Signatory of DORA
https://doi.org/10.56183/iberojhr.v4is.693
Ibero-American Journal of Health Science Research
OPEN ACCESS
BY-NC-ND
Received: 18/08/2024
Accepted: 02/12/2024
Published: 08/12/2024

Otago exercises adapted to balance to manage the risk of falls in the elderly

Exercícios Otago adaptados ao equilíbrio para gerenciar o risco de quedas em idosos

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ABSTRACT

(1) Background: Balance impairment is one of the main factors interfering with the increased risk of falls in the elderly. Between 28% and 35% of people over 64 years of age suffer falls each year and their incidence increases as they age. It has been shown that the use of Otago exercises (OE) reduces the risk of falls in this population. **(2) Methods:** The Otago exercise program (OEP) adapted to balance developed an initial 5-minute walk, warm-up exercises, flexibility, muscle activation, strength and balance. Two sessions per week were applied for 12 weeks and the approximate time of each intervention was 45 minutes. A pre and post evaluation was performed with the Timed Up and Go (TUG) and Single leg stance test (SLST) to measure the risk of falls. **(3) Results:** the final TUG showed that the high risk of falls present in 20% of participants was eliminated and the slight risk of falls decreased by 12%. The SLST revealed that 64% of the participants no longer presented a risk of falls. The applied T-STUDENT statistical test obtained a p-value<0.001 in both evaluations. **(4) Conclusions**: It was concluded that the balance-adapted OEP significantly decreased the risk of falls in the older adults.

Keywords: exercise therapy; postural balance; risk factors; accidental falls; aged.

RESUMEN

(1) Contexto: O comprometimento do equilíbrio é um dos principais fatores que interferem no aumento do risco de quedas em idosos. Entre 28% e 35% das pessoas com mais de 64 anos sofrem quedas todos os anos e a sua incidência aumenta à medida que envelhecem. Foi demonstrado que a utilização dos exercícios Otago (OE) reduz o risco de quedas nesta população. **(2) Métodos**: O programa de exercícios Otago (PEO) adaptado ao equilíbrio desenvolveu caminhada inicial de 5 minutos, exercícios de aquecimento, flexibilidade, ativação muscular, força e equilíbrio. Foram aplicadas duas sessões por semana durante 12 semanas e o tempo aproximado de cada intervenção foi de 45 minutos. Foi realizada avaliação pré e pós com o Timed Up and Go (TUG) e teste de apoio unipodal (SLST) para mensurar o risco de quedas. **(3) Resultados:** o TUG final mostrou que o alto risco de quedas presente em 20% dos participantes foi eliminado e o risco leve de quedas diminuiu 12%. O SLST revelou que 64% dos participantes não apresentavam mais risco de quedas. O teste estatístico T-STUDENT aplicado obteve valor de p<0,001 em ambas as avaliações. **(4) Conclusões**: Concluiu-se que a POE adaptada ao equilíbrio diminuiu significativamente o risco de quedas em idosos.

Palabras clave: terapia por exercício; equilíbrio postural; fatores de risco; quedas acidentais; envelhecido.

INTRODUCTION

The age distribution of the world's population is constantly changing over time. The current trend is the increase in the elderly population (EP) and the decrease in the number of young adults. Aging is defined as a continuous and irreversible process experienced by humans (Thomas et al., 2019). The presence of physical and emotional changes is reflected in functional, motor, sensory, cognitive and psychosocial aspects (Espejo-Atúnez et al., 2020).

The risk of falls in EP is one of the main health problems present in communities. Between 28% and 35% of people over 64 years of age suffer falls each year and their incidence increases as they age. In elderly people, over 80 years of age, it is evident that this figure rises to 50%, generating high demands for public care and physical disabilities in particular cases (Mittaz et al., 2019). According to the World Health Organization (WHO), falls represent the second cause of accidental deaths worldwide (Saftari & Kwon, 2018). Campoverde et al. (2022) in the city of Cuenca - Ecuador, a study was carried out on the risk of falls in older adults in the rural region using the Tinetti scale as the main testing means.

