Universidade de Aveiro
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Secção Autónoma das Ciências da Saúde da Universidade de Aveiro

SARA ISABEL LEBRE DE ALMEIDA

Equilíbrio das Pessoas Idosas em Função da Idade, Género e Composição Corporal

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Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Gerontologia ramo de Gestão de Equipamentos, realizada sob a orientação científica da Doutora Alda Marques, Professora Adjunta da Escola Superior de Saúde da Universidade de Aveiro

Dedico este trabalho à minha família pelo incansável apoio em todos os momentos da minha vida.

O júri

Presidente	Professora Doutora Maria Piedade Brandão Professora Adjunta da Escola Superior de Saúde da Universidade de Aveiro
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Palavras-chave Equilíbrio; Pessoas Idosas; Composição Corporal; Género

Resumo

Enquadramento: As quedas apresentam uma elevada incidência em pessoas idosas, representando um problema de saúde pública.
São mais comuns em mulheres, embora mais mortais para os homens. Sabe-se que as alterações da composição corporal com o envelhecimento podem prever problemas funcionais e de mobilidade. No entanto, desconhece-se se as mudanças nos sistemas responsáveis pelo equilíbrio no ser humano estão associadas ou não com a idade, o género ou com a composição corporal. Esta informação pode contribuir para a compreensão das causas das quedas e desenvolver programas de prevenção.

Objetivos: Explorar as diferenças no equilíbrio de acordo com a idade, o género ou a composição corporal em pessoas com idade igual ou superior a 60 anos.

Métodos: Foi realizado um estudo transversal quantitativo. O protocolo incluiu recolha de dados sociodemográficos, antropométricos e de clínica geral. A confiança no equilíbrio foi avaliada com a Activities-specific Balance Confidence (ABC), o equilíbrio com o Balance Evaluation System Test (BESTest) e com a Berg Balance Scale (BBS).
A análise estatística foi realizada com programa Statistical Package for the Social Sciences (SPSS) versão 22.0 para Windows. O nível de significância considerado foi de $p<0.05$.

Resultados: Participaram neste estudo 136 pessoas idosas (idade: 75.9±8.8).

O equilíbrio foi significativamente pior com o aumento da idade (60-69: 86.7±15.2, 70-79: 80.7±16.1 e 80+: 72.4±15.8, p=0,001). O género feminino apresentou significativamente piores resultados do que o género masculino (Masculino: 87.0±14.5 e Feminino: 76.0±16.6, p=0.000) para o equilíbrio. A confiança no equilíbrio apresentou-se elevada no género masculino e moderada no género feminino (Masculino: 88.4±14.2 e Feminino: 76.7±24.7, p=0.033). O grupo de idades com mais confiança no equilíbrio foi o de 70 a 79 anos e com menos confiança o grupo +80 anos (60-69: 80.1±14.6, 70-79: 85.4±17.1 e 80+: 68.3±26.9, p=0.000). A composição corporal não apresentou diferenças significativas no equilíbrio.

Conclusão: A idade e o género afetam significativamente o equilíbrio em pessoas idosas, no entanto a composição corporal não parece ter impacto sobre o equilíbrio ou sobre a confiança no equilíbrio nesta população. A confiança do equilíbrio parece estar associada com o equilíbrio em pessoas idosas, contudo nem sempre diminui conforme a idade aumenta.

Keywords Balance; Older People; Body Composition; Gender

Abstract

Background: Falls have a high incidence in older people, representing a public health problem.
They are most common in women although more mortal for men. It is known that body composition changes with aging and can predict functional and mobility problems. However, it is unknown whether the changes in the systems responsible for balance in humans are associated with age, gender or body composition.
This information can contribute to understand the causes of falls and to develop prevention programs.

Aim: Explore the balance-differences according to age, gender or body composition in people with 60 years or more.

Methods: A quantitative cross-sectional study was conducted. The protocol included socio-demographic, anthropometric and general clinical data. Balance confidence was evaluated with the Activities-specific Balance Confidence (ABC), the balance with the Balance Evaluation System Test (BESTest) and with the Berg Balance Scale (BBS).
The statistical analysis was conducted in the Statistical Package for Social Sciences (SPSS) version 22.0 for Windows. The level of significance considered was set at $p<0.05$.

Results: 136 older people (age: 75.9±8.8) participated in this study.
Balance was significantly worse with the increase of age (60-69: 86.7±15.2, 70-79: 80.7±16.1 and 80+: 72.4±15.8, p=0.001). Female presented significant worse results than male (Male: 87.0±14.5 and Female: 76.0±16.6, p=0.000). Confidence on balance was high in male and moderate in female (Male: 88.4±14.2 and Female: 76.7±24.7, p=0.033). The age group with more balance confidence was the 70 and 79 years old and the less confident was the older group +80 years old (60-69: 80.1±14.6, 70-79: 85.4±17.1 and 80+: 68.3±26.9, p=0.000). Body composition had no significant differences on balance.

Conclusion: Age and gender significantly affect balance in older people and body composition does not seem to have impact on balance or balance confidence in this population. Balance confidence seems to be associated with balance in older people but not always decreases as age increases.

Abbreviations and/or acronyms

ABC – Activities-specific Balance Confidence Scale

BBS – Berg Balance Scale

BESTest – Balance Evaluation System Test

BMI – Body Mass Index

FFM – Fat-free Mass

INSA – Instituto Nacional de Saúde Doutor Ricardo Jorge

WHO – World Health Organization

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1. Theoretical Framework

A fall is defined as the moment that a person rest inadvertently on the ground, floor or other level (WHO, 2012). It is kwon that after cardiovascular disease, cancer, stroke and respiratory disorders, unintentional injuries are the fifth cause of death in older people (Rubenstein, 2006), and falls are responsible for 424 000 victims per year (WHO, 2012). In 2005 the number of deaths from accidental falls (46 337) in 25 countries of the European Union represented 20.2% of deaths by external causes (Belanger and Falzon, 2008). In Portugal, falls represented approximately 92.3% (2008) of domestic accidents (INSA, 2011). Falls are more frequent in people over 65 years (WHO, 2012) and it is alarming to know that one older person will be in an emergency department for injuries related to fall in the next 17 seconds, and in the next 30 minutes, one will die as a consequence of fall(s) (CDC, 2005).

The prevalence of balance deficit in older people is estimated at 85% (Lopes, Passerini e Travensolo, 2010). Additionally, the impact of fear of falling restricts 56% of older people to perform their activities (Howland, Lachman, Peterson, Cote, Kasten and Jette, 1998). Therefore the increase incidence of falls and fear of falling in older people are the main responsible for increase of morbidity and mortality (40% of deaths from injury) rates or disability, social isolation, loss of independence, and institutionalisation (Rubenstein, 2006; WHO, 2012; Boyé, Lieshout, Beeck, Hartholt, Cammen and Patka, 2013).

The increase of older population is a reality for the coming decades worldwide, so it is time to reflect about the challenge of changing life style, public health and medical care (Boye et al., 2013). The economic impact of falls is critical for family, for community and for society (WHO, 2007). The associated costs can be divided into direct costs and indirect costs (WHO, 2007). The first costs are related with health care (e.g. medication and adequate services) and the seconds with social productivity losses (e.g. people could be more involved in activities if did not to sustain fall-related injuries) (WHO, 2007). The fall-related injuries increases affluence on health services (Boyé et al, 2013), representing a public health and economical problem in older people. Thus, studies are necessary to contribute to understand the causes of falls and to develop preventive strategies, reducing the inherent costs (Gillain, Elbouz, Beaudart, Bruyère, Reginster e Petermans, 2014).

Falls are most common in women although the mortality is most common in men (WHO, 2007). A study in Portugal has showed that the probability to suffer a fall is 40% higher in women than in men (Moniz-Pereira, Carnide, Machado, André and Veloso, 2012) and a study in the United States of America showed that the risk of death by accidental fall is 2.4 times higher among men (CDC, 2005).

