# 5 - COMPARISON OF THE LEVELS OF STATIC AND DYNAMIC BALANCE IN OLDER ADULTS ENGAGED OR NOT ENGAGED IN A PHYSICAL ACTIVITY PROGRAM

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## INTRODUCTION

The increase of the old adult population is a trend worldwide and, in Brazil, it is estimated that the percentage will exceed 13% of the population. Therefore, aging has been the subject of numerous studies in several areas. Regular physical activity is crucial in the prevention of the functional loss that accompanies the aging process. Balance is a physical quality of great importance not only for athletes but also for the elderly population, because most daily activities require static and dynamic balance, and the elderly who have low levels of balance are more prone to falls. (AUTHOR , YEAR).

Several studies have found that physical exercise may contribute to increased levels of static (AUTHOR, DATE) and dynamic (AUTHOR, DATE) balance of old adults (author, date). However, this is not a consensus in the scientific literature ( AUTHOR, DATE). Factors related to the improvement of balance through physical exercise practice are still unknown (author, date) and the type of exercise that contributes the most to this improvement has been investigated.

Studies which compared the difference in balance levels of old adults who practiced or not physical exercises have found conflicting results (author, date) and the comparison between them is difficult, due to the use of different types of exercise in the training programs and the different tools for assessment of balance. (AUTHOR, DATE).

Due to lack of consensus on the matter and the need for more research on this topic, the aim of this study was to compare the level of balance in older adults engaged or not engaged in a physical activity program.

## METHODOLOGY

This research is characterized as ex post facto (THOMAS; NELSON, 2002). The sample was composed by 30 individuals, divided into 2 groups, being 15 individual practitioners (GP) and 15 non-practitioners (GNP) of exercise. The GNP group was formed by older adults who were part of an older adults' co-living group of a neighborhood of the city of Guarapuava and the GP group was formed by individuals from the Extension Project of Physical Activity for the Elderly, Guairaca College, in Guarapuava. Exclusion criteria were the presence of any kind of pathology involving the balance systems or the use of any medication that interfered in balance.

Anthropometric measurements and height were measured, being the subjetc in standing position, measured with minimal clothing and barefoot, in the anatomical position, with mass (weight) distributed on both feet. The head was positioned looking ahead on the horizon, on the Frankfurt plan, with the shoulder blades and buttocks in contact with the equipment, free arms down along the body and palms facing the thighs. He/she was asked to inhale deeply, and then the cursor was positioned, touching the top of the head, with a precision of centimeters (COSTA, 2001). Weight was measured with the subject without shoes, his back to the scale, looking at a fixed point on the horizon in the standing position with his/her weight equally distributed on the scale platform, with feet apart and in the anatomical position. The weight was collected in grams accuracy. The BMI (body mass index) was calculated using the equation "BMI = weight / height ² (COSTA, 2001).

Regarding balance, we used the one-leg balance test to assess static balance and the stand-up and walk test to assess dynamic balance (Rikli and Jones, 2008). One-leg balance test was done with eyes open. The individual was standing only on one foot, collecting the time from the moment the subject flexed the knee until the moment he put his foot on the floor again. Time values were collected for both the right foot and he left one, with a maximum of 30 seconds. The evaluator made sure that, during the tests, subjects kept staring at the horizon. In the stand-up and walk test, subjects stood up from a chair and walked in a straight line, going around a cone, coming back and sitting down on the chair again. The cone was placed 2.44 meters from the chair.

The group practicing physical activity program, which is part of the Project Gym for Senior Citizens, had exercise sessions of one hour, divided into two blocks of thirty minutes. The first block consisted of resistance exercises, composed by one or two sets of fifteen repetitions with a moderate load, on the alternate segments method. The second block consisted of thirty minutes of gymnastics, in which there were side exercises, knee and hip flexion, inclination of the trunk, trunk flexion, elbow flexion, ballroom dancing movements and stretching exercises.

We used descriptive statistics such as mean and standard deviation of the sample and inferential statistics to test for normality with Shapiro Wilk and Levene's homogeneity of variance. For comparison of data, the student t test for independent samples was used.

## RESULTS AND DISCUSSION

The following table presents the average and standard deviation of anthropometric characteristics between the two groups evaluated.

