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Influence of Drugs of Continuous Use on the Sensory Regulation of the Static Balance of Elderly Regular Practitioners of the Pilates Method

Influência de Fármacos de Uso Contínuo Sobre a Regulação Sensorial do Equilíbrio Estático de Idosas Praticantes Regulares do Método Pilates

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Abstract

The combination of types of medications can compromise the regulation of body balance in older adults. This study evaluated the effect of continuous use drugs on the sensory regulation of static balance in elderly women who regularly practice the Pilates method with and without a history of falls and estimate the risk of falls in this population. Cross-sectional study, carried out with 94 women (67.12±4.74 years) practicing Pilates, divided into: non-fallers (n = 74) and fallers (n = 18). Sociodemographic data, comorbidities, medications, and Mini Mental State Examination (MMSE), Falls Efficacy Scale (FES), Confidence in Balance Scale (ABC) were applied. The examination of static balance was performed by the Clinical Test of Sensory Interaction and Balance (CTSIB). The risk of falling was analyzed using an adjusted multiple logistic regression model, while the effect of drugs on falls was estimated by binary regression, results were presented using the odds ratio (OR). The CTSIB test revealed Condition 4 (OR = 3.038; 95% CI = 1.321–15.674) and Condition 5 (OR = 5.542; 95% CI = 1.678–18.303) as predictors of falls. Drugs showing an effect on fall were β2 agonist associated with glucocorticoid (OR = 0.245; 95% CI = 1,233–2,400), thiazide diuretic (OR = 0.344; 95% CI = 1.122–2.234), statin (OR = 0.245; 95 % CI = 1,237–2,338), angiotensin II receptor antagonist (OR = 0,245; 95% CI = 1,236–2,339), beta blocker (OR = 0,245; 95% CI = 1,238–2,402) and anti-vertigo (OR = 0,245; 95 % CI = 1.230–2.399). Regardless of the history of falls, the risk of falling was present in older adult regular Pilates practitioners. Six different drugs for continuous use showed an effect on falls.

Keyword: Accidental Falls. Aging. Women´s Health. Accident Consequences.

Resumo

A combinação de tipos de medicamentos pode comprometer a regulação do equilíbrio corporal de idosos. Este estudo avaliou o efeito de fármacos de uso contínuo sobre a regulação sensorial do equilíbrio estático de mulheres idosas praticantes regulares do método Pilates com e sem histórico de queda e estimar o risco de queda dessa população. Estudo transversal, realizado com 94 mulheres (67,12±4,74 anos) praticantes de Pilates, divididas em: não-caidoras (n=74) e caidoras (n=18). Foram coletados dados sociodemográfico, comorbidades, medicamentos, e aplicado Mini Exame do Estado Mental (MEEM), Falls Efficacy Scale (FES), Escala de Confiança no Equilíbrio (ABC). O exame do equilíbrio estático foi realizado pelo Clinical Test of Sensory Interaction and Balance (CTSIB). O risco de queda foi analisado pelo modelo de regressão logística múltipla ajustado, enquanto, que o efeito dos fármacos sobre queda foi estimado pela regressão binária, resultados foram apresentados pelo odds ratio (OR). O teste CTSIB revelou a Condição 4 (OR= 3,038; 95% IC= 1,321–15,674) e Condição 5 (OR= 5,542; 95% IC= 1,678–18,303) como previsora de quedas. As drogas que mostram efeito sobre queda foram agonista β2 associada com glicocorticóide (OR=0,245; 95% IC= 1,233–2,400), diurético tiazídico (OR=0,344; 95% IC=1,122–2,234), estatina (OR=0,245; 95% IC=1,237–2,338), antagonista do receptor de angiotensina II (OR=0,245; 95% IC=1,236–2,339), betabloqueador (OR=0,245; 95% IC=1,238–2,402) e antivertiginoso (OR=0,245; 95% IC=1,230–2,399). Independente do histórico de quedas, o risco de cair esteve presente em idosas praticantes regulares do Pilates. Seis diferentes medicamentos de uso contínuo mostraram efeito sobre queda.

