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The Frenkel method for assessing balance in the elderly

El método Frenkel para evaluar el equilibrio en personas mayores

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ABSTRACT

Background: Aging comprises a gradual process of physical, biochemical and psychological deterioration, with alterations in balance, gait, increased risk of falls and the development of secondary diseases to this event. Considering the proposed context, the interest arises to research the Frenkel method and determine the effect on the balance of the elderly of the Association of Telecommunications Retirees of Guayas. A guide of therapeutic exercises to reduce the risk of falls in this population is designed. **Methods:** In this way, the present research is a descriptive observational type due to the characteristics of the population, based on a longitudinal study because measurements were carried out at two different times. That is, before and after the intervention. In addition to a quantitative approach for the analysis, data collection was used. The study was applied to 30 older adults, who met the inclusion criteria, as well as the exclusion criteria. **Results:** A considerable improvement of 4.9% in balance, 5.9% in gait and 40% low risk of falls was evidenced. **Conclusions**: Considering the findings and results of the study, it is concluded that the execution of the Frenkel Method improves balance and gait in older adults. It also reduces the risk of falls, thus avoiding future complications, promoting active and healthy aging.

Keywords: geriatrics; aging; functional status; exercise techniques with movements; position.

RESUMEN

Antecedentes: El envejecimiento comprende un proceso gradual de deterioro físico, bioquímico y psicológico, con alteraciones en el equilibrio, la marcha, aumento del riesgo de caídas y el desarrollo de enfermedades secundarias a este evento. Considerando el contexto planteado, surge el interés de investigar el método Frenkel y determinar el efecto sobre el equilibrio de los adultos mayores de la Asociación de Jubilados de Telecomunicaciones del Guayas. Se diseña una guía de ejercicios terapéuticos para disminuir el riesgo de caídas en esta población. **Métodos**: De esta manera, la presente investigación es de tipo observacional descriptiva por las características de la población, basada en un estudio longitudinal porque se realizaron mediciones en dos momentos diferentes. Es decir, antes y después de la intervención. Además de un enfoque cuantitativo para el análisis, se utilizó la recolección de datos. El estudio se aplicó a 30 adultos mayores, que cumplieron con los criterios de inclusión, así como con los de exclusión. **Resultados**: Se evidenció una mejoría considerable de 4,9% en el equilibrio, 5,9% en la marcha y 40% bajo riesgo de caídas. **Conclusiones**: Considerando los hallazgos y resultados del estudio, se concluye que la ejecución del Método Frenkel mejora el equilibrio y la marcha en adultos mayores. También reduce el riesgo de caídas, evitando así futuras complicaciones, promoviendo un envejecimiento activo y saludable..

Palabras clave: Escoliose; curvatura da coluna vertebral: método pilates; exercício; assimetria.

INTRODUCTION

The gradual, adaptive process, characterized by morphological, physiological, biochemical and psychological modifications in people over 60 years of age, is called aging. It comprises a universal phenomenon, which is the part of the life cycle of all individuals. Currently, around 7% of the world's population is over 65 years of age. This data increases in developed countries, reaching values of up to 15% and increasing over the years. The changes in this period of life intensify the risks of suffering from both acute and chronic diseases, due to the general cellular and molecular deterioration in the body. So those that stand out the most are geriatric syndromes (Rojas et al. 2020).

Evidence demonstrates that physical activity and specifically targeted exercises are effective for the functional recovery of motor abilities that include balance (Abreus et al. 2016). However, in older adults, the implementation of sports strategies should be approached with caution and careful planning to prevent injuries (Vieira Costa & Silva Dias, 2024).

In older adults, falls are very frequent, between 28-35%, people over 65 years of age, have suffered a fall, which increases as age advances. This event is mainly due to alterations in balance, associated with the deterioration in the physiological components that maintain the stability of the body in the face of different stimuli. They include the vestibular, visual and proprioceptive systems.

Falls are the second cause of death due to involuntary trauma worldwide, and those over 60 years of age are the ones who most frequently suffer this event (Díaz J, et al. 2018).