The University of Otago in New Zealand designed for the first time an exercise program aimed at preventing falls in older adults, treating muscle weakness and balance as causal factors of this problem. The program includes warm-up, strength and balance exercises aimed at working on the lower extremities. After the application of the Otago exercise program (OEP) in older adults who had experienced one or more falls in the last year, its effectiveness in reducing and preventing the number of falls in the EP was verified (Nam et al., 2020). But, in elderlies, adoption of sports and exercises strategies should be done with caution and detailed planning to minimize the risk of injuries (Vieira Costa & Silva Dias, 2024).

Almarzouki et al. (2020) with their research "Improved balance in middle-aged and older adults after 8 weeks of a modified version of the Otago Exercise Program" applied the OEP aimed at improving balance and strength. The study sample was 52 participants who completed the intervention to whom the exercises were adapted in relation to the abilities of each one. The program included 3 balance exercises and two strength exercises and single-leg dynamic balance was evaluated. The results of the intervention showed that the modified version of OEP was effective in improving dynamic balance parameters in the study population.

Jahanpeyma et al. (2021) in their study about the "effects of OEP on falls, balance and physical performance in nursing home residents at high risk of falls" obtained a sample of 72 people over 65 years of age who were randomly including the OE group and the walking or control group. The first group performed 45 minutes of OE, 3 days a week for 12 weeks. The walking group participated for a minimum of 30 minutes, 3 times a week during the same intervention time related to the first group. As evaluation means, the Berg balance scale, the 30-s support test and the 6-minute walk test were used.

The objective of the present research work was to reduce the risk of falls in elderly people living in the rural community through the application of an Otago exercise program adapted to balance. The geographical conditions of the participants' homes were analyzed and the work was carried out on irregular surfaces typical of their territory.

METHODOLOGY

The present research presented a descriptive observational methodology with a quantitative approach with longitudinal intervention. It was applied in the care unit of 40 older adults without disabilities "Leaving traces with gold in their hearts" belonging to the "Aging Together" project of the Ministry of Economic and Social Inclusion in the San Fernando parish, Ambato city, province of Tungurahua. . The OE program adapted to balance was applied under the home care modality in a period of 12 weeks. Two interventions were carried out per week with duration of approximately 45 minutes each. The modification of the OEP used the adaptations implemented in previous research that addressed the effectiveness of a targeted exercise intervention to reverse mild balance dysfunction in older adults where changes were made to the original OEP and implemented a visual information kit of Vestibular and Balance Exercises (Yang et al., 2012). It was reviewed and validated by experts.

To select the study population, two inclusion criteria were applied: the score of 5 or more on the Katz index of independence in activities of daily living and the range of 65 to 80 years of age. The exclusion criteria include older adults with palliative care, uncontrolled hypertension (systolic pressure greater than 160 mmHg) and sensory deficiencies that affect communication with the professional. To corroborate the information, a data collection form validated by 3 family doctors from the Type B Pasa Health Center was applied.

Of the 40 members belonging to the study population, 15 older adults did not meet the inclusion criteria. Of the total number of selected participants, 16 men and 9 women were found to have completed the Otago exercise program adapted

to balance. An evaluation was carried out at the beginning and at the end of the intervention with the Timed Up and Go (TUG) tests as an evaluator of the risk of falls in the elderly (Buisseret et al., 2020). It has a sensitivity of 0.74 and a specificity of 0.31 (Barry, E, et al., 2014). During its application, participants were asked to get up from a chair, walk and cross a 3-meter mark on the floor with a normal step, then turn, walk back to the chair and sit down. The time in which the participant took off their buttocks from the chair without supporting themselves with his hands until they sat down again was timed (Christopher et al., 2021). The Single Leg Stance Test (SLST) assessed single-leg dynamic balance in relation to the risk of falls, presenting a sensitivity of 0.33 and a specificity of 0.712 (Omaña et al., 2021). For its application, the time that the older adult remains on one foot with their eyes open and their hands located on the hips without losing balance was timed and the test was repeated three times and the average was taken between the attempts (Cederbom & Arkkukangas, 2019). The interpretation of results was carried out based on the normative values for the SLST with eyes open and closed developed by (Springer et al., 2007).

