, ensuring each student had an equal probability of being selected. This design is appropriate for identifying relationships between variables at a single point in time, but it cannot be used to infer causal relationships. The sample size of 151 was deemed appropriate for Exploratory Factor Analysis (EFA). According to guidelines [11] a sample of 150 is considered "good" for factor analysis when communalities are high and factor loadings are strong, conditions which were met in our study with several high-loading items (>0.70). Furthermore, our sample exceeds the recommended minimum subject-to-item ratio of 5:1 for EFA. Data were collected via a structured, 34-item questionnaire administered through face-to-face interactions, covering demographic and lifestyle factors, sleep habits, and psychological states. The questionnaire was pretested on a small pilot sample (n=15) to ensure clarity and relevance. Its internal consistency reliability was confirmed to be acceptable, with a Cronbach's alpha of 0.70 [12]. All participants provided written informed consent, and ethical guidelines for confidentiality were strictly followed in accordance with the institutional review board approval. The analysis employed a multi-faceted strategy: an Exploratory Factor Analysis (EFA) using Principal Component Analysis with Varimax rotation was first conducted to identify the underlying dimensions of sleep disturbance. The criteria for item retention included a primary factor loading of >0.4 and the item loading more strongly on its primary factor than on any other by a difference of at least 0.2. The normality of the data for the derived sleep dimension scores was assessed using the Shapiro-Wilk test and visual inspection of Q-Q plots, which indicated a significant departure from normality ($p<0.05$). Therefore, non-parametric tests (Mann-Whitney and Kruskal-Wallis) were used to compare these sleep dimensions across demographic groups to quantify the impact of key modifiable behaviors, specifically pre-bed screen use and self-reported nighttime stress, on critical sleep outcomes, including total sleep duration and sleep onset latency. All statistical analyses were performed using SPSS version 26.0, with statistical significance set at $p<0.05$.

RESULTS

The near-universal prevalence of pre-sleep screen use (88.1%) and alarming rates of daily self-medication (90.7%) point to a cohort relying on maladaptive coping strategies,

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while high rates of nocturnal worry (43.0%) and unrefreshing sleep (42.4%) suggest significant underlying anxiety and non-restorative sleep. These findings collectively sketch a clinical picture where poor sleep hygiene exacerbates cognitive arousal, which in turn perpetuates sleep insufficiency and daytime impairment, creating a self-sustaining cycle that warrants targeted therapeutic intervention (Table 1).

Table 1: Participant Characteristics and Key Sleep Behaviors (N=151)

Characteristics	N (%)
Demographic Profile	
Female	133 (88.1%)
Age 18-20 years	76 (50.3%)
Urban Residence	128 (84.8%)
Family Income >60,000 PKR	91 (60.3)
Critical Sleep Behaviors and Deficits	
Insufficient Sleep (5-7 hours/night)	77 (51.0%)
Prolonged Sleep Onset (>30 minutes)	100 (66.2%)
Uses Screens in Bed	133 (88.1%)
Engages in Daily Self-Medication	137 (90.7%)
Has a Diagnosed Sleep Disorder	37 (24.5%)
Sleep Quality and Daytime Impact	
Wakes Up Feeling Unrefreshed	64 (42.4%)
Often Feels Drowsy During the Day	49 (32.4%)
Clinical and Nocturnal Symptoms	
Worries and finds it Hard to relax at Night	65 (43.0%)
Experiences Restlessness During Sleep	36 (23.8%)
Wakes Up During the Night	38 (25.2%)

The Principal Component Analysis (PCA) yielded an eight-component solution based on the Kaiser criterion (eigenvalues > 1), which collectively accounted for **63.465% of the total variance** in the dataset. The scree plot criterion likely further supported the retention of these components, given the notable drop in eigenvalues after the eighth component (from 1.019 to 0.977). The initial solution indicated a dominant first component, explaining **18.499%** of the variance, which is common in psychological and social science data where a general factor often emerges. However, to achieve a simpler and more interpretable factor structure, a Varimax rotation was employed. This rotation successfully redistributed the variance more equitably across the components, as evidenced by the first rotated component now explaining **14.598%** and the second **10.317%**. This eight-factor structure demonstrates a robust and parsimonious representation of the underlying constructs, providing a solid foundation for subsequent interpretation and analysis (Table 2).

Table 2: PCA Results Showing Eigenvalues, Variance Percentages, and Cumulative Variance for Each Component

Components	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.700 (18.50%)	18.50	18.50	3.700 (18.50%)	18.50	18.50	2.920 (14.60%)	14.60	14.60
2	1.753 (8.76%)	8.76	27.26	1.753 (8.76%)	8.76	27.26	2.063 (10.32%)	10.32	24.92
3	1.422 (7.11%)	7.11	34.37	1.422 (7.11%)	7.11	34.37	1.465 (7.32%)	7.32	32.24
4	1.341 (6.70%)	6.70	41.07	1.341 (6.70%)	6.70	41.07	1.442 (7.21%)	7.21	39.45
5	1.252 (6.26%)	6.26	47.33	1.252 (6.26%)	6.26	47.33	1.309 (6.55%)	6.55	45.99
6	1.132 (5.66%)	5.66	52.99	1.132 (5.66%)	5.66	52.99	1.202 (6.01%)	6.01	52.00
7	1.075 (5.38%)	5.38	58.37	1.075 (5.38%)	5.38	58.37	1.169 (5.85%)	5.85	57.85
8	1.019 (5.10%)	5.10	63.47	1.019 (5.10%)	5.10	63.47	1.123 (5.62%)	5.62	63.47
9	0.977 (4.89%)	4.89	68.35	–	–	–	–	–	–
10	0.849 (4.24%)	4.24	72.60	–	–	–	–	–	–
11	0.829 (4.14%)	4.14	76.74	–	–	–	–	–	–
12	0.777 (3.88%)	3.88	80.62	–	–	–	–	–	–
13	0.667 (3.34%)	3.34	83.96	–	–	–	–	–	–
14	0.648 (3.24%)	3.24	87.20	–	–	–	–	–	–
15	0.572 (2.86%)	2.86	90.06	–	–	–	–	–	–
16	0.503 (2.51%)	2.51	92.58	–	–	–	–	–	–
17	0.443 (2.21%)	2.21	94.79	–	–	–	–	–	–
18	0.426 (2.13%)	2.13	96.92	–	–	–	–	–	–
19	0.377 (1.89%)	1.89	98.80	–	–	–	–	–	–
20	0.239 (1.20%)	1.20	100.00	–	–	–	–	–	–

