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Relationship between physical activity level and plantar sensitivity, balance in postmenopausal women

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ABSTRACT

This research was planned to investigate the relationship between physical activity level and plantar sensitivity, static and dynamic balance in postmenopausal women. Forty women between the ages of 50 and 65, who had not had a menstrual period for at least 12 months, and who had undergone menopause due to hormonal, surgical or natural means were involved in the research. International Physical Activity Questionnaires Short Form (IPAQ-SF) was used to assess the level of physical activity. Light touch pressure threshold on soles of the individuals and two-point discrimination sense were evaluated bilaterally from 6 different regions of the sole of the foot. Single leg and tandem stance tests were used for static balance assessment. Dynamic balance was evaluated with Berg Balance Scale (BBS) and Timed Up and Go Test (TUG). As a result of the statistical analysis, a negative correlation was found between the total physical activity level of the participants and the light touch pressure of the right big toe. There was a significant negative correlation between total physical activity level and left big toe, and the 1st and 5th metatarsal heads of the left foot. A significant negative correlation between total physical activity level and TUG test was detected. However, no significant difference between total physical activity and BBS, static balance tests was found. As a result of this research, it was concluded that the level of physical activity affects the light touch sense of big toes of both feet, and the 1st and 5th metatarsal heads of left foot. During this study, it was seen that if total physical activity level decreases, then the score of TUG can increase. Physical activity level and related factors should be examined with a larger number of samples.

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KEYWORDS
Physical activity; plantar plate; postmenopause; postural balance; sensation

1. Introduction

In the postmenopausal period, women experience many important physiological changes such as decreased muscle strength, differences in body composition, and loss of skin receptor sensitivity and reaction time (Maltais et al., 2009; Tin Tin et al., 2020). These physiological changes cause sensorimotor disturbances of postural control and negatively affect parameters such as balance and walking (Beretta-Piccoli et al., 2021; Ünver & Akbaş, 2018; Xiao et al., 2020). Physical dysfunction that develops with balance disorder causes a decrease in physical performance. Continuous and intense afferent inputs from the plantar region in the foot, which is in constant contact with the environment in order to maintain balance, are of great importance to maintain postural control (Michalska et al., 2021; Zhang & Lu, 2020). In addition, the information of orientation and awareness of the body from the visual and vestibular systems can affect the reaction time and coordination in static and dynamic movements (De Maio et al., 2021; Michalska et al., 2021). Balance control in standing and dynamic movement positions depends on the density, sensitivity, and accuracy of the cutaneous afferents originating from the plantar region of the foot (Ueda & Carpes, 2013; Yümin et al., 2016). As a result of the study by Bretan et al. (2010) investigating balance and plantar sensation loss and its relationship in the elderly, loss of skin sensitivity was found in people with balance disorders.

One of the parameters that significantly affect physical performance is physical activity. It has been determined that the majority of women in the postmenopausal period switch to a sedentary lifestyle for various reasons (LaMonte et al., 2018; McNeil et al., 2018). Physical inactivity and physiological changes with age cause postural instability and an increased risk of falling. This is extremely important because it leads to dependency on daily living activities and a decrease in quality of life (Tuunainen et al., 2014). In

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the review (Caputo & Costa, 2014), it has been studied that the relationship between physical activity level and quality of life in postmenopausal women. Hence, it has been concluded that exercise is necessary and a very useful physical activity to improve quality of life and positively affects balance and muscle strength. Studies have also reported that regular physical activity modulates the functional state of the muscle and repetitive stimulation improves proprioception (Borba-Pinheiro et al., 2010; Decker et al., 2015; Marini et al., 2017). Therefore, questioning the physical activity level of women who applied to the hospital in the postmenopausal period and evaluating their balance and sensory parameters are of great importance in terms of reducing the negative consequences that may be experienced in older ages. However, to the best of knowledge, limited information can be found from the relevant literature about the relationship between physical activity and plantar sensitivity, balance. In the light of this information, the aim of this study is to examine the relationships between physical activity level and plantar sensitivity, static and dynamic balance in postmenopausal women, and to identify risks and the related factors affecting balance. Analysis of these parameters in postmenopausal women will be useful to decide the appropriate treatment strategies and to plan different exercise programs for motor and sensory components. Hence, according to the purpose of this study, the following hypotheses have been developed:

Hypothesis 0: In postmenopausal women, there is no significant relationship between the level of physical activity and the sense of the plantar surface of the feet, balance.