Palavras-chave: *Acidentes por Quedas. Envelhecimento. Saúde da Mulher. Consequências de Acidentes.*

1 Introduction

Falls are adverse events with significant impact on the health and quality of life of the elderly population. Approximately between 28 and 35% of individuals aged 65 years or older fall at least once a year[1], and individuals aged 75 years or older have a drop rate between 32 and 42%[2]. The fact is also more common among women[3] because compared to men, they are more exposed to domestic accidents[4]. At an advanced age, falls are considered a public health problem[5], since they cause injuries, fractures, hospitalization days, limitation of functionality. Therefore, after the fall, there is a limitation of social contact, which contributes to depressive symptoms[6].

The causes that cause an elderly person to fall are multifactorial[7], and there are intrinsic and extrinsic factors. Intrinsic issues are associated with balance performance, gait, vision problems, hearing, fear of falling, and low confidence in balance. While extrinsic factors represent the set of objects scattered in the environment, such as irregular surfaces, slippery surfaces or lighting problems[8]. In the context of falls, the types of medicines consumed by the elderly should also be considered[9], as well as the association among their substances.

Some pharmacological classes are responsible for increasing the risk of elderly falls, especially psychotropic drugs[10,11], cardiac[12], opioids and antiepileptic drugs [11].

Each drug has a profile of adverse reactions, therefore, during treatment one should consider the choice of drugs, considering the interaction effects. The measure can contribute to the rational and safe use of medicines, also minimizing the occurrence of adverse reactions[13]. Polypharmacy is defined as the concomitant use of five or more drugs[14]. In the case of the elderly population, control of polypharmacy is important because it helps to prevent iatrogenic diseases such as fall[11]. Polypharmacy is also related to the increase of drug interactions and antagonistic reactions to the medications themselves, which may suppress pharmacological treatment and intensify, among others, morbidity and mortality[15].

The direct relationship between the fall of the elderly and medications occurs as well as their adverse effects[6,16]. Some drugs generate sleepiness[17], hypotension, change muscular tonicity[11], in addition to compromising the functioning of the visual, vestibular and somatosensory system. In elderly people, changes in vision performance are considered a risk factor for fall. Medications used by elderly individuals such as antipsychotics and tricyclic antidepressants may cause vision to become blurred, generating diplopia[18]. Whereas drugs such as antibiotics, anticonvulsants and anti-inflammatory drugs can cause vertigo[19].

It is known that physiological aging causes alterations in the functioning of sensory organs[20], affecting both the capture of postural information and the data transmission to the Central nervous System (CNS). Moreover, when compared to young individuals, elderly individuals present a higher risk of falling. And, knowing that some medications also alter the functioning of receptive inputs, their regular consumption may potentiate deficits in the CNS during the postural information processing. As a result, there may be delays in the postural information processing and in the sending of commands to the extremities of the body, necessary for postural adjustments[21]. This also causes postural imbalance and increased risk of falling[22].

The goal of this study was to evaluate the effect of continuous use drugs on the sensory regulation of static balance in elderly women who regularly practice the Pilates method with and without a history of falls and estimate the risk of falls in this population.

2 Material and Methods

This was a cross-sectional, descriptive and analytical study. The collections were developed between January and March 2019 with members of the Pilates group of the Open University at the third Age (UNATI), linked to the Federal University of Vale do San Francisco (UNIVASF), located in the city of Petrolina-PE. All participants signed the Informed Consent Form (ICF). The study was approved by the Research Ethics on Human Beings Research of UNIVASF (Legal Opinion number 088832/2017).

2.1 Participants

Members of this research regularly participated in Pilates method classes twice a week (60 min.). 94 female individuals were included. The inclusion of only women is justified because 96% of the members of this project were female. Based on the history of falls (last 12 months), the participants were allocated to the groups: non-fallers (n = 98) and fallers (n = 18). The sampling calculation was performed *a posteriori* using the Software G*Power 3.1.3, *an effect size of* 50% was considered and α mean probability error of 0.50 ,(1- β probability error) = 0,6153753, DF = 114, *Critical t* = 1.6583300, *Noncentrality parameter* 1.9498011 was obtained.