The factor analysis elucidated eight distinct, clinically coherent dimensions of sleep disturbance, revealing that the sleep challenges in this student population are not monolithic but rather a confluence of separate yet potentially interacting issues, including pronounced daytime functional deficits, clinical conditions marked by medication use and stress, maladaptive behavioral patterns like pre-sleep screen use, and a core cognitive-

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emotional component of nocturnal hyperarousal, thereby providing a structured framework for targeted, multi-component assessment and intervention. The exploratory factor analysis delineates eight distinct dimensions of sleep disturbance, which collectively explain a substantial 63.47% of the variance in sleep pathology. The structure clearly differentiates daytime functional deficits from key perpetuating mechanisms. The prominence of Nocturnal Hyperarousal (loading=0.85) and Pre-sleep Stimulation (loading=0.82) as standalone factors with high loadings highlights cognitive arousal and technology use as central, independent drivers of sleep pathology in this population. This empirical taxonomy provides a validated framework for clinicians to move beyond generic sleep assessment and instead tailor multi-component interventions, such as CBT-I, to target these specific, maladaptive domains (Table 3).

Table 3: Eight-Factor Structure of Sleep Disturbances in University Students (N=151)

Factor	Items (Factor Loadings)	Defining Characteristics
Factor 1: Daytime Impairment	- I feel unfresh and tired in the morning despite sleeping at night (0.75) - I often feel drowsy and lazy all day (0.77) - I feel a headache and neck pain in the morning (0.72)	Daytime functional deficits; fatigue, drowsiness, and physical discomfort affecting daily performance
Factor 2: Clinical Sleep Disorder	- I use sleeping pills to get good sleep (0.68) - I have a sleeping disorder (0.65) - My stress level seems high when I lie down to rest at night (0.57)	Clinical conditions marked by medication use and stress; diagnosed or self-perceived sleep disorders
Factor 3: Perceived Sleep Quality	- I feel refreshed when awaken (0.60) - I am satisfied with my sleep quality last week (0.51)	Subjective evaluation of sleep quality; satisfaction and feeling refreshed upon awakening
Factor 4: Sleep Hygiene	- I have a regular bedtime routine (0.67) - I use caffeine before sleep (reverse-scored) (-0.74)	Behavioral sleep patterns; routines and substance use affecting sleep quality
Factor 5: Sleep Fragmentation	- After waking up during the night, I fall asleep slowly (-0.87) - I have a sleep attack during the day (0.75)	Interrupted sleep and daytime sleepiness; difficulties maintaining continuous sleep
Factor 6: Pre-sleep Stimulation	- I use screen (smartphone, laptop, or television) in bed (0.82)	Pre-bedtime behaviors that stimulate cognitive or sensory arousal; technology use before sleep
Factor 7: Nocturnal Hyperarousal	- I worry and find it hard to relax (0.85)	Cognitive-emotional arousal at night; anxiety and difficulty relaxing before sleep
Factor 8: Autonomic Symptoms	- I sweat during the night (0.85)	Physiological symptoms related to sleep disturbance; autonomic nervous system activation

Factors were extracted using Principal Component Analysis with Varimax rotation. The eight-factor solution accounted for 63.47% of the total variance (Table 4).

Table 4: Statistically Significant Group Differences in Sleep Domains

Grouping Variable	Sleep Domain	Test	Test Statistic	*p*-Value	Mean Rank/ Note
Gender	Daytime Impairment	Mann-Whitney U	Z=2.620	0.009	Females (78.80) > Males (51.28)
Gender	Perceived Sleep Quality	Mann-Whitney U	Z=2.209	0.027	Males (93.83) > Females (73.00)
Monthly Family Income	Sleep Fragmentation	Kruskal-Wallis H	χ^2=8.669	0.034	Significant difference across income groups

The analysis revealed statistically significant group differences in specific sleep domains. Regarding gender disparities, females reported significantly greater Daytime Impairment than males (Mean Rank: 78.80 vs. 51.28; *p* = .009), indicating more pronounced difficulties with daytime functioning. Conversely, males demonstrated significantly poorer Perceived Sleep Quality compared to females (Mean Rank: 93.83 vs. 73.00; *p* = .027), reflecting greater subjective dissatisfaction with their sleep. Furthermore, a significant association was observed between socioeconomic status and sleep continuity. The Kruskal-Walli's test confirmed that Sleep Fragmentation varied significantly across different monthly family income groups (χ^2 = 8.669, *p* = .034), suggesting that financial standing is a salient factor influencing sleep maintenance, independent of other sleep parameters. These findings highlight distinct sleep challenges stratified by gender and socioeconomic factors within the studied population (Table 5).

Table 5: Multiple Linear Regression Model Predicting Typical Nightly Sleep Hours (N=151)

Predictor Variables	B (Un-standardized Coefficient)	SE (Standard Error)	β (Standardized Coefficient)	t-Value	p-Value
(Constant)	7.45	0.61	—	12.18	< .001
Screen use in bed	-0.24	0.10	-0.20	-2.44	.016
Pre-sleep stress level	-0.13	0.07	-0.15	-1.86	.065
Gender	-0.18	0.24	-0.06	-0.75	.453
Age	0.05	0.12	0.03	0.39	.694
Monthly Family Income	0.09	0.11	0.07	0.82	.412

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The multiple regression analysis confirms that pre-bed screen use is a significant, independent predictor of reduced sleep duration (β = -0.20, *p* = .016), even after controlling for gender, age, and income. Pre-sleep stress level showed a non-significant trend toward predicting shorter sleep (β = -0.15, *p* = .065). The model indicates that screen-based stimulation is a more robust behavioral contributor to sleep insufficiency in this student population than demographic factors or stress alone.