Hypothesis 1: In postmenopausal women, there is a significant relationship between the level of physical activity and the sense of plantar surface of the feet, balance.

The hypothesis is that while the level of physical activity is decreasing, the plantar sensitivity and balance deteriorate.

2. Materials and methods

During this study, the power analysis ofthe research was provided. However, because of the restrictions of COVID-19, the research was carried out on 40 volunteer patients aged between 50 and 65 who had not menstruated for at least 12 months and undergone hormonal, surgical or natural menopause. Persons with dermatological problems affecting the sole of the foot, a history of trauma or surgery in the lower extremity within the last 6 months, severe postural disorders and severe visual impairment were not included in the research. This research was carried out with the approval Non-Invasive Clinical Research Ethics Committee of Medipol University (Decision No: 75 Date: 11th January 2019). The participants included in the research were informed and all the procedures to be done were explained. The individuals were required to read the 'Informed Consent Form' and their signed consents were collected.

2.1. Evaluation

Socio-demographic information and fall history of the individuals were questioned and recorded. All evaluations were made by the physiotherapist.

2.1.1. Physical activity level

IPAQ-SF questions time spent sitting, walking, and moderately vigorous and vigorous activities. The elapsed time (minutes) and frequency (days) of these activities in the previous seven days are collected. Indeed, Craig et al. (2003) suggested that the last seven days version is enough for the IPAQ-SF related to physical activity research, partially because the burden on participants to report their activity is small. Sedentary behavior is calculated by sitting time. A point is obtained as 'MET- minutes/week' by multiplying the metabolic equivalent (MET) of the activity level, minutes and days. Classification is done by $<$600 MET- min/week (physically inactive), 600–3000 MET- min/week (low physical activity level), and $>$3000 MET- min/week (adequate physical activity level), respectively (Lee et al., 2011).

2.1.2. Light touch pressure sensation (Semmes–Weinstein monofilament test)

The evaluation of the light touch pressure threshold of the plantar surface of the feet of the individuals included in the study was made using a five-piece monofilament set of Chattanooga. The participants were placed in supine position with bare feet and the soles of the feet were evaluated bilaterally from 6 different regions (big toe, 1st metatarsal, 5th metatarsal, medial midfoot, lateral midfoot and heel) with eyes closed. The individuals were asked to answer 'yes' when they felt the filament touch. Starting from the lowest pressure filament in the tested areas, 3 applications were made vertically on the sole of the foot for 1 to 1.5 seconds until the monofilament bent. When an individual knew 2 of these 3 touches correctly, the relevant filament thickness was recorded as the light touch-pressure threshold value for that test point of the individual (see Figure 1) (Perry, 2006).

2.1.3. Two-point discrimination

The two-point discrimination sensitivity was evaluated bilaterally from 6 measurement points of the sole of the foot in the supine position using an aesthesiometer (Baseline 2-Point Discriminator). The sole of the foot was touched with an aesthesiometer without applying pressure, and the individuals were asked to say ‘double’ if they felt that two points were touched, and ‘single’ if they felt that only one point was touched. During the test, when an individual expressed the 2-point touch as ‘single’ three times, the distance read on the aesthesiometer was accepted as the two-point discrimination distance threshold (see Figure 1) (Nolan, 1983).

2.1.4. Static and dynamic balance tests

Special tests were used to measure the sustainability of postural balance in static and dynamic positions. Next, a static balance was evaluated with tandem stance and single leg stance (SLS) tests. Later, Timed Up and Go Test (TUG) and Berg Balance Scale (BBS) were used to evaluate dynamic balance.

2.1.4.1. Tandem stance test. The participants were asked to do the heel-to-toe stance with their hands tied in front of their chests. Three measurements were made with a stopwatch and the average time was recorded. The test was repeated in eyes open and closed positions (Black et al., 1982).

2.1.4.2. SLS test. Participants were said to stand on one leg for 30 seconds with one knee flexed to 90°. Three measurements were made with a stopwatch and the average time was recorded. The test was repeated for both sides in the eyes open and closed positions. For the single leg stance test, values below 30 seconds indicate impaired balance (Vellas et al., 1997).