Pilates classes were taught by a certified instructor in Pilates method, accompanied by a physical Education student. The physical program consisted of the following set of exercises: *the hundred, roll up, single leg circle, single leg stretches, double leg stretches, single straight leg stretches, side kick lift, spine stretch forward, swimming, shoulder bridge* and torpedo. According to the Pilates team, planning the degree of difficulty of each sequence of exercises was modified every six meetings, respecting, however, the physical and functional fitness of each participant. As an inclusion criterion, 75% participation in Pilates activities was adopted over the last six months before the study was carried out and age ≥60 years. Elderly individuals who did not sign the ICF or did not complete all stages of the study were excluded.

2.2 Procedures

The investigation comprised three moments. Initially, by means of a questionnaire, sociodemographic data, comorbidities, life habits and history of falls were collected (last 12 months) and the different types of drugs consumed. The anthropometric assessment was carried out with the aid of a mechanical scale of up to 300 kg. Body mass index (BMI) was calculated using the formula: mass (kg)/height (m)^2;

In a second moment, the instruments were used: a) Mini Mental State examination(MMSE)[23]: used for screening low cognition capacity and screening to detect possible Dementia cases. The diagnosis was established by a scoring system: 18 points for illiterate people, 21 for 1-3 years of schooling, 24 for 4-7 years of schooling, and 26 points for people with education over 7 years ; b) A *Falls Efficacy Scale* (FES)[24]: used to assess the fear of falling, based on 16 questions, that investigate the individual's degree of confidence to perform different tasks, without falling or losing balance. There are four possible answers: i) I am not worried, ii) a little worried, iii) moderately worried, and iv) very worried. The total score ranges from 16 (absence of worry) to 64 (extreme worry); c) Confidence Scale in Balance (ABC)[25]: used to assess participants' perception of their confidence in balance. The ABC scale consists of 16 questions with an emphasis

on individual attitudes during the performance of daily life activities. The scoring system is established by the percentage assigned by the interviewee. Values range from 0% (no confidence) to 100% (total confidence).

Finally, with the *Clinical Test of Sensory Interaction and Balance*(CTSIB) test [26], the sensory regulation of the static balance was examined. CTSIB is known as Sensory Interaction Test, its purpose is to test the influence of stimuli originating in the visual, somatosensory and vestibular system on the static balance regulation. This is a semi-quantitative evaluation method, since it depends on observing the postural strategies performance[27]. CTSIB consists of six tasks, titled as Intersensory conditions, verified in two different types of bases: i) stable, when tasks are performed on the ground, and ii) unstable, when tasks are performed on a foam (*Airex® Balance Pad*, 16" x 20" x 2-1/2"). The test instruction consists of asking the individual to remain in each condition for 30 seconds in the orthostatic position, feet joined, arms along the body, being instructed not to move the upper limbs, heels and feet to compensate for instability. Three tasks are performed on each of these bases: i) stationary subject with eyes open, ii) standing with eyes closed, and iii) standing with visual conflict, so the subject dresses over the head with a hood consisting of a Japanese flashlight adapted[26].

During the evaluation, participants were allowed a single attempt for each of the six conditions of the CTSIB. According to Shumway-Cook and Horak[26], there are two ways to interpret the results of the CTSIB sensorial performance. The first is for stay time in the requested position (<30 seconds = abnormal and ≥30 seconds = normal). The second form is the subjective evaluation, performed by observing the degree of postural oscillation. A subjective system with the following score was adopted for evaluation: 1 = minimum oscillation, 2 = light oscillation, 3 = moderate oscillation and, 4 = fall. Therefore, to facilitate data processing, the scores were grouped in a dichotomous manner. Thus, scores 1 and 2 formed the category of normal postural control (classification 1), while results 3 and 4 were assumed as abnormal postural control (classification 2), considered as risk for fall.