Ecuador does not live in an isolated reality. Thus, through the Health, Wellbeing and Aging survey in 2009, it is evident that 38.7% of older adults between 65 - 74 years old have suffered a fall. This demonstrates the need for timely and comprehensive interventions that act on the factors that contribute to the risk of this decline, such as balance (INEC. Salud, Bienestar y Aging 2009).

One of the recommended methods is Frenkel exercises, since, through concentration, precision and repetition of specific movements, the regulation of this essential activity for independence in life is achieved. (Montero J, et al. 2021)

Considering the proposed context, the interest arises in studying the Frenkel method and determining the effect on the balance of older adults from the Telecommunications Retirees Association of Guayas. A guide to therapeutic exercises to reduce the risk of falls in this population is implemented, improving balance and gait.

Background

Montero, et al. (2021), in their study on "Frenkel exercises in the balance of older adults", mention that loss of balance is a predisposing factor for falls, representing a global health problem. Thus, the fear of falling and the low level of balance makes it difficult to perform physical exercise. However, performing exercises is necessary for motor control. They used a sample of 30 older adults between 65 - 75 years old with balance problems. The Frenkel protocol lasted 30 minutes. During the first month supine exercises were done. In the second month, they were in a sitting position and in the third month in a standing position. Data were collected before and after the intervention by applying the Tinetti Test. The research results establish an improvement in balance and a significant decrease in the risk of falling after the intervention. Therefore, Frenkel exercises are effective in older adults to improve balance.

Rojas, et al. (2020), in their study on "Physical activity and successful aging: considerations of a necessary relationship", highlight that aging is a universal process, which leads to a deterioration in health that constitutes a multiple risk factor. From this idea, the authors started to assess the different forms of contribution of physical exercise to the aging process, through a review study. Thus, they have been able to corroborate that, in general, physical activity can be a resource to preserve health and maintain independence in older adults free of disability. Its habitual and oriented practice can generate aging with energy, motivation to carry out activities, as well as reduce the risk of diseases. Exercise, as a type of physical activity, helps prevent diseases, and serves as support in the reestablishment of habits. Therefore, its constant practice could prolong life and improve quality of life. Physical activity programs must be perfected to offer methodological indications regarding the evaluation of physical condition, as a basic cognitive element on an individual and group basis.

Filar, et al. (2020), in their study on the "Effect of different forms of physical activity on balance in older women", emphasize the deterioration of body and functional systems that comes with age. In this way, physical exercises improve the state of muscle strength, elasticity, balance and coordination. Therefore, the authors proposed to analyze the effect of two types of physical activity, dance and general exercises, on balance in older women; through a randomized study in 39 women, who attended 45-min DMT sessions (n=20) and GRE (n=19) 3 times a week, for 3 months. They were assessed before and after training with the Postural Stability Test. The results confirmed the improvement in balance in the groups. Thus, they conclude that both dance and exercises can improve balance skills and reduce the risk of falls in older adults.

Abreus, et al. (2019), in their study "Evaluation of physical balance capacity in older adults", consider that alterations in gait and balance in the elderly represent the main cause of falls. The development of valid assessment methods is essential as well as to identify in a timely manner the main cause of falls. Consequently, we proposed to determine the relationships of some indicators of the Fullerton advanced balance scale test and age in older adults through an exploratory, descriptive and cross-sectional study, of 115 older adults, who were selected by age and sex. 4 of the 10 items were taken that applied the Spearman correlation coefficient and the Gamma coefficient, with a confidence level of 95%. The results show that the most representative group was 71 to 75 years old, with a prevalence of 16% of men. In the Fullerton test, older adults managed to maintain balance in standing in more than 25% of cases. They were able to take the object without moving their feet or by taking a step. In the orthostatic control, the highest values are concentrated in the group aged 71 to 75 years. In this way, the authors conclude that there is a certain deterioration in the physical capacity of balance, inability to execute certain actions, and affirm that older adults who remain physically active as they age retain a higher level of orthostatic control.

