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Dietary Patterns, Sleep Quality, and Musculoskeletal Health: A Comprehensive Analysis of Body Composition and Psychological Status in University Students

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Abstract

Introduction: The university period is critical for the formation of lifestyle habits. Changes in dietary patterns, reduced physical activity, sedentary behaviors, poor sleep quality, and psychological stress can lead to body composition disorders and musculoskeletal abnormalities. This study aimed to determine the status of body composition indices,



physical activity, sleep quality, psychological health, and dietary patterns, and to investigate the prevalence of skeletal abnormalities in students.

Methods: This descriptive-analytical study was conducted on 150 students of the Resam Higher Education Institute. Data collection tools included the International Physical Activity Questionnaire (IPAQ), a researcher-made sleep quality questionnaire, a General Psychological Health Questionnaire, and a Food Frequency Questionnaire (FFQ). Body composition was measured using the InBody 270 device. Musculoskeletal abnormalities were assessed using a mirror box and checkerboard plate. Data were analyzed using SPSS 27.

Results: The mean BMI was 23.36 ± 6.108 , but the mean body fat percentage was 31.037 ± 7.238 , indicating high body fat despite normal weight. Students spent an average of 6.43 hours sitting per day. Sleep quality was poor in 27.8% and moderate in 40.3% of participants. Psychological assessment showed that 19.4% of students experienced moderate to severe nervousness, and 27.8% reported moderate to severe fatigue. The highest prevalence of abnormalities was observed for forward head posture (76.4%), lordosis (70.8%), and limb asymmetry (69.4%). Dietary analysis showed a high frequency of unhealthy oil consumption. A significant correlation was found between the consumption of unhealthy oils and visceral fat ($P < 0.05$).

Conclusion: Despite having a normal BMI, students are in a critical condition regarding high body fat percentage, prolonged sitting times, poor sleep quality, and psychological distress. These factors are associated with a high prevalence of musculoskeletal abnormalities. Universities are recommended to design comprehensive interventions focusing on nutritional education, posture correction, sleep hygiene, and psychological counseling.

Keywords: Body Composition, Musculoskeletal Abnormalities, Sleep Quality, Dietary Pattern, Psychological Status, Students.



Introduction

The spine and musculoskeletal system, as the primary structures of the human body, play a vital role in bearing weight, maintaining balance against gravity, and facilitating daily movements. Maintaining the correct posture of these structures is an essential prerequisite for preventing chronic musculoskeletal pain, optimizing motor performance, and enhancing the quality of life at all ages (Ahmadi et al., 2021). However, in the current century, humanity has faced fundamental changes in lifestyle. The widespread use of smart digital devices, increased sitting times, and reduced physical activity among students have led to the emergence of a set of postural abnormalities that can threaten the future health of this segment of society (Karimi et al., 2022). University students are particularly susceptible to these changes due to academic pressures and lifestyle transitions. Factors influencing healthy behaviors in this population are complex and multifaceted, involving not only physical habits but also psychological well-being (Sng et al., 2021). The prevalence of sedentary behaviors, weight issues, and psychological distress such as anxiety and depression among university students is a growing concern globally (Irwin, 2019). From a biomechanical perspective, body composition plays a determining role in skeletal stability. Increased fat mass, especially visceral fat, can shift the body's center of gravity and increase the torque applied to joints and the spine (Mohammadi & Rezaei, 2020). Although the Body Mass Index (BMI) is a common and accessible indicator for weight classification, it faces serious criticisms because it cannot distinguish fat mass from muscle mass (Romero-Corral et al., 2008). Modern studies have shown that the phenomenon of normal weight obesity (NWO), where individuals have a high percentage of fat despite normal BMI, can severely increase the risk of metabolic and skeletal abnormalities (Oliveros et al., 2014).

In addition to physical factors, recent scientific literature emphasizes the vital role of psychological factors and sleep patterns. High academic stress, anxiety, and poor sleep quality can facilitate the onset or exacerbation of postural abnormalities through physiological mechanisms such as increased muscle tension, impaired connective tissue repair, and reduced pain threshold (Hosseini et al., 2022). Psychological distress is often correlated with fatigue and a sense of losing control, which can further exacerbate poor lifestyle choices. Furthermore, recent studies have shown that prolonged sitting time is independently associated with core muscle weakness and changes in the natural curvature of the spine (Owen et al., 2010).