Aging also implies changes in body composition of people and it is known that fat-free mass (FFM) (primarily skeletal muscle) decreases 40% between 20 and 70 years old (Villareal, Apovian, Kushner and Klein, 2005). It is also known that less physical activity, which is common in older people, leads to a further decline in metabolic rate associated with losses of FFM (Campbell, Crim, Young and Evans, 1994). Therefore the decrease of FFM with age is associated with functional ability decrease in older people (Broadwin, Goodman-Gruen and Slymen, 2001; Kyle, Genton, Hans, Karsegard, Michel, Slosman and Pichard, 2001). On other side, high prevalence of overweight and obesity have been reported among this population (Janssen, Katzmarzyk and Ross, 2005). The decrease of muscle mass and the proportional increase of body fat can predict functional and mobility problems among older people (Davison, Cogswell and Dietz, 2002). An American study has showed that in people with 60 years old or older, 74% of men and 66% of women were overweight or obese according to BMI and it is known that high BMI is associated with functional limitations (Davison, Cogswell and Dietz, 2002; Flegal, Carroll, Ogden and Curtin, 2010). Thus, body composition might be a major contributor to body balance decline and falls increase (Kejonen, Kauranen and Vanharanta, 2003). However, it is not certain if obesity has influence on balance or if there are factors associated with balance and composition that make people fall. The risk of falls can be higher because of factors/mediators as sedentary behaviour; chronic health conditions, (such as anxiety/depression and diabetes) or medication use and not because of obesity itself (Mitchell, Lord, Harvey and Close, 2015). Thus, the increases of BMI may not be the cause for falls, other factors needs to be considered (Villareal, Apovian, Kushner and Klein, 2005).

Good balance, to have a normal daily life, requires the integration of sensory information of the body position relatively to the surroundings and the ability to generate appropriated motor responses to control the body movements (Sturnieks, George and Lord, 2008). The maintenance of static and dynamic balance involves the integration of activity, sensory and motor systems, which usually are more affected in older people (Rodrigues Marques, Barros and Michaelsen, 2014). Hence it is known that balance stability normally decreases due to muscle weakness, visual loss and sensory changes (Rodrigues et al., 2014). However, the changes in the systems responsible for human balance that may be associated with gender and body composition among older people are unknown.

Therefore, the aim of this study was to explore the balance-differences according to age, gender or body composition in people with 60 years old or more. This knowledge can inform the development of more effective falls prevention programs (WHO, 2007) in older people providing an important contributor for public health prevention (Kannus, Palvanen, Niemi and Parkkari, 2007; Panel on Prevention of Falls in Older Persons, 2010).

2. Method

2.1. Study Design

A quantitative cross-sectional study was conducted. Cross-sectional studies collect information from a sample of a population, at a single point in time (Muller, 2009).

2.2. Ethical Considerations

Ethical approval was obtained from the Ethics Committee of the Research Unit of Health Sciences at the School of Nursing in Coimbra, Coimbra, Portugal with number 238/10-2014 (Annex I).

2.3. Participants' Recruitment

Fifteen day care centres, five gymnasiums and one senior university were contacted. From these six day care centres (Associação de Solidariedade Humanitária de Canelas, Associação Paz e Amizade (APA) Lar de Idosos, Casa do Professor de Aveiro, Centro Social e Paroquial de Santo André de Esgueira, Centro Social Nossa Senhora do Extremo and Lar Monte dos Burgos), two gymnasiums (Ginásio Fit&Fun and Ginásio Knock-out) and one senior university (Academia de Saberes de Aveiro) accepted to participate (Annex II). A meeting was scheduled with the direction of each institution to explain the aims of the study. In this meeting, written permission to conduct the study was obtained. Each direction selected professionals to identify eligible participants.

A healthy and older population was recruited, considering the inclusion and exclusion criteria. For the purposes of this study, the following definition was used: a healthy person is not the one who just have absence of disease or infirmity but the one who fills a physical, mental and social well-being (WHO, 2003). Participants were eligible if they were 60 years old or older; were considered healthy with common morbidities considering their age; understood the goals of the study; had capacity to express opinions; demonstrated coherent discourse and spatiotemporal orientation and accepted voluntarily to participate. Participants were excluded if they had been hospitalised in the last month; demonstrated signs of cognitive impairment; had significant musculoskeletal, neurological or respiratory disorders (e.g., amputation, scoliosis, stroke, severe asthma); if physical assistance to walk was necessary and showed signs of substances abuses (e.g., alcohol and drugs), as these factors could affect balance scores and consequently the study results.

Interested participants were then contacted by the researchers. Prior to data collection participants received written information (Appendix I) and further oral explanations about the study. The strict confidentiality and anonymity of all data collected was ensured. It was also explained that all data would be kept in databases password protected, using codes and their names would not ever be disclosed. Written informed consents were then obtained (Appendix II). Data collection was carried out in the presence of two researchers and in an available room. A data sample of 136 individuals was collected.

2.4. Data Collection

Data collection occurred between November 2014 and February 2015. The protocol included socio-demographic (age, gender, date of birth, education, marital status, with whom he/she lives and occupation), anthropometric (height, weight, BMI (in Kg/m^2) and FFM (in %)) and general clinical (used medication, technical aids, urinary incontinence, respiratory crises, sleeping problems, vision, hearing, number of falls, have or not fear of falling, number of times/week of 20 minutes of intense physical activities and number of times/week of 30 minutes of moderate physical activities or walk) data. The Activities-specific Balance Confidence (ABC) (Branco, 2013) was applied to evaluate balance confidence. The balance was evaluated with the Balance Evaluation System Test (BESTest) (Padgett, Jacobs and Kasser, 2012; Maia, Rodrigues-de-Paula, Magalhães and Teixeira 2013) and with the Berg Balance Scale (BBS) (Miyamoto, Junior, Berg, Ramos and Natour, 2004; Major, Fatone and Roth, 2013).

2.4.1. Measures

Socio-demographic, anthropometric and general clinical data. These measures were assessed to characterise the sample with a structured questionnaire based on International Classification of Functioning, Disability and Health (CIF – checklist) because it is a classification of health and health-related domains recommended by the World Health Organization (WHO, 2014).

Body composition. Body composition was measured with BMI ($weight/height^2$) and FFM (%) that were assessed with bioimpedance equipment (Omron body fat monitor BF306) (Nagaya, Yoshida, Takahashi, Matsuda and Kawai, 1999; Santos and Sichieri, 2005). BMI is a good nutritional indicator for older people (Cervi, Franceschini and Priore, 2005), however does not distinguish body composition (i.e. fat from muscle), as a result, BMI overestimates fatness among those who are muscular of body fat (Prentice and Jebb, 2001; Burkhauser and Cawley, 2008). For this reason FFM was also collected. Another reason for collecting BMI and FFM were the technical simplicity, low costs and low time consuming (Deurenberg, Weststrate and Seidell, 1991).

BMI assessed the body composition measuring weight relatively to height (WHO, 2015). BMI has been used in type 2 diabetes (Tobia, Pan, Jackson, O'Reilly, Ding, Willett, Manson and Hu, 2014), quality of life (Kerman, Hopman, Vandenkerkhof and Rosenberg, 2012), hip fracture (Reider, Hawkes, Hebel, D'Adamo, Magaziner, Miller, Orwig and Alley, 2013), Parkinson's disease (Kim, Oh, Lee, Moon, Oh, Shin, Lee, Baek, Jeong, Song, Sohn, and Lee, 2012), multiple sclerosis (Hedstrom, Olsson and Alfredsson, 2012), obesity (Flegal, Carroll, Kit and Ogden, 2012) and anorexia nervosa (Bühren, Ribbeck, Schwart, Egberts, Pfeiffer, Fleischhaker, Wewetzer, Kennes, Dempfle and Herpertz-Dahlmann, 2013). Good correlation between IMC and body fat ($r=.743-.924$; $p<0.001$) measured with a bioimpedance equipment (Nagaya, Yoshida, Takahashi, Matsuda and Kawai, 1999).

