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ORIGINAL RESEARCH

Static postural control and risk of falls in older women with and without urinary incontinence

Controle postural estático e risco de quedas em mulheres idosas com e sem incontinência urinária

Control postural estático y riesgo de caídas en mujeres ancianas con y sin incontinencia urinaria

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ABSTRACT | Urinary incontinence (UI) is associated with the occurrence of falls in older people and may be related to failure in the postural control of older people. This study aims to compare static postural control under eyes-closed and eyes-open conditions as well as the risk of falls in older women with UI and without UI. The sample was divided in two groups: a group of older women with UI (n=21, age=65.33±4.57 years) and a group of older women without UI (n=19, age=66.37±5.26 years). The urinary loss characteristics of the UI group were evaluated with use of the International Consultation on Incontinence Questionnaire – Short Form (ICIQ-SF). The static postural control of the groups was measured using displacement of center of pressure (COP) through a force platform and the risk of falls was evaluated with the Timed Up and Go test (TUG). Statistical analysis was performed using Mann Whitney's U-Testand the chi-square test. Most participants with UI lost urine in small amounts and at low frequency. No difference was observed between the groups with respect to COP variables (p>0.05) and risk of falls (p=0.082). However, in the intragroup analysis, a difference was observed in the COP velocity of both groups comparing open and closed eyes (p<0.05). No difference was observed in the static postural control and risk of falls in older women with and without UI.

Keywords | Aged; Urinary Incontinence; Postural Balance; Accidental Falls.

RESUMO | A incontinência urinária (IU) está associada à ocorrência de quedas em idosos e pode ter relação com déficits no controle postural. O objetivo deste trabalho é comparar o controle postural estático, na condição de olhos abertos e fechados, e o risco de quedas entre idosas com IU e idosas sem IU. A amostra foi dividida em dois grupos: idosas com IU (n=21, idade=65,33±4,57 anos) e idosas sem IU (n=19, idade=66,37±5,26 anos). As características da perda urinária do grupo com IU foram avaliadas por meio do *International Consultation on Incontinence Questionnaire: Short Form* (ICIQ-SF). O controle postural estático dos grupos foi mensurado pelo deslocamento do centro de pressão (COP) por meio de uma plataforma de força; e o risco de quedas foi avaliado pelo teste *timed up and go*. Para a análise estatística, foi utilizado o teste U de Mann-Whitney e o teste qui-quadrado. A maioria das participantes com IU perdiam urina em pequena quantidade e todas perdiam em baixa frequência. Não foi observada diferença entre os grupos em relação às variáveis do COP (p>0,05) e o risco de quedas (p=0,082). Entretanto, na análise intragrupos, houve diferença na velocidade do COP de ambos os grupos na comparação olhos abertos versus olhos fechados (p<0,05). Não houve diferença no controle postural estático e no risco de quedas entre idosas com e sem IU.

Descritores | Idoso; Incontinência Urinária; Equilíbrio Postural; Acidente por Quedas.

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Corresponding address: Guilherme Tavares de Arruda – Av. Roraima, 1000 – Santa Maria (RS), Brazil – Zip Code: 97105-900 – E-mail: gui_tavares007@hotmail.com – Finance source: Programa de Bolsas de Iniciação Científica ou Auxílio à Pesquisa da Fundação Instituto de Pesquisas Econômicas (Fipe) Sênior do Centro de Ciências da Saúde (CCS) of Universidade Federal de Santa Maria (UFSM) - Conflict of interests: Nothing to declare. Presentation: Jul. 3rd, 2018 - Accepted for publication: Jun. 25th, 2019. Approved by Comitê de Ética em Pesquisa da Universidade Federal de Santa Maria (UFSM) nº 1.948.557.

RESUMEN | La incontinencia urinaria (IU) está asociada con la presencia de caídas en los ancianos y puede estar relacionada con déficits en el control postural de ellos. El presente estudio tuvo como objetivo comparar el control postural estático con los ojos abiertos y con los ojos cerrados y el riesgo de caídas entre mujeres ancianas con IU y mujeres ancianas sin IU. La muestra se dividió en dos grupos: ancianas con IU (n=21, edad=65,33±4,57 años) y ancianas sin IU (n=19, edad=66,37±5,26 años). Las características de pérdida urinaria en el grupo con IU se evaluaron utilizando el *International Consultation on Incontinence Questionnaire: Short Forma* (ICIQ-SF). El control postural estático de los grupos se midió por el desplazamiento del centro de presión (COP) por medio de una plataforma de fuerza; y el riesgo de caídas fue evaluado por el test del *timed up and go*. En el análisis estadístico, se utilizaron la prueba U de Mann-Whitney y la prueba de Chi-cuadrado. La mayoría de las participantes con IU perdieron una pequeña cantidad de orina y todas la perdieron a baja frecuencia. No se observó diferencia entre los grupos en relación con las variables COP (p>0,05) y el riesgo de caídas (p=0,082). Sin embargo, en el análisis intragrupo hubo una diferencia en la velocidad de COP de ambos grupos en la comparación ojos abiertos versus ojos cerrados (p<0,05). No hubo diferencias en el control postural estático y en el riesgo de caídas entre las ancianas con y sin IU.