DISCUSSION

This study presents a clinically actionable, eight-factor model of sleep disturbance in university students, deconstructing the monolithic concept of "insomnia" into distinct, co-occurring dimensions. Beyond description, this taxonomy provides prescriptive guidance for targeted interventions. Key modifiable factors—pre-sleep screen use and nocturnal cognitive hyperarousal emerged as core drivers of sleep insufficiency, aligning with global insomnia models and highlighting the relevance of "revenge bedtime procrastination" in this population [13, 14]. Females reported greater daytime impairment, consistent with literature on fatigue and somatic distress, suggesting the need for behavioral activation and energy-pacing strategies [15]. Males reported poorer perceived sleep quality despite similar objective patterns, indicating potential cultural or normative biases in help-seeking [16]. Socioeconomic influences were also evident, with lower family income associated with greater sleep fragmentation, underscoring environmental contributors such as crowded or noisy living conditions [17]. Importantly, these findings extend previous research by situating sleep pathology within the local Pakistani context, where high rates of pre-sleep screen use (88.1%) and self-medication (90.7%) reflect culturally and technologically mediated coping patterns [18]. Compared with regional studies, the prevalence of maladaptive behaviors and nocturnal worry is elevated, emphasizing the urgent need for tailored interventions in South Asian university settings. Clinically, these results argue for a modular CBT-I approach: interventions targeting Pre-sleep Stimulation (screen use) via stimulus control and digital sunset strategies, and Nocturnal Hyperarousal via scheduled worry time or imagery rehearsal, can directly address the most influential mechanisms [19, 20]. Other factors, such as Sleep Fragmentation or Autonomic Symptoms, may require relaxation training or sleep consolidation strategies, highlighting the importance of personalized, multi-component therapy rather than generic sleep hygiene advice. This study's cross-sectional design limits causal conclusions between sleep dimensions and predictors. Self-reported data may be affected by recall and social desirability biases. Regression models showed low explanatory power (R^2=0.049 and 0.029), indicating that screen use and pre-sleep stress explain only a small part of sleep variability. Other factors, such as genetics, health conditions, or academic pressures, likely contribute. Future longitudinal or experimental studies are needed to clarify causality and temporal relationships.

CONCLUSIONS

It is concluded that this study provides an empirically derived clinical map of sleep pathology in students. By identifying distinct dimensions and their key predictors, we equip therapists with the necessary tools to move from a one-size-fits-all approach to precision care. Assessing these eight domains in initial clinical intake can rapidly identify a client's primary perpetuating mechanisms. Future research should focus on developing and testing brief, modular intervention protocols that target these specific dimensions, ultimately enhancing the efficacy and efficiency of sleep treatment for this vulnerable, high-risk popular.

Authors Contribution

Conceptualization: MI
Methodology: MI
Formal analysis: MI
Writing review and editing: IF

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

All the authors declare no conflict of interest.

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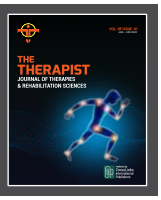

Original Article

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Pistoning versus Holding Dry Needling for Pain, Disability, and Cervical ROM in Upper Trapezius Myofascial Pain Syndrome

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ABSTRACT

Myofascial Pain Syndrome is a prevalent musculoskeletal pain that is characterized by myofascial trigger points. Myofascial trigger points often occur in the upper trapezius. **Objectives:** To determine the comparison of the effects of the use of pistoning on the pain intensity, the presence of disability, and cervical range of motion in adults with upper trapezius myofascial pain syndrome compared to holding dry needling. **Methods:** It was quasi-experimental study in which twenty-four participants were randomized in the pistoning dry needling group (twelve subjects) or the holding dry needling group (twelve subjects). The use of interventions was in three sessions weekly over a three weeks' continuous period. The outcome measures (prone to pain measured with the help of the Visual Analogue Scale, cervical range of motion assessed with the help of the goniometer, disability measured with the Disabilities of the Arm, Shoulder and Hand questionnaire) were compared at the baseline and one week after the last intervention. **Results:** The intensity of pain and disability related to the pain was reduced, and the range of motion of the cervix was higher in all directions: flexion, extension, lateral flexion, and rotation. Nonetheless, between-group analysis showed that there were not statistically significant differences in the extent of improvement in any of the outcome measures which showed that the two techniques were equally effective. **Conclusions:** Pistoning and holding dry needling method are effective in pain reduction, cervical range of motion, and disability among upper trapezius myofascial pain syndrome patients.

