INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

PREVALENCE OF STATIC AND DYNAMIC BALANCE DISTURBANCE AMONG UNIVERSITY STUDENTS, ISLAMABAD WITH ASSOCIATED FACTORS

Original Research

Saania Kanwal Khanzada[1]*, Syeda Hufsa Asif[2], Syeda Maheen Jawad[2], Malaika Raffial[2], Wajahat Haider[2], Nighat Afraz[3]
[1]Assistant Professor, Ibadat International University Islamabad, Pakistan.
[2]Physiotherapist, University of Lahore, Islamabad Campus, Pakistan.
[3]University Of Lahore, Pakistan.
Corresponding Author: Saania Kanwal Khanzada, Assistant Professor, Ibadat International University Islamabad, Pakistan. dr.saaniakhan@gmail.com

Conflict of Interest: None
Grant Support & Financial Support: None

ABSTRACT

Background: Balance, a vital component of human health, involves coordination between the vestibular, somatosensory, and visual systems. University students are particularly susceptible to balance disturbances due to sedentary behavior, poor lifestyle habits, and fluctuating BMI, all of which can affect both static and dynamic balance. Identifying the prevalence and factors influencing balance disturbances in this population is essential to support targeted interventions that reduce health risks associated with balance impairment.

Objective: To determine the prevalence of static and dynamic balance disturbances among university students, evaluate gender differences, and examine the impact of BMI on balance stability.

Methods: A cross-sectional study was conducted with 394 university students, selected using Slovin's formula for sample size calculation. Data were collected through a semi-structured questionnaire encompassing demographics, anthropometric data, and specific inclusion and exclusion criteria. Balance assessments included the Stork Test, Single Leg Stance (eyes open and closed) for static balance, and the Y Balance Test and Timed Up and Go Test for dynamic balance. Data analysis was performed using SPSS version 26.

Results: The study sample (n = 394) had a mean age of 21.58 ± 1.64 years. BMI distribution indicated 12.5% underweight, 75.1% normal weight, and 12.4% overweight. Male participants demonstrated greater balance stability compared to females, with mean Stork Test times of 4.79 ± 0.407 seconds for males and 4.96 ± 0.198 seconds for females. Static balance impairments were more prevalent than dynamic ones, and higher BMI was correlated with poorer balance. Participants with normal BMI achieved higher reach distances (107.07 ± 12.56 cm) in the Y Balance Test compared to overweight individuals (86.05 ± 15.23 cm).

Conclusion: A significant prevalence of balance disturbances was observed, with static impairments more common than dynamic. Higher BMI, low physical activity levels, and sedentary habits were associated with poorer balance, whereas an active lifestyle contributed to improved balance control.

Keywords: Balance disturbances, Body Mass Index, Dynamic balance, Physical activity, Postural stability, Static balance, University students.

INTRODUCTION

Balance, an integral aspect of human health, relies on the complex interaction of three primary systems: the vestibular, somatosensory, and visual systems. The vestibular system, located within the inner ear and innervated by the vestibular branch of the vestibulocochlear nerve, plays a vital role in spatial orientation and the detection of head movements across three dimensions, supporting equilibrium and coordinated bodily movements (1). The semicircular canals within this system are sensitive to rotational movements, while the otolith organs detect linear accelerations and gravitational forces, relaying critical information about head position to the brain(2, 3). The somatosensory system contributes to balance by providing proprioceptive data on body positioning and movement through sensory receptors in muscles, tendons, and joints. This system enables the brain to maintain a continuous awareness of body alignment, which is fundamental for coordinated and balanced movement (4). Similarly, the visual system aids balance by processing visual cues, allowing for constant adjustments in response to environmental shifts. Light signals, transmitted from the eyes through the optic nerve, are interpreted by the visual cortex to facilitate spatial orientation(5, 6).