FFM assessed the nutritional status to know the level of muscularity of a person (Taguri, Dabbas-Tyan, Goulet and Ricour, 2009; González-Martí, Bustos, Jordán and Mayville, 2012). FFM has been studied in stroke (Marzolini, Oh, McIlroy and Brooks, 2013), diabetes (Strugnell, Dunstan, Magliano, Zimmet, Shaw and Daly, 2014), obesity (Strugnell, et al., 2014), lifestyle (Strugnell, et al., 2014), chronic obstructive pulmonary disease (Emtner, Hallin, Arnardottir and Janson, 2015), cystic fibrosis (King, Nyulasi, Bailey, Kotsimbos and Wilson, 2014) and healthy older people (Pfrimer, Moriguti, Lima, Marchini and Ferriolli, 2012; Genton, Graf, Karsegard, Kyle and Pichard, 2013). Strong and significant correlation between FFM and Bioelectrical Impedance Analysis formula Valencia ($r=0.968$; $p<0.005$) (Pfrimer, et al., 2012).

Balance. Balance was assessed with the BESTest (Padgett, Jacobs and Kasser, 2012; Maia, 2013) and BBS (Miyamoto, Junior, Berg, Ramos and Natour, 2004; Major, Fatone and Roth, 2013) scales.

The BESTest includes 27 items (and a total of 36 tasks) and is categorised into six balance sections (Biomechanical Constraints, Stability Limits/Verticality, Transitions/Anticipatory, Reactive, Sensory Orientation and Stability in Gait) which identify who are at risk of falling and contribute to enhance the understanding of which factors are contributing for the balance deficit (Maia, 2013). The items are rated in an ordinal scale (0-3) which 0 indicates “failure” or “inability” to complete the task and 3 indicates success to complete the task (Padgett, Jacobs and Kasser, 2012). The total score (108 points) is calculated with a percentage score (0-100%) (Huang, Lytle, Miller, Smith and Fredrickson, 2014). BESTest has been used in people with balance deficits (Padgett, Jacobs and Kasser, 2012), cerebellar stroke (Rodrigues et al., 2014), Parkinson's disease (Leddy, Crowner and Earhart, 2011), peripheral neuropathy (Horak, Wrisley and Frank, 2009) and vestibular dysfunction (Horak, Wrisley and Frank, 2009). The internal consistency of 5 out of 6 subsections is excellent and poor for the section “stability limits/verticality” ($\alpha_{\text{Biomechanical constrains}}=0.83$; $\alpha_{\text{Stability limits/verticality}}=0.62$; $\alpha_{\text{Anticipatory Postural Adjustment}}=0.87$; $\alpha_{\text{Postural Responses}}=0.86$; $\alpha_{\text{Sensory orientation}}=0.81$; $\alpha_{\text{Stability in gait}}=0.92$) (Leddy, Crowner and Earhart, 2011). The BESTest has an excellent correlation with the Functional Gait Assessment ($r=0.882$; $p<0,001$) and with the BBS ($r=0.873$; $p<0,001$) (Leddy, Crowner and Earhart, 2011). It also has an excellent validity compared to BBS, since it has the advantages of determining which equilibrium system is affected and provides information for developing a treatment or specific intervention (Rodrigues et al, 2014).

The BBS includes 14 items. The items are summed and rated from 0-4 with a maximum score of 56 points (Downs, Marquez and Chiarelli, 2013). This scale has static and dynamic activities with different degrees of difficulty. BBS can be applied to anyone independently of their age, with frail older people and with who was referred for rehabilitation because of balance deficits (Miyamoto, Junior, Berg, Ramos, and Natour, 2004). The scale has been used in a variety of population such as brain injury (Stevenson, 2001), community dwelling older (Donoghue and Stokes, 2009), multiple sclerosis (Learmonth, Paul, McFadyen, Mattison and Miller, 2012), osteoarthritis (Jogi, Spaulding, Zecevic, Overend and Kramer, 2011), Parkinson’s disease (Qutubuddin, Pegg, Cifu, Brown, McNamee and Carne, 2005), spinal cord injury (Lemay and Nadeau, 2010), stroke (Hiengkaew, Jitaree and Chaiyawat, 2012), traumatic and acquired brain injury (Newstead, Hinman and Tomberlin, 2005) and vestibular dysfunction (Whitney, Wrisley and Furman, 2003). The BBS has an excellent internal consistency ($\alpha=0.92$) (Scalzo, Nova, Perracini, Sacramento, Cardoso, Ferraz and Teixeira, 2009). In criterion validity, the BBS has shown excellent correlation with the Balance Self-Perceptions Test ($r=0.76$; $p\leq0.001$) (Shumwat-Cook, Baldwin, Polissar and Gruber, 1997).

Balance confidence. The ABC includes 16 items and the confidence is rated from 0-100 where zero represents “no confidence” and 100 “complete confidence” (Branco, 2013). The total values are divided by 16 to obtain the score, that is categorised in Low (<50), Moderate (50-80) and High (>80) balance confidence (Myers, Fletcher, Myers and Sherk, 1998). This scale has been recommended to be used in conjunction with the BESTest to identify in which activities of daily living people are at greatest risk of falling or the perception of individuals with regard to the fear of falling (Rodrigues et al, 2014). ABC scale has been tested in healthy older people (Hatch, Gill-Body and Portney, 2003), in people with multiple sclerosis (Nilsagard, Koch, Nilsson and Forsberg, 2014), Parkinson's disease and Parkinsonism (Dal, Klassen, Sheppard and Metcalfe, 2011), stroke (Botner, Miller, and Eng, 2005), unilateral transtibial amputation (Miller, Deathe, and Speechley, 2003) and vestibular disorders (Alghwiri, Marchetti and Whitney, 2011). The ABC has been shown to have better scale responsiveness than the Falls Efficacy Scale when used with older people (Powell and Myers, 1995). Excellent internal consistency (α=0.96) has also been reported (Huang and Wang, 2009). The correlation between the ABC scale and the BESTest has also shown to be excellent ($r=0.636$; $p<0.01$) (Horak, Wrisley, and Frank, 2009).

2.4.2. Procedures

Socio-demographic, anthropometric and clinical assessment were first collected to characterise the sample. The structured questionnaire was used for this purpose to capture a holistic perspective of each participant.

Anthropometric data: height and weight were collected with one scale (Taurus 990537), one tape measure and with one bioimpedance equipment (Omron body fat monitor BF306). Participants were encouraged to perform the measurements without shoes and wearing the fewer clothes as possible. Bioimpedance was measured in order to assess the FFM in percentage (Lorenzo, Andreoli, Matthie and Withers, 1997). The bioimpedance equipment also measured the BMI (weight in kilograms/ (height in meters)^2). This equipment was first used inserting participant's height, weight, gender and age. Participants were then asked to stay standing with both feet slightly separated; with both hands holding the monitor electrodes; the shoulders to 90° and the elbows stretched (Lorenzo, Andreoli, Matthie and Withers, 1997) while the researcher pressed the on button. The measurement took a few seconds to be collected.

The ABC scale was then administered in order to measure the balance in activities of daily living (Branco, 2013). A personal interview was conducted after providing some brief explanations about the scale to each participant (Branco, 2013). After participant's answer "How confident are you that you will not lose your balance or become unsteady when you…" about each question, the percentage was registered by the researcher (Branco, 2013).