2.3 Statistical Procedures

Data on types of medicines were initially tabulated and organized in excel program and after being treated in a statistical program. *Shapiro-Wilk* test was used to verify the data normality. Nominal variables were analyzed using the Chi-square test, in the presence of values lower than five, Fisher's exact test was applied. The Student's t-test for independent samples was used to determine the significance levels among the comparisons of the performance of the faller and non-faller group in the six tasks of the CTSIB test. Considering that the regulation of the participants' postural control had already been favored by the practice of regular physical exercise and the use of medications was continuous, the independent variables (1) static balance and (2) medications were not manipulated. Through the multivariate linear regression analysis, it was identified which of the six conditions of the CTSIB test (dependent variable) would be fall predictors (dependent variable), therefore the magnitude of the effect of the types of medication on the balance sensory regulation was established, only the variables that indicated significance levels in the univariate model ($p \leq 0{,}020$) were considered for the calculation. The insertion order was from the highest to the smallest (*forward model*), respecting *the* magnitude of the *Spearman* correlation coefficient. Whereas, the effects of medicines on falls were calculated by binary logistic regression. Odds ratios (OR, 95% CI) were used to present the results. The data were processed at the statistic Program SPSS, version 22.0. The significance level established was $p < 0.050$.

3 Results and Discussion

94 women (67.12±4.74 years) who practice physical exercises regularly participated in the study (Table 1). Of these, 83% (78/94) did not present a history of falls, whereas 17% (16/94) were fallers. 72.3% (68/94) of the sample was composed of sexagenarians. Among the group with a history of falls, 68.8% (11/16) were sexagenarian and 6.3% (5/16) were septuagenarian ($p>0.050$). No statistically significant result was found for BMI ($p>0.050$). The mean time of weekly practice of physical exercise ranged from 18 to 24 months ($p = 0.132$). Among the comorbidities only Arterial Hypertension presented significance levels ($p = 0.032$). The MMSE instrument attests to the health mental state maintained for both groups ($p=0.404$). Regarding the confidence in balance (ABC), the non-faller group presented a higher score ($p = 0.007$), while the fear of falling (FES) was higher among the members of the faller group ($p = 0.016$) for the scale of fear of falls and confidence in balance.

Table 1 - Key characteristics of the population evaluated

Variables	Non-fallers (n=78)	Fallers (n=16)	p
Age 60-69 years (f %) 70-79 years (f %)	67.15±4.52 57 (73.1) 21 (26.9)	66.94±5.85 11 (68.8) 5 (6.3)	0.890
Schooling Illiterate 0-3 years 4-8 years >8 years	 1 (1.3) 18 (23.1) 29 (37.2) 30 (38.5)	 2 (12.5) 3 (6.3) 7 (43.8) 6 (37.5)	0.118

Conitnued...