Balance can be divided into static and dynamic categories. Static balance refers to the ability to maintain an upright posture without movement, whereas dynamic balance involves maintaining control of the body's center of gravity during motion. In recent years, balance disturbances have become increasingly common, especially among university students undergoing neurological, hormonal, and physical changes, potentially elevating their risk of health complications(4). The lifestyle and habits prevalent among university students—often marked by sedentary behavior, irregular eating patterns, and fluctuations in body mass index—can contribute to a decline in balance stability(7, 8). Balance disorders also arise from various medical conditions and external factors. Inner ear dysfunctions, such as Benign Paroxysmal Positional Vertigo (BPPV), Meniere's disease, and vestibular neuritis, disrupt equilibrium by affecting the vestibular system(1). Neurological disorders, including stroke and cerebellar ataxia, further impair balance due to damage within brain regions responsible for motor coordination. Additionally, prolonged use of certain medications for conditions like anxiety, insomnia, muscle spasms, and blood pressure management can lead to balance impairments over time(9).

Understanding these risk factors, such as physical inactivity, prolonged sedentary behavior, suboptimal footwear, and environmental influences, is crucial for developing interventions to reduce the risk of balance-related injuries, especially in physically active students(10, 11). Therefore, this study aims to investigate the prevalence of static and dynamic balance disturbances among university students in Islamabad and to identify associated risk factors, contributing to informed strategies for enhancing student health and safety(12, 13).

METHODS

This study employed a descriptive cross-sectional survey design to evaluate balance disturbances among undergraduate university students. The target population consisted of students from multiple universities in Islamabad, including Ibadat International University, Foundation University, Shifa Tameer-e-Millat University, National University of Health Sciences, Margalla Institute of Health Science, and Capital University of Science & Technology. The study was conducted over a six-month period, from March to August 2024, following the approval of the research synopsis(14). A non-probability convenience sampling technique was applied, with a sample size calculated using Slovin's formula. Based on an estimated population size of 30,000 students and a margin of error set at 0.05, a sample size of 394 was determined. Participants met specific inclusion criteria: they were undergraduate students aged 18–25 of both genders, physically healthy, capable of walking and standing independently, without scoliosis or other anatomical or physical limitations (11). Individuals with musculoskeletal impairments, cardiopulmonary disorders, neurological impairments, or physical asymmetries such as asymmetric toes, leg length discrepancies, or persistent lower extremity pain were excluded. Additionally, participants who had undergone surgical procedures in the lower extremities within the previous six months were excluded from the study (15).

Data collection was conducted through a semi-structured questionnaire designed to gather both qualitative and quantitative data. The questionnaire included sections on demographic information and questions based on the inclusion and exclusion criteria. Balance assessment was conducted using the Stork Test, Single Leg Standing, Y Balance Test, and Timed Up & Go Test, which are reliable measures for assessing static and dynamic balance. Additionally, the International Physical Activity Questionnaire (IPAQ) was used to