METHODOLOGY

The research was descriptive, observational and longitudinal cohort, under a quantitative approach. Based on an analysis of scientific information, the risk of falls in the population was evaluated using gait and balance indicators obtained through the Tinetti scale. A Frenkel exercise guide was applied, which was reviewed and validated by expert judgment.

To validate the guide, a questionnaire was designed that consisted of 12 questions distributed in 4 dimensions (general, format, culture, grammar and writing), which was applied to three experts with experience on the subject. The rating scale of the items was structured based on the Likert recommendations for their acceptance (1 Very low, 2 Low, 3 Medium, 4 High, 5 Very High). With the scores obtained, the content validation coefficient (CVC) suggested by Hernández Nieto (2011) could be calculated, which allowed the CVC degree to be assessed among the experts. Thus, 0.96 per item and overall was obtained, which is considered excellent and allowed the exercise guide to be applied to the population.

The study was carried out in the Association of Telecommunications Retirees of Guayas (ASOJUSTEL) located in the city of Guayaquil, Province of Guayas - Ecuador, with a population of 123 members. The selection of participants was carried out based on the application of inclusion criteria: men and women aged 65 to 80 years, individuals with functional independence as well as autonomy to carry out activities. They signed the informed consent. The exclusion criteria were: old people who present cognitive impairment, acute or chronic respiratory diseases, urinary or fecal incontinence, those who did not sign the informed consent. In this way, a census sample of 30 older adults was reached.

Two measures of the risk of falls were made in the participants, based on the measurement of balance and gait using the Tinetti scale; applied before and after the intervention. The results allowed us to obtain information that was analyzed clinically and statistically to assess differences.

The Tinetti scale, through two observational subscales (gait and balance), allows measuring the risk of falls presented by older adults; being an instrument validated in Spanish and with an interobserver reliability of 0.4 to 0.6, intraobserver reliability of 0.6 to 0.8; reliability of 0.91 in Cronbach's Alpha (Tinetti, et al. (1986). It was considered the ideal tool to measure the risk of falls and also obtain a perspective of the state of balance and gait of the population. The evaluator begins by asking the patient: Are you afraid of falling? and continues with the tests. The scale lasts approximately 8 to 10 minutes. To assess the balance subscale, the evaluator must remain standing next to the person; while in the walking subscale the patient must walk behind the person.

The first subscale assesses balance, both dynamic and static, in 9 tests totaling 16 points. The second subscale corresponds to gait and includes 10 tests, which are a total of 12 points. In this way, when adding the subscales, a total of 28 points is obtained. The results should be interpreted according to the following scale:

High risk of falls (<19)

Low risk of falls (19 to 23)

Slight risk of falls (>24)

With the results of the initial evaluation applied before the intervention, the most appropriate and relevant Frenkel exercises for the population were selected; considering that there was an important need to program the exercises progressively (from least to greatest difficulty) and avoid overexertion (exercises with load). The intervention lasted 9 weeks with a frequency of 3 times per week, and a session time of 45 min.

The exercises were programmed in 3 phases: supine - prone, sitting and standing.

The materials used were: mats for recumbency, chairs for sitting and balls for balance exercises while standing.

The information obtained from the balance measurements was processed through the IBM SPSS statistical system Version 29.0, the results were presented in frequency, percentages and tables.

The research was carried out with the approval of the Human Research Ethics Committee of the Faculty of Health Sciences of the Technical University of Ambato, with code 024-CEISH-UTA-2023. Ethical considerations were taken into account, as well as authorization from the president of the Guayas Telecommunications Retirees Association. The members were informed about the research process, intervention, and the benefits of their participation. In this way, once the older adults decided to contribute, they signed the informed consent freely and voluntarily.