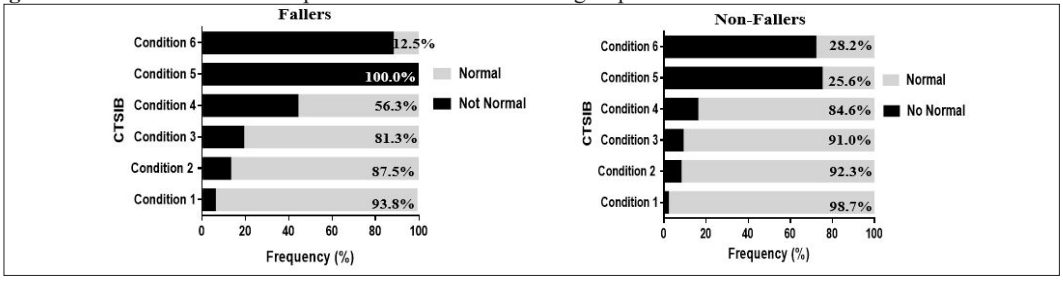
Continuation

Variables	Non-fallers (n=78)	Fallers (n=16)	p
Income 0-1 SM 2-3 SM 4-5 SM > 5 SM	 11 (14.1) 42 (53.8) 16 (20.5) 9 (11.5)	 5 (31.3) 5 (31.3) 5 (31.3) 1 (6.3)	 0.518
Mass (kg)	65.88±11.49	63.11±10.08	0.340
Height (cm)	150.00±0.06	149.00±0.03	0.309
CA	90.51±14.06	90.66±9.04	0.955
BMI (Kg/h^2)	30.56±23.51	28.21±4.50	0.418
Falls	-------	1.54±0.22	0.999
Exercise time (months)	26.24±6.32	25.74±4.24	0.132
Medications	2.38±1.31	2.35±1.67	0.940
Polypharmacy (f%) (≥5 medications)	5 (6%)	6 (37%)	0.527
Smoking (f%)	2 (2%)	1 (6%)	0.988
Heavy drinking (f%)	------	------	-----
Hypertension Yes (f%) No (f%)	 36 (46.2) 42 (53.8)	 12 (75.0) 4 (25.0)	 **0.032**
Diabetes Yes (f%) No (f%)	 14 (17.9) 64 (82.1)	 2 (12.5) 14 (87.5)	 0.457
Vision Yes (f%) No (f%)	 60 (76.9) 18 (32.1)	 12 (75.0) 4 (25.0)	 0.526
Hearing Yes (f%) No (f%)	 5 (6.4) 72 (92.3)	 7 (43.8) 9 (56.3)	 0.638
Labyrinthitis Yes (f%) No (f%)	 14 (17.9) 64 (82.1)	 5 (31.3) 11 (68.8)	 0.547
Dizziness Yes (f%) No (f%)	 27 (34.6) 51 (65.4)	 8 (50.0) 8 (50.0)	 0.190
Osteoporosis Yes (f%) No (f%)	 18 (23.1) 60 (76.9)	 3 (18.8) 13 (81.3)	 0.497
Rheumatism Yes (f%) No (f%)	 21 (26.9) 57 (73.1)	 6 (37.5) 10 (62.5)	 0.285
MMSE	24.53±2.65	23.80±3.07	0.404
FES	23.53±6.13	25.53±5.07	**0.050**
ABC	79.05±16.51	69.13±14.92	**0.007**

CA: Abdominal Circumference; BMI: Body mass index; MMSE: Mini Mental State Examination; EDG: Geriatric Depression Scale; FES-1: International Falls Efficiency Scale; ABC: Balance Confidence Scale; SM: Minimum wage.
Source: Research data.

Figure 1 shows the participants' performance in the six conditions of the CTSIB test. The *Mann Whitney T test* showed significance for Condition 4 (t= -2.641; p = 0.010), and Condition 5 (t=-2.324; p = 0.022). According to the analysis, comparatively, the best sensory performance of the static balance was indicated by elderly without a history of fall. An interesting finding was that, regardless of the history of falls, the sensory control deficit (neuromotor interference) was more evident in condition 5 (eyes closed on unstable basis) and condition 6 (visual conflict on unstable basis) (Figure 1).

Figure 1- Normal and abnormal performance results of both groups under the six conditions of CTSIB test



CTSIB: *Clinical Test of Sensory Interaction and Balance*: Condition 1: Stable base, eyes open; Condition 2: Stable base, eyes closed; Condition 3: Stable base with visual conflict; Condition 4: Unstable base, eyes open; Condition 5: Unstable base, eyes closed; Condition 6: Unstable base with visual conflict.
Source: Research data

Table 2 shows the results of the adjusted multiple linear regression model for the medications considered to be fall predictors. For the univariate analysis, only drugs with p value≤0.020 were included. The model obtained was statistically significant [$X^2(1)$= 27.889; p= 0.001; $R^2_{Negelkerke}$ = 0.429]. Of the eight drugs included in the analysis, six indicated a significant effect: Formoterol + budesonide, one agonist β2 glucocorticoid (β = 0.245; t = 2.927; p = 0.004); Chlortalidone, a thiazide diuretic (β = 0.344; t = 4.116; p = 0.000); Atorvastatin, a statin (β = 0.245; t = 2.927; p = 0.002); Candesartan an Angiotensin II conversion enzyme inhibitor (β = 0.245; t = 2.927; p = 0.005); Nebivolol a beta-blocker (β = 0.245; t = 2.927; p = 0.003); and Betahistine, an anti-vertigo (β = 0.245; t = 2.927; p = 0.002).