INTRODUCTION

Myofascial Pain Syndrome (MPS) refers to pain in skeletal muscles due to the formation of myofascial trigger points (MTPs). Despite frequently occurring in combination with other pain syndromes, MPS must be differentiated from inflammatory disorders (e.g., polymyositis), neurologic disorders (e.g., radiculopathies), soft tissue disorders (e.g., bursitis and tendonitis), and other chronic pain syndromes like fibromyalgia. The key point for the differential diagnosis of MPS is the presence of MTPs in taut bands within the skeletal muscles [1, 2]. Epidemiological studies indicate that MPS involves men and women equally, with its prevalence varying from about 20-30% in general orthopedic clinics to 85-90% in pain clinics [3, 4]. Therapeutic interventions for MPS are generally divided into pharmacologic and non-pharmacologic interventions. Drugs commonly prescribed include nonsteroidal anti-inflammatory drugs (NSAIDs) [5, 6], muscle relaxants, benzodiazepines (e.g., clonazepam and diazepam), tramadol [7], and lidocaine patches [8]. Non-pharmacological interventions encompass a wide variety

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of methods such as exercise therapies, manual therapies [9], electrotherapy modalities [10], postural and ergonomic modifications, as well as more invasive techniques like acupuncture, dry needling, and botulinum toxin injection. Myofascial Trigger Points (MTPs) are highly irritable spots within a tight band produced in skeletal muscles. These points are sensitive and painful during contraction, stretching, and stimulation and can cause sensory, motor, neurologic, and autonomic symptoms. MTPs are among the most important causes of both acute and chronic pain and may also be present in systemic, metabolic, and internal diseases, as well as traumas and joint degeneration. The pain induced by MTPs may persist even after treating the primary disorders. MTPs are characterized by local and referral pain, restriction in the range of motion, and muscle weakness due to pain [11]. Dry needling (DN) is a relatively novel therapeutic technique that has become very common among physical therapists in recent decades. It involves inserting a thin needle into a muscle, without any injection, to treat acute or chronic muscle pains, especially myofascial pain syndromes [12]. The underlying mechanism of DN is not completely understood, but several pathophysiologic effects have been attributed to it, including effects on taut bands, blood circulation, and central and peripheral neurophysiology [13]. UT is a typical location of MTPs. It helps to lift the upper limb and uplift the pectoral girdle. MTPs in UT are extremely common in shoulder pain patients; one study established that approximately 58% of participants with shoulder pain had active MTPs in their UT [14]. Local pain in the shoulder region or a referral to other, more distant regions may be caused by active MTPs in the UT [15]. Despite the widespread application of dry needling to upper trapezius myofascial trigger points, comparison of the methods of pistoning and holding has little evidence.

This study aims to compare their effect on pain, range of motion of the cervical joints, and upper extremity activity so as to inform clinicians in choosing which approach is most effective.

METHODS

This experimental study was a quasi-experimental study conducted at the Department of Physiotherapy, Government Hospital, Qom, Iran. The total duration of the study was six months following the approval of the synopsis (July to December 2024). The sample size was calculated as 24 participants (12 in Group A and 12 in Group B) using Open Epi version 3. Although the minimum sample size derived from Visual Analogue Scale (VAS) scores of a related study was 18 (9 per group), it was increased to 24 to compensate for potential dropouts. Participants were recruited using a non-probability convenience sampling method via an opaque envelope method. Twenty-four subjects with a definite diagnosis of an active MTP in the UT muscle were recruited. The inclusion criteria were: age between 18 and 65 years; no sensitivity to needles; the presence of unprovoked pain for at least three months in the neck/shoulder girdle region; the presence of an MTP in one or more specific locations within the UT; and the presence of at least one active MTP in the UT muscle, identified by palpating a taut band with a tender spot. Exclusion criteria included rheumatological and neurological diseases (e.g., radiculopathies, cervical disk lesions); fibromyalgia or active infection; pregnancy; a history of neck or shoulder surgery; current use of acupuncture, steroidal analgesics, anti-inflammatory drugs, or muscle relaxants; and progressive pain or an unwillingness to attend follow-up sessions. Participants were non-randomly allocated to either the pistoning or holding dry needling group based on their order of enrollment (alternate). Random allocation to either the pistoning or holding dry needling group was performed using opaque envelopes. After recording demographic data and obtaining written informed consent, participants were randomly allocated into one of two intervention groups. In the Holding Method DN group (n=12), the needle was retained for 10 minutes after insertion. In the Pitoning Method DN group (n=12), the needle was ejected immediately after insertion. Dry needling was administered three times per week for three consecutive weeks. A 0.3 × 50-mm Huan-Qiu® acupuncture needle with a guiding tube was used. With the patient in a prone position, the therapist identified the taut band and inserted the needle directly into the MTP. Patients were blinded to their group allocation. Outcomes were assessed at baseline and one week after the final treatment session. Pain intensity was measured using the Visual Analogue Scale (VAS), which ranges from 0 (no pain) to 10 (worst perceivable pain). Cervical Range of Motion (ROM) was assessed in three planes (sagittal, frontal, transverse) using a hand goniometer. Movements evaluated included flexion, extension, right and left lateral flexion, and right and left rotation. The disability level was evaluated using the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire, a 30-item reliable and valid tool where each item is scored from 1 (no symptom) to 5 (very severe symptom). Data were analyzed using SPSS version 20. Data normality was tested using the one-sample Kolmogorov-Smirnov test and found to be normal. Parametric tests were used: paired t-tests for within-group and independent t-tests for between-group comparisons. A p-value <0.05 was considered significant. Written informed consent was obtained from all participants. Confidentiality was maintained by replacing names with identification numbers. Only the researcher and supervisor had access to

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the data, which were stored on secured, password-protected computers. Participants retained the right to discontinue the study at any stage, and no financial benefits were provided for participation.

RESULTS

According to the results obtained, both methods significantly improved main outcome measures (pain, disability, and cervical ROMs) in patients with active MTP in the UT muscle. However, between-group comparisons of data revealed no statistically significant change between the two DN methods. These findings imply that there is no superiority of one technique over the other. In our study, 24 individuals with active MTP of UT were randomly assigned to the pistoning (n=12) and holding (n=12) groups. Both groups were matched, and no between-group difference was observed at baseline of the trial regarding demographic data (age, height, and weight) (Table 1).

Table 1: Patients' Demographic Data

Variable	Pistoning Dry Needle	Holding Dry Needle	p-Value
Age	26.50 ± 4.14	24.08 ± 4.69	0.195
Height	169.41 ± 10.47	167.91± 9.38	0.715
Weight	62.16 ± 11.59	66.25 ± 10.44	0.375

Pain intensity (VAS), disability level (DASH score), and cervical ROMs are compared between the two groups. Average values of outcomes were compared before and after the trial by Paired-Samples t-Test, and a p-value<0.05 was considered as a statistically significant change. Findings indicated considerable improvements in all the variables, following treatments (p-value) (Table 2).

