

## Training program focused on tasks aimed at promoting sustainable balance management in elderly individuals

Programa de formación centrado en tareas dirigidas a promover la gestión sostenible del equilibrio en personas mayores

**Vanessa Maribel Valencia Muñoz**

Technical University of Ambato. Master in Neuromusculoskeletal  
vvalencia0715@uta.edu.ec  
<https://orcid.org/0009-0006-7011-7601>

**Gabriela Estefanía Robalino Morales**

Technical University of Ambato  
ge.robalino@uta.edu.ec  
<https://orcid.org/0000-0002-9301-3411>

### ABSTRACT

**Background:** physical performance deteriorates over the years, due to the disuse of the musculoskeletal system, predisposing to balance and gait problems. During the development of the research the priority attention group-elderly population. **Objective:** to implement physical activity, prevention of sedentary lifestyle, through exercise it was possible to improve balance with the implementation of a double and simple task exercise program due to the consequences generated by dependence in older adults regarding physical, psychological and social health, in which older adults have been found to lose their independence. **Methods:** the research was descriptive based on the qualitative, cross-sectional approach in which an initial and final evaluation of the Tinetti test was performed, then the exercise program was executed for 16 weeks, lasting 10 to 45 minutes for each exercise. **Results:** there was a predominance of 63.3% to the female gender and 36.7% male gender, with the significant verification ap value of ( $p>0.039$ ) was obtained in the test; being less than alpha ( $p<0.05$ ) rejecting the null hypothesis. **Conclusions:** the double and simple task exercise program was systematically applied to the entire sample population, which through its intervention is concluded to give the expected results verified with the Initial and Final Tinetti Test there is a finding of great importance improving balance and avoiding the risk of falls in older adults.

**Keywords:** training program, balance, sustainability, elderly, prevention;

### RESUMO

**Antecedentes:** o desempenho físico se deteriora com o passar dos anos, devido ao desuso do sistema musculoesquelético, predispondo a problemas de equilíbrio e marcha. Durante o desenvolvimento da pesquisa, o grupo de atenção prioritária foi a população idosa. Objetivo: implementar a atividade física, a prevenção do sedentarismo, por meio de exercícios, foi possível melhorar o equilíbrio com a implementação de um programa de exercícios de tarefa dupla e simples, devido às consequências geradas pela dependência em idosos em relação à saúde física, psicológica e social, em que se constatou que os idosos perderam sua independência. Métodos: a pesquisa foi descritiva com base na abordagem qualitativa e transversal, na qual foi realizada uma avaliação inicial e final do teste de Tinetti e, em seguida, o programa de exercícios foi executado por 16 semanas, com duração de 10 a 45 minutos para cada exercício. Resultados: houve uma predominância de 63,3% para o gênero feminino e 36,7% para o masculino, com a verificação significativa do valor ap de ( $p>0,039$ ) obtido no teste; sendo menor que o alfa ( $p<0,05$ ) rejeitando a hipótese nula. Conclusões: o programa de exercícios de tarefas duplas e simples foi aplicado sistematicamente a toda a população da amostra, que, por meio de sua intervenção, concluiu-se que deu os resultados esperados, verificados com o Teste de Tinetti Inicial e Final, e que há um achado de grande importância para melhorar o equilíbrio e evitar o risco de quedas em idosos..

**Palavras-chave:** programa de treinamento, equilíbrio, sustentabilidade, idosos, prevenção.

### INTRODUCTION

According to the WHO, one of the reasons why aging has become a key political issue is that both the proportion and the absolute number of older people are increasing significantly in populations around the world. Currently only one country (Japan) has a proportion greater than 30%. The aging of the population seems less important in Sub-Saharan Africa. It has twice as many older adults as in northern Europe, and it is estimated that this figure will increase faster than anywhere else, since it will go from 46 million in 2015 to 157 million in 2050. (HEALTH, 2015)

The aging of the world population is a phenomenon that will mark the 21st century. On a global scale, every second 2 people turn 60 years old and there are currently 810 million people in the world of that age. In our country, Ecuador, there are: 1,049,824 people over 65 years of age (6.5 of the total population). In 2020, it will be 7.4%. By 2054, it is expected that it will represent 18% of the population. For women, life expectancy will be higher at 83.5 years compared to 77.6 years for men. (SOCIAL, sf).