Palabras clave | Anciano; Incontinencia Urinaria; Balance Postural; Accidente por Caídas.

INTRODUCTION

Urinary incontinence (UI) is defined by the *International Continence Society* (ICS) as any urine involuntary loss and is more dominant in females, affecting about 75% of older women[2,3]. Advanced age, female gender and number of pregnancies are some UI risk factors[4]. UI is considered a public health problem that negatively affects the individual's quality of life and social relations, generating high expenses with its treatment[2,4]. In addition, studies suggest that urinary loss is strongly associated with falls in older people[5-8], and its incidence tends to increase with age[9].

Aging decreases electrical activity of the somatosensory, vestibular and visual systems, responsible for postural control, which generates oscillations of the body's center of pressure (COP) beyond the limits of the individual's support base, leading to a fall[10,11]. As such, the individual needs the integrity of these systems in order to maintain an adequate upright posture[10], wherein the visual system is the main component in postural control[12,13].

Older people who have suffered a fall may develop fear of falling again, which ends up interfering in their self-esteem, reducing mobility and affecting their quality of life[9], especially of the older person with UI. At this point, the physical therapist plays an important role in the development of exercise programs for fall prevention in older women with UI[14], improving their muscular endurance and balance, thus reducing the risk of falls[14], which is associated with failures in the postural control mechanisms[11] and may be related to UI[15]. Some studies[15,16] identified a greater COP displacement in women with UI compared with women without UI. As these studies indicate, bladder filling alters postural control and impairs the performance of women with UI in executing tasks. However, scarce studies verify the postural control of incontinent women without filling the bladder as an outcome. In addition, few studies on this subject were performed to have a broader view of UI influence on postural control.

Thus, the objective of this study was to compare static postural control under eyes-closed and eyes-open conditions, and the risk of falls in older women with UI and older women without UI.

METHODOLOGY

This is a cross-sectional case-control study with quantitative approach, performed with older women with UI and older women without UI.

As eligibility criteria, women aged between 60 and 80 years; with preserved cognitive capacity, evaluated via the Mini-Mental State Examination (MMSE), according to their education level[17]; and with functional independence as assessed by the Katz et al[18]. Index were included for convenience[18]. Older women with (self-reported) neurological and/or cognitive pathologies, evaluated with the MMSE; with labyrinth disorders; that use orthoses or prostheses in upper or lower limbs; with limb amputation; who have undergone surgery or therapy for UI treatment; and who were under hormone replacement therapy were

excluded. Data collection occurred between February and September 2017.

A participant data record composed of identification data and obstetric data (number of pregnancies and deliveries) was produced by the researchers to characterize the sample. In order to characterize urinary losses, the *International Consultation on Incontinence Questionnaire: Short Form* (ICIQ-SF) was used, as it is an instrument validated and translated into Portuguese[19], composed of four questions groups about quantity, frequency, occasion of urinary loss and impact of urinary loss on daily life. Values were assigned, ranging from zero to 21, wherein a score equal to zero classifies the subject as not having UI; a score of 1 to 3 refers to mild impact on quality of life; 4 to 6, moderate; 7 to 9, severe; 10 or more, very serious.

The risk of falls was assessed using the *timed up and go* (TUG) test, which is based on the timed task of getting up from a chair, walking three meters, turning 360°, going back to the chair and sitting again. The time taken to perform the test ranks the subject's risk of falls into: low risk of falls – less than 10 seconds; medium risk – 10 to 20 seconds; and high risk – over 20 seconds[20].