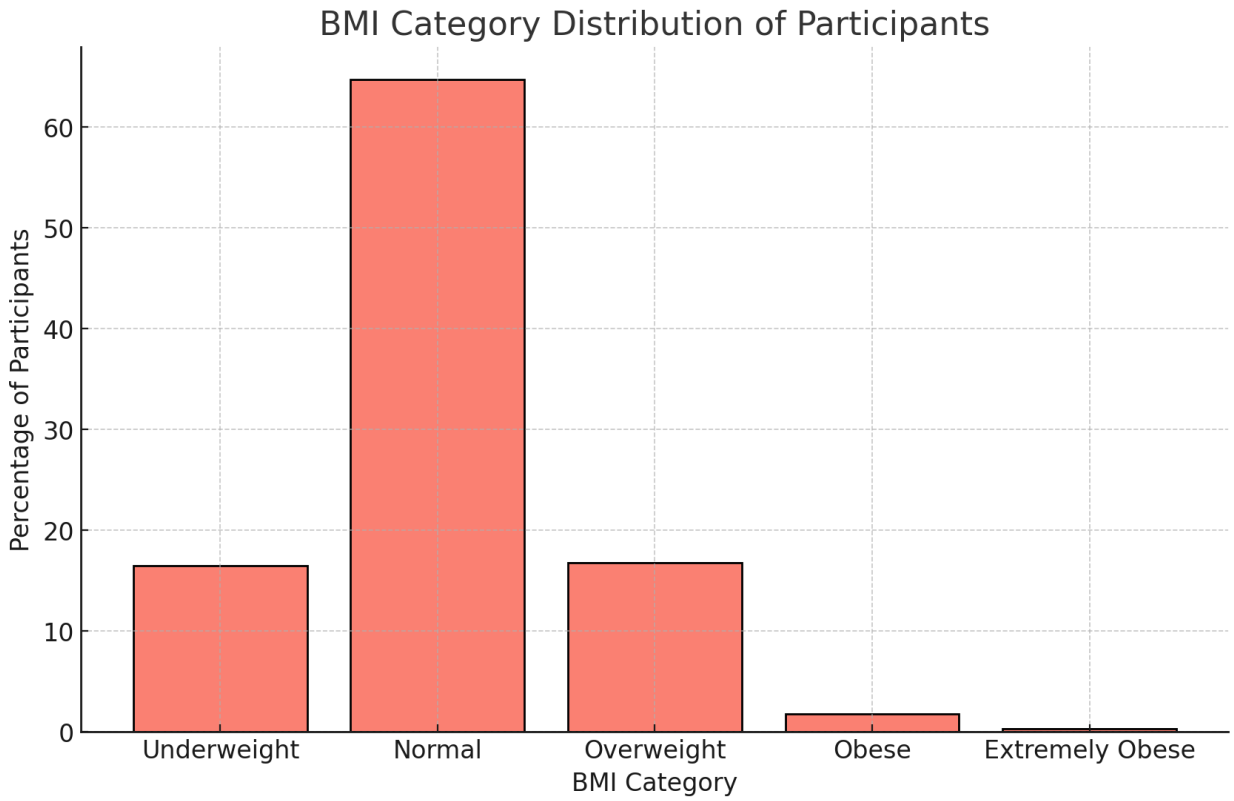
assess the physical activity levels of the participants, offering a comprehensive evaluation of their activity patterns, which could influence balance and coordination.