According to statistics carried out in the INEC census of the year 2010 (Population and Housing Census of the Rural Santa Fe Parish), there is a total population of 1,752 inhabitants, 822 men and 930 women. By age groups, the population between 65 years and older or older adults represents 15.70% of the total population. This group became a growing population segment in recent years, due to the sociocultural and psychological reality. (FE, 2015)

A trial conducted by Dr. Sevil Karagul "The effect of single- and dual-task balance exercises on balance performance in older adult patients with degenerative lumbar spinal stenosis" aimed to compare the effects of balance exercise programs of single task and dual task on the performance of activity-specific balance in adults with LSS. The research had a sample of

43 patients with LSS over 65 years of age in which they were divided into two groups: group one in training single-task balance training and group two dual-task balance training. It had a difference that group two had balance exercises accompanied by cognitive tasks, assessed with Berg Balance Scales (BBS), Timed Up and Go test (TUG) and the 10-meter walking test. Tinetti's balance and gait test at the beginning and end of four weeks, resulted in the one- and two-task exercises significantly improving static and dynamic balance and especially confidence in Specific activity balance in older adults with spinal stenosis. (Karagül, 2023)

According to David Conradsson in his essay entitled "The effects of dual-task balance training on gait in older women with osteoporosis" there is a growing body of literature showing promising effects of balance training on gait in older adults. However, little is known about the effects of dual-task training in various domains of spatial and temporal parameters of gait. For this reason, a trial was carried out with 68 women with osteoporosis who experienced fear of falling in the last 12 months. During 12 weeks, they received balance and walking exercises three times a week, with double tasks and the control group received a usual task. Conclusion: the cognitively demanding balance exercise training program found greater training effects in a variety of domains of dual-task gait compared to single-task gait. (Conradsson, 2019)

As stated by Karen Rodríguez, the increase in the population aged 60 and older requires special attention, given the fragility that characterizes it and the appearance of chronic diseases and disabilities derived from the aging process. The study they carried out confirmed that physical activity is an effective and low-cost strategy, which entails enormous social and psychological benefits. It helps to counteract all the problems that arise from a sedentary lifestyle and chronic diseases, which is typical of older people. Physical activity is capable of slowing or controlling the aging process and chronic non-communicable diseases, as it positively affects the cardiovascular system, blood composition, musculoskeletal system, mental health, weight and general well-being of the elderly. Health disorders and problems that this population generally faces can be counteracted if factors such as lifestyle are controlled. Among the physical activity programs for the elderly are prophylactic and therapeutic programs for various diseases such as: high blood pressure, obesity, bronchial asthma, diabetes, respiratory problems, and heart problems. (Martinez, 2020)

For this reason, the objective of this research was to implement an exercise program for balance management in older adults in the Santa Fe Parish.

## METHODS

The research study had a quantitative approach. Numerical data was collected which helped to verify numerically in the implementation of a dual and single task exercise program for balance management in older adults. And it is cross-sectional since the information collected was analyzed during the execution time of the study in the aforementioned population.

The present research work was carried out in zone 5 belonging to the Guaranda District, which is located in the Bolívar Province, Guaranda Canton, Santa Fe Parish, Ecuador, in the "Caritas Alegres" Home Care Program of the Aging Together Project validated by the State Government of Ecuador. The unit is located 10 minutes from the capital, a parish of people mainly dedicated to agriculture and where there is a larger population of elderly people in extreme poverty. It is comprised of 30 elderly adults, from 65 to 90 years old, men and women, people who have suffered a fall without complications, who have a history of balance deficit. The implementation of the dual and single task exercise program for balance management was carried out, for which it began with the application of the Tinetti Test as an evaluation instrument which serves to assess balance. It is an instrumental sheet validated by Dr. Tinetti from Yale University, in 1986, with the aim of evaluating the mobility of the elderly. The evaluation scale has two domains: gait and balance, but on this occasion only balance was evaluated. By doing so, it helps to detect those older adults at risk of falls. The evaluation was carried out with an initial evaluation in the first session and a final one that was applied in the second session at 16 weeks. It lasted 30 minutes for each older adult.

The scale is composed of 9 balance items and 7 gait items. The responses are graded as follows:

0, the person who does not achieve or maintain stability in position changes or has an inappropriate gait pattern, according to the different parameters described in the scale, this is considered abnormal.

1, means that the patient achieves the changes, which is called adaptive.

2, a person with position or gait patterns with postural compensations is considered. This condition without any difficulty in executing the different tasks of the scale is considered normal.