The COP measurements of static postural control were obtained through the force platform Advanced Mechanical Technologies, Inc. (AMTI) model OR6-5. The following COP variables were acquired: anteroposterior range of displacement (COPap); mediolateral range of displacement (COPml); mean displacement velocity (COPvel); and area. The kinetic data acquired through the force platform operated at the 100Hz frequency at ground level. For the filtering of the force and moment raw data, a 4th order Butterworth Low-Pass Filter with cut-off frequency of 10Hz was used.

During the COP measurements evaluation, subjects were instructed to position themselves on the force platform with their feet apart at hip width, head forward and eyes fixed on a target at a distance of approximately two meters. The position of the feet was drawn in paper and fixed to the ground so that each attempt was made with the same positioning, maintaining the same support base. Three 30-second attempts were performed, the subject having their eyes open, with a one-minute interval between attempts, and subsequent three attempts with eyes closed. During data collection, subjects should be barefoot, with bipedal support and arms extended along the body[21]. Evaluation of COP measurements was performed by a blind investigator.

Sample calculation was estimated to obtain a 5% significance level (α) and 80% power (1–β). Postural control evaluation was performed in a sample of at least 19 subjects in each group, based on the results obtained by Chmielewska et al.[16], considering the comparison between the with UI and without UI groups with empty bladder and eyes open of the COP area variable as primary outcome.

Statistical analyses were performed using the application software Statistical Analysis System version 9.0. In order to verify data normality, the Shapiro-Wilk test was performed. For inter-group and intra-group comparisons, the Mann-Whitney U-test was used. The chi-square test was performed for frequency comparisons, and the significance level adopted was 5% for all tests.

RESULTS

The study included 40 older women, divided into two groups: without UI (n=19) and with UI (n=21). All participants (n=40) had preserved cognitive capacity and functional independence assessed by MMSE and Katz index, respectively. Data for sample characterization are shown in Table 1. No statistically significant difference was observed between groups for the analyzed variables, showing homogeneity between the groups.

Table 1. Characterization of study participants (n=40)

Characteristics	Older women with UI, n=21	Older women without UI, n=19	*p
	Mean±SD or Median (IQ) or n (%)	Mean±SD or Median (IQ) or n (%)	
Age (years)	65.33±4.57	66.37±5.26	0.540
Number of pregnancies	2 (2.5)	3 (2)	0.890
Number of births	2 (1)	3 (1.5)	0.657
Previous falls			
Yes	15 (71.43%)	12 (63.16%)	0.311
No	6 (28.57%)	7 (36.84%)	
Risk of falls (TUG)			
Low risk	9 (42.86%)	9 (47.37%)	0.082
Medium risk	12 (57.14%)	10 (52.63%)	

UI: urinary incontinence; SD: standard deviation; IQ: interquartile range; TUG: timed up and go; *$p \leq 0.05$.

Table 2 shows characteristics of older women with UI urinary losses, presenting a higher frequency of older women with mixed UI, with urinary loss once a week or less and a small amount of urine loss. UI impact on daily life was considered moderate in most participants.

Table 3 shows COP analysis data of the static and intragroup static postural control. No statistically significant difference was observed between the groups and the variables of COP, both for the evaluation under eyes-open and eyes-closed conditions. However, the data in Table 3 show that older women with UI had a higher mean COP displacement than older women without UI, with higher values in all variables under the condition of eyes-open and eyes-closed. During intragroup analysis with eyes-open versus eyes-closed, a statistically significant difference was observed only for the COPvel variable.

Table 2. Characterization of study participants' urinary loss (n=21) according to the ICIQ-SF.

Characteristics	Older women with UI, n=21 n (%)
Type of IU	
SUI	6 (28.57%)
UUI	6 (28.57%)
MUI	9 (42.86%)
Urinary loss frequency	
Once a week or less	13 (61.90%)
Two or three times a week	2 (9.52%)
Once a day	2 (9.52%)
Several times a day	4 (19.05%)
Amount of urinary loss	
Small	21 (100%)
Impact of UI on daily life	
Minor	5 (23.81%)
Moderate	7 (33.33%)
Severe	5 (23.81%)
Very severe	4 (19.05%)

UI: urinary incontinence; SUI: stress urinary incontinence; UUI: urge urinary incontinence; MUI: mixed urinary incontinence.