2.1.4.3. TUG. In the TUG, a point was marked 3 meters from the chair, where the participants were sitting. The participants were asked to get up from the chair, walk 3 meters and return from the marked place at the end of 3 meters and sit back on the chair. The time to complete the test was measured. If an elderly person takes longer than 12 seconds to complete the test, he or she is classified as at high risk of falling (Podsiadlo & Richardson, 1991).

2.1.4.4. BBS. BBS measures the continuity of balance by reducing the support floor during activities. It assesses the individual’s independence and ability to change positions during standing up from sitting, standing with feet together, standing in tandem, and standing on one leg. As the score increases, the risk of falling decreases and the balance improves. A score of 0–21 indicates high risk, a score of 21–40 medium risk, and a score of 41–64 low risk (Berg et al., 1992; Lusardi et al., 2003).

Table 1. Socio-demographic characteristics of participants ($n = 40$).

	X ± SD	Min.	Med.	Max.
Age (years)	57.75 ± 4.69	50	58	65
Height (cm)	159.90 ± 5.55	150	160	175
Body weight (kg)	79.75 ± 12.88	60	80	112
Menopause age (years)	46.10 ± 6.09	36	47.5	55
Time spent in menopause (years)	11.75 ± 6.75	2	12	26
	***n* (%)**			
Educational status				
Literate without educational level	10 (%25)			
Primary school graduate	7 (%17.5)			
Middle school graduate	23 (%57.5)			
Profession				
Housewife	40 (%100)			
Smoking				
Yes	6 (%15)			
No	34 (%85)			

Min: Minimum; Med: Median; Max: Maximum.

Table 2. Analysis of physical activity, static and dynamic balance tests of participants ($n = 40$).

	X ± SD	Min.	Med.	Max.
Total physical activity (MET-min/week)	394.40 ± 231.47	99	396	990
RSLST (Eye open) (sec)	11.60 ± 8.86	2.2	9.3	35.7
RSLST (Eye closed) (sec)	2.63 ± 3.47	0	2.2	15.7
LSLST (Eye open) (sec)	12.64 ± 12.04	0	7.75	45.7
LSLST (Eye closed) (sec)	2.21 ± 2.56	0	1.05	7.7
TST (Eye open) (sec)	32.12 ± 21.33	10.3	25.6	73.4
TST (Eye closed) (sec)	10.37 ± 9.38	2.3	5.8	32.5
TUG (sec)	17.08 ± 2.98	12.6	16.62	22.2
BBS	48.25 ± 3.55	42	47.5	55

RSLST: Right Single Leg Stance Test; LSLST: Left Single Leg Stance Test; TST: Tandem Stance Test; TUG: Timed Up and Go Test; BBS: Berg Balance Scale; Min: Minimum; Med: Median; Max: Maximum.

2.2. Statistical analysis

Statistical analysis was performed with the Windows-based SPSS 20.0 (SPSS Inc, Chicago, IL, USA) package program. Continuous variables were given as mean ± standard deviation (X ± SD), categorical variables as numbers and percentages (%). Pearson correlation analysis was used for the correlation analysis between parameters. In the evaluations, $p < 0.05$ was accepted as the level of significance.

3. Results

3.1. Socio-demographic characteristics of participants

The mean age of 40 female individuals included in the investigation was calculated as 57.75 ± 4.69 years, and the mean time spent in menopause was calculated as 11.75 ± 6.75 years. As for the included participants, there was no history of falling in the last 1 year. Table 1 shows the socio-demographic information of the participants.

Table 3. Analysis of relationship between total physical activity level and plantar sensitivity of individuals ($n = 40$).