The BBS is more used to measure balance than the BESTest, however the BBS do not discriminate the different human systems responsible for balance and therefore, the BESTest has been gaining some interest among the academic and clinical communities. Both scales were applied simultaneously as many tasks are similar (BBS1-BESTest9; BBS2-BESTest2; BBS8-BESTest7; BBS12-BESTest12; BBS14-BESTest11; BBS7-BESTest19) and avoided repetition. In both scales, between each exercise an interval of two minutes was given for participants rest and to minimise the effect of fatigue (Weisman and Zeballos, 2002). Fatigue was assessed based on the modified Borg scale (Wilson and Jones, 1989).

In BBS, participants were instructed about each task and in most of the items were asked to maintain a position for a certain time (Miyamoto *et al*, 2004). Points were progressively deducted if the time or distance were not reached, if the participant required supervision or if the participant used an external support or got help from the researcher (Barth, Herrman, Levine, Dunning and Page, 2008). Participants had to maintain the balance in their performance and they had the opportunity to select which leg remained as support and the range of movements (Berg, Wood-Dauphinee and Williams, 1995). The material used to apply the scale was one chronometer; one tape measure, two chairs (one with and other without arms) and one stair step (Miyamoto *et al*, 2004).

The BESTest has specific procedures for each task, but for all, participants were tested with flat heeled shoes or without shoes, and if they were using a technical aids for some items those were scored one category below (Horak, 2009). Participants were instructed and when necessary some exercises were demonstrated. The BESTest was applied using one chronometer; one measuring tape mounted on wall; one block (approximately 60cm x 60cm); one medium-density Tempur foam; one 10 degree incline ramp; one stair step (15 cm); two stacked shoe boxes; one 2,5kg free weight; and one masking tape to mark the meters on the floor (Horak, Wrisley and Frank, 2009).

2.5. Data Analysis

Each participant was identified on database with a code with the letter B and with a number (e.g., B1, B2, B3).

Descriptive statistics were applied to characterise the sample, describe and summarise the data from the different measures. The normality of data distribution was tested with Kolmogorov-Sminorv tests (Mullner, 2009).

After a characterisation of the total sample, data were also grouped according participants ages (Young-Old (age 60-69), Old-Old (age 70-79) and Oldest-Old (age 80+)) and then according gender (Male and Female) (Garfein and Herzog, 1995). FFM was categorised in low [0, 17], normal [17, 26], high [26, 34] and too high [34, 50] for men and in low [0, 28], normal [28, 37], high [37, 44] and too high [44, 50] for women (Deurenberg, Yap and Staveren, 1998; WHO, 2000). The "low" categorisation was not presented as no participants were within that category. BMI was categorised in underweight (<18.5), normal (18.5-24.9), overweight (25.0-29.9), obesity I (30.0-34.9), obesity II (35.0-39.9) and obesity III (>40.0) (Arena, 2014). There were no underweight participants so this category was also not used and the obesity categories were grouped into just one category ("obesity") as obesity II and III were also not present.

Results from BESTest, BBS and ABC were compared with age, with gender and with FFM with the One-way ANOVA. Two-way ANOVA was used to explore data on BESTest, BBS or ABC with BMI and gender.

All statistical analysis was conducted in the Statistical Package for Social Sciences (SPSS) version 22.0 for Windows. The level of significance considered was set at $p<0.05$.

3. Results

A total of 155 older people were approached by the research team for inclusion in the study, however eight had dementia, two had spatiotemporal disorientation, three refused for personal reasons and one was amputated and five did not fulfil the inclusion/exclusion criteria. Therefore, a total of 136 participants were included, which mean age was 75.9 (±8.8) years old (Table 1).

Most participants were female (n=96; 70.6%), widowed (n=64; 47.1%), retired (n=126; 92.6%), were living with their spouse (n=43; 31.6%) and had a level of education between 1 and 4 years (n=82; 60.3%) (Table 1).

Table 1: Socio-demographic characterisation of sample (n=136)

		n %
Gender (n,%)	F	96 (70.6)
	M	40 (29.4)
Marital Status (n,%)	Single	10 (7.4)

	Married	51 (37.5)
	Separated	4 (2.9)
	Divorced	7 (5.1)
	Widowed	64 (47.1)
Household (n,%)	Alone	33 (24.3)
	Spouse	43 (31.6)
	Children	15 (11.0)
	Home Care	37 (27.2)
	Other	6 (5.9)
Education (n,%)	<1	17 (12.5)
	1-4	82 (60.3)
	5-6	14 (10.3)
	7-9	17 (12.5)
	10-12	5 (3.7)
	13+	1 (.7)
Occupation (n,%)	Paid employment	2 (1.5)
	Domestic work	5 (3.7)
	Retired	126 (92.6)
	Unemployed	2 (1.5)

M±SD: Media±Standard Deviation; M: Male; F: Female; BMI: Body Mass Index; FFM: Free-fat mass Index; *p<0.05

Participants' mean height was 160.8±9.8m, weight 69.8±13Kg and their FFM was 35.1±7%. The majority of the sample was overweight (n=66; 48.5%) and had no smoking history (n=123; 90.4) (Table 2).

Only five people did not take same kind of medication. Most took 3 medicines a day. The most commonly reported were hypertension (n=66; 50.4%), cholesterol inhibitors (n=59; 45.0%), cardiovascular system (n=43; 32.8%), anxiolytic sedatives and hypnotics (n=41; 31.3%) and antidepressants (38; 29.0%). There were no urinary incontinence accidents (n=104; 76.5%) or respiratory crises (130; 95.6%) in most people. The technical aid most often used were glasses (n=85; 62.5%) (Table 2).

Most participants had not fallen in the last year (n=96; 70.6%) and the ones who had, presented a mean number of falls of 1.3±0.5. Nevertheless, most had fear of falling (n=75; 55.1%). Most participants were not involved in any intense (n=82; 60.3%) or even moderate physical activities or walk (n=67; 49.3%) (Table 2).

Table 2: General clinical characterisation of the sample.

	n %	M±SD

Height (M±SD)		-	160.8±9.8 (142-190)
Weight (M±SD)		-	69.8±13.0 (44-106)
FFM (M±SD)		-	35.1±7.0 (13-50)
BMI (n,%)	Underweight	0 (.0)	-
	Normal	47 (34.6)	-
	Overweight	66 (48.5)	-
	Obesity I	15 (11.0)	-
	Obesity II	7 (5.1)	-
	Obesity III	1 (.7)	-
Number of medicines	0	5 (3.7)	-
	1	26 (19.1)	-
	2	32 (23.5)	-
	3	34 (25.0)	-
	4	26 (19.1)	-
	>5	13 (9.6)	-
Technical aids	None	20 (14.7)	-
	Glasses	85 (62.5)	-
	Dental plaque	13 (9.6)	-
	Crutches	12 (8.8)	-
	Hearing aid	3 (2.2)	-
	Walker	2 (1.5)	-
	Tripod	1 (.7)	-
Last year falls (n,%)	Yes	40 (29.4)	-
	No	96 (70.6)	-
Number of falls (M±SD)		-	1.3±0.5 (1-2)
Fear of falling (n,%)	Yes	75 (55.1)	-
	No	61 (44.9)	-

Number of times/week of 20 minutes of intense physical activities (n,%)	Nothing	82 (60.3)	-
	1 to 2 times/week	30 (22.1)	-
	3 times/week	24 (17.6)	-
Number of times/week of 30 minutes of moderate physical activities or walk (n,%)	Nothing	67 (49.3)	-
	1 to 2 times/week	30 (22.1)	-
	3 to 4 times/week	21 (15.4)	-
	≥5 times/week	18 (13.2)	-

M±SD: Media±Standard Deviation; M: Male; F: Female; BMI: Body Mass Index; FFM: Free-fat mass Index; *p<0.05

3.1. Balance and its associations with age, gender, FFM and BMI

Table 3 presents the BESTest results of the total sample and per age group. The BESTest section that presented a lower score, and therefore, indicated more balance difficulties was the Reactive section when the total sample was analysed. This section was also the one presenting worst results for all age groups. All sections were significantly worse with the increasing of age.

