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Research Article

INVESTIGATION OF THE RELATIONSHIP BETWEEN POSTURAL SWAY AND PHYSICAL ACTIVITY IN ADULTS

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ABSTRACT

Objective: The body exhibits postural sway during quiet standing The aim of this study is to examine the relationship between the level of physical activity and postural sway in adults.

Materials and Method: A total of 67 adults were included in this study. Physical activity were determined using the International Physical Activity Questionnaire–Short Form. Postural sway was evaluated using a swaymeter. Measurements were obtained under four standing conditions. For each condition, a 30-second recording period was used to quantify the sway.

Results: In the firm–eyes open condition, anteroposterior displacement was obtained as 1.8 cm and mediolateral displacement as 1.7 cm. These values increased to 2.3 cm and 1.9 cm when the eyes were closed. On the foampad, anteroposterior and mediolateral displacements were 2.6 cm and 2.3 cm with eyes open, reaching their highest levels under the eyes-closed condition at 3.9 cm and 3.1 cm. When examining the association between sway area across the four conditions and physical activity level, significant correlations were identified under the firm surface with eyes closed, as well as the eyes-open and eyes-closed conditions on the foam pad (rs = -0,373, rs = –0.451; rs = –0.421) in minimally active group.

Conclusion: This study found no strong association between physical activity level and postural sway, which may relate to the static nature of the sway assessment and the limited timeframe of the self-report activity measure. In addition, the sway values obtained provide useful normative data that may support future clinical and research applications of the swaymeter.

Keywords: Exercise, Postural Balance, Posture, Standing Position, Body Mass Index

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INTRODUCTION

Posture is defined as an individual's ability to maintain their body position against the force of gravity while standing, sitting, or lying down (1). During upright stance, the head, neck, trunk, and lower extremities form a vertical column in which each segment supports the one above it (1,2). It is not possible for these segments to remain entirely static. To maintain or restore balance, the human body must keep its center of mass (COM) within the limits of its base of support. Therefore, the body exhibits postural sway. These oscillations occur even during the seemingly stationary state of quiet standing (2). The methods used to assess the postural control system and to assess standing balance have changed in time. The most frequently employed methods in clinical practice are static and dynamic force platforms. In addition to these, Multisensory Insoles, Three-Dimensional Video Analysis, and Accelerometers are also utilized (3). However, such equipment is costly for many clinics and research centers. Therefore, there has been a need for a simple device that is easy to use, low-cost, and capable of providing reliable and valid measurements (4,5). Dr. Lord and his team developed the Swaymeter for use in both research and clinical domains. This instrument is employed to quantitatively measure postural balance during standing (6). Considering the current literature, a study providing normative data for the Swaymeter across a broad age range and a large sample size has not been identified.

Physical activity (PA) is defined as any bodily movement produced by muscles that results in energy expenditure. Individuals engage in PA to sustain daily life functions. The period and intensity of PA vary according to personal preferences and may differ both between individuals and within the same individual over time (7) . According to the World Health Organization (WHO), adults should undertake at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic PA, or an equivalent combination of both, per week. It has been reported that this duration can be increased for extra health benefits (8). In the literature, several studies have investigate on the relationship between balance and PA or exercise. These studies, mostly conducted among older adults, have shown that regular PA and exercise programs improve both muscle strength and postural balance (9,10). The purpose of this study is to examine the relationship between the level of PA and postural sway. In addition, it aims to demonstrate that the swaymeter method can serve as a valid and practical measurement tool for the quantitative assessment of postural stability in clinical settings.

MATERIALS AND METHODS

This study was performed in line with the principles of the Declaration of Helsinki and approved by the Ankara Yıldırım Beyazıt University Ethics Committee (approval number: 07/877). All participants were informed about the study procedures, and written consent was obtained from each participant.

Participants

A power analysis was conducted to determine the required sample size, resulting in the inclusion of 67 healthy adult individuals in the study ($1-\beta = 0.80$; alfa value=0.05, effect size= 0.3). An effect size of 0.3 was obtained from the pilot study, in which 25 participants were evaluated. The demographic characteristics of the participants are presented in Table 1. All participants were healthy, independent, and community-dwelling individuals.Inclusion criteria included being between 18 and 55 years of age, having no vestibular, neurological, or musculoskeletal disorders or impairments that could affect balance, and providing voluntary consent to participate in the study.