Table 3. COP variables analyses of the static and inter-group static postural control of older women with and without urinary incontinence with open and closed eyes

Variables	Older women with UI, n=21 Mean±SD			Older women without UI, n=19 Mean±SD			*p'	
	Eyes open	Eyes closed	p"	Eyes open	Eyes closed	p"	Eyes open	Eyes closed
COPap (cm)	1.96±0.59	2.17±0.63	0.326	1.84±0.41	2.14±0.59	0.070	0.524	0.913
COPml (cm)	1.28±0.55	1.39±0.52	0.406	1.14±0.48	1.29±0.73	0.704	0.343	0.217
COPvel (cm/s)	0.98±0.30	1.23±0.43	0.040*	0.93±0.22	1.18±0.30	0.012*	0.625	0.765
COP area (cm^2)	1.97±1.47	2.26±1.54	0.351	1.58±0.95	1.91±1.35	0.267	0.336	0.408

UI: urinary incontinence; COP: center of pressure; COPap: center of pressure anteroposterior range of displacement; COPml: center of pressure mediolateral range of displacement; COPvel: center of pressure mean displacement velocity; cm: centimeter; SD: standard deviation; s: seconds; *p*': intergroup analysis level of significance; *p*": intragroup analysis level of significance; *$p \leq 0.05$.

DISCUSSION

This study sought to compare static postural control (open and closed eyes) and the risk of falls in older women with UI and older women without UI. The UI interference in the static postural control of older women and in the risk of falls in this population was shown to be null. In addition, none of the COP parameters presented statistical significance in the intergroup analysis. However, older women with UI had, on average, a greater COP displacement compared to older women without UI group. In addition, a significant difference was found only for the COP oscillation velocity of the postural control in the intragroup analysis, under the eyes-open versus eyes-closed condition.

The intergroup and intragroup analysis in the eyes-open and eyes-closed conditions allowed to verify the influence of vision on the women's postural control. When vision is impaired, postural instability increases and the body needs more activity from other postural control mechanisms to quickly compensate for vision loss[10,11]. Therefore, with eyes closed, the older women in this study had a significant difference in COPvel, that is, a greater difference in body mean velocity of oscillation than in body amplitude and area of displacement. However, the other COP variables presented no statistically significant difference. The difference in COPvel may have occurred due to the somatosensory system's early adjustment mechanism, which allows body fast adjustments against disturbances that generate a greater COP displacement range[10,11].

Regarding the postural control comparison, some data may explain that the lack of difference between the groups with and without UI evaluated in this study. Most older women with UI had urine loss once a week or less, and all women reported losing a small amount of urine. In addition, most participants were classified as having moderate UI impact on daily living. In this regard, Kim et al.[22] identified that UI severity is related to maintaining balance and postural control. For these authors, older women have a decrease in the strength of the pelvic floor muscles (PFM), which interferes with lumbo-pelvic stability and changes postural control[22].

This suggests that perhaps the weakness of PFMs could be a cause of greater COP displacement in the UI group. However, in this study, PFM functionality was ignored.

Comparing the number of pregnancies and deliveries between groups, the variables were not statistically significant. The higher number of pregnancies and births are possible risk factors for UI[23], however, although the pathophysiology involved is unknown, the increased intra-abdominal pressure on the bladder by the fetus during pregnancy and hormonal changes in women may lead to the weakening of the pelvic floor structures and predispose UI occurrence[24,25]. Thus, the increase in number of pregnancies and births progressively damages the PFM and intensifies urinary loss.

When analyzing the occurrence of previous falls and the risk of falls, no significant difference was found when comparing the study groups. In the literature, the association between UI and falls in older people is well reported[7-9]. Possible causes involve extrinsic factors, such as the urgency to get to the bathroom at night[8] and intrinsic factors such as the weakening of PFMs[24]. However, falls are likely consequences of several factors besides UI[26].

The eligibility criteria applied in this study increased the reality of the results by including only older women with preserved and functionally independent cognitive status, as well as excluding other factors that could interfere with postural control, such as neurological pathologies, labyrinth disorders and the use of orthoses or amputated limbs. However, the study had some limitations. Postural control evaluations without bladder filling control limited the comparison with other studies, since a full bladder seems to alter the postural control of incontinent women more[16]. In addition, this study included women with different UI types, which may have influenced the results, since different incontinence mechanisms may be involved besides PFM weakness[7,8]. Another possible limitation of the study was the lack of PFM functionality evaluation, which could contribute to data analysis to identify PFM weaknesses severity.

CONCLUSION

In this study, no difference in static postural control and risk of falls in older women groups with and without UI was observed. However, under eyes-open versus eyes-closed conditions, both groups showed significant difference in COP displacement velocity. Further studies on the subject are recommended, such as bladder filling evaluation and PFM function, in order to obtain a better control of this variable on postural control.

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