Diet and physical activity are two pillars of health directly affecting body composition. Improper dietary patterns, high consumption of processed foods, and saturated fats can lead to increased visceral fat and metabolic disorders (Esmailzadeh et al., 2007). A review of the literature shows that while studies have been conducted on skeletal abnormalities in children and adolescents, limited data exist on the simultaneous status of body composition, sleep patterns, dietary habits, psychological health, and a wide range of skeletal abnormalities in the Iranian student population. Therefore, the present study was conducted to determine the status of body composition indices, investigate



sleep quality, psychological status, and dietary patterns, and determine the prevalence of various skeletal abnormalities in students.

Methods

This was a descriptive-analytical cross-sectional study conducted in 2024 on 150 students of the Resam Higher Education Institute. Inclusion criteria included being a female student, no history of spinal surgery, no congenital skeletal diseases, and not taking medications affecting weight or appetite. Exclusion criteria included incomplete questionnaires and failure to adhere to standard pre-test conditions.

Body Composition Assessment: Precise measurement of body composition was performed using the InBody 270 device (Biospace, Korea). Standard conditions included fasting for at least 2 hours and avoiding heavy exercise for 12 hours.

Physical Activity and Sitting Time: The short form of the International Physical Activity Questionnaire (IPAQ) was used to assess activities over the past 7 days. Daily sitting time was also recorded.

Sleep Quality: Sleep quality, duration, and daytime sleepiness were assessed using a researcher-made questionnaire.

Psychological Status: A General Psychological Health Questionnaire was used to assess students' mental well-being. This questionnaire consisted of 6 items measuring feelings of nervousness, hopelessness, fatigue, lack of control, depression, and hopelessness about the future. Responses were recorded on a 5-point Likert scale ranging from "Never" to "Very much."

Dietary Pattern: A Food Frequency Questionnaire (FFQ) was used to investigate dietary patterns.

Musculoskeletal Assessment: Screening for postural abnormalities was performed using a mirror box and a checkerboard plate from anterior, posterior, and lateral views.

Statistical Analysis Data were analyzed using SPSS version 27. Descriptive statistics (mean, standard deviation, frequency, percentage) were used to describe the data. To investigate the relationship between variables, Pearson's correlation coefficient and Spearman's test were used at a significance level of 0.05.

Results

Body Composition and Physical Characteristics The study included 150 female students. The mean BMI was 23.36 ± 6.108 (normal range). However, the mean body fat percentage was 31.037 ± 7.238 , and mean visceral fat was 4.742 ± 2.642 kg, indicating high body fat despite normal weight. The mean waist-to-hip ratio was 0.756 ± 0.066 .

Table 1. Mean and Standard Deviation of Participants' Characteristics



Variable	Mean	Standard Deviation	Minimum	Maximum
Age (years)	23.36	6.108	18	38
Weight (kg)	63.441	11.857	45	99.30
Height (cm)	164.50	5.206	154	179
BMI (kg/m ²)	23.165	4.110	16.5	35.60
Waist Circumference (cm)	75.21	10.429	61	105
Hip Circumference (cm)	98.75	8.108	86	124
WHR (Waist-to-Hip Ratio)	0.756	0.066	0.61	0.95
Body Fat Percentage (%)	31.037	7.238	12.80	47.20
Visceral Fat (kg)	4.742	2.642	2.00	12.00
Subcutaneous Fat (kg)	18.422	7.668	3.70	42.70
Lean Body Mass (kg)	42.476	6.972	4.80	61.80
Skeletal Muscle (%)	40.523	3.921	33.50	60.30
Bone (%)	4.190	0.431	3.00	4.90
Protein (%)	17.531	3.492	9.80	27.10

Physical Activity and Sitting Time Students spent an average of 6.43 hours per day sitting. Based on the IPAQ results, participants engaged in vigorous physical activity an average of 1.48 ± 2.101 days per week and moderate activity on 2.18 ± 2.377 days per week.