The best result for the age groups of 60-69 (87.0±16.5) and 80+ (65.3±21.3) were in Biomechanical Constraints whereas for the age group of 70-79 was Stability in Gait (79.4±23.0).

Similar to the BESTest, the BBS showed that balance performance decreased when age increased (p<0.0001) (Table 3).

The age group of 70 and 79 years old was the group with more balance confidence. The less confident was the older group +80 years old were showed (p<0.0001) (Table 3).

Table 3: BESTest, BBS and ABC results of the total sample and per age group.

		Total (n=136)	60-69 (n=39)	70-79 (n=45)	80+ (n=52)	P
BESTest	Biomechanical Constraints	74.4±20.7	87.0±16.5	74.1±17.9	65.3±21.3	.000*
	Stability Limits/Verticality	70.0±21.6	80.5±17.9	72.9±19.8	59.7±21.3	.000*
	Transitions/Anticipatory	70.6±22.5	82.2±19.5	75.9±20.5	57.3±19.7	.000*
	Reactive	65.7±35.7	79.2±28.5	70.2±36.3	51.7±35.7	.001*
	Sensory Orientation	69.5±27.4	81.5±22.7	75.8±26.0	54.9±25.7	.000*
	Stability in Gait	75.0±24.9	86.4±19.2	79.4±23.0	62.6±25.1	.000*
	Total	79.2±16.7	86.7±15.2	80.7±16.1	72.4±15.8	.000*
BBS		46.8±10.2	51.8±5.6	49.0±8.6	41.2±11.5	.000*
ABC		80.1±22.8	80.1±14.6	85.4±17.1	68.3±26.9	.000*

Results are presented as M±SD, mean±standard deviation; p: p-value; BBS: Berg Balance Scale; ABC: Activities-specific Balance Confidence

*Statistical significant results

Female presented significant worse results than male in every sections of BESTest (Table 4). The largest difference was observed in the Reactive section (Male 83.3±27.2 vs Female 58.4±36.4; p<0.0001). This was also the section with worst results in female whereas the male group presented the worst results in the Stability Limits/Verticality section (78.6±19.6).

In the BBS, male presented significantly better balance performance than female (p<0.001) (Table 4). Male also presented a significantly higher balance confidence than female (Male: 88.4±14.2 vs Female: 76.7±24.7; p=0.033) (Table 4).

Table 4: BESTest, BBS and ABC results for male (n=40) and female (n=96).

		M (n=40)	F (n=96)	P
BESTest	Biomechanical Constraints	82.8±18.6	70.9±20.7	.002*
	Stability Limits/Verticality	78.6±19.6	66.5±21.5	.003*
	Transitions/Anticipatory	80.8±17.8	66.3±23.0	.000*
	Reactive	83.3±27.2	58.4±36.4	.000*
	Sensory Orientation	81.8±23.2	64.3±27.5	.001*
	Stability in Gait	84.5±22.8	71.0±24.7	.003*
	Total	87.0±14.5	76.0±16.6	.000*
BBS		51.3±7.2	45.0±10.7	.001*
ABC		88.4±14.2	76.7±24.7	.033*

Results are presented as M±SD, mean±standard deviation; M: Male; F: Female; p: p-value; BBS: Berg Balance Scale; ABC: Activities-specific Balance Confidence

*Statistical significant results

When BESTest results were compared according to the FFM of male or female, no significant differences were found (Table 5). There were two exceptions in the female group where it was showed that people with higher FFM presented significant worse results in the total of BESTest (p=0.020) and in the Reactive section (p=0.021).

No significant results for BBS or ABC according to FFM in male or female were found (Table 5).

Table 5: BESTest, BBS and ABC according to FFM in male (n=40) and female (n=96).

		Normal		High		Too High		Total		p	p
		M	F	M	F	M	F	M	F	M	F
		(n=11)	(n=45)	(n=23)	(n=38)	(n=6)	(n=13)	(n=40)	(n=96)	(n=40)	(n=96)
BESTest	Biomechanical Constraints	80.0±23.7	76.0±21.7	85.2±17.3	67.5±18.6	78.9±14.2	63.1±19.7	82.8±18.6	70.9±20.7	.649	.059
	Stability Limits/ Verticality	77.5±21.6	71.1±21.4	78.9±18.0	63.3±20.7	79.4±25.0	59.7±22.2	78.6±19.6	66.5±21.5	.977	.121
	Transitions/ Anticipatory	77.8±20.6	71.1±23.6	81.9±16.8	62.3±22.4	82.4±18.7	61.5±20.5	80.8±17.8	66.3±23.0	.807	.158
	Reactive	74.2±35.9	67.0±34.5	87.9±24.4	55.7±34.2	82.4±18.1	36.3±40.7	83.3±27.2	58.4±36.4	.400	.021*

	Sensory Orientation	67.9±29.9	71.0±27.9	87.2±19.3	57.5±27.4	86.7±13.3	61.0±22.2	81.8±23.2	64.3±27.5	.060	.076
	Stability in Gait	71.9±33.8	74.2±26.3	89.0±16.0	68.8±23.9	90.5±12.8	66.3±21.5	84.5±22.8	71.0±24.7	.094	.473
	Total	82.0±19.2	81.0±15.9	89.0±12.4	72.4±16.0	88.6±12.0	69.5±16.9	87.0±14.5	76.0±16.6	.411	.020*
BBS		48.8±8.6	46.5±11.0	52.1±6.9	43.5±11.1	52.8±4.7	44.2±7.8	51.3±7.2	45.0±10.7	.402	.430
ABC		87.0±15.9	78.6±26.3	89.6±14.9	78.7±22.7	86.2±8.5	64.2±22.9	88.4±14.2	76.7±24.7	.823	.150

Results are presented as M±SD, mean±standard deviation; M: Male; F: Female; p: p-value; BBS: Berg Balance Scale; ABC: Activities-specific Balance Confidence

*Statistical significant results

When BESTest, BBS and ABC results were compared according to BMI of male or female participants, no significant differences were found (Table 6).

Table 6: BESTest, BBS and ABC results according to BMI in male (n=40) and female (n=96).

		Normal Weight		Overweight		Obese		Total		
		M (n=15)	F (n=33)	M (n=17)	F (n=47)	M (n=8)	F (n=16)	M (n=40)	F (n=96)	p
BESTest	Biomechanical Constraints	80.0±20.8	76.0±17.9	83.9±18.3	69.6±22.8	85.8±16.5	64.2±18.0	82.8±18.6	70.9±20.7	.224
	Stability Limits/ Verticality	78.1±18.7	69.7±19.4	83.8±17.7	67.4±23.1	68.4±23.2	57.1±19.2	78.6±19.6	66.5±21.5	.652
	Transitions/ Anticipatory	80.0±15.4	67.2±22.6	82.0±20.1	67.4±24.5	80.0±19.2	61.5±19.5	80.8±17.8	66.3±23.0	.892
	Reactive	80.7±29.7	67.8±32.2	87.2±23.8	58.9±37.4	79.9±31.7	37.5±34.9	83.3±27.2	58.4±36.4	.234
	Sensory Orientation	79.6±24.5	68.3±27.9	87.1±22.8	63.3±29.4	75.0±21.9	59.2±20.0	81.8±23.2	64.3±27.5	.524
	Stability in Gait	79.0±27.2	71.4±25.9	87.7±21.2	72.4±24.6	88.1±17.1	65.8±23.2	84.5±22.8	71.0±24.7	.680
	Total	86.7±14.4	78.2±16.1	89.1±14.2	77.2±17.1	83.3±16.3	67.9±14.4	87.0±14.5	76.0±16.6	.708
BBS		50.2±7.5	45.7±11.3	52.6±7.1	44.8±11.3	50.8±7.4	44.1±7.6	51.3±7.2	45.0±10.7	.727
ABC		85.0±13.7	76.5±26.8	88.6±16.9	78.6±23.4	94.0±5.8	71.4±25.1	88.4±14.2	76.7±24.7	.777

Results are presented as M±SD, mean±standard deviation; M: Male; F: Female; p: p-value; BBS: Berg Balance Scale; ABC: Activities-specific Balance Confidence

4. Discussion

This study showed that age and gender significantly affect balance performance and confidence whereas body composition (BMI or FFM) do not seem to have a significant impact on balance of older people.