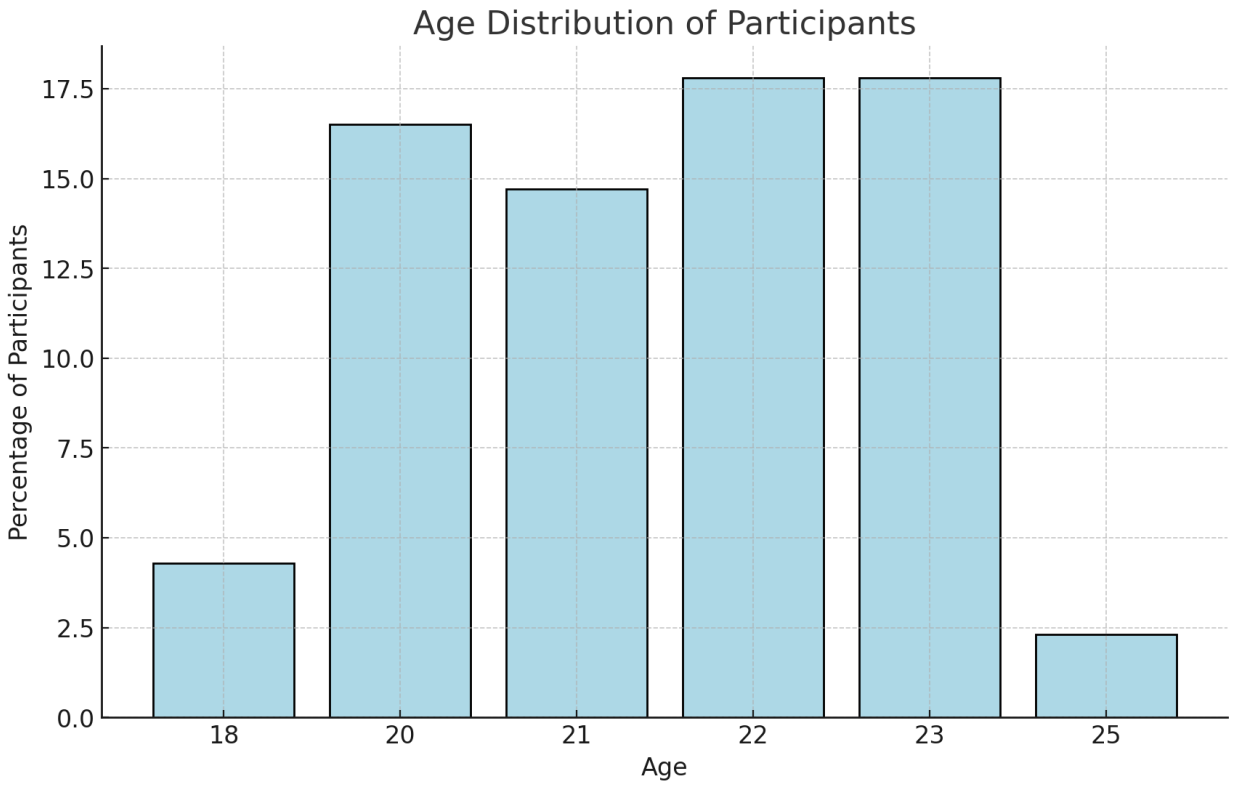
RESULTS

A sample size of 394 university students was utilized, determined through Slovin's formula to represent a population of approximately 30,000 students. The age distribution among participants ranged primarily between 18 and 25 years, with the most common ages being 22 and 23 (each at 17.8%), followed by 20 (16.5%) and 21 (14.7%). The mean age of participants was 21.39 years (SD = 1.823). Gender distribution was evenly balanced at 50% male and 50% female. The BMI categories showed a predominance of normal-weight individuals (64.7%), with the remainder categorized as overweight (16.8%), underweight (16.5%), obese (1.8%), and extremely obese (0.3%).

Table 1: Mean and Standard Deviation of Age of Participants

Statistics	
Age of participants	
N	394
Mean	21.39
Std. Deviation	1.823





Balance test results revealed an overall average stork test duration of 4.88 seconds (SD = 0.33), with 87.6% of participants demonstrating poor balance. For the single-leg stance test with eyes open, the average time was 48.98 seconds (SD = 8.13), and for the eyes-closed condition, the average time was 8.23 seconds (SD = 5.37). Performance in the Y Balance Test showed an average absolute reach distance of 96.56 cm (SD = 19.56). In the Time Up and Go (TUG) test, participants took an average of 7.10 seconds (SD = 1.35) to complete the task.

Table 2: Single Leg Stance Test Results Eye Open by BMI

BMI category * single leg stance eye opened (sec) Cross tabulation							
Single leg stance eye opened (sec)							
BMI Category	0-10 sec	11-20 sec	21-30 sec	31-40 sec	41-50 sec	51-60 sec	Total Count
Underweight (≤18.5)	1	5	13	19	12	15	65
Normal (≤24.9)	13	43	80	73	36	10	255
Overweight (≤29.5)	3	15	24	18	4	2	66
Obese (≤34.9)	0	1	2	2	1	1	7
Extremely Obese (≥35)	0	0	1	0	0	0	1

When examining performance based on BMI, individuals in the normal BMI category performed better across most balance assessments. Those underweight generally managed between 10 and 50 seconds on the single-leg stance test with eyes open, while those in the normal BMI category showed a broader range of 0–60 seconds. Overweight participants typically performed up to 30 seconds, with decreased performance as BMI increased, particularly among obese and extremely obese categories, which displayed limited balance stability.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Table 3: Y Balance Test Results by BMI

BMI category * y balance (absolute reach distance) (cm) Cross tabulation						
Reach Distance (cm)	Underweight (<=18.5)	Normal (<=24.9)	Overweight (<=29.5)	Obese (<=34.9)	Extremely Obese (>=35)	Total
48-57	1	1	1	0	0	3
58-67	3	7	3	0	0	13
68-77	9	22	4	1	0	36
78-87	9	22	6	1	0	38
88-97	7	33	7	1	0	48
98-107	7	21	7	1	0	36
108-117	6	20	6	0	0	32
118-127	4	5	3	0	0	12
128-137	2	5	1	0	0	8
138-149	1	3	1	0	0	5
150-159	0	0	0	0	1	1