Table 1. Demographic Characteristics of Participants

	Mean ± SD	Min-Max
Age (year)	30 ± 9,8	18-55
Genders (%)		
Female	38 (%56,7)	
Male	29 (%43,3)	
Total	**67 (%100)**	
Weight (kg)	68 ± 13,4	49-105
Height (cm)	168 ± 9	149-195
Body Mass Index (kg/m²)	24.11 ± 3.9	18,4-37,7

Methods

Participants were assessed using the International Physical Activity Questionnaire (IPAQ) and the swaymeter.

International Physical Activity Questionnaire – Short Form (IPAQ-SF): The IPAQ-SF is a scale developed to assess PA levels. It includes both long and short forms, with the short form based on activity over the last 7 days. The questionnaire evaluates various domains of PA, including occupational, transportation, housework, and leisure-time activities, as well as inactivity (sitting). These activities are categorized into three intensity levels (vigorous physical activities-VPA, moderate physical activities-MPA, and walking-W) and participants report the number of days they performed these activities as well as the duration (in minutes) on those days.

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PA level was determined using the Metabolic Equivalent of Task (MET) method. At rest, each individual consumes 3.5 ml of oxygen per kilogram of body weight per minute; therefore, 1 MET is equivalent to 3.5 ml/kg/min. The total MET value for each participant was calculated based on the number of days per week and the duration (in minutes) spent performing VPA, MPA, and walking. PA level was then classified into three categories (11).

Category I – Inactive: < 600 MET·min/week
Category II – Minimally active: 600–3000 MET·min/week
Category III – Very active: > 3000 MET·min/week

Swaymeter: The swaymeter is a device designed to measure postural sway by tracking the body's involuntary movements during upright stance. It consists of a 40-cm rigid rod attached to a belt secured around the participant's waist, with a pen mounted at the end of the rod. A sheet of millimeter graph paper is placed on a height-adjustable table behind the participant. The pen records the body's movements in both the anteroposterior (AP) and mediolateral (ML) directions for 30 seconds. The resulting sway area serves as an indicator of postural stability—smaller sway areas reflect better postural control. Previous studies have shown that the swaymeter is a reliable tool for assessing postural sway (4,5,12).

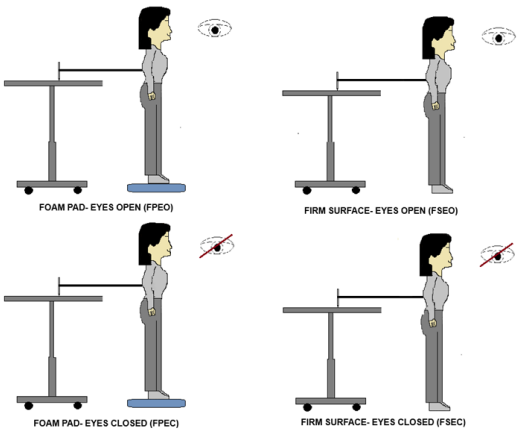


Figure 1. Illustration of the four conditions measured using the swaymeter.

In this study, sway measurements were conducted under quiet standing conditions: (1) firm surface – eyes open, (2) firm surface – eyes closed, (3) foam pad – eyes open, and (4) foam pad – eyes closed (Figure 1).

A standard foam pad was used to provide the compliant surface condition. The millimeter graph paper was fixed on an adjustable-height table to prevent slipping. For each of the four conditions, three 30-second trials were performed. The sway measurements were thus completed across a total of 12 trials. Participants were instructed to stand quietly with their arms by their sides, feet shoulder-width apart, and eyes focused on a point on the wall in front of them. They were asked to remain still and refrain from speaking during the trials. Before each trial, the procedure was explained to the participants. Rest periods were provided between trials, during which participants sat for at least one minute. The Intraclass Correlation Coefficient (ICC) values and 95% confidence intervals were calculated for the measurements.–

Statistical analysis

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) software (IBM Corp. Released 2012. Armonk, NY: IBM Corp.). Descriptive variables were expressed as mean ± SD and minimum–maximum values. The relationship between study variables was examined using Spearman's rank correlation test. The Kruskal–Wallis test was employed to determine differences in quantitative variables between groups. To assess the reliability of swaymeter measurements, average measurement reliability The ICC (3,3) values were calculated for each condition. Statistical significance was determined as $p < 0.05$.

RESULTS

To evaluate the reliability of repeated tests performed with the swaymeter, the ICC and 95% confidence intervals were evaluated for each condition. Accordingly, ICC(3,3) values ranged from 0.588 to 0.802, indicating moderate to good reliability overall (Table 2).