Table 2: Within-Group Comparisons of Pain Intensity (VAS Score), Disability Level (DASH Score), and Neck ROMs

Variables	Pistoning Dry Needle			Holding Dry Needle		
	Pre-interventions	Post-interventions	p-Value	Pre-interventions	Post-interventions	p-Value
Pain Intensity (VAS)	5.75 ± 1.35	2.83 ± 1.80	<0.001	6.08 ± 1.56	2.16 ± 0.93	<0.001
Disability Level (DASH Score)	86.41 ± 19.95	60.91 ± 19.95	0.001	87.25 ± 26.99	64.25 ± 33.65	<0.001
Flexion	41.66 ± 11.77	49.66 ± 12.76	<0.001	46.41 ± 13.14	56.08 ± 10.61	0.002
Extension	51.16 ± 9.07	61.33 ± 9.05	<0.001	51.41 ± 13.99	62.66 ± 11.97	<0.001
Ipsilateral Lateral Flexion	43.16 ± 9.17	47.16 ± 8.18	<0.001	42.16 ± 5.40	48.91 ± 5.43	<0.001
Contralateral Lateral Flexion	43.58 ± 7.46	48.50 ± 8.14	0.001	45.75 ± 5.64	50.91 ± 7.45	<0.001
Ipsilateral Rotation	60.58 ± 5.68	64.75 ± 6.18	<0.001	64.58 ± 5.82	69.16 ± 6.26	0.001
Contralateral Rotation	61.16 ± 5.65	65.25 ± 6.48	0.001	64.25 ± 0.89	69.66 ± 0.46	<0.001

The Independent-Samples t-Test was applied to compare the results of the pre-post difference of the outcome measures between the two groups. To also measure the extent of the differences, Cohen's d was used to estimate the effect sizes. The values of all between-groups comparisons were small to medium, with the range of d = 0.15 for disability (DASH score) and d = 0.64 for pain intensity (VAS). No statistically significant difference was found between the two groups. p-value >0.05. The result of this finding indicates that the good effects of the two DN techniques were equal (Table 3).

Table 3: Between-Group Comparison of Pain, Disability, and Neck ROMs

Variables	Pistoning Dry Needle (Pre-Post Change) (Mean ± SD)	Holding Dry Needle (Pre-Post Change) (Mean ± SD)	p-Value	Cohen's d (Effect Size)
VAS	2.91 ± 1.50	3.91 ± 1.62	0.132	0.64 (Medium)
DASH score	25.50 ± 19.75	23.00 ± 13.54	0.721	0.15 (Small)
Flexion	8.00 ± 5.49	9.66 ± 8.46	0.573	0.23 (Small)
Extension	10.16 ± 3.88	11.25 ± 7.60	0.665	0.18 (Small)
Ipsilateral Lateral Flexion	4.00 ± 2.73	6.75 ± 4.30	0.075	0.76 (Medium)
Contralateral Lateral Flexion	4.91 ± 4.03	5.16 ± 3.01	0.865	0.07 (Small)
Ipsilateral Rotation	4.16 ± 2.51	4.58 ± 3.34	0.733	0.14 (Small)
Contralateral Rotation	4.08 ± 3.28	5.41 ± 2.57	0.281	0.0

DISCUSSION

The results of the current research proved that not only the holding but also the pistoning technique of dry needling (DN) was effective in relieving pain, cervical range of motion (ROM), and functional status of the upper extremity evaluated using the DASH questionnaire. These findings are corroborated by Navarro *et al.* who have found DN as effective as local lidocaine injection in reducing pain [16] in upper trapezius myofascial trigger points (MTPs), and by Jimbo *et al.* who have found DN to be as effective as local lidocaine injection in reducing pain [17]. Nonetheless, the

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two intervention groups did not show any statistically significant difference, which means that the level of their efficacy is the same. As far as we know, the study is the first to directly compare these two particular methods of DN to the treatment of upper trapezius MTPs. The significant reduction in pain intensity achieved by both techniques suggests that the therapeutic effect of DN may be attributable more to the fact of needle insertion itself than to the duration the needle is retained. This interpretation is supported by previous studies which concluded that post-needling pain relief is probably due to the process of insertion [18]. Literature proposes several mechanisms for this effect. DN can induce a local stretch in the muscle, relaxing the tight muscle fibers. Furthermore, it is believed to help eliminate noxious biochemical substances by enhancing local blood flow, as demonstrated by Cagnie *et al.* who showed a significant increase in local blood flow and oxygen saturation in the upper trapezius following DN [19]. The results also showed that both DN techniques induced a significant increase in cervical ROM across all planes of motion, with no significant difference between groups. This finding aligns with previous studies by Jimbo *et al.* and Gerber *et al.* which demonstrated that DN effectively restores motion in the upper trapezius by deactivating MTPs that cause pain during muscle contraction and stretching [17, 20]. Finally, both groups showed significant improvement in functional ability, as measured by the DASH score. DASH questionnaire evaluates the capacity of a patient to conduct daily activities and rates symptoms like pain and stiffness [21], the improvements in primary outcomes would logically lead to a better score. This correlation is supported by Aksan *et al.* who found a relationship between DASH scores and the prevalence of MTPs in the upper trapezius [22].

CONCLUSIONS

Both pistoning and holding dry needling techniques are effective in reducing pain, improving cervical range of motion, and decreasing disability in patients with upper trapezius myofascial trigger points. No significant difference was observed between the two methods, indicating that clinicians can choose either technique based on patient preference and clinical feasibility.

Authors Contribution

Conceptualization: ZE
Methodology: MAK
Formal analysis: HI
Writing review and editing: NB, HS

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

All the authors declare no conflict of interest.