BESTest and BBS demonstrated that balance performance decreases when age increases and that male have better balance than female. These findings are in line with previous reports stating that falls rates increase exponentially with age in both genders, however falls are more common among older women (WHO, 2007).

Despite BBS being more commonly used in the literature, the BESTest allows the identification of which system(s) of balance is/are affected(s) (Horak, Wrisley, and Frank, 2009). This might be especially useful to develop tailored interventions aiming at preventing falls. Ageing increases alterations on different balance systems, namely the reactive and limits of stability (Andrade, Stella, Barbieri, Rinaldi, Hamanaka and Gobbi, 2011; Pereira, Maia and Silva, 2013), which are intimately related with the dynamic balance. Hence, deficits of dynamic balance have been shown to be related with an increase of multiple falls in older people (Callisaya, Blizzard, Schmidt, McGinley, Lord and Srikanth, 2009). Corroborating this line of argument, BESTest indicated more balance difficulties in the Reactive section, independently of the age group.

Male presented more balance difficulties in Stability Limits/Verticality whereas female were more affected in the Reactive section. The reaction time varies between gender, being female more susceptive to fall than male (Callisaya, Blizzard, Schmidt, McGinley, Lord and Srikanth, 2009). This study also found significant differences on balance confidence among male and female, having female worst results on balance confidence. This result is in line whit previous studies, which have shown that the prevalence of fear of falling is higher among female than male (Maki, Holliday and Topper, 1991; Arfken, Lach, Birge and Miller, 1994).

Balance performance is strongly associated with balance confidence in older people (Hatch, Gill-Body and Portney, 2003) and a low balance confidence restricts participation in daily life (Maki, 1997; Lach, 2005; Rand, Miller, Yiu and Eng, 2011). As factors related with the physical and public environments are the most common cause of falls (30 to 50% of falls) in older people (WHO, 2007), it seems essential to modify the environments where people live and socialise at the same time we encourage people to be physically active, if we want to start preventing falls and promoting people's health and well being. This research showed that balance confidence did not necessarily decrease with age, i.e., the age group of 60-69 years old was less confident than the group of 70 and 79 years old and more confident than the group of +80 years old. These results might be explained by the fact that this age group (60-69 years old) was composed of people that were still working and active in many daily life activities. It is known that performing activities of daily living increases risk of falling in older people and hence, affects their balance (WHO, 2007). Moreover, this age group is living a period of transition between adult and older people (Logan, 1992) and the social perception is that older people fall (WHO, 2007). They are often tired and frail, which is a state of increased vulnerability to poor resolution of homoeostasis after a stressor event, increasing the risk of falls (Clegg, Young, Iliff, Rikkert and Rockwood, 2013). Often, this age group presents more fear of falling in workplaces/groundwork, commercial area/services or in outdoors (INSA, 2011). Conversely, when people were all retired (70-79 years old), their confidence on balance increased to then decline due to age and general physical impairment (80+ years old). Older people usually are afraid of being hurt or hospitalised, not being able to get up after a fall, being social embarrassed, loosing of independence and having to move from their house (WHO, 2007). People who are fearful of falling also tend to lack confidence in their ability to prevent or manage falls, which increases the risk of falling (WHO, 2007). Additionally, people with 80+ have more comorbidities and are physically weaker (Christensen, Doblhammer, Rau and Vaupel, 2009), and therefore less confident in their balance. However, this age group is especially afraid of falling at home (INSA, 2011).

This research also showed that obesity non-related with a presence of chronic health condition do not seem to be associated with balance and consequently with risk of fall. There are conflicting findings in the literature regarding the association between obesity and falls (Rekeneire, Visser, Peila, Nevitt, Cauley, Tylavsky, Simonsick and Harris, 2003). Whilst some authors have reported no evidence of a correlation between BMI and balance ability and postural stability (Rosenblatt and Grabinen, 2012; Baierle, Kromer, Petermann, Magosh and Luomajoki, 2013), others have found obesity associated with increased risk of fall (Richardson, 2002; Fjeldstad, Fjeldstad, Acree, Nickel and Gardner, 2008; Mitchell, Lord, Harvey and Close, 2014). It has been shown that increased risk of fall can be caused by other factors (mediators) common fall-related risk in older people independently of body composition (Mitchell, Lord, Harvey and Close, 2015). For example, the use of sedatives, neurocardiovascular complications, vision impairment and/or environment alterations can be the factors responsible for falls when associated with high or low body composition (Shaw, 2007; Mitchell, Lord, Harvey and Close, 2015). Thus, falls might be related with body composition if it is related with some intrinsic or extrinsic factors, which was not the case of the sample of this study.

In fact, body composition changes progressively in older people (Rudman, Feller, Cohn, Shetty, Rudman and Draper, 1991). A study showed that body weight and BMI have a constant increase from 40 to 66 years of age in both male and female (Guo, Zeller, Chumlea and Siervogel, 1999; Buffa, Floris, Putzu and Marini, 2011). Another study showed that FFM progressively increases until 40 years old and after it begins to decrease (Buffa, FLoris, Putzu and Marini, 2011). Therefore, oscillations on body composition on a healthy population occur progressively and the systems responsible for the balance as well people's confidence of balance will be adjusting progressively. Hence, it is not surprising that no significant differences were found between body composition and balance performance or balance confidence.

4.1. Limitations and Future Research

Some limitations of this study need to be acknowledged.

A sample relatively small in each age group was recruited and therefore, a larger sample would strengthen the findings. This would also allow data collection on people underweight which would be important to confirm the results about the lack of association between body composition and balance/balance confidence.

Additionally, the same research could be done in different pathological populations in order to find if balance change with age, gender and body composition and what systems are more affected, using the data of this study as comparator.

Nevertheless, this study contributed to enhance our understanding about the main areas responsible for human balance that might be maintained versus affected in older people. This information might be essential to develop tailored interventions to prevent falls. It also contributed for understanding balance confidence among older people.

5. Conclusions

Balance studies are crucial to develop falls prevention programs in older people. This study showed that age and gender significantly affect balance performance and confidence in older people and that specific programs to prevent falls should focus in stability limits/verticality when directed to male and in reactive movements if directed to female. Moreover body composition (BMI and FFM) do not seem to impact on balance performance or balance confidence in this population. Balance confidence is associated with balance in older people but does not decline as age increases as the 70-79 group age presented a better score. Nevertheless, further studies should analyse balance in different populations (underweight, chronic diseases and impairment) and reflect about specific trajectories to create programs to reduce falls and fear of falling.

Balance problems are a worldwide concern, thus prevention strategies must be developed to reduce risk of fall in older people. Treatments or programs based only on balance, without considering different systems, might not achieve the best possible results. Thus, specific performance and confidence balance treatments/programs might be developed for each population instead of being generalised as a single problem for everybody.

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Annex I – Ethics approval

COMISSÃO DE ÉTICA

da **Unidade Investigação em Ciências da Saúde: Enfermagem** (UICISA: E)

da **Escola Superior de Enfermagem de Coimbra** (ESEnfC)

Parecer Nº 238/10-2014

Título do Projecto: Avaliar os diferentes sistemas responsáveis pelo equilíbrio na população idosa.