Table 2 - Results of the adjusted multiple linear regression model for the medications considered to be fall predictors

Medications	B	OR (95%)	p
Formoterol + budesonide	0.897	0.245 (1.233 – 2.400)	0.004
Chlortalidone	0.796	0.344 (1.122 – 2.234)	0.000
Atorvastatin	0.897	0.245 (1.237 – 2.338)	0.004
Candesartan	0.897	0.245 (1.236 – 2.339)	0.004
Nebivolol	0.897	0.245 (1.238 – 2.402)	0.004
Betahistine	0.897	0.245 (1.230 – 2.399)	0.004

Source: Research data.

Table 3 shows the results of the regression model that included the participants' performance in CTSIB test. For the calculation of the univariate analysis, only drugs with p value≤0.020 were considered. The model obtained was statistically significant [$X^2(1)$= 9.426; p= 0.002; $R^2_{Negelkerke}$ = 248]. Among the six conditions of CTSIB, only two were identified as significant fall predictors: CTSIB 4 (OR= 3.038; IC 95%= 1.321 – 15.674; p= 0.004), and CTSIB 5 (OR= 5.542; IC 95%= 1.678 – 18.303; p= 0.003).

Table 3 - Results of the regression model of CTSIB balance sensory test in relation to the drugs used

Variable	B	OR (95%)	p
CTSIB 4	1.598	3.308 (1.321 – 15.674)	0.004
CTSIB 5	1.712	5.542 (1.678 – 18.303)	0.003

Source: Research data.

According to the clinical examination of the sensory postural control inputs, performed by the CTSIB test (Figure 1), fallers and non-fallers indicated performance classified as normal, since their uses under conditions 1, 2 and 3 of CTSIB were higher than 80%. Therefore, when the three static balance adjustment systems were evaluated on the stable basis with the eyes open, closed and with partial obstruction, the risk for fall was low. On the other hand, when the participants were submitted to the same tasks on the unstable basis (condition 4, 5 and 6), the sensory systems responsible for organizing the postural data were observed to be compromised.

Elderly fallers pointed to a deficit of 100% in condition 5 of the CTSIB test and 87.5% in condition 6, while members of the group without a history of fall indicated a deficit of 74.4% in condition 5, and a deficit of 71.8% in condition 6. According to the odds ratio (OR), the conditions 4 and 5 of the CTSIB test showed an increase of 230% and 454% respectively on the chance to fall. The finding is important, because it warned that regardless of the participants' history of fall in this study, and it is worth highlighting, that they were regular physical exercises practitioners, the sensory system responsible for the static balance regulation presented deficits.

In the context of the elderly fall, the evaluation of the fear of falling (FES scale) and the balance confidence (ABC scale) are important because these perceptions may restrict the realization of ADLs (activities of daily life), affecting the individual's autonomy and quality of life[28]. Despite the fact that the members of the faller group indicated a lower confidence index in the balance than non-fallers, both groups indicated a low concern with a fall (score between 23-25 points of a total of 69 points). The results showed a lack of concern for this population with falls. The literature points out that the fact may increase the risk of accidents due to attitudes of imprudence and, therefore, greater exposure to the danger of falling[29].

In the case of self-report on hearing problems, labyrinthitis and dizziness, a prevalence was observed for members of the group with a history of falls (p>0.050). Literature points out that vestibulopathies have vertigo and visual disorders as symptoms, reflecting on gait and body balance performance[19]. Elderly patients in the present study used the anti-vertigo Betahistine (p<0.050). Tsukamoto and colleagues[30] found among the elderly that anti-vertigo drugs can negatively affect the postural balance.

It is known that, in general, the elderly population is user of a high number of drugs and that some substances have adverse effects that can increase the risk of falls[10,12], especially when the individual presents comorbidities[11]. We found statistically significant results for self-reported comorbidities, such as arterial hypertension, which showed a prevalence of 75% for the faller group. The finding serves as an alert for adverse effects caused by antihypertensive drugs, including orthostatic hypotension, syncope and dizziness[31,32].