RESULTS AND DISCUSSION

In the initial evaluation of balance according to the Tinetti scale, in sitting balance, 53% of older adults from the Telecommunications Retirees Association lean or slide in the chair and 47% remain safe. When getting up, 40% were unable to do so without help, 37% did so using their arms as help and only 23% demonstrated the ability to get up without using their arms. In the attempts to get up, 50% were unable to stand up without help, 47% were able but needed more than one attempt and only 3% were able to do it on the first attempt. In immediate balance when standing up, 47% of older adults presented instability by staggering or moving their feet, while the remaining 53% presented stability, but using a walker, cane or crutch. In standing balance, 47% had instability and the remaining 53% were stable, worse with an increase in the base of support. In the push response, 53% of older adults tended to fall and 47% staggered, held on, but maintained the position alone; In the eyes closed test, 50% were unstable and the other 50% stable. In the 360º turn they had 63% discontinuous steps and 37% continuous steps; Furthermore, 60% rotated unstably and 40% rotated stably. Finally, when sitting, 27% demonstrated insecurity, 43% used their arms or did not have a smooth movement and only 30% demonstrated turning safely, with a smooth movement. Table 1 shows a summary of these findings.

Table 1. *Initial balance assessment*

Scores	**0**		**1**		**2**		**Total**
BALANCE	**Fr**	**%**	**Fr**	**%**	**Fr**	**%**	
Sitting balance	16	53.00	14	47.00	-	-	100.00
Get up	12	40.00	11	37.00	7	23.00	100.00
Attempt to get up	15	50.00	14	47.00	1	3.00	100.00
Immediate balance upon standing up	14	47.00	16	53.00	0	0.00	100.00
Standing balance	14	47.00	16	53.00	0	0.00	100.00
Push	16	53.00	14	47.00	0	0.00	100.00
Closed eyes	15	50.00	15	50.00	-	-	100.00
360º turn	19	63.00	11	37.00	-	-	100.00
	18	60.00	12	40.00	-	-	100.00
Sitting	8	27.00	13	43.00	9	30.00	100.00

Note. Authors' development

In the initial evaluation of walking according to the Tinetti scale, at the beginning of walking 37% of older adults hesitate and 63% start without hesitation. In the length test, the right foot surpasses the left foot with the step in 50% of older adults and the remaining 50% does not; and at the height of the step, the right foot is completely lifted off the ground in 60% and not in 40%; while in the left foot in the length of the step, 43% of older adults do not exceed the left foot over the right and 53% do. Likewise in the step height in the left foot, 67% do not completely separate of the floor while 33% do. In the symmetry of the steps, 53% have a difference in the length of the step between the right and left foot while and 47% maintain steps of equal lengths between the feet.

In the continuity of steps, 70% have a discontinuity in steps or stopping when walking and 30% maintain continuous steps. In the trajectory, 20% of older adults demonstrate a marked deviation, 60% moderate or medium deviation and the remaining 20% maintain a straight gait. In the trunk, 33% reflect a marked sway, 37% do not sway, but present knee or back flexion, and the remaining 30% do not sway, flex, or use aids. Finally, in the posture during walking, 43% keep their heels apart and 57% walk with their heels almost touching. Table 2 shows a summary of these findings.

Table 2. Initial gait evaluation

Scores	0		1		2		Total
GAIT	**Fr**	**%**	**Fr**	**%**	**Fr**	**%**	
Start of march	11	37.00	19	63.00			100.00
Right foot complete ground clearance	12	40.00	18	60.00			100.00
Left foot complete ground clearance	20	67.00	10	33.00			100.00
Right foot surpasses the left	15	50.00	15	50.00			100.00
Left foot surpasses the right	14	47.00	16	53.00			100.00
Symmetry of the step	16	53.00	14	47.00			100.00
Continuity of steps	21	70.00	9	30.00			100.00
Trajectory	6	20.00	18	60.00	6	20.00	100.00
Trunk	10	33.00	11	37.00	9	30.00	100.00
Walking posture	13	43.00	17	57.00			100.00

Note. Authors' development

Initial fall risk assessment

According to the Tinetti total scale that measures the risk of falls based on the assessment of gait and balance; 28 of the 30 participants, representing 93%, demonstrated a high risk of falling; while 2 participants corresponding to 7%, a medium fall risk. The data reflected a considerable alteration in the balance and gait of the older adults. It is evident that there is a high risk of falls in this study group, suggesting the development and application of an urgent physiotherapeutic intervention that mitigates this problem. Table 3 shows a summary of these findings.