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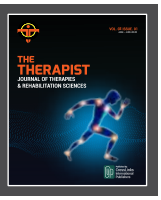

Original Article

OPEN ACCESS

Detrimental Effect of Prolonged Lower Limb Static Stretching on Dynamic Balance in Older Adults with Knee Osteoarthritis

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ABSTRACT

Due to the fast aging of the world's population, physiological alterations associated with age that impair postural control and boost the risk of falls are becoming more common. Falls are a major public health concern among the elderly, and knee osteoarthritis (OA). **Objectives:** To investigate the short-term effects of a multi-muscle lower limb stretching regimen on the balance performance of older adults with knee OA. **Methods:** Twenty-nine individuals with OA, aged 60 to 75 years, participated in a quasi-experimental study. Participants were divided into two groups: a control group (n=15) that performed placebo stretches and an intervention group (n=14) that underwent static stretching for five minutes each, targeting the hamstring, tensor fascia latae, and calf muscles. The Fullerton Advanced Balance (FAB) scale, the Timed Up and Go (TUG) test, the Functional Reach (FR) test, and knee range of motion (ROM) were used to assess mobility and balance outcomes both before and after the intervention. **Results:** Reduced FAB and FR scores and longer TUG times after stretching were indicative of a statistically significant loss in dynamic balance in the intervention group. The control population, on the other hand, showed no discernible changes in any of the balance metrics. The intervention group's knee range of motion improved somewhat, but this difference was not statistically significant. **Conclusions:** A single session of prolonged static stretching of lower limb muscles can acutely impair dynamic balance in older adults with knee OA. Immediate rest following such exercises is recommended to reduce the potential risk of falls in this vulnerable population.

INTRODUCTION

Aging is a complex and inevitable biological process, though its progression can be moderated with appropriate care to achieve a long, healthy life. The older adult population is growing significantly in modern societies, making evidence-based understanding of their issues crucial for planning and decision-making [1]. The demographic shift is substantial; the global population over 60 years is projected to rise from 11% in 2000 to 22% by 2050, with the most rapid increases occurring in low-to middle-income countries [2]. Iran exemplifies this trend, where the population is currently young but is expected to see 33% of its citizens over the age of 65 by 2050, posing a considerable future societal burden [3]. The aging process is accompanied by various physiological alterations, including changes to cognitive function and postural control systems. The efficacy of the visual, vestibular, and somatosensory systems, which are integral to balance, diminishes with age [4]. A higher likelihood of falling, which

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is defined as an abrupt, unintentional change in position that results in a descent, is a crucial effect of these changes [5]. With over one-third of adults over 65 experiencing a fall each year, falls are a serious health problem and the sixth highest cause of death among the elderly in the US [6]. Environmental risks, problems with gait and balance, and functional deficiencies in the integration of sensory and motor information required for postural control are some of the multifactorial causes [7]. For older adults, maintaining an upright posture and controlling the body's center of mass within its base of support, known as balance, becomes increasingly difficult [8]. Age-related reductions in neural and muscle fibers further contribute to instability, jeopardizing simple daily activities [9]. Stretching the muscles of the lower extremity is a common intervention aimed at improving joint range of motion and balance. However, its acute effects on dynamic balance, the ability to maintain postural stability during movement, can be paradoxical. Prolonged static stretching may temporarily reduce muscle stiffness and alter proprioceptive feedback, leading to delayed neuromuscular responses and decreased balance control. A study by Min-Jung-Han et al. found that five minutes of plantar flexor stretching significantly increased postural sway in the elderly, indicating a temporary impairment in static balance [10]. These findings suggest that stretching may also influence dynamic balance by affecting coordinated movement and reaction time during mobility tasks such as walking or standing transitions. Studies consistently report increased postural sway and a higher risk of instability in this population [11]. These challenges are often exacerbated by comorbid conditions such as knee osteoarthritis (OA), a degenerative joint disease prevalent in approximately 10% of men and 18% of women over 60. Knee OA is characterized by pain, stiffness, and reduced range of motion, and individuals with this condition demonstrate greater impairments in both static and dynamic balance compared to their healthy peers [12]. Given that daily exercise regimens for older adults frequently include stretching, it is vital to understand its immediate impact on balance, particularly in a fragile population already at risk due to conditions like knee OA.

This study aims to examine the short-term effects of a multi-muscle lower limb stretching regimen on the balance performance of older adults with knee OA.

METHODS

This research was designed as a quasi-experimental study, aimed at evaluating the effects of lower limb stretching exercises on balance and knee range of motion (ROM) in older adults with knee osteoarthritis. The trial was conducted at a center for community-dwelling older adults, located within a private clinic in Ghaemshahr, Iran, for six months following official approval of the research synopsis (July to December 2024). The sample size was calculated a priori using Open Epi version 3.3 for comparing two independent means. The calculation was based on the Fullerton Advanced Balance (FAB) scale as the primary outcome. The expected mean ±SD scores were 10.8 ± 2.0 for the control group and 8.8 ± 2.0 for the intervention group, derived from a pilot study conducted by the authors (unpublished data). This represented an expected mean difference of 2.0 points. Using a two-sided significance level (α) of 0.05, a power (1-β) of 80%, and an allocation ratio of 1, the formula for the sample size per group was: n per group $= (2 * (Z\alpha/2 + Z\beta)^2 * SD^2) / (Mean_1 - Mean_2)^2$. Where $Z\alpha/2 = 1.96$ (for $\alpha=0.05$) and $Z\beta = 0.84$ (for $\beta=0.20$). This calculation yielded a minimum of 14 participants per group. To account for a potential 10% attrition rate, we aimed to recruit 31 participants. However, due to time constraints and eligibility criteria, a final sample of 29 participants was enrolled. Participants were first recruited through a non-probabilistic, convenience sampling method from community-dwelling older adults attending the clinic. Following eligibility screening according to inclusion and exclusion criteria, individuals were assigned to either the control or intervention groups using a non-randomized allocation procedure based on scheduling availability. No random number generation or allocation concealment was employed. This approach allowed for practical recruitment while ensuring comparable baseline characteristics between groups to minimize selection bias. A total of 29 older adults aged 60–75 years with knee osteoarthritis were enrolled. All participants were included in the final analysis, and for the lone participant who dropped out, baseline observation was carried forward (BOCF) to impute missing post-intervention data. he intervention group received targeted lower limb stretching exercises, whereas the control group received placebo stretching in similar positions without actual stretching. Functional balance tests and knee ROM assessments were conducted before and after the interventions. Participants aged 60–75 years were included if they exhibited at least three of the following features: morning stiffness lasting less than 30 minutes, crepitus, tenderness in the knee joint, swelling in the knee joint, and no sensation of warmth on palpation. Exclusion criteria included a history of rheumatologic or myopathic conditions, fracture or trauma to the knee meniscus or ligaments, use of systemic or intra-articular corticosteroids in the past three months, use of NSAIDs in the past two months, cognitive impairment preventing questionnaire completion, cardiovascular diseases or diabetes, conditions affecting balance, or severe visual or auditory impairment. Demographic data, including age, height, weight, and BMI, were recorded using a data