Six out of 70 types of drugs identified indicated a significant effect on falls. Of these, three drugs (Chlortalidone, Candesartan and Nebivolol) had significant implications for conditions 4, 5 and 6 of the CTSIB test, indicating an increase in the chance (OR) of falling between 65-75%. Chlortalidone is a thiazide diuretic used to treat hypertension that can cause orthostatic hypotension. Its action inhibits sodium and chloride import in the distal convoluted tubule, reducing sodium and water reabsorption, with consequent depletion of plasma volume[33]. The literature reports cases of elderly people who consumed this class of drugs and presented fall events right in the first weeks of treatment.

Although there are no evidences to determine the

association between Atorvastatin and Candesartan with the fall of elderly, our analysis observed the fact. Atorvastatin is used to treat hypercholesterolemia, reducing low-density lipoprotein (LDL) levels in blood[35]. One possible explanation for its significant association with fall is that statins present adverse reactions such as myalgia, myopathy and myonecrosis that can cause muscle weakness that is a risk for falls. Candesartan acts as an inhibitor of the angiotensin II converting enzyme, it is used in the treatment of heart failure and arterial hypertension[34], however, studies are still needed to prove the relationship between this class of drugs and falls in the elderly population[12].

A drug that showed association with the condition 6 of the CTSIB test was Nebivolol, considered a beta blocker. Nebivolol has adverse reactions that can lead elderly people to fall, such as orthostatic hypotension, dizziness, bradycardia and fatigue[34]. Its hypotensive action comes from the reduction of the activity of the renin-angiotensin-aldosterone system caused by the β1 receptor blockade in the juxtapoclarular renal cells. Nebivolol can also cause orthostatic hypotension in response to changes induced by intravascular volume severity due to negative inotropic and chronotropic effects of β1 blockers[36]. All of this reduces the capacity of the heart to increase heart rate and cardiac output, increasing the risk of falls[33]. For this reason, it is advisable for elderly individuals to remain physically active, since physical exercise acts as an effective strategy to improve and maintain adjusted cardiovascular function and functional parameters[37].

The association of β2 agonists with glucocorticoids is widely used in the treatment of respiratory diseases such as asthma and COPD (Chronic Obstructive Pulmonary Disease). There are no evidences to justify an increase in the risk of falls due to the use of these drugs. However, it is known that the prolonged use of glucocorticoids in the treatment of chronic inflammatory diseases may cause adverse reactions, such as changes in bone structure due to reduced mineral density, another problem is loss of muscle mass. These transformations may compromise the balance, increasing the risk of falls, which may generate fractures[38,39].

This study is considered to have limitations. First, because the cross-sectional design does not allow us to explore the temporality of the associations found. Thus, it was not possible to determine whether the relationships established for the increase of the risk of falls resulting from the deficit in sensory regulation of balance were caused by the use of medications. Second, it was also not possible to infer whether changes in the body balance regulation system were already present even before the beginning of the drugs consumption. Third, it should be considered that falls are multifactor events (gait speed, extrinsic factors), therefore, they cannot be explained solely by the examination of static balance, drug consumption, fear of falling and confidence in balance. Fourth, data on visual and auditory system deficits were self-reported and not obtained by qualified laboratory tests, based on medical report.

4 Conclusion

With aging, vestibular, visual and somatosensory systems suffer alterations, causing dysfunctions in their receptive inlets. Due to that, the CNS is not able to integrate postural data coming from the peripheral sensory regions. Thus, the body of elderly individuals can generate distortion during the reception and transmission of information, preventing balance from being restored in a timely manner. In the present study, the effect of six drugs of continuous use was checked on the static balance performance, as well as reports on vision and hearing problems. Therefore, it is concluded to be important that elderly people have regular medical follow-up to check for the drugs of continuous use. In addition to carrying out periodic tests to examine the function of the regulatory mechanisms of the sensory system.

In the present study, the static balance examination pointed to a risk of falling regardless of the history of falls of the population assessed, especially in unstable baseline situations with eyes open and closed. Our results warn to the natural and gradual changes in the balance sensory regulation system even in elderly individuals who practice the Pilates method. Another issue to consider is the rational use of medications, especially those highlighted in this study as responsible for increasing the risk of falls. In order to deepen and qualify the understanding of the findings of the present investigation, it is advisable to perform future studies with a prospective design, with longitudinal follow-up.

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