Table 3. *Initial results of fall risk*

Tinetti test	Initial evaluation	
Risk of falls	**Fr**	**%**
Medium risk	2	7.00
High risk	28	93.00
Total	30	100.00

Note. Authors' development

RESULTS OF THE COMPARISON BETWEEN MEASURES

Clinical comparison between measures of balance and gait

In the clinical comparison between balance and gait measurements applied to 30 older adults, differences between the means can be observed. It can be seen that the initial evaluation of balance, the average was (**μ**5.73) which increases in the final evaluation, achieving an average of (**μ**13.3), showing an improvement in the balance of older adults. Similarly, in the initial evaluation of the brand, an average of the initial evaluation of (**μ**5.93) and after the intervention this average increase reaching a value of (**μ**10.83), which reveals an improvement in the gait of older adults. Regarding the standard deviation of the evaluation of the initial equilibrium of (**Ʊ**2.31834265) and in the final evaluation of (**Ʊ**1.4656699786). On the other hand, the initial evaluation of gait a standard deviation of, (**Ʊ**2.14850924) and end of (**Ʊ**1.019916607); which reveals that, in the two measurements, both in balance and gait, the data did not have great variability in relation to the average; considering the improvement in balance and gait as a general response in the study population, after the application of Frenkel exercises. Table 4 shows a summary of these findings.

Table *4.* Clinical comparison between measures of balance and gait

Measures	μ (Mean)	Ʊ(UNVEST)
Initial Balance	5.733333333	2.31834265
Final Balance	13.3	1.465699786
Initial gait	5.933333333	2.14850924
Final gait	10.83333333	1.019916607

Note. Authors' development

Clinical comparison between measures of fall risk

Differences were obtained in the comparison of the results from the measures of the risk of falls in older adults, which were obtained from the initial evaluation and the final evaluation after the physiotherapy intervention through the application of the Tinetti Test. 2 older adults represented 7% of the population at medium risk and 28 older adults represented 93% at high risk; 60% of the population became at medium risk and the remaining 40% at low risk of falls. In this way, an improvement in balance and gait is seen, reflecting a decreased risk of falls, according to the Tinetti scale. Table 5 shows a summary of these findings.

Table 5. Clinical comparison between measures of fall risk

Tinetti test Risk of falls	Initial evaluation Frequency %		Final evaluation Frequency %	
Low risk	0	0.00	12	40.00
Medium risk	2	7.00	18	60.00
High risk	28	93.00	0	0.00
Total	30	100.00	30	100.00

Note. Authors' development

Statistical comparison between measures of balance and gait

For statistical comparison between balance and gait measurements, the Student's t test for related samples was used, obtaining a p value of 0.000 in both dimensions. It demonstrated significant differences between before and after the Frenkel exercises, since a lower alpha value (0.05) was obtained. Table 6 shows a summary of these findings.

Table 6. *Statistical comparison between measures of balance and gait*

	Related differences					t	gl	Sig. (bilateral)
	Half	Typical deviation	Typical error of the average	95% Confidence interval for the difference				
				Lower	Upper			
Balance Last initial	-7.56667	1.85106	.33796	-8.25787	-6.87547	-22,389	29	,000
March Last initial	-4.90000	1.98876	.36310	-5.64262	-4.15738	-13,495	29	,000

Note. Authors' development

Statistical comparison between measures of fall risk

For statistical comparison between measures of fall risk, the Wilcoxon rank test was used; obtaining a p value of 0.000. It showed significant differences between before and after the application of the Frenkel exercises, since a lower alpha value (0.05) was obtained. Given that significant differences were obtained between measurements in balance, gait and risk of falls, the research hypothesis can be accepted. And after the application of Frenkel's exercise guide, the state of balance and gait improved, reducing the risk of falls in older adults. Table 7 shows a summary of these findings.