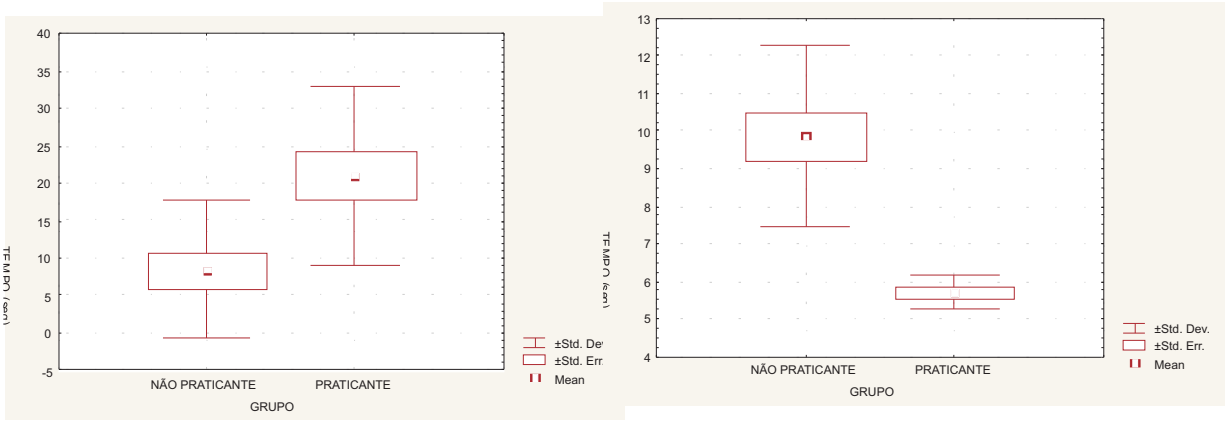
**TABLE** - AVERAGE (M) AND STANDARD DEVIATION (SD) OF THE ANTHROPOMETRIC CHARACTERISTICS OLDER ADULTS WHO WERE EXERCISE PRACTITIONERS OR NON-PRACTITIONERS

| Variables | Exercise Practitioners m? dp | Exercise Non-practitioners m? dp | P |
|---|---|---|---|
| Age (years) | 66 ? 3,8 | 68,9? 6,3 | 0,14 |
| Weight (kg) | 68,5 ? 9,14 | 63? 16,6 | 0,27 |
| Height (cm) | 156 ? 7,2 | 152? 5,3 | 0,07 |
| BMI (kg/m²) | 28 ? 4,0 | 27? 5,9 | 0,5 |

BMI = Body Mass Index; p<0,05

On anthropometric difference was not statistically significant, with very similar values mainly in body mass index. The results for the BMI values found classify the elderly in both groups as being overweight, as the normal tropism values (normal) range from 18.5 to 24.9, according to data established by WHO (1995).

In the figure below are the graphs that represent the values in the evaluation test of static and dynamic balance between the groups and practitioners do not practice exercises. There was a statistically significant difference in the time of the static balance test, and the group practicing physical exercise spent more time in static equilibrium relative to the group that does not perform physical exercise (21 8.4 vs. 11.9 ± 9.2, p = 0.003). There was also a statistically significant difference in time of the test stand, walk and sit between the groups, with group practicing physical exercise spent more time in dynamic balance in relation to the group that does not perform physical exercise (6 vs. 0.5 9 , 9 2.4, p = 0.0000).




**FIGURES** - BOX PLOT OF STATIC BALANCE IN TEST VALUES (LEFT) AND DYNAMIC (RIGHT) BETWEEN GROUPS OF ELDERLY PRACTITIONERS AND NON PRACTITIONERS PHYSICAL EXERCISE

For the variables of dynamic and static balance, there is a statistically significant difference between exercise practitioners and non-practitioners. The group of elderly practitioners of exercise had significantly higher values in the one-leg balance test time, indicating that this group has a better static balance. In the stand up and walk, the group of elderly practitioners of exercise had significantly lower time levels, indicating a better dynamic balance.

Studies evaluating the topic have found similar results, but there is a consensus on all variables. Many of them have evaluated the equilibrium or static or dynamic, using different tests, making it difficult to compare studies.