Sleep Quality The mean sleep duration was 7.13 ± 1.38 hours per night. Regarding sleep quality, 31.9% reported good quality, 40.3% moderate, and 27.8% poor quality.

Psychological Status The results of the psychological assessment are presented in Table 1.

- Nervousness/Restlessness: 20.8% never, 36.1% mild, 23.6% moderate, 8.3% high, and 11.1% very high.
- Hopelessness: 43.1% never, 29.2% mild, 19.4% moderate, 4.2% high, and 4.2% very high.
- Fatigue/Lack of Energy: 15.3% never, 36.1% mild, 23.6% moderate, 15.3% high, and 9.7% very high.
- Lack of Control: 31.9% never, 38.9% mild, 12.5% moderate, 12.5% high, and 4.2% very high.
- Depression/Sadness: 41.7% never, 33.3% mild, 15.3% moderate, 5.6% high, and 4.2% very high.



- Hopelessness about Future: 52.8% never, 27.8% mild, 11.1% moderate, 6.9% high, and 1.4% very high.

The highest frequency of food consumption was for fruits (4-6 times/week), dairy, and grains (daily). Fish consumption was negligible. Unhealthy oil consumption showed a daily pattern, while salty/sweet snacks and sugary drinks were consumed 1-3 times per week.

The prevalence of abnormalities was high: Forward Head Posture (76.4%), Lordosis (70.8%), Limb Asymmetry (69.4%), Flat Foot (37.5%), Genu Valgum (29.2%), and Scoliosis (25%).

Table 2. Prevalence of Musculoskeletal Abnormalities

Abnormality	Total Prevalence (%)	No Abnormality (%)
Spinal Disorders		
Forward Head Posture	76.4	23.6
Kyphosis	22.2	77.8
Lordosis	70.9	29.1
Scoliosis	25.0	75.0
Flat Back	0.0	100.0
Upper Limb Disorders		
Uneven Shoulders	41.7	58.3
Drooping Shoulders	13.0	86.1
High Scapula	18.1	81.9
Lower Limb Disorders		
Pelvic Misalignment	4.4	98.6
Genu Recurvatum	2.8	98.6
Knee Flexion Deformity	4.4	91.6
Genu Varum (Bow-Leg)	8.4	91.6
Genu Valgum (Knock-Knee)	29.2	70.8
Foot and Toe Disorders		
Flat Foot (Pes Planus)	37.5	62.5
Pes Cavus (Hollow Foot)	0.0	100.0
Hammer Toe	1.4	98.6
Claw Toe	0.0	100.0
Hallux Valgus (Bunion)	34.7	65.3
Overall Symmetry		
General Limb Asymmetry	69.4	30.6

The analysis of correlations revealed significant relationships between musculoskeletal abnormalities and body composition indices. Specifically, a significant positive correlation was observed between Genu Varum and Body Protein ($P=0.045$), as well as between Flat Foot and Skeletal Muscle Mass ($P=0.044$). Furthermore, Genu Valgum showed a significant correlation with Visceral Fat ($P=0.017$). Regarding overall alignment, General Limb Asymmetry was significantly correlated with Waist Circumference ($P=0.008$), Waist-to-Hip Ratio ($P=0.019$), and Visceral Fat ($P=0.008$).

A significant correlation was found between the consumption of unhealthy oils and visceral fat ($P < 0.05$). Furthermore, qualitative analysis suggested that students reporting higher levels of psychological distress (nervousness, fatigue, and depression) tended to report poorer sleep quality and higher prevalence of musculoskeletal pain, although specific statistical correlations for psychological variables with posture require further investigation in this sample.