Table 2. Intraclass Correlation Coefficient (ICC) and 95% Confidence Intervals for Sway Measurements Across Four Conditions Assessed with the Swaymeter

	Firm Surface		Foam Pad	
	Eyes Open	**Eyes Closed**	**Eyes Open**	**Eyes Closed**
AP (cm)	0,767 (534-894)	0,640 (280-836)	0,630 (260-831)	0,738 (475-880)
ML (cm)	0,638 (275-835)	0,588 (177-812)	0,672 (344-850)	0,641 (282-836)
Sway Area (cm²)	0,690 (380-859)	0,712(424-869)	0,645 (290-838)	0,802 (604-910)

AP: anteroposterior ML: mediolateral

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Table 3. Relationship Between Physical Activity Levels (IPAQ Categories) and Postural Sway Measured by the Swaymeter

	FSEO		FSEC		FPEO		FPEC	
	r_s	*p*	r_s	*p*	r_s	*p*	r_s	*p*
Inactive (n=12)	-0,053	0,871	-0,049	0,88	-0,144	0,656	-0,070	0,829
Minimally Active (n=25)	-0,061	0,771	**-0,373**	**0,066**	**-0,451***	**0,024**	**-0,421***	**0,036**
Very Active (n=30)	-0,083	0,661	-0,134	0,487	0,233	0,215	0,207	0,273
Total (n=67)	-0,038	0,76	0,002	0,985	-0,048	-,702	0,046	0,714

*p< 0.05 n: number of participants, FSEO: Firm Surface Eyes Open; FSEC: Firm Surface Eyes Closed; FPEO: Foampad Eyes Open; FPEC: Foampad Eyes Closed

The relationship between PA level and postural sway measures was examined. In the minimally active group, postural sway values showed a significant negative correlation under the conditions of firm surface with eyes closed (r_s = –0.373, p < 0.066), foam pad with eyes open (r_s = –0.451, p < 0.05), and foam pad with eyes closed (r_s = –0.421, p < 0.05). Under the firm surface with eyes open condition, the correlation was negative but not significant. Among participants in the inactive and very active groups, no significant relationship was found between PA level and postural sway in any of the balance conditions (FSEO, FSEC, FPEO, FPEC). When all participants were analyzed collectively, regardless of category, no significant correlations were observed between PA level and sway area across balance conditions (p > 0.05) (Table 3).

The analysis of differences in sway area among inactive, minimally active, and very active individuals revealed no significant differences in sway area between PA level categories under any balance condition: firm surface–eyes open (χ^2 = 0.014, p = 0.993), firm surface–eyes closed (χ^2 = 0.128, p = 0.938), foam surface–eyes open (χ^2 = 0.530, p = 0.767), and foam surface–eyes closed (χ^2 = 0.392, p = 0.822) (Figure 2).

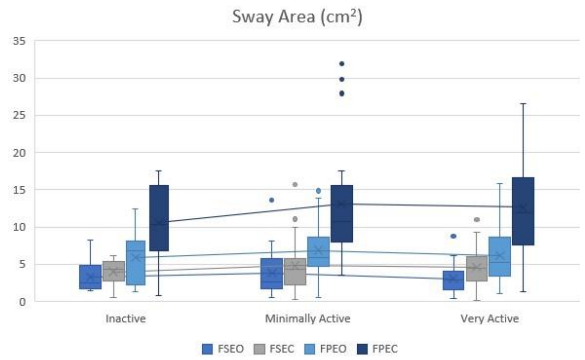


Figure 2. Comparison of Sway Areas Across IPAQ Physical Activity Categories

Postural sway values differed between firm and foam surface conditions depending on whether the eyes were open or closed (Table 4). On a firm surface with eyes open, the mean anteroposterior (AP) displacement was 1.8 ± 0.6 cm, mediolateral (ML) displacement was 1.7 ± 0.8 cm, and the sway area was 3.3 ± 2.3 cm². With eyes closed on the same surface, these values increased to 2.3 ± 0.8 cm, 1.9 ± 0.8 cm, and 4.5 ± 2.8 cm², respectively. On a foam pad ieyes open, the AP displacement was 2.6 ± 0.7 cm, ML displacement was 2.3 ± 1.2 cm, and sway area was 6.3 ± 3.5 cm². Under the foam pad–eyes closed condition, the AP displacement increased to 3.9 ± 1.0 cm, ML displacement to 3.1 ± 2.2 cm, and sway area to 12.6 ± 7.6 cm².