Martins and Lopes (2010) compared the levels of balance of older practitioners and non practitioners through the Time Up and Go test and the Berg Balance Scale and found that only the Time Up and Go test showed significant difference between the groups, being the exercise practitioners group the one which presented better dynamic balance (6.5 ± 1.4 vs 8.5 ± 1.4, p = 0.008). This result was similar to the one found in our study, suggesting that elderly practitioners of exercise have better levels of dynamic balance, when compared to non-practitioners.

In a study by Silva et al (2008) in which older people underwent a resistance exercise intervention, there was an improvement in dynamic balance, assessed through the Time Up and Go test (7.95 vs. 1.31 8.58 1.03, p = 0.00). Considering that the exercise conducted by the elderly in our study was resistance ones, our results corroborate the studies of this author, suggesting that resistance training contributes significantly to the improvement of dynamic balance in the elderly.

In another study, Adams et al (2010) compared the static and dynamic balance of female practitioners of aerobics and water aerobics through the Caromano and the 8-Feed Up and Go tests and found higher levels of dynamic balance in the gymnastics group when compared to the water gymnastics group. However, there was no significant difference in the static balance. According to the author, this difference can be connected directly to the agility and ability to maintain balance while moving the center of gravity in gymnastics activities. In our study, the group of elderly practitioners of physical exercises also do aerobics as complementing the resistance exercises. Therefore, our results were similar to this study, except for the increase of static equilibrium.

Pereira (2007), by testing balance through the one-leg static balance test, has found an increase in the strength of lower limbs of 17.83% after training of 12 weeks of Tai Chi Chuan, and also found a improvement in balance of 26,10%. However, when correlating the strength of knee extensors, there was no relation with the improvement of balance. Thus, the author suggests that the improved stability is due to an improvement in muscle balance, by strengthening the anterior posterior muscle groups. This study shows that efforts to strengthen the lower limbs can improve balance, which contributes to the findings of the study with practitioners and non practitioners of exercise program in order to have that strength training for muscle strengthening this role. The practitioner group may have obtained better results owing perhaps to a better speed or the fact that practice bodybuilding exercises that besides providing a more balanced muscle strengthening also works hand-eye coordination Another factor that may have influenced a better performance of the practitioner may be that they are more active than the group not practicing.

Most of the evidence found in studies show that exercise can improve both the dynamic balance and static balance. These improvements, as described by Teixeira (2007), Sacco (2008), Pereira (2007), Martins and Lopes (2010) and Almeida (2010). These studies showed a statistically significant difference in their work, which was also found in this study. It affirms the hypothesis that it was expected that there would be differences in the levels of balance between practitioners and non practitioners of physical activity. However, these changes are not yet clarified.

The limitations of this study were lack of control of the groups, no control group, also the study design (ex post facto and experimental) and the fact that there was no experimental group so we could relate cause and effect in the results presented. The number of subjects investigated was relatively small. This study did not investigate the fear of falling among the elderly. The physically active older people may have been exercise practitioners before joining the research sample, which was not investigated. The aging level of the elderly has not been taken into account, and another limitation was that the one leg balance test was performed with eyes open, though in literature we find noticeable difference for tests with eyes open and closed.

**CONCLUSIONS**

This work had the aim of investigating the difference in balance levels of older people engaged or not in physical activity programs. From these results, we accept the hypothesis that there would be differences between the groups and reject the hypothesis that there was no significant difference between the two groups in levels of static and dynamic balance in elderly people.

These results show that physical activity can be monitored and programmed to contribute to an improvement in this level of fitness. We therefore encourage the practice of physical exercises, consisting of counter-resistance exercises and aerobic fitness for the elderly population in order to improve dynamic and static balance.

We suggest further studies with greater control of variables and different testing and analysis, as studies show improvement in the balance but do not clarify details on this improvement. Future studies should be done using different tools, such as electromyography and baropodometry, in order to identify where improvement is. We also suggest that future studies with larger samples and different experimental groups and applied programs of physical exercise in the elderly.

**REFERENCES**

ALMEIDA, A.P.V.; VERAS,R.P.;DOIMO,L.A. Avaliação do equilíbrio estático e dinâmico de idosas praticantes de hidroginástica e ginástica. **Revista Brasileira de Cineantropometria e Desempenho Humano**. v12, n. 1, p. 55-61, 2010.