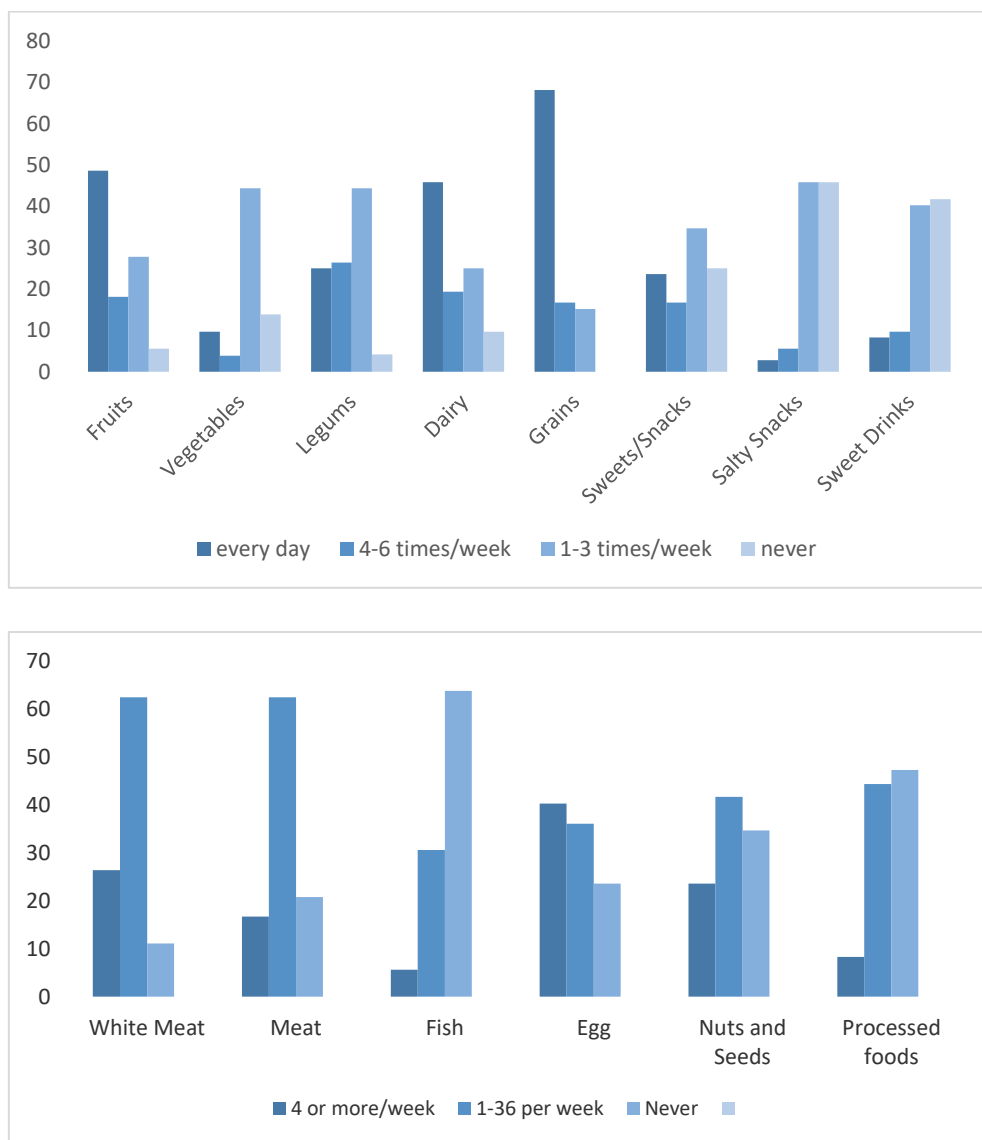


Chart1. Frequency of Food Group Consumption

Discussion and Conclusion

The findings of this study present a comprehensive and concerning picture of the biopsychosocial health of university students. The results indicate that despite having a normal Body Mass Index



(BMI), students suffer from high body fat percentage, poor dietary habits, sedentary behavior, sleep disturbances, and psychological distress, all of which contribute to a high prevalence of musculoskeletal abnormalities.

Body Composition and the Paradox of Normal Weight Obesity

One of the most significant findings of this study is the discrepancy between BMI and body fat percentage. While the mean BMI (23.36 ± 6.108) falls within the normal range, the mean body fat percentage (31.037 ± 7.238) is alarmingly high. This confirms the phenomenon of "Normal Weight Obesity" (NWO) or "skinny fat," a condition where individuals have a normal weight but a high percentage of body fat and low muscle mass (Oliveros et al., 2014). Romero-Corral et al. (2008) demonstrated that BMI fails to distinguish between fat mass and lean mass, leading to a false sense of security regarding health risks. In this population, high visceral fat (4.742 ± 2.642 kg) is particularly concerning as it is metabolically active and associated with increased inflammation and insulin resistance (Klein et al., 2004). This altered body composition shifts the center of gravity, potentially contributing to the postural deviations observed in this study.