Table 4. Mean and Standard Deviation Values of Postural Sway Parameters Under Different Conditions

	Firm Surface		Foam Pad	
	Eyes Open	**Eyes Closed**	**Eyes Open**	**Eyes Closed**
AP (cm)	1,8 ± 0,6	2,3 ± 0,8	2,6 ± 0,7	3,9 ± 1
ML (cm)	1,7 ± 0,8	1,9 ± 0,8	2,3 ± 1,2	3,1 ± 2,2
Sway Area (cm²)	3,3 ± 2,3	4,5 ± 2,8	6,3 ± 3,5	12,6 ± 7,6

AP: anteroposterior ML: mediolateral

DISCUSSION

This study investigated the relationship between PA level and postural sway. When participants were categorized into three groups based on PA level, no significant relationships were observed between PA and postural sway in the inactive and very active groups. However, in the minimally active group, weak but significant correlations were identified. Moreover, no differences were found in sway area among individuals with different PA levels.

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In this study, postural sway was assessed using a static evaluation method. It is generally recognized that dynamic balance assessments are more challenging than static ones and engage a greater number of components within the postural control system. Previous research has also reported that different movement conditions and interventions can influence dynamic balance but may not exert the same level of effect on static balance (13). Therefore, static assessment methods are considered to have lower sensitivity in detecting balance differences compared to dynamic methods (14,15). The use of a static measurement approach in this study may have limited the ability to detect potential balance differences related to PA level.Similarly, in a study conducted by Çetin et al., no significant differences were observed in static balance tests among individuals with varying levels of PA. However, during more demanding tasks, very active individuals demonstrated better balance performance. It has also been suggested that simple static tests may lead to a ceiling effect and that postural control could be independent of PA level (16).

The IPAQ, used to assess PA level in this study. Because it reflects only the past week, it may not accurately represent participants' habitual PA patterns. This limitation may have contributed to the lack of significant associations, particularly among inactive individuals, who might have engaged in regular PA shortly before assessment. Consequently, balance performance or postural control ability may have been influenced by prior activity rather than typical behavior. Previous studies have indicated that the IPAQ tends to overestimate PA levels compared to objective measures (17-19). Although the IPAQ-SF is useful for classifying individuals into general activity categories, it may lack sufficient sensitivity in identifying inactive participants (19). A systematic review further reported that while the IPAQ-SF is not adequate for precisely quantifying PA, it can serve as a reliable tool when used cautiously for repeated measurements (20).
It is well established that regular exercise or physical activity improves postural balance in both younger and older adults. In addition, participation in any sport has been shown to enhance postural stability during upright standing (21–23) . Nevertheless, postural balance is influenced by the type, intensity, and duration of the activity performed, as well as the level of proprioceptive stimulation involved. The pattern of muscle contraction and muscle fiber recruitment during exercise may also affect post-exercise postural sway. In general, impairments in balance have been observed following both short- and long-duration exercise. These changes have been attributed to physiological mechanisms such as fatigue, hyperventilation, alterations in the vestibular system and visual cues, muscle damage, and dehydration (24–27) . In this study, sway area was not significantly associated with physical activity level in very active individuals. In contrast, a weak yet statistically significant association between physical activity level and postural sway was observed only in minimally active individuals, indicating that higher levels of physical activity were associated with reduced postural sway in this group. Physical activity level was assessed only with a physical activity questionnaire. This questionnaire evaluates activity based on how long the activity lasts and how intense it is. However, it does not ask about the type of activity performed. The activities reported by individuals in the minimally active group may have included activities that also improve balance. Similarly, the activities reported by individuals in the very active group may have included activities that do not directly affect balance. Another possible reason why no significant association was found between postural sway and physical activity level in the very active group is that the questionnaire assesses activities performed only during the last 7 days. Individuals in the very active group may have reported recent activities that caused high energy expenditure but were not part of a regular exercise routine. This may have affected the group classification and may have prevented a significant association between sway area and physical activity level from being observed in very active individuals. Future studies should examine not only the level of physical activity but also the type of activity performed, and should evaluate physical activity over a longer period, such as the previous six months, to better determine the relationship between physical activity and postural sway. The present study highlights the need for further research on the relationship between physical activity and static balance by considering both the type and continuity of physical activity. In this respect, it provides a basis for future studies with larger sample sizes and more comprehensive designs.