AVERINO,M.C.;NAVEGA,M.T.;GRANITO,R.N.;RENNÓ,A.C.M.;OISHI,J. Efeito de um programa de atividade física no equilíbrio e na força muscular do quadríceps em mulheres osteoporóticas visando uma melhor qualidade de vida. **Revista Brasileira de Cineantropometria e Movimento**. Brasília v.12.n.3 p.33-38.set 2004.

BANKOFF,A.D.P.;CIOL,P.;ZAMAI,C.A.SCHIMIDT,A.; BARROS,D.D. Estudo do equilíbrio corporal postural através de baropodometria eletrônica. **Conexões**, v. 2, n. 2, 2004.

BEAR,M.F.;CONNORS,B.W.;PARADISO,M.A. **Neurociência desvendando o sistema nervoso.**2ed.Porto Alegre: Artmed, 2006.

CARR,G. **Biomecânica dos Esportes.** Editora Manole.1º São Paulo 1998

COSTA,R.F. **Composiçao corporal teoria e pratica da avaliação.** Barueri. Manole.2001.

DANGELO,J.G.; FATTINI,C.A. **Anatomia Humana Básica**. 2ed.Atheneu São Paulo.2006

DURAKOVIC,Z.;DURAKOVIC,M.M.Does Cronological Age Reduce workin Ability.Coll.Antrpolo.30.1. p231-219.2006.

DAVIES,A.;BLAKELEY,A.G.H.;KIDDC.**Fisiologia Humana**.Artmed São Paulo
2001.

EKDAHL,C.;JARNLO.G.B.;ANDERSSON,S.L. Standing balance in health subjects.**Scand j Rehab Med**. v21p.187-195. 1989.

GOLDIE,P.A.;BACH,T,M.;EVENS,O.M. Force plataform measures for evaluating postural control. **Arch Phys Med Rehabil**. v 70.p.510-517.1989.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATISTICA-IBGE. Perfil dos idosos responsáveis pelos domicílios no Brasil.2000.

MACIEL,A.C.C.;GUERRA,R.O. Prevalência e fatores associados ao defíct de equilíbrio em idosos. **Rev. brasileira de ciência e movimento** 2005 13(1)p.37-44.

MATSUDO,M.S.;MATSUDO,V.K.R.;NETO,T.L.B. Impacto do envelhecimento nas variáveis antropométricas, neuromotoras e metabólicas da aptidão física. **Revista Brasileira ciência e movimento.** Brasília.v.8.n.4.set 2000.

MENESES,M.S. **Neuroanatomia Aplicada**. 2ed.Guanabara Koogan. Rio de Janeiro.2006.

PEREIRA, C.A.;FILHO,L.A.D.Efeito de um programa de treinamento de exercícios proprioceptivos no equilíbrio postural de mulheres adultas saudáveis e fisicamente ativas. Congresso Forma Centro de atividade corporal. 2007.

PEREIRA,M.M.; OLIVEIRA,R.J.; SILVA,M.A.F.;SOUZA,L.H.R.;VIANNA, L.G. Efeitos do Tai Chi Chuan na força dos músculos extensores dos joelhos e no equilibrio em idosas. **Revista Brasileira de Fisioterapia.**v.12. N.2.p.121-126mar/abri. São Carlos.2008.

PERRACINI,M.R.; GAZZOLA,J.; OKUMA,L.; MEDEIROS, PR.S. Apoio Unipedal (Unipedal Stence) .**Pequi Portal Equilíbrio e Quedas em Idosos.** Disponível em: http://www.pequi.iv.org.br/portal/testes/UnipedalStance. Acessado em: 28/09/2010.

LEMOS,L.F.C.;ALVES,R.F.;TEIXEIRA,C.S.;MOTA,C.B.Futebol de campo e o equilíbrio corporal de adolescentes**.Revista brasileira de ciência e movimento.**v.11p.1-19.2008

RABELATTO,J.R.;CASTRO,A.P.;SACO,F.K.;AURICHIO,T.R.Equiilibrio estático e dinâmico em indivíduos senescentes e o índice de massa corpora.**fisioterapia movimento**.21(3) p.69-75.Jul/ set.2008.

RIKLI,R.E.JONES,C.J. Testes de Aptidão física para idosos. São Paulo. Manole.2008.