Data from the Y Balance Test indicated that underweight and normal-weight participants reached greater distances compared to their overweight and obese counterparts, with the latter showing reduced reach, reflecting the impact of increased BMI on balance and mobility. The TUG test results further supported these findings, where participants with normal BMI typically completed the task in 6–7 seconds, with slower completion times seen in higher BMI categories. Gender comparisons indicated that while males generally performed better in the single-leg stance with eyes open, females demonstrated slightly poorer performance in the stork test. Activity level analysis revealed that 38.1% of males were highly active compared to 18.8% of females, while inactivity was higher among females (62.4%) than males (45.7%).

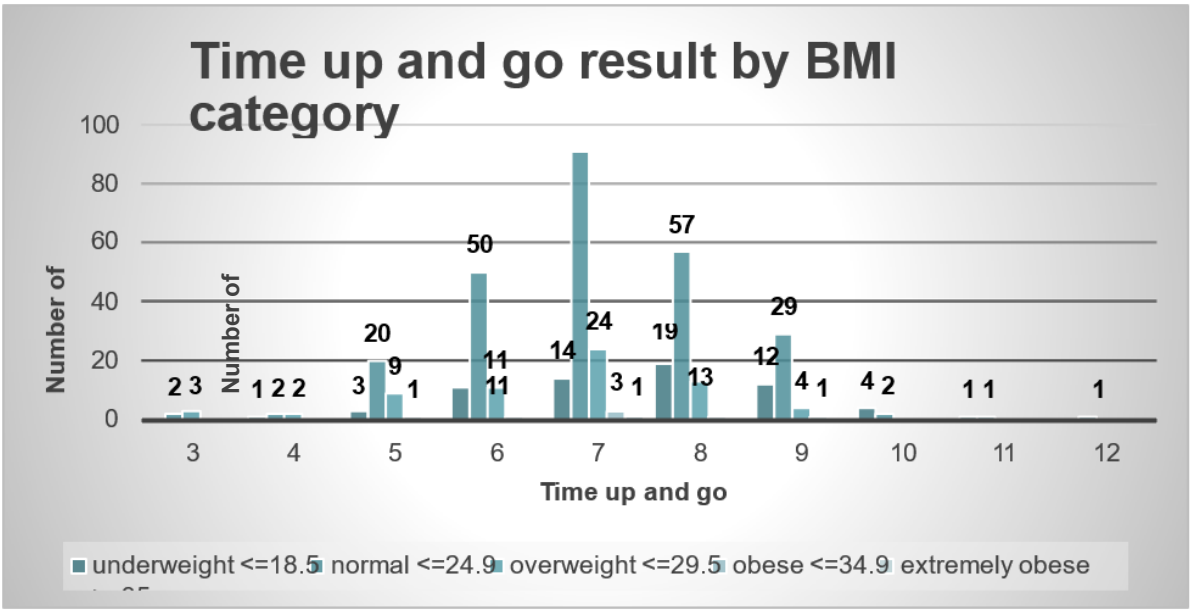


Figure 3: Time Up & Go Test Result by BMI Category

Further analysis revealed that lifestyle factors, such as daily physical activity and environmental conditions, play a significant role in balance outcomes among university students. Students with higher physical activity levels demonstrated better performance across balance assessments, supporting the notion that active lifestyles contribute positively to stability and coordination. Conversely, sedentary behavior, more common among females in this sample, correlated with poorer balance test results, suggesting a possible association between reduced physical activity and balance disturbances. Environmental factors, including prolonged hours spent in academic settings with limited physical movement, may further exacerbate balance instability, highlighting the need for targeted interventions that promote regular physical activity and ergonomic adjustments in academic environments.