Throughout the intervention, it began with warm-up and flexibility exercises that took an estimated application time of 10 minutes. This phase focused on cervical, trunk and lower extremity mobility. The muscle activation exercises were applied only to the lower limbs during the first two weeks for an approximate time of 20 minutes. The number of repetitions for each series performed increased progressively. From the third to the eighth week, muscle strengthening with EO was applied. Each session lasted 45 minutes while the dosage and intensity of the exercise increased according to the progress of the program. Mini squats, back squats, and front walking with light turns were developed. The exercises that used weight were the calf raise, lateral walk, toe walk, heel walk, posterior heel walk, and tandem walk. Finally, the exercises focused on Otago balance work were developed over the last three weeks, each session lasted approximately 50 minutes and their difficulty increased gradually. The same exercises from the strengthening phase were used, but the use of weight was replaced with the elimination of the participants' visual field (blindfolded) (Kocic et al., 2018).

Information processing was carried out with the Student T test. The statistical analysis of the results obtained was processed through the Windows operating system using the IBM SPSS STATISTICS 20 program. The information obtained was indexed in the Microsoft Office Excel application. Participants' results are protected under alphanumeric encryption without revealing personal information data. The ethics committee of the Technical University of Ambato approved the application of this research under resolution n° 031-CEISH-UTA-2023.

Within ethical and gender considerations, the study population was analyzed and particular cases of indigenous women participants were identified who were respectfully asked to wear lycra pants underneath their traditional clothing.

RESULTS AND DISCUSSION

Within the analysis of the results of the study population during the course and completion of the intervention with the OEP adapted to balance, the following were identified:

Sociodemographic data

Table 1: Sociodemographic characteristics of the elderly in the care unit "Leaving footprints with gold in your heart"

Variable		Frequency	Percentage (%)
Gender	Female	9	36
	Male	16	64
	Total	25	100
Ethnicity	Indigenous	11	44
	Half Blood	14	56
	Total	25	100

In relation to 100% of participants included in the research, 64% belonged to the male gender and 36% to the female gender. Regarding ethnicity, it is evident that 56% of the elderly identified themselves as mestizos while 44% as indigenous population (Table 1).

Timed up and go

When reviewing the results obtained before and after the intervention with the TUG, it was evident that the high risk of falls in the study population was eliminated. In relation to the slight risk of falls, it decreased from an initial 68% to a final 44%. Meanwhile, the percentage of older adults who no longer present a risk of falls increased significantly from an initial 12% to a final 44% (Table 2). It shows that the intervention with OEP adapted to balance significantly reduced the risk of falls in the elderly.

Table 2. Initial and final evaluation of the elderly in the care unit "Leaving traces with gold in your heart" with the Timed up and go (TUG) test.

	INITIAL TUG		FINAL TUG	
VARIABLES	Frequency	Valid percentage (%)	Frequency	Valid percentage (%)
NORMAL	3	12	11	44
SLIGHT RISK OF FALLS	17	68	14	56
HIGH RISK OF FALLS	5	20		20
Total	25	100	25	100

Single leg stance test

When analyzing the results obtained before and after the intervention with the SLST, it was verified that the percentage of the population that did not present a risk of falls and was in normal conditions increased from 36% to 64%, while the population that presented a risk of falls decreased from 64% to 36% (Table 3). For this reason, it was evident that the intervention with OEP adapted to balance significantly reduced the risk of falls in the elderly.