Light touch-pressure (grams)						
(RIGHT FOOT)	T1	T2	T3	T4	T5	T6
Total physical activity	**$p = 0.00$***	$p = 0.14$	$p = 0.15$	$p = 0.35$	$p = 0.32$	$p = 0.36$
	r = −0.44	r = −0.24	r = −0.23	r = −0.15	r = −0.16	r = −0.16
Age	**$p = 0.01$***	$p = 0.35$	$p = 0.14$	$p = 0.43$	$p = 0.42$	**$p = 0.01$***
	r = 0.37	r = 0.15	r = 0.24	r = 0.13	r = 0.13	r = 0.39
BBS	**$p = 0.01$***	$p = 0.15$	$p = 0.15$	$p = 0.56$	$p = 0.63$	**$p = 0.00$***
	r = −0.40	r = −0.23	r = −0.23	r = −0.09	r = −0.08	r = −0.42
(LEFT FOOT)						
Total physical activity	**$p = 0.00$***	**$p = 0.03$***	**$p = 0.04$***	$p = 0.09$	$p = 0.09$	$p = 0.17$
	r = −0.52	r = −0.33	r = −0.33	r = −0.27	r = −0.27	r = −0.22
Age	**$p = 0.00$***	$p = 0.14$	**$p = 0.04$***	$p = 0.15$	$p = 0.15$	**$p = 0.00$***
	r = 0.45	r = 0.23	r = 0.32	r = 0.23	r = 0.23	r = 0.48
BBS	**$p = 0.00$***	$p = 0.06$	$p = 0.06$	$p = 0.33$	$p = 0.33$	**$p = 0.00$***
	r = −0.46	r = −0.29	r = −0.29	r = −0.15	r = −0.15	r = −0.42
Two-point discrimination (millimetres)						
(RIGHT FOOT)	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**
Total physical activity	$p = 0.72$	$p = 0.42$	$p = 0.42$	$p = 0.40$	$p = 0.40$	$p = 0.98$
	r = −0.06	r = −0.13	r = −0.13	r = −0.14	r = −0.14	r = −0.00
Age	$p = 0.64$	$p = 0.74$	$p = 0.74$	$p = 0.72$	$p = 0.72$	$p = 0.94$
	r = 0.07	r = 0.05	r = 0.05	r = 0.05	r = 0.05	r = −0.01
BBS	$p = 0.06$	$p = 0.12$	$p = 0.12$	$p = 0.11$	$p = 0.11$	**$p = 0.00$***
	r = 0.31	r = 0.24	r = 0.24	r = 0.25	r = 0.25	r = 0.52
(LEFT FOOT)						
Total physical activity	$p = 0.72$	$p = 0.42$	$p = 0.42$	$p = 0.42$	$p = 0.40$	$p = 0.98$
	r = −0.06	r = −0.13	r = −0.13	r = −0.13	r = −0.17	r = −0.00
Age	$p = 0.64$	$p = 0.74$	$p = 0.74$	$p = 0.74$	.$p = 0.72$	$p = 0.94$
	r = 0.07	r = 0.05	r = 0.05	r = 0.05	r = 0.05	r = −0.01
BBS	$p = 0.06$	$p = 0.12$	$p = 0.12$	$p = 0.12$	$p = 0.11$	**$p = 0.00$***
	r = 0.30	r = 0.24	r = 0.24	r = 0.24	r = 0.25	r = 0.52

Pearson correlation analysis.
T1: Big Toe; T2: 1st metatarsal head; T3: 5th metatarsal head; T4: Medial Midfoot, T5: Lateral Midfoot; T6: Heel; BBS: Berg Balance Scale; * $p < 0.05$.

3.2. Analysis of physical activity, static and dynamic balance tests of participants

The analysis of the total physical activity, static and dynamic balance evaluations of the participants are given in Table 2. By the result of IPAQ-SF analysis, it was found that all of the participants were in the physically inactive group. According to BBS results, all of the participants were found to be at low risk.

3.3. Analysis of relationship between total physical activity level and plantar sensitivity of individuals

As a result of the statistical analysis, a negative correlation was found between the total physical activity level of the participants and the light touch pressure of the right toe ($p = 0.00$, $r = -0.44$). A significant negative correlation was detected between the total physical activity level and the left big toe ($p = 0.00$, $r = -0.52$), the 1st ($p = 0.03$, $r = -0.33$) and 5th metatarsal heads of the left foot ($p = 0.04$, $r = -0.33$). No significant relationship was found between the total physical activity and the two-point discrimination sense of the soles of the feet ($p > 0.05$). A negative significant correlation was determined between BBS and the light touch pressure of right and left big toes and heels. A positive correlation was found between BBS and the two-point discrimination sense of right and left heels ($p = 0.00$, $r = 0.52$) ($p = 0.00$, $r = 0.52$). There was a significant positive correlation between age and right toe ($p = 0.01$, $r = 0.37$) and heel ($p = 0.01$, $r = 0.39$) light touch pressure. A significant positive correlation was found between age and the light touch pressure of the left big toe ($p = 0.00$, $r = 0.45$), 5th metatarsal head ($p = 0.04$, $r = 0.32$) and heel ($p = 0.00$, $r = 0.48$) (Table 3).