DISCUSSION

This study investigated the prevalence of static and dynamic balance disturbances among university students, examining influential factors such as gender and BMI. Utilizing a sample of 394 students equally divided between genders, this research employed the Stork Test, Single Leg Stance (eyes open and closed) for static balance, and the Y Balance Test alongside the Timed Up and Go (TUG) test for dynamic balance assessments. The findings revealed significant balance disturbances, with notable variations between static and dynamic balance performances among participants(14). Gender differences emerged as a meaningful factor, with males showing better static balance stability in the Stork Test compared to females, who generally exhibited lower scores. This aligns with previous research by Mocanu et al., which attributes improved balance in males to muscle mass distribution differences (7-9, 12). Male participants averaged 4.79 seconds in the Stork Test, while females averaged 4.96 seconds, confirming minor but consistent gender-based disparities in balance performance. Additionally, males generally outperformed females in the Y Balance Test with a mean reach distance of 107.07 cm compared to 86.05 cm, suggesting that gender-specific physiological and anatomical factors might impact dynamic stability(16, 17).

BMI also emerged as a significant determinant in balance performance. Participants categorized as underweight demonstrated stable performance across both static and dynamic tests, possibly due to a lower fat percentage and relatively higher muscle mass. In contrast, those in overweight and obese categories exhibited decreased balance stability, consistent with findings from Barira et al., who reported shorter reach distances among overweight and obese individuals. This study's results further support the inverse relationship between BMI and balance performance, where increasing BMI correlated with lower reach distances in the Y Balance Test and prolonged times in the TUG test, reflecting compromised dynamic balance and mobility(18, 19). Comparisons with other studies underscore the reliability and potential limitations of the current study's findings. For instance, a previous study conducted with 252 participants reported average ages around 19.8 years, slightly younger than this study's average of 21.39 years, which may contribute to observed variations in balance performance. Unlike previous study, which only used the Single Leg Stance Test (eyes closed) for static balance, this study included additional static tests, potentially providing a more comprehensive view of balance capabilities. While these methodological differences add depth, they may also limit direct comparability with studies using single methods or younger cohorts(15, 20).

The current study's strengths lie in its diverse balance assessment methods and equal gender representation, which enhances its relevance and depth. However, limitations include its reliance on a convenience sample, potentially limiting the generalizability of the results to other student populations. Further, environmental and lifestyle factors, such as daily physical activity levels, were not fully controlled or analyzed, which may influence balance outcomes in this demographic. Although previous studies suggest that factors like academic demands and physical inactivity play a role in balance stability, these aspects warrant more precise investigation in future studies. Moreover, while gender and BMI were identified as critical factors, the complexity of balance disturbances suggests that additional variables, including nutrition, sleep patterns, and mental health status, could provide further insight(21, 22). This study highlights the prevalence of balance disturbances among university students and underscores the role of BMI and gender in shaping balance stability. It suggests that targeted interventions addressing modifiable factors, such as physical activity and lifestyle changes, may help improve balance outcomes, particularly in populations with higher BMI. The findings contribute to a growing body of evidence on balance disturbances among young adults and underscore the need for multidimensional approaches in understanding and addressing balance issues in this demographic.

CONCLUSION

This study concluded that balance disturbances are notably prevalent among undergraduate university students, with static balance impairments occurring more frequently than dynamic ones. The findings underscore the influence of higher BMI and lower physical activity levels as primary risk factors affecting balance stability. These results highlight the importance of targeted interventions aimed at promoting regular physical activity and healthy weight management to enhance balance, ultimately reducing health risks and supporting better physical well-being in this population.

REFERENCES

1. Casale J, Browne T, Murray I, Gupta G. Physiology, vestibular system. 2018.

2. Koreili Z, Fatahi A, Azarbaijany MA, Sharifnezhad A. Comparison of Static Balance Performance and Plantar Selected Parameters of Dominant and Non-dominant Leg in Active Adolescent's Female With Ankle Pronation. The Scientific Journal of Rehabilitation Medicine. 2023;12(2):306-19.

3. Ghorbani M, Yaali R, Sadeghi H, Luczak T. The effect of foot posture on static balance, ankle and knee proprioception in 18-to-25-year-old female student: a cross-sectional study. BMC musculoskeletal disorders. 2023;24(1):547.