The swaymeter has been established as a reliable tool for static balance assessment in various populations, including children with cerebral palsy, individuals with neurological disorders, and patients with diabetes mellitus (28-31). To the best of our knowledge, the present study is the first to investigate the relationship between PA level and postural sway using this measurement method. Moreover, unlike previous research, this study included both a broader age range and a larger sample size.In the existing literature, only one study has aimed to establish normative data for the swaymeter. That study, conducted among individuals aged 20–25 years, recorded postural

sway in the anteroposterior (AP) and mediolateral (ML) planes under eyes-open and eyes-closed conditions (32). The AP and ML sway values obtained in the present study are generally consistent with those findings. However, the inclusion of a foam-surface condition and the evaluation of sway area in our study expand the normative reference range for swaymeter-based measurements.

CONCLUSION

In this study, no strong relationships were found between PA level and postural sway. This outcome may be attributed to the use of a static assessment method for sway measurement and the reliance on a self-report questionnaire that captures PA within a limited time frame. This study provides reference values for the swaymeter based on data obtained from a wide age range, thereby offering a methodological contribution to the literature. Expanding the number of studies utilizing the swaymeter could help standardize measurement protocols, promoting its use as a low-cost, practical, and valid tool for static balance assessment.

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None

Authorship contributions
All authors have made substantial, direct, and intellectual contributions to the work and approved it forpublication.

Data availability statement
All data generated or analyzed during this study are included in this article. Further inquiries can be directed to thecorresponding author.

Declaration of competing interest
The authors declare no competing interests.

Ethics
This study was approved by the Ankara Yıldırım Beyazıt University Ethics Committee (approval number: 07/877)

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REFERENCES

1. Newton' RU, Neal RJ. Three-dimensional quantification of human standing posture. Gait Posture. 1994;2:205–12 DOI: 10.1016/0966-6362(94)90105-8
2. Şimşek TT, Şimşek İE. Balance and postural control. In: Comparative Kinesiology of the Human Body. Elsevier; 2020. p. 467–75. DOI: 10.1016/B978-0-12-812162-7.00026-6
3. Browne JE, O'Hare NJ. Review of the different methods for assessing standing balance. Physiotherapy. 2001;87(9):489–95.
4. Parameyong A, Boripuntakul S, Kamnardsiri T, et al. Validity and reliability of the Swaymeter for postural sway measurement in typically developing children aged 7–12 years. Gait Posture. 2018;66:273–7. DOI: 10.1016/j.gaitpost.2018.09.004
5. Sturnieks DL, Arnold R, Lord SR. Validity and reliability of the Swaymeter device for measuring postural sway. BMC Geriatr. 2011;11:63. DOI: 10.1186/1471-2318-11-63
6. Lord SR, Menz HB, Tiedemann A. A physiological profile approach to falls risk assessment and prevention. Phys Ther. 2003;83:237–52. DOI:10.1093/ptj/83.3.237
7. Caspersen CJ, Powell KE, Christenson GM. Physical Activity, Exercise, and Physical Fitness: Definitions and Distinctions for Health-Related Research. 1985;(126–131).
8. World Health Organization. Global recommendations on physical activity for health. Geneva, Switzerland: World Health Organization; 2010. 1 p.
9. Thomas E, Battaglia G, Patti A, et al. Physical activity programs for balance and fall prevention in elderly: A systematic review. Medicine (Baltimore). 2019;98(27):e16218. DOI: 10.1097/MD.0000000000016218
10. Adams M, Gordt-Oesterwind K, Bongartz M, et al. Effects of physical activity interventions on strength, balance and falls in middle-aged adults: A systematic review and meta-analysis. Sports Med Open. 2023;9(1):61. DOI: 10.1186/s40798-023-00606-3
11. Elbasan B, Düzgün İ. Fiziksel aktivite skalaları – Kanıta dayalı fiziksel aktivite. Turkiye Klinikleri J Physiother Rehabil-Special Topics. 2016;2(1):36–9.
12. Tharani, G., Vedha Varshini, M. G., Senthil Nathan, C. V., Mohan Kumar, G., & Kamatchi, K. (2019). Correlation between body weight and postural control in healthy individuals using sway meter. Obesity and Metabolism, 16(2), 36–41. DOI:10.14341/omet10110
13. Karimi MT, Solomonidis S. The relationship between parameters of static and dynamic stability tests. J Phys Ther. 2010;16(4):530–5.
14. Ross SE, Guskiewicz KM. Examination of static and dynamic postural stability in individuals with functionally stable and unstable ankles. Clin J Sport Med. 2004;14(6):332–8. DOI: 10.1097/00042752-200411000-00002
15. Sarto F, Pizzichemi M, Chiossi F, et al. Physically active lifestyle promotes static and dynamic balance performance in young and older adults. Front Physiol. 2022;13:986881. DOI:10.3389/fphys.2022.986881
16. Cetin H, Ozcelik BA, Yucedag D. Postural stability in individuals with different levels of physical activity: A preliminary study. J Hacettepe Univ Phys Ther Rehabil. 2025;3(2):77–84.