Identificação das Proponentes

Nome(s): Joana Carvalho Santos e Sara Isabel Lebre de Almeida
Filiação Institucional: Escola Superior de Saúde da Universidade de Aveiro
Investigador Responsável/Orientador: Prof.ª Alda Sofia Pires de Dias Marques (PhD)

Relator: Rogério Manuel Clemente Rodrigues

Parecer

As proponentes, propõem-se realizar, no âmbito de Curso Mestrado em Gerontologia da Escola Superior de Saúde da Universidade de Aveiro, estudo com o objectivo de *"(...) avaliar os diferentes sistemas responsáveis pelo equilíbrio na população idosa e compará-los entre subgrupos populacionais"*
O estudo é definido como "*exploratório*" "*transversal e quantitativo*".
A população do estudo inclui residentes na comunidade, residentes em lar (Lar Monte dos Burgos - Porto) e utentes de outras instituições da cidade de Aveiro (Academia de Saberes de Aveiro; Ginásio Fit&Fun; e Health Club Knock-Out). São indicadas, e apresentadas as autorizações, das instituições onde irá decorrer o estudo. A amostra será obtida por conveniência não estando definido o seu tamanho.
Não o sendo expressamente referido, depreende-se que o contacto com os participantes e a recolha de dados será efectuada pelas proponentes.
No documento apresentado:
- É justificada a utilidade do estudo para o planeamento das intervenções junto da população alvo;
- Estão definidos os critérios de inclusão;
- Os instrumentos de recolha de dados são apresentados;
- A recolha de dados decorrerá nas instituições participantes ou em casa dos participantes;
- É garantida a participação livre, voluntária e informada dos participantes;
- É obtido o consentimento informado dos participantes;
- É garantida a confidencialidade dos dados recolhidos;
- Não são identificados danos, ou custos, para os participantes.

Pelo exposto o parecer desta Comissão é favorável ao estudo tal como apresentado.

O relator: Rogério Manuel Clemente Rodrigues

Data: 19/11/2014 O Presidente da Comissão de Ética:

Annex II – Institutions' approval

Autorização Institucional

Eu, Sara Mariana Carneiro Teixeira responsável pela instituição Associação de Solidariedade Humanitária de Canelas declaro que fui informado dos objetivos do estudo científico intitulado "Avaliar os diferentes sistemas responsáveis pelo equilíbrio na população idosa", e concordo em autorizar a execução da mesma nesta instituição. Caso necessário, a qualquer momento como instituição CO-PARTICIPANTE desta investigação podemos revogar esta autorização, se comprovadas atividades que causem algum prejuízo a esta instituição ou ainda, a utilização de qualquer dado que comprometa o sigilo da participação dos integrantes desta instituição. Declaro também, que nós enquanto instituição, bem como os participantes não recebemos qualquer pagamento por esta autorização.

Sara Mariana Carneiro Teixeira	12/01/2015	[signature]
Representante da Instituição	Data	Assinatura
Sara Isabel Lobas de Almeida	12/01/2015	Sara Almeida
Investigadora	Data	Assinatura
Joana Santos	12/01/2015	[signature]
Investigadora	Data	Assinatura

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Autorização Institucional

Eu, Heitor Antunes Silva responsável pela instituição APA - Lar de Idosos declaro que fui informado dos objetivos do estudo científico intitulado "Avaliar os diferentes sistemas responsáveis pelo equilíbrio na população idosa", e concordo em autorizar a execução da mesma nesta instituição. Caso necessário, a qualquer momento como instituição CO-PARTICIPANTE desta investigação podemos revogar esta autorização, se comprovadas atividades que causem algum prejuízo a esta instituição ou ainda, a utilização de qualquer dado que comprometa o sigilo da participação dos integrantes desta instituição. Declaro também, que nós enquanto instituição, bem como os participantes não recebemos qualquer pagamento por esta autorização.

Heitor Silva	23/11/2014	[signature]
Representante da Instituição	Data	Assinatura
Joana Santos	23/11/2014	[signature]
Investigadora	Data	Assinatura
Sara Almeida	23/11/2014	Sara Almeida
Investigadora	Data	Assinatura

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Autorização Institucional

Eu, Luís João Santos Freire Jorge responsável pela instituição Casa do Professor declaro que fui informado dos objetivos do estudo científico intitulado "Avaliar os diferentes sistemas responsáveis pelo equilíbrio na população idosa", e concordo em autorizar a execução da mesma nesta instituição. Caso necessário, a qualquer momento como instituição CO-PARTICIPANTE desta investigação podemos revogar esta autorização, se comprovadas atividades que causem algum prejuízo a esta instituição ou ainda, a utilização de qualquer dado que comprometa o sigilo da participação dos integrantes desta instituição. Declaro também, que nós enquanto instituição, bem como os participantes não recebemos qualquer pagamento por esta autorização.

Luís João Santos Freire Jorge	23.12.2014	[signature]
Representante da Instituição	Data	Assinatura
Sara Isabel Lebre de Almeida	23/12/2014	Sara Almeida
Investigadora	Data	Assinatura
Joana Carvalho Santos	23/12/2014	[signature]
Investigadora	Data	Assinatura

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Autorização Institucional

Eu, Susana Maria Teixeira Fernandes Amaral responsável pela instituição Centro Social e Paroquial Santo André declaro que fui informado dos objetivos do estudo científico intitulado "Avaliar os diferentes sistemas responsáveis pelo equilíbrio na população idosa", e concordo em autorizar a execução da mesma nesta instituição. Caso necessário, a qualquer momento como instituição CO-PARTICIPANTE desta investigação podemos revogar esta autorização, se comprovadas atividades que causem algum prejuízo a esta instituição ou ainda, a utilização de qualquer dado que comprometa o sigilo da participação dos integrantes desta instituição. Declaro também, que nós enquanto instituição, bem como os participantes não recebemos qualquer pagamento por esta autorização.

	02.12.2014	
Representante da Instituição	Data	Assinatura
Joana Santos	2/12/2014	
Investigadora	Data	Assinatura
Sara Isabel [illegible] de Almeida	2/12/2014	
Investigadora	Data	Assinatura

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Autorização Institucional

Eu, Manuel Agostinho Borges Machado responsável pela instituição Centro Social Nª Sª do Extremo declaro que fui informado dos objetivos do estudo científico intitulado "Avaliar os diferentes sistemas *responsáveis pelo equilíbrio na população idosa*", e concordo em autorizar a execução da mesma nesta instituição. Caso necessário, a qualquer momento como instituição CO-PARTICIPANTE desta investigação podemos revogar esta autorização, se comprovadas atividades que causem algum prejuízo a esta instituição ou ainda, a utilização de qualquer dado que comprometa o sigilo da participação dos integrantes desta instituição. Declaro também, que nós enquanto instituição, bem como os participantes não recebemos qualquer pagamento por esta autorização.

	2/02/2015	
Representante da Instituição	Data	Assinatura
Joana Carvalho Santos	2/02/2015	
Investigadora	Data	Assinatura
Sara Lebre Almeida	2/02/2015	Sara Almeida
Investigadora	Data	Assinatura

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Autorização Institucional

Eu, MARIA ISAURA FERREIRA REGALADO RIBEIRO responsável pela instituição LAR DO MONTE DOS BURGOS declaro que fui informado dos objetivos do estudo científico intitulado "Avaliar os diferentes sistemas responsáveis pelo equilíbrio na população idosa", e concordo em autorizar a execução da mesma nesta instituição. Caso necessário, a qualquer momento como instituição CO-PARTICIPANTE desta investigação podemos revogar esta autorização, se comprovadas atividades que causem algum prejuízo a esta instituição ou ainda, a utilização de qualquer dado que comprometa o sigilo da participação dos integrantes desta instituição. Declaro também, que nós enquanto instituição, bem como os participantes não recebemos qualquer pagamento por esta autorização.