The maximum score for balance is 16 and for gait 12. From the total sum a score of 28 is obtained, with which the risk of falls is determined. It is considered that between 19-24 the risk of falls is minimal, less than 19, the risk of falls is high. The validity of the Cronbach scale was 0.95 and a variance of 13.89. It has been demonstrated that the scale is a valid and

reliable tool for the assessment of mobility (r 0.74- 0.93) and inter-reliability (0.95) (Guevara Rodriguez, 2012)

The exercise program was carried out in three stages, with a duration of 16 weeks, distributed as follows: once a week for a period of 40 to 45 minutes per individual. According to the stages and indications established within the program, the different scores from its maximum to its minimum were taken as a reference. Initial stage with 5 exercises that includes from week one. Stage one consisted of 3 exercises with a total of 40 minutes, from week two to week six. Stage two consisted of 5 exercises, which included from the seventh week to the eleventh week. In stage three, older adults performed 3 exercises. The final stage is of 5 exercises.

### **Initial stage (1 week)**

- ✘ Neck movement: Perform up and down, right and left movements and lateral inclination.
- ✘ Neck and head movement: Perform neck movements forward and backward, up and down.
- ✘ Shoulder and arm movement: Perform lateral raising movements of the arms until the hands come together above the head.
- ✘ Wrist and hand movement: Make fist opening and closing movements.
- ✘ Back movement: Standing, tilt the trunk forward and backward, turn the trunk to the right and left.

### **Stage 1 (2 to 6 weeks).**

Getting up from a chair / simple task (10 minutes)

- Put a cushion on the back of the chair.
- Sit at the end or in the middle of the chair, with the knees bent, feet apart and flat on the floor.
- Lie on the cushion, in a "semi-lying" position, with the back and shoulders straight.
- Raise the upper body, trying not to use the hands, until you are sitting upright.
- Stand up slowly, using the hands as little as possible.
- Slowly sit back down.
- Keep the shoulders and back straight throughout the exercise.

Knee extension exercise/simple task (10 minutes)

- Ask the individual to stand behind a firm chair and hold onto a chair or table for balance.
- Give the commands to slowly lift one leg backwards, keeping it completely straight, without bending the knee or pointing the toes.
- Try not to lean the trunk forward.
- Finishing the series, repeat with the other leg.

Knee flexion/simple task (10 minutes)

- Stand in front of a table or the back of a chair and hold on for balance.
- Slowly begin to raise the leg as high as possible, until it reaches the closest to your thigh.
- Do not move the upper leg, just bend the knee.
- Start slowly lowering the leg and repeat the exercise with the other leg.
- Alternate legs.

### **Stage 2 (7 to 10 weeks)**

Leg raises to the sides / simple task (10 minutes)

- Stand behind a table or back of a chair, with the feet slightly apart.
- Hold on to them with the hand or fingers, so as not to lose balance.
- Remain with the back and knees straight throughout the exercise.
- Slowly raise the leg to the side, until it is 15 or 20cm from the ground.
- Hold in this position.

- Slowly lower the leg until you reach its original position.  
Self-loading exercise/simple task (10 minutes)
- Stand behind a chair, feet slightly apart.
- Ask the user to lift the right heel, then the left heel, and finally with both feet.
- Adding more intensity, ask them to place the arms on the waist.  
Lateral movement and ball throwing / double task (10 minutes)
- Stand in front of each obstacle.
- Looking ahead, cross each obstacle laterally.
- When passing each obstacle throughout the exercise, raise the leg to the side.
- When the goal is reached, throw the ball.
- Continue with the return exercise in the same way.  
Lateral movement and ball throwing / double task (10 minutes)
- Stand in front of each obstacle.
- Looking ahead, cross each obstacle laterally.
- When passing each obstacle throughout the exercise, raise the leg to the side.
- When the goal is reached, throw the ball.
- Continue with the return exercise in the same way.

### **Stage 2 (11 week)**

Strength exercise and self-loading of weight / simple task (20 minutes)

- He appears to be facing the wall, placing himself a little further than the length of his arms. Lean her body forward and place her palms flat on the wall at shoulder height.
- Move the body closer to the wall, trying to keep the back straight, and then move away. Optionally, you could increase the load of the exercise, starting with the feet further away from the wall.  
Throwing a towel on an unstable surface (ball)/ double task (20 minutes)
- Ask the individual to stand up.
- Looking ahead, the right leg resting on a ball.
- When passing the towel throughout the exercise, maintain balance.
- When the goal is reached, throw the ball.
- Continue with the exercise by changing the left leg on the ball and perform the exercise in the same way.