Sedentary Behavior and Musculoskeletal Abnormalities

The extremely high sitting time (6.43 hours/day) is a critical risk factor identified in this study. This duration exceeds the threshold often associated with negative health outcomes. Prolonged sitting creates a flexed posture, leading to adaptive shortening of the hip flexors and hamstrings, and weakening of the gluteal and abdominal muscles (Bagheri et al., 2018). This muscular imbalance forces the pelvis into anterior tilt, exacerbating lumbar lordosis, which was found in 70.8% of participants. Furthermore, the high prevalence of forward head posture (76.4%) is likely a direct consequence of "tech neck" or poor posture while using digital devices during prolonged study sessions. Owen et al. (2010) emphasized that sedentary behavior is an independent risk factor for poor health, distinct from physical inactivity, suggesting that even students who exercise may not be immune to the effects of prolonged sitting.

Psychological Distress and its Somatic Manifestations

The psychological profile of the students reveals significant vulnerability. Nearly 20% of students reported moderate to severe nervousness, and 25% reported significant fatigue. The biopsychosocial model of pain suggests that psychological distress can lower the pain threshold and increase muscle tension, thereby predisposing individuals to musculoskeletal disorders (Hosseini et al., 2022). The high prevalence of fatigue (25% moderate to severe) is particularly noteworthy; fatigue is not merely a symptom of poor sleep but is also linked to mental exhaustion and depression (Sng et al., 2021). The sense of "lack of control" reported by 16.7% of students reflects academic stress, which can lead to sustained muscle contraction (guarding), further contributing to spinal pain and postural abnormalities. Irwin (2019) also highlighted the strong correlation between university stress and somatic symptoms, reinforcing the need to address mental health in physical health interventions.

Dietary Patterns and Metabolic Health

Dietary analysis revealed a paradoxical pattern: while consumption of fruits and dairy was acceptable, the intake of unhealthy oils and sugary drinks was frequent, and fish consumption was negligible. The significant correlation between unhealthy oil consumption and visceral fat aligns with global evidence linking trans-fats and saturated fats to central obesity (Esmailzadeh et al., 2007). The low consumption of fish is a missed opportunity for obtaining anti-inflammatory



omega-3 fatty acids, which are protective against both metabolic syndrome and depression (Mohammadifard et al., 2015; Gao et al., 2025). Malik et al. (2006) demonstrated the strong link between sugar-sweetened beverages and weight gain; in this study, the consumption of these beverages likely contributes to the high visceral fat observed despite normal BMI. It appears that in this population, dietary quality is a stronger determinant of body composition than physical activity levels, as no significant correlation was found between physical activity and body composition indices.

Sleep Quality and Recovery

Sleep is essential for tissue repair and hormonal regulation. The fact that 27.8% of students had poor sleep quality and nearly 20% suffered from moderate to severe nervousness creates a vicious cycle: stress disrupts sleep, and poor sleep increases stress and pain sensitivity (Saeedi, 2019). Poor sleep hygiene, combined with late-night screen use (contributing to forward head posture), compounds the risk for musculoskeletal issues.

Limitations and Future Directions

This study has limitations, including the cross-sectional design which precludes causal inference, and the use of self-reported questionnaires for diet and activity, which may be subject to bias (Sallis & Saelens, 2000). Furthermore, the sample was restricted to female students at one institute, limiting generalizability. Future studies should include longitudinal designs and objective measures of physical activity and sleep.

Conclusion

In conclusion, this study reveals that university students face a "silent health crisis." Despite normal BMI, they exhibit high body fat, visceral obesity, and alarming rates of musculoskeletal abnormalities. These physical issues are intertwined with poor dietary habits, excessive sitting, inadequate sleep, and significant psychological distress. The findings suggest that interventions focusing solely on weight loss (BMI) are insufficient. Instead, universities must adopt a holistic approach that integrates nutritional education (reducing unhealthy oils and sugars), ergonomic interventions to reduce sitting, sleep hygiene programs, and psychological support services to effectively enhance the health and quality of life of students.

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