3.4. Relationship between total physical activity level and static, dynamic balance

No significant correlation was found between total physical activity level and static balance tests ($p > 0.05$). While there was a negative correlation between total physical activity and TUG ($p = 0.01$, $r = -0.39$), no significant difference was found with BBS ($p = 0.22$). A significant negative correlation was detected between age and single leg (eyes open, closed) and tandem stance balance test (eyes open). There was a negative correlation between age and BBS ($p = 0.00$, $r = -0.56$) and a positive correlation between age and TUG ($p = 0.00$, $r = 0.46$) (Table 4).

4. Discussion

This research was carried out to investigate the relationship between physical activity level and plantar

Table 4. Relationship between total physical activity level and static, dynamic balance ($n = 40$).

	Total physical activity	RSLST (eyes open)	RSLST (eyes closed)	LSLST (eyes open)	LSLST (eyes closed)	TST (eyes open)	TST (eyes closed)	TUG	BBS
Age	$p = 0.05$ $r = -0.31$	$\mathbf{p = 0.00}^*$ $r = -0.44$	$\mathbf{p = 0.00}^*$ $r = -0.47$	$\mathbf{p = 0.00}^*$ $r = -0.62$	$\mathbf{p = 0.00}^*$ $r = -0.56$	$\mathbf{p = 0.00}^*$ $r = -0.59$	$p = 0.05$ $r = -0.30$	$\mathbf{p = 0.00}^*$ $r = 0.46$	$\mathbf{p = 0.00}^*$ $r = -0.56$
Total physical activity	–	$p = 0.51$ $r = 0.10$	$p = 0.98$ $r = -0.00$	$p = 0.76$ $r = 0.05$	$p = 0.90$ $r = 0.02$	$p = 0.09$ $r = 0.26$	$p = 0.28$ $r = 0.17$	$\mathbf{p = 0.01}^*$ $r = -0.39$	$p = 0.22$ $r = 0.19$

Pearson correlation analysis.
RSLST: Right Single Leg Stance Test; LSLST: Left Single Leg Stance Test; TST: Tandem Stance Test; TUG: Timed Up and Go Test; BBS: Berg Balance Scale; $^*p < 0.05$.

sensitivity, static and dynamic balance in postmenopausal women. As a result of this research, it arrived that the light touch sensitivity of big toes of both feet and the 1st and 5th metatarsal heads of the left foot increased with the rising scores in total physical activity. It was observed that the TUG scores decreased and the dynamic balance improved with the increase in total physical activity level. It was also determined that increasing age affected the static and dynamic balance negatively.

4.1. Relationship between physical activity and balance

Studies have shown that healthy lifestyle behaviors such as not smoking and quitting smoking, regular sleep, balanced diet and physical activity are highly associated with general health (Alalwan et al., 2019; Al-Omoush et al., 2020). In some studies, those can be found in the literature, it has also been determined that women in the postmenopausal period switch for a sedentary lifestyle in terms of physical activity level (Nelson et al., 2008; Ranasinghe et al., 2017). All of the participants in this research were sedentary. Due to the lifestyles, habits, different roles of women at home, the physiological changes seen with the transition tomenopause, and the lack of awareness about participation in physical activity, these assumptions can be considered. In postmenopausal women, who have sedentary behavior, decreased lower extremity muscle mass and strength, and decreased cutaneous receptor sensitivity and density, together with low estrogen levels, cause postural dysfunction and balance problems (Morales et al., 2013; Naessen et al., 2007; Perry, 2006). Next, in the recent work of Michalska et al. (2021), it is noted that ageing, being a natural process, involves many functional and structural changes within the body and identifying the age-related postural changes can provide insight into the role of ageing on postural control during locomotion. In Michalska et al. (2021), age-related postural changes during a transitional task under different conditions were investigated. Here, it is followed that the analysis of double-support time, when each foot is in contact with one of the platforms, enabled the detection of early signs of balance changes in middle-aged adults and the older women demonstrated postural impairments before movement initiation and also after a motor task. Furthermore, independent of age, the transitional task parameters changed with the increasing difficulty of tasks. In every condition, the postural changes in the double support time, especially among adults over 60 y/o were also observed. However, the most demanding task for all groups of adults was the step-down condition. In the literature, it has also been found that physical activity improves walking, increases balance and minimizes the risk of falling (Borba-Pinheiro et al., 2010; Otero et al., 2017). It is emphasized that personalized physical activity training in postmenopausal women is necessary and important in preventing falls because it increases postural control strategies and somatosensory input (Bazanova et al., 2015). In this study, with the increase in total physical activity scores, improvement in TUG scores, which is one of the dynamic balance tests, has been determined. However, it has not been found a significant difference between total physical activity and BBS, static balance tests. This result could be raised due to the group of participants being homogeneous. Additionally, in this work, the dynamic balance was evaluated with clinical balance tests such as BBS and TUG. Some differences here come from the sensitivity of TUG and BBS.