### **Stage 3 (11-14 weeks)**

- Double-task lower in front of a table or the back of a chair and hold on for balance.  
Begin to limb coordination and mobility exercises. (20 minutes)
- Stand
- slowly raise the leg as high possible, until it reaches as close to the thigh as possible, moving forward, to the side and back.
- Touch the obstacle that is ahead to the side and behind.
- Start slowly lowering the leg and repeat the exercise with the other leg.
- Alternate legs  
Cross exercise on the floor/double task. ( 10 minutes)
- We ask the individual to stand up.

- We place the left foot forward, or towards the upper quadrant and then return, while the right foot is stable in the lower quadrant.
- We ask you to count from 1 to 10 and when it lands on even numbers, raise your right arm.
- Now we ask you to continue the exercise with your right foot and count the numbers from 1 to 10. When it lands on an odd number, lift the left arm.

Weighted standing exercise/simple task. (10 minutes)

- Ask the individual to sit properly in a firm chair.
- Give commands: sitting in the front half of the chair with arms on the chest.
- Stand with your back straight, use the arms to break inertia.
- Load is added to the exercise using a dumbbell held firmly at chest level.

### **Final stage (15-16 weeks)**

Walking exercise with crossed feet/double task (10 minutes)

- We ask the individual to stand up.
- We tell them to walk with one foot in front of the other in a straight line touching your toe to your front heel.
- While walking he counts from 1 to 20 and from 20 to 1 back and forth.

### **Walking exercise raising knees in the same place / double task (10 minutes)**

- Ask the individual to march in the same place, raising their legs and arms, alternating the movement.
- We give the order to spell words like: winter, onomatopoeia, ENT while raising his legs and arms.

### **Walking exercise with movement/double task (10 minutes)**

- Ask the individual to walk from place to place, raising their knees and arms, alternating the movement.
- We give the order to repeat the tongue twister, while raising his legs and arms, until the tongue twister is finished.

Lateral loading and unloading exercise with obstacle/double task (10 minutes)

- Ask the individual to move by raising their knees over the obstacles on the floor.
- We give the order for them to repeat the days of the week, while raising the knees from side to side, until the tongue twister is finished.

Stationary bicycle exercise and balloon launch. (10 minutes)

- Ask the individual to remain seated in the chair, with their back straight.
- Give orders for the individual to raise the knees above the air in the manner of pedaling the bicycle.
- While performing the movement, begin to throw the balloon against the wall, and grab the balloon, until the order is finished.

### **Statistical analysis**

The SPSS System (Statistical Package for Social Sciences) version was used. The results are expressed in tables with tests on frequency, standard deviation, and percentage. The T-Student's statistical test had a significance of  $p < 0.05$ .

### **Bioethical Considerations**

This research has the approval of the "Human Research Ethics Committee of the Faculty of Health Sciences – Technical University of Ambato, dated 10-28-2022 (second version). The assigned code is 021-CEISH-UTA-2023. Ethical and gender considerations were considered, in which the older adults in the research, after giving their approval, signed the informed consent freely and voluntarily.

## **RESULTS**

The Tinetti Test, which was observational to the older adults of the Care Unit of the Santa Fe Parish, was carried out during a 16-week intervention and the initial and final data were collected. The information obtained at the beginning and at the end of the intervention had the following results:

**Table 1.** Sociodemographic Characteristics of the Elderly at the "Mano Amiga" Unit.

Gender	Frequency	Percentage (%)
Female	19	63.3
Male	11	36.7
Total	30	100.0

**Analysis and Interpretation**

The demographic analysis of the older adults in the research is based on the recovery of data as gender, resulting in the majority of adults with 63.3% corresponding to the female group and 36.7% of the group being male.

**Table 2.** Tinetti Initial- Categorical Results

Tinetti_Total_Initial_Categorical		
Falling risk	Frequency	Percentage (%)
High	11	36.7
Half	19	63.3
Total	30	100.0

**Analysis and Interpretation**

The descriptive data of the two items of Balance and Gait of the Tinetti Total Initial test were analyzed in order to categorize according to the risk of falls. It resulted in that, within the group of older adults in the Care Unit, there is 63.3% within medium risk, followed by 36.7% of adults who are at high risk of falls.

**Table 3.** Final Tinetti Results

Tinetti_Total_Final_Categorical		
Falling risk	Frequency	Percentage (%)
Low	25	83.3
Half	5	16.7
Total	30	100.0

**Analysis and Interpretation**

After obtaining the final results of the Tinetti Test with its two items applied to older adults already in the last week of the exercise program, a great difference in the values is observed. The results were 83.3% with a low risk of falls and 16.7% of adults in the care unit with a medium risk of falls.