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collection form. After obtaining written informed consent, participants were assigned to intervention or control groups. In the intervention group, three key muscle groups underwent static stretching, each held for five minutes to the point of mild discomfort, followed by a five-minute rest between stretches. The hamstring group included the semitendinosus, semimembranosus, and biceps femoris, stretched in a straight leg raise (SLR) position with the participant supine and the therapist raising the leg until discomfort was noted. The gastrocnemius and soleus muscles were stretched with the participant lying supine and the knee extended, while the therapist applied dorsiflexion at the ankle until mild discomfort was felt. The tensor fascia lata was stretched in the Ober test position, with the participant lying in side-lying position and the upper leg guided into adduction until mild discomfort was noted. Three standardized balance assessment tools were used: The Fullerton Advanced Balance (FAB) test, the Timed Up and Go (TUG) test, and the Functional Reach (FR) test. The FAB test assesses multiple aspects of balance and mobility in higher-functioning older adults and contains 10 items, each scored from 0 to 4, with a total of 40 points, where scores below 25 indicate a high fall risk. Participants were also instructed to rise from a chair, walk three meters, turn 180 degrees, return, and sit for the TUG test, which measures dynamic and static balance, gait, and directional change ability. The FR test measured the distance participants could reach forward while standing without losing balance, assessing postural control. All data were analyzed using SPSS version 20. Normality was evaluated using the Kolmogorov–Smirnov test, and comparisons between and within groups were made using independent t-tests and paired t-tests, respectively, with $p<0.05$ deemed statistically significant. Frequency and percentage were used to report descriptive data. The instruments used for data collection included data collection forms, a tape measure, and a digital weighing scale. A pilot study was not conducted for this research. All participants provided written informed consent before enrollment. Confidentiality of participant data was maintained through coding and secure storage. Ethical approval was obtained from the Iran University Ethical Review Board, and the estimated budget for the study was approximately 30,000 Rs. Active knee flexion and extension ROM were measured using a standard 12-inch universal goniometer (Baseline®) with 1° increments. The measurement protocol followed established anatomical landmarks to ensure reliability. Participants were positioned in a supine position for measurements. The goniometer's axis was positioned above the femur's lateral epicondyle, with the moving arm lining up with the lateral malleolus and the stationary arm with the greater trochanter. All ROM measures were carried out by the same skilled physiotherapist, who was blind to group assignment. Each motion was measured twice to increase reliability, and the average value was analyzed. The intra-rater reliability of this method was established in a pilot study (n=10) before the main trial, showing an Intraclass Correlation Coefficient (ICC) of 0.92 for knee flexion, indicating excellent reliability.

RESULTS

A summary of the subjects' demographic information is provided. A one-sample Kolmogorov–Smirnov test was used to determine whether the data was normal. For intra-group comparisons, the paired T-test was used, and for inter-group comparisons, the T-test. Significant values are denoted by an asterisk (*) in this chapter, and a p-value of less than 0.05 was deemed statistically significant. Prior to the interventions, the two groups' age, height, weight, and BMI were all well matched (Table 1).

Table 1: Demographic Characteristics

Variables	Intervention Group	Control Group	p-Value
Age (Years)	67.07	67.26	0.098
Height (cm)	162.07	158.13	0.679
Weight (kg)	70.85	62.73	0.751
BMI (kg/m^2)	26.86	24.84	0.387

Mean values of balance tests and knee ROM, pre- and post-trial in the intervention group (* statically significant (p-value≤0.05). The study summarizes the results of intra-group comparisons in group 1 and shows that FAB and FR scores decreased, and TUG score increased significantly following the stretching exercises. ROM increased in this group, although it was not statistically significant (Table 2).

Table 2: Gender of Participants

Variables	Gender	Frequency
Group 1	Male	6
	Female	8
Group 2	Male	5
	Female	10

Results indicate the intra-group comparisons in group 2. Based on this table, none of the balance tests and knee ROM showed statistically significant change after placebo stretch (Table 3).

Table 3: Balance Tests and Knee ROM, Pre- and Post-Trial in the Intervention Group

Variables	Pre-intervention	Post-intervention	p-Value
ROM	123.28 ± 5.71	124.14 ± 4.95	0.082
FAB	34.21 ± 3.78	31.35 ± 4.87	0.0002*
TUG	12.28 ± 1.63	14.14 ± 1.51	0.001*
FR	20.35 ± 4.16	16.92 ± 4.14	0.0001*

The study demonstrates the pre-post changes of values in

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each group. According to the findings, all the tests, except ROM, show significant between-group differences (Table 4).