17. Ryan DJ, Wullems JA, Stebbings GK, et al. Reliability and validity of the International Physical Activity Questionnaire compared to calibrated accelerometer cut-off points in older adults. PLoS One. 2018;13(4):e0195712. DOI: 10.1371/journal.pone.0195712
18. Johnson-Kozlow M, Sallis JF, Gilpin EA, et al. Comparative validation of the IPAQ and the 7-Day PAR among women with breast cancer. Int J Behav Nutr Phys Act. 2006;3:7. DOI: 10.1186/1479-5868-3-7
19. Ekelund U, Sepp H, Brage S, et al. Criterion-related validity of the short-form International Physical Activity Questionnaire in Swedish adults. Public Health Nutr. 2006;9(2):258–65. DOI: 10.1079/phn2005840
20. Lee PH, Macfarlane DJ, Lam T, et al. Validity of the International Physical Activity Questionnaire Short Form (IPAQ-SF): A systematic review. Int J Behav Nutr Phys Act. 2011;8:115. DOI: 10.1186/1479-5868-8-115
21. Paillard T. The optimal method for improving postural balance in healthy young and older people: specific training for postural tasks encountered in personal physical practice. Front Physiol. 2023 Jun 28;14:1188496. DOI: 10.3389/fphys.2023.1188496
22. Zemková E. Physiological Mechanisms of Exercise and Its Effects on Postural Sway: Does Sport Make a Difference? Front Physiol. 2022 Feb 14;13:792875. DOI:10.3389/fphys.2022.792875
23. Andreeva A, Melnikov A, Skvortsov D, Akhmerova K, Vavaev A, Golov A, et al. Postural stability in athletes: The role of sport direction. Gait & Posture. 2021 Sep;89:120–5. DOI:10.1016/j.gaitpost.2021.07.005
24. Barbieri FA, Rodrigues ST, Polastri PF, Barbieri RA, De Paula PHA, Milioni F, et al. High intensity repeated sprints impair postural control, but with no effects on free throwing accuracy, in under-19 basketball players. Human Movement Science. 2017 Aug;54:191–6. DOI:10.1016/j.humov.2017.04.010
25. Bouchnak MM, Ostolin TLVDP, Sperandio EF, Vieira WDO, Dourado VZ. Association between electromyographic localized muscle fatigue of the rectus femoris and static postural balance in physically active adult men. Rev bras cineantropom desempenho hum. 2020;22:e66062. DOI:10.1590/1980-0037.2020v22e66062
26. Lion A, Bosser G, Gauchard GC, Djaballah K, Mallié JP, Perrin PP. Exercise and dehydration: A possible role of inner ear in balance control disorder. Journal of Electromyography and Kinesiology. 2010 Dec;20(6):1196–202. DOI:10.1016/j.jelekin.2010.07.016
27. Zemková E, Hamar D. Physiological Mechanisms of Post-Exercise Balance Impairment. Sports Med. 2014 Apr;44(4):437–48. DOI:10.1007/s40279-013-0129-7
28. Chaudhary V, Gupta N. Postural sway in diabetic neuropathy patients using Swaymeter. Bull Environ Pharmacol Life Sci. 2022;Spl Issue(4):414–8
29. Parameyong A, Boripuntakul S, Thawinchai N, et al. Reliability and validity of the Swaymeter for measuring trunk control in children with spastic cerebral palsy. Dev Neurorehabil. 2022;25(7):462–8. DOI: 10.1080/17518423.2022.2055189
30. Priyadarshini S, Gopalswami A. Efficacy of core musculature strengthening on postural sway. J Clin Diagn Res. 2019;13(7):YC07
31. James TT, Oza A, Parveen A, et al. Validity and reliability of Swaymeter in assessing postural sway among neurologic patient populations: A preliminary study. Int J Curr Res. 2019;11:5994–8. DOI: 10.24941/ijcr.36412.08.2019
32. Ramachandran S, Yegnaswamy R. Measurement of postural sway with a sway meter: An analysis. J Phys Ther. 2011;2:46–53.