**Table 4.** Initial and Final Fall Risk Score Variation.

Punctuation	Tinetti Initial Total		Tinetti Final Total		
	Risk of falls	Frequency	Percentage (%)	Frequency	Percentage (%)
< 19	High	11	36.7		
19-24	Half	19	63.3	5	16.7
25-28	Low			25	83.3
Total		30	100.0	30	100.0

**Analysis and Interpretation**

The present statistical comparison table in the initial and final application of the Tinetti Test shows a finding of differences with the reduction in the risk of falls. 83.3% show that older adults have a low risk of falling followed by 16.7% with a medium risk of falling, while in the initial test it indicates that the population had a medium risk of falling with 63.3% followed by 36.7% at high risk of falling.

**Table 5.** Analysis of the Hypothesis with the T-Student statistic

Independent Samples Test		Levene's test for equality of variances		T test for equality of means						
		F	Next	t	GI	Sig. (bilateral)	Mean difference	Standard error difference	95% confidence interval of the difference	
									lower	Superior
Numeric Tinetti_Final Total	Equal variances are assumed	.670	.420	-2,164	28	.039	-108,612	.50195	-211,433	-.05792
	Equal variances are not assumed			-1,996	16,441	.063	-108,612	.54424	-223,736	.06511

### Interpretation

The present investigation consists of sampling of the initial and final descriptive Tinetti Test for the comparison of balance management. The T-Student's test was used for related samples, since it is a numerical variable and a p value of 0.039 was obtained, being less than alpha ( $p < 0.05$ ). Therefore, the research hypothesis can be accepted and the null hypothesis rejected. Thus, it can be said that there is a significant difference in relation to before and after applying the dual- and single-task exercise program for balance management in older adults.

## DISCUSSION

The purpose of this research was to improve balance in older adults with the implementation of a dual- and single-task exercise program from 65 to 90 years of age who are part of the "Caritas Alegres" Home Care Unit of the Santa Fe Parish, Bolívar Province, Guaranda Canton, Ecuador. The Initial and Final Tinetti Test was applied, where several results were observed.

Through the results obtained in the research, it was possible to conclude that, when applying the evaluation instrument, the initial Test showed results of 63.3% within medium risk, followed by 36.7% of adults who are at high risk of falling and the final evaluation with 83.3% with a low risk of falls. 16.7% of the adults in the care unit presented a medium risk of falls, throughout the dual or single task exercise program, with a duration of 16 weeks. The results have proven that there is an improvement in avoiding the risks of falling in older adults. The program has been effective compared to a study by Yuzlu V, et al, where in a trial carried out on 58 participants, older than 65 years old, with a dual-task training (IDTT) group (n=29) and a consecutive dual-task training (CDTT) group (n=29), balance exercises and cognitive tasks that were performed simultaneously by the IDTT group and consecutively by the CDTT group for 8 weeks, there was no significant difference nor was it statistically different. Therefore, it can be concluded that consecutive dual-task balance training can be used as an alternative to increase balance.

In the research, findings were obtained using the T-Student's test for related samples, given that it is a numerical variable and a p value of 0.039 was obtained in the test. As it was less than the alpha ( $p < 0.05$ ), the research hypothesis can be accepted and the null hypothesis rejected. Thus, it can be said that there is a significant difference in relation to before and after applying the dual- and single-task exercise program for balance management in older adults. Regarding the CHI-SQUARE statistic there is a significant difference between the expected and observed results using a non-parametric test that examines the differences between categorical variables in the same population. Given that the chi square value of 0.236 is greater than ( $p > 0.05$ ), we can affirm that there are no differences between men and women within the study.

A study conducted in a trial by Karagul S, et al, with a sample of forty-three patients randomly divided into 2 groups as single-task balance training (group1, n=21) and dual-task balance training (group 2, n=22), the exercises were performed in group 1, only exercises in a single task condition, group 2 performed balance exercises accompanied by cognitive tasks. These exercises showed results of a difference in favor of a training group dual-task in the 10-meter walk test performed separately in the single-task and dual-task training group ( $p < 0.05$ ). The differences in data and ABC between the groups ( $p > 0.05$ ) were compared. There was significantly improved static balance, dynamic balance and confidence in activity-specific balance in older adults.

## CONCLUSIONS

Defining the type of single and double task exercises to integrate into the program allowed improving balance in the older adults of the Unit. It met all the parameters of exercise type, duration and series.

Results were obtained at the beginning and end of the program, with initial and final findings of fall risks. The Tinetti Test was applied, which demonstrates that the exercises applied to older adults helped to improve balance. The double and simple task program was applied systematically to the entire sample population.

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