Table 4: Balance Tests and Knee ROM, Pre- and Post-Trial in the Control Group

Variables	Pre-intervention (Mean ± SD)	Post-intervention (Mean ± SD)	p-Value
ROM	125.53± 5.66	125.66 ± 5.38	0.550
FAB	32.60 ± 3.78	32.66 ± 4.87	0.709
TUG	12.06 ± 1.63	12.20 ± 1.51	0.685
FR	17.53 ± 4.16	18.06 ± 4.14	0.088

*Statically Significant (p-value≤0.05)

The between-group analysis revealed significant differences in the change scores for dynamic balance measures. The intervention group showed a significantly greater decline in FAB score (Mean Difference [MD] = -2.92, 95% CI: -4.17 to -1.67, p=0.0001, Cohen's d = -1.85), a significantly greater increase in TUG time (MD = 1.72, 95% CI: 0.67 to 2.77, p = 0.002, Cohen's d = 1.27), and a significantly greater decrease in FR distance (MD = -3.95, 95% CI: -5.34 to -2.57, p = 0.0001, Cohen's d = -2.20) compared to the control group (Table 5).

Table 5: Between-group comparison of change scores (post-intervention - Pre-intervention)

Variables	Intervention Group Change	Control Group Change	Between-Group Mean Difference (95% CI)	p-Value	Cohen's d
ROM	0.86 ± 1.70	0.20 ± 1.26	0.66 (-0.48, 1.79)	.246	0.44
FAB	-2.85 ± 2.14	0.07 ± 0.96	-2.92 (-4.17, -1.67)	.0001*	-1.85
TUG	1.85 ± 1.51	0.13 ± 1.24	1.72 (0.67, 2.77)	.002*	1.27
FR	-3.42 ± 2.34	0.53 ± 1.12	-3.95 (-5.34, -2.57)	.0001*	—

DISCUSSION

This study sought to investigate the immediate effects of 5-minute static stretching of multiple lower limb muscle groups (hamstrings, calf muscles, and tensor fascia latae) on balance performance and knee ROM in older adults with knee osteoarthritis (OA). Our results demonstrated a significant deterioration in dynamic balance, as reflected in decreased scores in the Functional Reach (FR) and Fullerton Advanced Balance (FAB) tests, and a significant increase in TUG time, indicating reduced dynamic balance and mobility immediately after stretching. Meanwhile, increases in knee ROM were observed in the intervention group but were not statistically significant. The decline in balance aligns with prior research suggesting that prolonged static stretching can reduce neuromuscular performance. Behm *et al.* found that 45-second static stretches repeated over the hamstring, quadriceps, and calf muscles led to decreased dynamic balance [13]. Similarly, Nagano *et al.* reported increased postural sway after 3-minute static stretching of calf muscles [14]. In contrast, shorter-duration stretches (~15–30 seconds) have sometimes improved balance and strength, possibly by enhancing muscle spindle sensitivity and neural activation [15]. Previous studies observed increased power and strength following brief proprioceptive neuromuscular facilitation and static stretching in younger subjects [16]. Static stretching reduces muscle–tendon unit (MTU) stiffness, which may enhance flexibility but compromise reactive balance. Toninelli demonstrated that prolonged stretching decreases stretch reflex sensitivity and H-reflex amplitude, indicating reduced neuromuscular excitability [17]. This neuromuscular suppression can lead to delayed corrective responses during balance tasks. Cramer *et al.* also reported reductions in EMG activity and power output following static stretching, further supporting a neural basis for post-stretch performance declines [13]. The discrepancy may be due to our inclusion of additional muscle groups (hamstrings and tensor fascia latae), potentially inducing broader neuromuscular disruption. Moreover, our sample consisted of older adults with knee OA, who are already at a baseline disadvantage in balance due to joint degeneration and proprioceptive decline. Oba *et al.* recently evaluated five sets of 1-minute static calf stretches in older adults and found increased center-of-pressure velocity post-stretch, indicating potential instability, despite improvements in joint range and lean limits [18]. These findings further suggest that static stretching, even of moderate duration, can acutely affect dynamic postural control in aging populations. Regarding knee ROM, the improvements observed in our intervention group were not statistically significant. This is unsurprising given the single-session design. Most prior studies reporting significant ROM gains used multi-week stretching protocols. Pourahmadi et al. implemented a 6-week program of static hamstring stretches and found significant ROM improvements in older adults [19]. These findings indicate that duration and frequency are critical factors in achieving significant flexibility gains. Furthermore, structural and physiological differences between younger and older populations may impact outcomes. With aging, skeletal muscles undergo fibrosis, fat infiltration, and loss of contractile tissue, reducing elasticity and adaptability [20]. Wilson et al. showed that while young adults gained dorsiflexion ROM after three consecutive days of stretching, the improvements diminished within days of cessation [21]. Such results suggest that acute flexibility gains are both minimal and short-lived, especially in aged populations with musculoskeletal impairments. From a clinical standpoint, our findings suggest caution in recommending long-duration static stretching immediately before functional activities like balance or gait training in older adults with knee OA. Instead, short-duration or dynamic stretching, or

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stretching at the end of training sessions, may offer flexibility benefits without compromising immediate balance and mobility. Additionally, separating stretching and balance training by a recovery interval might allow neuromuscular performance to normalize post-stretch.

CONCLUSIONS

The present study showed that applying stretch over the lower limbs of older adults with chronic knee OA reduces their balance status, but may not affect their knee ROMs. Therefore, it is highly suggested that the elderly have a rest just after stretching exercise in order to prevent falling. Lack of follow-up: Only one session of intervention due to the unavailability of subjects.

Authors Contribution

Conceptualization: MRG
Methodology: MDBC
Formal analysis: SU
Writing review and editing: ML, STZ

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

All the authors declare no conflict of interest.

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