4. Hayward V. A brief overview of the human somatosensory system. Musical haptics. 2018:29-48.

5. Ahmad T, Nawaz A, Ejaz U, Shah IA. Evaluation of Static and Dynamic Balance among Undergraduate Students of Allied Health Sciences in Sarhad University of Science and Information Technology, Peshawar. Journal of Rehabilitation and Clinical Research (JRCR). 2023;1(2):49-54.

6. Wah SW, Chatchawan U, Chatprem T, Puntumetakul R. Prevalence of static balance impairment and associated factors of university student smartphone users with subclinical neck pain: cross-sectional study. International journal of environmental research and public health. 2022;19(17):10723.

7. Mocanu GD, Murariu G, Potop V. Optimization of body balance indices according to Body Mass Index categories during physical education lessons for university students. Pedagogy of Physical Culture and Sports. 2022;26(4):233-43.

8. Mocanu GD, Murariu G, Onu I, Badicu G. The influence of gender and the specificity of sports activities on the performance of body balance for students of the faculty of physical education and sports. International Journal of Environmental Research and Public Health. 2022;19(13):7672.

9. Mocanu GD, Murariu G, Onu I. The Influence of BMI Levels on the Values of Static and Dynamic Balance for Students (Men) of the Faculty of Physical Education and Sports. Men's Health. 2022;18(156):10.31083.

10. Alqaraan AA, Alsharksi RM, Taha NSQ, al-Awamleh A. BMI and static, dynamic balance abilities among undergraduate sports students. American International Journal of Contemporary Research. 2018;8(3).

11. Eliks M, Ostiak-Tomaszewska W, Lisiński P, Koczewski P. Does structural leg-length discrepancy affect postural control? Preliminary study. BMC Musculoskeletal Disorders. 2017;18:1-7.

12. Mocanu GD, Murariu G. The association of gender and body mass index on the values of static and dynamic balance of university students (a cross-sectional design study). Applied Sciences. 2022;12(8):3770.

13. Do Nascimento J, Silva C, Dos Santos H, de Almeida Ferreira J, De Andrade P. A preliminary study of static and dynamic balance in sedentary obese young adults: the relationship between BMI, posture and postural balance. Clinical obesity. 2017;7(6):377-83.

14. Gonçalves C, Bezerra P, Clemente F, Vila-Chã C, Leão C, Brandão A, et al. The relationship between static and dynamic balance in active young adults. Human Movement. 2022;23(2):65-75.

15. Emara A, Mahmoud S, Emira M. Effect of body weight on static and dynamic posturography. The Egyptian Journal of Otolaryngology. 2020;36:1-8.

16. Choi KY, Wong HY, Cheung HN, Tseng JK, Chen CC, Wu CL, et al. Impact of visual impairment on balance and visual processing functions in students with special educational needs. Plos one. 2022;17(4):e0249052.

17. Alice A, Yadav M, Verma R, Kumari M, Arora S. Effect of obesity on balance: A literature review. International Journal of Health Sciences. 2022;6(S4):3261-79.

18. Christopher A, Kraft E, Olenick H, Kiesling R, Doty A. The reliability and validity of the Timed Up and Go as a clinical tool in individuals with and without disabilities across a lifespan: A systematic review: Psychometric properties of the Timed Up and Go. Disability and rehabilitation. 2021;43(13):1799-813.

19. Cao C, Cade WT, Li S, McMillan J, Friedenreich C, Yang L. Association of balance function with all-cause and cause-specific mortality among US adults. JAMA Otolaryngology–Head & Neck Surgery. 2021;147(5):460-8.

20. Alshehre Y, Alkhathami K, Brizzolara K, Weber M, Wang-Price S. Reliability and validity of the Y-balance test in young adults with chronic low back pain. International Journal of Sports Physical Therapy. 2021;16(3):628.

21. Inness EL, Sweeny M, Perez OH, Danells C, Chandra T, Foster E, et al. Self-reported balance disturbance and performance-based balance impairment after concussion in the general population. The Journal of head trauma rehabilitation. 2019;34(3):E37-E46.

22. Carral JMC, Ayán C, Sturzinger L, Gonzalez G. Relationships between body mass index and static and dynamic balance in active and inactive older adults. Journal of geriatric physical therapy. 2019;42(4):E85-E90.