Table 3. Initial and final evaluation of the older adults of the care unit "Leaving traces with gold in your heart" with the Single leg stance test (SLST)

	INITIAL SLST		END SLST	
VARIABLES	Frequency	Valid percentage (%)	Frequency	Valid percentage (%)
NORMAL	9	36	16	64
PRESENCE OF RISK OF FALLS	16	64	9	36
Total	25	100	25	100

Statistical analysis with the t-student test for related samples of the elderly from the care unit "Leaving traces with gold in your heart" with the TUG and SLSTT tests

Table 4 shows the tests of related samples between the results of the initial and final TUG and SLST based on the management of the risk of falls with the application of the Otago exercise program (OEP) adapted to balance in the elderly. The Student's T test showed a value $p<0.001$ in both tests being less than the alpha value $p<0.05$. For this reason, it was shown that the OEP adapted to balance statistically significantly decreased the risk of falls in the study population.

Table 4. Student T test for related samples of older adults from the care unit "Leaving traces with gold in your heart" with the TUG and SLST tests

Test related samples									
Variables		**Related differences**					**t**	**gl**	**Sig. (bilateral)**
		Half	**Typical deviation**	**Typical error of the average**	**95% Confidence interval for the difference**				
					lower	**upper**			
Pair1	INITIAL TUG FINAL TUG	1.5124	0.49473	0.09895	1.30818	1.71662	15,285	24	,000
Pair 2	RIGHT INITIAL SLST RIGHT END SLST	-2.47800	1.10658	.22132	-2.93477	-2.02123	-11,197	24	,000
Par 3	LEFT INITIAL SLST LEFT FINAL SLST	-1.99400	.99847	,19969	-2.40615	-1.58185	-9,985	24	,000
Par 4	AVERAGE INITIAL SLST AVERAGE FINAL SLST	-2.23600	.71410	.14282	-2.53077	-1.94123	-15,656	24	,000

Discussion

Lytras et al. (2022) in their study "Effects of a modified Otago exercise program administered through outpatient physiotherapy to community-dwelling older adults with falls in Greece during the COVID19 pandemic", showed that when applying the OEP 3 times per weekly during the first 3 weeks and subsequently once a week until completing the 6 months of intervention, a significant reduction of 17.8% was obtained through the TUG in relation to the initial time. It demonstrates that the OEP is beneficial in reducing the risk of falls in the EP. Leem et al. (2019) in their research on the effects of Otago exercise combined with action observation training on balance in older adults, developed 3 times a week over a period of 12 weeks, significantly reduce TUG test times by 4.08 seconds. For this reason, agreement is established with the results obtained with this research. However, it is recognized that by increasing one day of intervention per week, TUG times increased significantly, considerably reducing the risk of falls in the elderly.

Martins et al. (2018) in their systematic review analyzed several modified OE programs adapted to the needs of the EP in which they added vestibular exercises, multisensory balance exercises at home and augmented reality exercises where they used tests that evaluated balance, gait and the risk of falls. It was evident that the modifications made to the OEP generated better benefits in relation to the original program, presenting a relationship with the findings obtained with the OEP adapted to balance. Kozinc et al. (2020) conducted a study addressing the effectiveness of the Otago group exercise program on physical function in nursing home residents aged 65 years and older. Physical function was assessed at baseline, 3 and 6 months after OEP using three performance tests: Berg balance scale, TUG and the chair rise test. Participants were randomly assigned to an experimental group and a control group. Among the results obtained, the effectiveness of the Otago exercises to improve balance, functional mobility and muscle strength of the lower extremities of older adults was evident. However, the program applied in the present research work obtained better results in the TUG test.

CONCLUSION

With the findings obtained from the final evaluations, it was determined that the risk of falls decreased significantly in the study population after participation in the OEP adapted to balance. The T student statistical test corroborated the data obtained by expressing a p value <0.001. The older adults showed total acceptance and participation in the exercise program applied. The physical activity carried out during the intervention improved the strength and balance of the elderly, which gave them confidence and security when walking. For this reason, it is concluded that the Otago exercise adapted to balance significantly reduces the risk of falls in older adults and is an excellent option for physiotherapy treatment focused on managing this problem.

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