4.2. Relationship between age, physical activity level and plantar sensitivity

Sensory inputs are visual, vestibular, and proprioceptive senses. In order to achieve balance, precise data from the vestibular, visual and proprioceptive systems must be combined with each other, unnecessary information should be discarded, and selected information should be converted into appropriate action. The foot is a hypercomplex structure characterized by being the only area on which our body rests and is in contact with the ground. Among its functions, the feature of providing afferent information to the central nervous system from the plantar receptors, which will be used to maintain posture and create movement patterns, stands out. In recent

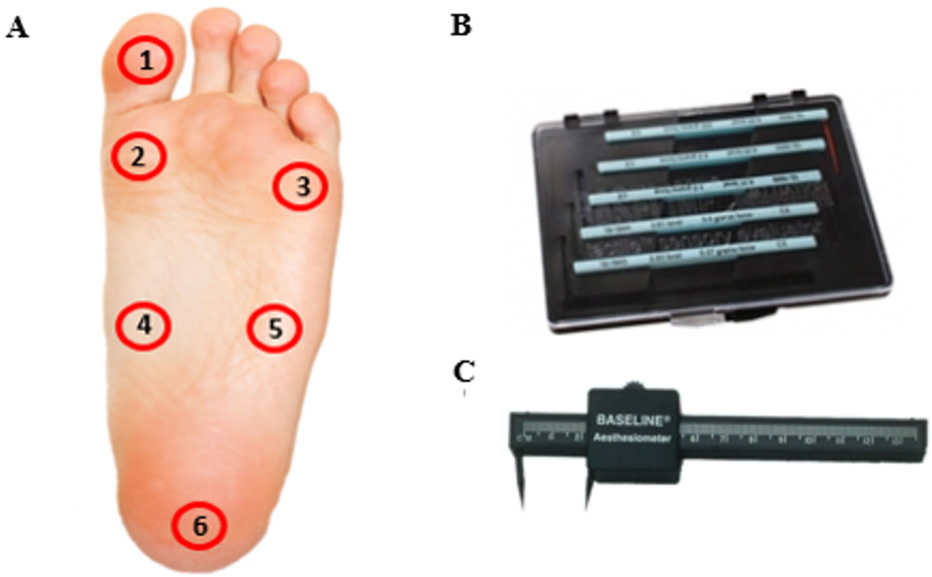

Figure 1. Illustration of the points where plantar sensitivity was evaluated and the monofilaments set and aesthesiometer used in the study. (A) T1: Big Toe; T2: 1st metatarsal head; T3: 5th metatarsal head; T4: Medial Midfoot T5: Lateral Midfoot; T6: Heel. (B) Baseline Tactile Semmes Weinstein Monofilaments Set, 5 pieces (Chattanooga). (C) Baseline 2-Point Discriminator.