Table 7. *Statistical comparison between measures of fall risk*

	Initial Tinetti - Final Tinetti
Z	-4,964b
Asymptotic sig. (bilateral)	,000

to. Wilcoxon signed rank test
b. Based in the positives ranks.

Note. Authors' development

Discussion

Aging is a natural process that includes a series of physiological changes that, over the years. It generates progressive functional deterioration in the body, which can lead to mobility problems, cognitive dysfunction, decreased balance, alterations in coordination, among others. This increases the risk of suffering from diseases or falls. Since one of the main

causes of falls in older adults is loss of balance, the initial evaluation reflects a high risk of falls in 93% of the population measured through the Tinetti Scale. Particularly in the balance and gait tests, low average scores of 7/16 and 6/12 respectively were obtained. These results are similar to those found by Menéndez et al. (2021) where adults over 70 years of age demonstrated alterations in ambulation (OR: 17.9; 95% CI: 7.1- 45.3) and a high risk of falling (OR: 6.4; 95% CI: 3.8 – 10.8).

In comparison of the results obtained from the measures of balance, gait and the risk of falls in older adults, differences were found both before and after the application of the guide. Thus, an improvement in balance is seen, going from 5.7 to 13.3 points, as well as in gait, going from 5.9 to 10.8 points. It shows a gain of 4.9 points in balance and 5. 9 in gait. Regarding the risk of falls, 7% of the population had medium risk and 93% had high risk. 60% of the population became at medium risk and the remaining 40% at low risk of falls.

These findings are similar to the results of studies carried out by Montero et al. (2021), where in a group of older adults, their balance improved and the risk of falls decreased. Significant differences between measurements of 0.018 and 0.004 were found after the application of a Frenkel exercise protocol for 3 months and 30 minutes per session and a progression of supine exercises in the first month, in sitting position in the second month and in standing position in the third month.

Carballo, A. et al. (2018) found a high risk of falls in 81.3% of institutionalized older adults and a dependence on technical assistance for ambulation of 100%.

Likewise, statistically significant differences were found between measures of balance (0.000), gait (0.000) measured with the Student's t test and risk of falls (0.000) measured with the Wilcoxon rank test. In this way, the clinical improvement in balance and gait is verified. It reflected a decrease in the risk of falls after applying the exercise guide based on the Frenkel Method.

Likewise, Bharathi et al. (2016) demonstrated the effectiveness of Frenkel exercises (0.001) compared to general exercise (0.23). In a comparative study in Parkinson's patients over 50 years of age, significant differences were obtained in favor of Frenkel after 8 weeks of intervention. On the other hand, in the study by Yesil, H., where he compared the effects of proprioceptive Neuromuscular Facilitation PNF versus Frenkel exercises in postmenopausal women, the two programs had significant effects $p<0.05$ on balance parameters, risks of falls and quality of life. But considering that Frenkel exercises are cheaper and require less skill in their development, the author believes that they may be more accepted. In this way, it can be said that Frenkel exercises can be applied to improve balance and stability, reducing the risk of falls in older adults.

CONCLUSION

Although information on the effect of the Frenkel Method on the balance of older adults is limited, the results of different studies have shown to be effective compared to other techniques or exercise in general. Due to its easy application and low cost, the need for its implementation in this age group is required.

The evidence suggests programs with a duration between 2 weeks and 6 months, the most effective being the interventions that last 8 weeks. It is recommended a frequency between 2 and 3 times per week and a duration per session of 10 to 45 minutes. The benefits are not only reflected in the improvement of balance, gait and decreased risk of falls but also in the increase in flexibility, strength and coordination.

At the end of the research, it can be seen that the risk of falls also decreased in the entire population, going from a high risk to a medium and low risk.

Considering the findings and results of the research, it is concluded that the execution of the Frenkel Method improves balance as well as gait in older adults. It also reduces the risk of falls. And in this way, future complications are avoided and active and healthy aging are promoted.

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