ROSSI,S.L.R.;SIMON,L.F.Equilíbrio no idoso. **Revista Brasileira de Otorrinolaringologia.** São Paulo.V71.n3.p.298-303.mai/jun.2005

RIBAS,.S.I;GUIRRO,E.C. O.Analise da Pressão Plantar e do Equilíbrio Postural em diferentes Fases da Gestação. **Revista Brasileira de Fisioterapia.** São Carlos.v.11.n.p.391-396 set-out. 2007.

SACCO,I.C.N.;BACARIN,T.A.;WATARI,R.;SUDA,E.Y.;CANETTIERI,M.G.;SOUZA,.LC.;OLIVEIRA, M.F.;SANTOS,S. Envelhecimento,atividade física,massa corporal e arco plantar longitudinal influenciam no equilíbrio funcional de idosos? **Revista Brasileira de Educação física e esporte**. v.22.n.3.p183-191.jul/set São Paulo 2008.

SILVA,A.;ALMEIDA,G.J.M.;CASSILHAS,R.S.;COHEN,M.;PECCIN.M.S.;TUFIK,S.; MELLO,M.T. Equilíbrio, Coordenação e Agilidade de Idosos Submetidos a Prática de Exercícios Físicos Resistidos. **Revista Brasileira de Medicina do Esporte**.v.14.n2.mar/abr.2008

SPIRDUSO,W.W. **Dimensões físicas do envelhecimento**. Barueri São Paulo .manole 2005

THOMAS,J.R.;NELSON,J.K. **Métodos de pesquisa em atividade Física**. 3ed.Porto Alegre:Artimed.2002.

TEIXEIRA,C.S.;LEMOS,L.F.C.;LOPES,L.F.D.;ROSSI,A.C.;MOTA,C.B. **Equilíbrio corporal e exercício físico:uma investigação com mulheres idosas praticantes de diferentes modalidades** .Acta Fisiatra.15.3.p.154-157.2008.

TEIXEIRA, D.C. JUNIOR,S.R.R.P;LIMA,D.F.;GOMES,S.C.;BRUNETTO,A.F. Efeito de um programa de exercícios físicos para idosas sobre variáveis neuromotoras, antropometricas e medo de cair. **Revista brasileira de Educação Física e Esporte**. São Paulo. V.21.n.2 p.107-120.abr/jun.2007.

VALENTE,M.M.Analise baropodometrica e estabiliometrica em mulheres jovens antes e após a aplicação do protocolo de base do método de equilíbrio neuromuscular (ENM).**Universidade do vale do Paraíba**. São Jose dos campos.2006.

ZAGO,A.S.;GOBBI,S.Valores normativos da aptidão funcional de mulheres de 60 a 70 anos. **Departamento de educação física / UNESP**. Rio Claro.2003.

**COMPARISON OF THE LEVELS OF STATIC AND DYNAMIC BALANCE IN OLDER ADULTS ENGAGED OR NOT ENGAGED IN A PHYSICAL ACTIVITY PROGRAM**

**ABSTRACT**

Aging is a process that affects all systems, including those that control body balance, and physical exercise may be one factor that contributes to the maintenance or improvement of balance levels in the elderly. This study aimed to compare the level of balance in elderly practitioners and non practitioners of programmed physical activities. The study included 30 subjects divided into two groups, 15 practitioners (PG) and 15 non-practitioners of physical exercises (NPG). To characterize the sample data, age, weight, height and BMI were collected. We used the stand up and walk test and to assess the dynamic balance and to assess the static balance, the one leg balance test was used. For comparison of test results between groups, we used the Students t test for independent samples. There was a significant difference in dynamic balance (6.0 0.5 2.4 vs 9.87, p = 0.00) and static balance with the right leg (21.0 11.9 vs 8, 4 9.2, p = 0.003) and with the left leg (20.0 vs 11.6 6.6 8.5, p = 0.0013). We conclude from this study that both the static and the dynamic balance were higher in physically active older adults.