years, numerous researches have focused on the effect of afferent information provided by the plantar receptors of the somatosensory system on the mechanism of injury, balance, postural control and movement. It is also emphasized that the motor and sensory components required for balance are significantly affected by the plantar tactile sense, which is one of the afferent pathways. Plantar sensitivity varies greatly in the healthy and pathological population. Depending on age, foot area, gender, stimulus type and activity level, very different activation thresholds can be observed. In a recent and systematic review, Zhang and Lu (2020) provided an overview of literature describing the relationship between foot deformities and plantar pressure in the elderly. In Zhang and Lu (2020), fifteen studies fulfilled the selection criteria. The findings of the review of Zhang and Lu (2020) verified that the plantar pressure parameters were closely related to foot deformities in seniors. All these suggest that plantar afferent information may directly affect balance and motor pattern functions (Maitre & Paillard, 2016). In the study of Yümin et al. (2016) which is related to healthy women aged 52.59 ± 13.05 years, it was determined that plantar sense decreased when age and body mass index values increased. Recently, Machado et al. (2017) investigated the changes in 'Center of Pressure' position in response to plantar sensitivity (Semmes–Weinstein Monofilaments) of elderly and young adults. They found that plantar sensitivity decreases while age is increasing. Young adults achieved better postural control than older participants. In a study evaluating the two-point discrimination, joint position sense, and perceived strength levels of young and old adults, it was concluded that the young physically active group was more sensitive in the foot sole two-point discrimination test (Franco et al., 2015). Kattenstroth et al. (2013) reported that regular moderate levels of physical activity can improve the sense of touch. In this study, it was observed that the tactile sensitivity of right big toe, right heel, left big toe, the 5th metatarsal head of left foot and left heel region decrease with increasing age. As a next observation, it was found that if the total physical activity level increases, then the light touch sense of big toes of both feet, the 1st and 5th metatarsal heads of left foot increase, too. This may be due to the density of cutaneous receptors on the thumb, metatarsal head and plantar pressure distribution.

4.3. Relationship between balance and plantar sensitivity

Some scientific works in the literature highlight the importance of foot plantar feedback in maintaining posture, displacement, and specific movement patterns. Indeed, in the study of Menz et al. (2005), it was noted that the sensitivity of the plantar surface of the foot and ankle flexibility is independent determinants of postural balance. Next, Cruz-Almeida et al. (2014) evaluated the relationship between somatosensation of different regions on the plantar surface of the foot and mobility function in elderly adults, and they concluded that the tactile perception under the first metatarsal head is strongly correlated with the BBS score. In addition, in Song et al. (2021), it was underlined that especially cutaneous sensitivity and muscle strength are associated with static balance and dynamic balance in older adults, respectively. It has also been stated that more sensitive plantar areas of the foot such as the big toe and arch are more closely related to static balance. In this study, it was determined that the scores of BBS, which is one of the dynamic balance tests, can be improved with the increase in the light touch pressure sensitivity of the right and left big toes and heel region. This supports the somatosensory importance of the plantar sense as the primary interface between the ground and the body.

4.4. Limitations

1. During this study, the power analysis of research was provided. However, the present study includes a small sample size because of the difficulties of the COVID-19 period. Here, a physical activity level and a related bigger sample size for future works were planed.
2. In the present study, the foot posture, and deformities were not included and evaluated. The effects of foot problems on the parameters have not been investigated.
3. All participants of this study are in the physically inactive group. Comparative researches should be done by adding a physically active group. We plan to do this work in advance.

5. Conclusion

Questioning the physical activity level of women who applied to the hospital in the postmenopausal period and evaluating their static and dynamic balance are of great importance in terms of reducing the negative consequences that may be experienced in older ages. The reasons for the transition to a sedentary life of postmenopausal women should be questioned. In order to increase the physical activity level of postmenopausal women, appropriate exercise programs should be created and suggested, and it should be aimed to raise the awareness of the participants about a healthy-quality life and exercise and to encourage their participation in physical activities. Precautions including comprehensive and structured exercise programs should be taken to reduce the symptoms seen in the postmenopausal period and to prevent falls and chronic diseases.

As a result of this research, these evaluations which can be done practically, fast and in an inexpensive way in the clinic are recommended to be routinely used by physiotherapists. With routine evaluations, it will be easier to identify risky and related factors affecting balance in this population. After the related factors are determined, studies to compare different exercise interventions for motor and sensory components can be designed and thus contribute to the literature. Finally, as a recommendation, proper future works should include more age groups and different physical activity levels.

Disclosure statement

No potential conflict of interest was reported by the authors.

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