**KEYWORDS:** physical activities, balance, elderly.

**RESUMEN**

Le vieillissement est un processus qui affecte tous les systèmes y compris ceux qui comprennent l'équilibre du corps et de l'exercice physique peut être un facteur qui contribue au maintien ou l'amélioration du niveau d'équilibre chez les personnes âgées. Cette étude visait à comparer le niveau d'équilibre dans praticiens âgées et des praticiens non programmé des activités physiques. L'étude a inclus 30 patients répartis en deux groupes, 15 praticiens (GP) et 15 non-pratiquants d'exercices physiques (PNB). Pour caractériser l'échantillon de données ont été recueillies sur l'âge, poids, taille et l'IMC. Nous avons utilisé le test de se lever et marcher pour évaluer le test d'équilibre dynamique et la tige de support pour évaluer l'équilibre statique. Pour la comparaison des résultats des tests entre les groupes, nous avons utilisé le test t de Student pour échantillons indépendants. Il y avait une différence significative dans l'équilibre dynamique (6,0 0,5 2,4 vs 9,87, p = 0,00) et l'équilibre statique avec la jambe droite (21,0 11,9 vs 8, 4 9,2, p = 0,003) et avec la jambe gauche (20,0 vs 11,6 6,6 p 8,5, = 0,0013). Nous concluons que sur léquilibre statique et le dynamique ont eté plus élevés chez les personnes âgées plus physiquement actives.

**MOTS-CLÉS**: exercice, équilibre, personnes âgées..

**RESUMEN**

El envejecimiento es un proceso que afecta a todos los sistemas incluidos los que forman el equilibrio del cuerpo y el ejercicio físico puede ser un factor que contribuye al mantenimiento o mejora de los niveles de equilibrio en los ancianos. Este estudio tuvo como objetivo comparar el nivel de equilibrio en los profesionales de edad avanzada y los profesionales no programado actividades físicas. El estudio incluyó a 30 pacientes divididos en dos grupos, 15 profesionales (GP) y 15 no profesionales de ejercicios físicos (PNB). Para la caracterización de los datos se recolectaron en la edad, peso, talla e índice de masa corporal. Se utilizó la prueba de pararse y caminar para evaluar la prueba de equilibrio dinámico y el soporte de las piernas para evaluar el equilibrio estático. Para la comparación de resultados de la prueba entre los grupos, se utilizó la prueba t de Student para muestras independientes. Hubo una diferencia significativa en el equilibrio dinámico (6,0 0,5 2,4 vs 9,87, p = 0.00) y el equilibrio estático con la pierna derecha (21,0 vs 11,9 8, 4 9.2, p = 0,003) y con la pierna izquierda (20,0 frente al 11,6 6,6 8,5 p = 0,0013). Llegamos a la conclusión de este estudio que tanto el equilibrio estático y dinámico fueron mayores en personas más activas físicamente.

**PALABRAS-CLAVE:** ejercicio, balance, edad avanzada.

**COMPARAÇÃO NOS NÍVEIS DE EQUILIBRIO ESTÁTICO E DINÂMICO DE IDOSOS PRATICANTES E NÃO PRATICANTES DE EXECICIOS FISICO**

**RESUMO**

O envelhecimento é um processo que atinge todos os sistemas inclusive os que compõem o equilíbrio do organismo e a prática de exercícios físicos pode ser um fator que contribui para a manutenção ou melhora dos níveis de equilíbrio em idosos. Este estudo teve como objetivo comparar o nível de equilíbrio em idosos praticantes e de não praticantes atividades físicas programadas. Participaram deste estudo 30 idosos divididos em dois grupos, 15 praticantes (GP) e 15 não praticantes de exercícios físicos (GNP). Para a caracterização da amostra foram coletados os dados de idade, peso, estatura e IMC. Utilizou-se o teste de levantar e caminhar para avaliar o equilíbrio dinâmico e o teste de apoio unipodal para avaliar o equilíbrio estático. Para a comparação dos resultados dos testes entre os grupos, utilizou-se o teste t student para amostras independentes. Verificou-se uma diferença significativa no equilíbrio dinâmico (6,0? 0,5 vs 9,87? 2,4, p= 0,00) e no equilíbrio estático com perna direita (21,0? 11,9 vs 8,4? 9,2, p=0,003) e com a perna esquerda (20,0? 11,6 vs 6,6? 8,5, p=0,0013). Conclui-se com este estudo que tanto o equilíbrio dinâmico como estático foram maiores nos idosos praticantes de atividade física programada.

**PALAVRAS-CHAVE**: exercício físico, equilíbrio, idosos.