DIRECTORA	13.10.2014	[signature] Lar Monte dos Burgos – CCD Centro de Cultura e Desporto dos Trabalhadores da Segurança Social do Porto
Representante da Instituição	Data	Assinatura
Joana Carvalho Santos	13/10/2014	[signature]
Investigadora	Data	Assinatura
Sara Isabel Alves de Almeida	13/10/2014	Sara Almeida
Investigadora	Data	Assinatura

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Autorização Institucional

Eu, Francisco de Almeida Gomes responsável pela instituição Fit & Fun Aveiro declaro que fui informado dos objetivos do estudo científico intitulado "Avaliar os diferentes sistemas responsáveis pelo equilíbrio na população idosa", e concordo em autorizar a execução da mesma nesta instituição. Caso necessário, a qualquer momento como instituição CO-PARTICIPANTE desta investigação podemos revogar esta autorização, se comprovadas atividades que causem algum prejuízo a esta instituição ou ainda, a utilização de qualquer dado que comprometa o sigilo da participação dos integrantes desta instituição. Declaro também, que nós enquanto instituição, bem como os participantes não recebemos qualquer pagamento por esta autorização.

Francisco Gomes	24/10/2014	FGomes
Representante da Instituição	Data	Assinatura
Joana Carvalho Santos	24/10/2014	JoanaSantos
Investigadora	Data	Assinatura
Sara Isabel Nebre de Almeida	24/10/2014	SaraAlmeida
Investigadora	Data	Assinatura

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Autorização Institucional

Eu, [illegible] responsável pela instituição [illegible] declaro que fui informado dos objetivos do estudo científico intitulado "Avaliar os diferentes sistemas responsáveis pelo equilíbrio na população idosa", e concordo em autorizar a execução da mesma nesta instituição. Caso necessário, a qualquer momento como instituição CO-PARTICIPANTE desta investigação podemos revogar esta autorização, se comprovadas atividades que causem algum prejuízo a esta instituição ou ainda, a utilização de qualquer dado que comprometa o sigilo da participação dos integrantes desta instituição. Declaro também, que nós enquanto instituição, bem como os participantes não recebemos qualquer pagamento por esta autorização.

[illegible]	22/10/2014	[illegible]
Representante da Instituição	Data	Assinatura
Joana Carvalho Santos	22/10/2014	[illegible]
Investigadora	Data	Assinatura
Sara Isabel Febra de Almeida	22/10/2014	Sara Almeida
Investigadora	Data	Assinatura

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Autorização Institucional

Eu, Maria Cacilda de Freitas Morado responsável pela instituição Academia de Saberes de Aveiro declaro que fui informado dos objetivos do estudo científico intitulado "Avaliar os diferentes sistemas responsáveis pelo equilíbrio na população idosa", e concordo em autorizar a execução da mesma nesta instituição. Caso necessário, a qualquer momento como instituição CO-PARTICIPANTE desta investigação podemos revogar esta autorização, se comprovadas atividades que causem algum prejuízo a esta instituição ou ainda, a utilização de qualquer dado que comprometa o sigilo da participação dos integrantes desta instituição. Declaro também, que nós enquanto instituição, bem como os participantes não recebemos qualquer pagamento por esta autorização.

Maria Cacilda de Freitas Morado	20/10/2014	[signature]
Representante da Instituição	Data	Assinatura
Joana Carvalho Santos	20/10/2014	[signature]
Investigadora	Data	Assinatura
Sara Isabel Nobre de Almeida	20/10/2014	Sara Almeida
Investigadora	Data	Assinatura

Appendix I – Information sheets to the Participants

Folhas de Informação ao Participante

As estudantes Joana Carvalho Santos e Sara Isabel Lebre de Almeida, a frequentar o Mestrado de Gerontologia da Escola Superior de Saúde da Universidade de Aveiro, sob a orientação científica da Professora Doutora Alda Sofia Pires de Dias Marques, vêm por este meio solicitar-lhe a autorização para participar no estudo intitulado: "Avaliar os diferentes sistemas responsáveis pelo equilíbrio na população idosa".

Antes de decidir, deve compreender o motivo da realização da investigação e o que a mesma envolve. Por favor, leia com atenção a informação e, se houver algo que não esteja claro para si ou se necessitar de informações adicionais não hesite em contactar as estudantes ou a orientadora (contactos no final do documento).

Qual o propósito do estudo?

Este estudo tem como objetivo avaliar os diferentes sistemas responsáveis pelo equilíbrio nas pessoas idosas e comparar os resultados entre subgrupos populacionais. Com este estudo pretende-se avaliar o que está preservado e/ou alterado no equilíbrio das pessoas idosas, contribuindo para o futuro planeamento de políticas públicas e para a elaboração de programas de saúde preventivos relativamente às quedas.

Porque fui escolhido?

Foi escolhido para participar porque é uma pessoa saudável com idade igual ou superior a 60 anos, que tem capacidade de expressar opiniões e apresenta discurso coerente e orientação espácio-temporal.

Tenho de participar?

A decisão de participar ou não é completamente sua. Se decidir participar ser-lhe-á pedido que assine dois consentimentos informados, um para si e outro para as estudantes de Mestrado. É livre de desistir a qualquer altura do estudo, sem que tenha de dar qualquer justificação.

O que acontece após aceitar participar?

Se aceitar participar ser-lhe-á pedido que preencha o consentimento informado anexo a esta folha e só depois se iniciará a aplicação do protocolo de recolhas de dados.

Inicialmente serão feitas algumas perguntas de caráter sociodemográfico e será recolhida alguma informação sobre a sua saúde. Neste campo serão recolhidos o seu peso em quilogramas (kg) e a sua altura em centímetros (cm).

Será também avaliada a bioimpedância onde lhe será pedido que agarre com as suas mãos um pequeno aparelho que fará a leitura automática da sua percentagem de massa gorda corporal, em breves segundos.

Depois destes testes breves, ser-lhe-á solicitado o preenchimento de três breves escalas. A escala Avaliação da Qualidade de Vida da Organização Mundial de Saúde que avalia a sua qualidade de vida e é constituída por 26 perguntas que seguem uma escala de Likert de 1 a 5, ou seja, quanto maior a pontuação melhor a qualidade de vida. É constituída por 4 domínios que são: físico, psicológico, relações sociais e meio ambiente. A escala de Confiança no Equilíbrio Específica para a Atividade (ABC Scale) é constituída por algumas questões (nº 2, nº 9, nº 11, nº 14 e nº 15) que dizem respeito a atividades complementares: confiança ao subir e descer escadas (questão nº 2), confiança ao entrar e sair de um carro (questão nº 9), confiança ao subir e descer uma rampa (questão nº 11), confiança ao entrar e sair de uma escada rolante (questões nº 14 e nº 15). E por fim, a escala de Ansiedade e Depressão Hospitalar (HADS) que é composta por uma subescala de ansiedade e uma subescala de depressão, ambas constituídas por sete itens. Cada item permite a escolha entre quatro opções de resposta, em que a pessoa deve escolher aquela que corresponde à forma como se tem sentido durante a última semana.

De seguida, iniciar-se-á uma avaliação da atividade física com duas perguntas sobre a sua atividade física semanal. Ser-lhe-á solicitado que caminhe num corredor para realizar o Teste de Marcha dos 10 Metros enquanto o tempo é cronometrado. O teste é realizado 3 vezes à velocidade de marcha mais rápida possível.

Para avaliar a força muscular ser-lhe-á pedido que se sente e se levante com os braços cruzados sobre o peito e com as costas contra o encosto da cadeira, cinco vezes enquanto a investigadora regista com um cronómetro o tempo que lhe demorará a executar esta tarefa (Teste de Sentar e Levantar Cinco Vezes – Five times Sit to Stand Test).

A flexibilidade será avaliada pelo Chair sit and reach test (Teste de sentar na cadeira e alcançar) no qual lhe será pedido que se sente na parte anterior do assento da cadeira, coloque um joelho em extensão (anca a 0º de abdução), o calcanhar no chão e o pé em posição neutra. Em seguida deverá levar o seu tronco à frente, mantendo a coluna e a cabeça alinhadas, e deslizar com os braços esticados e as mãos sobrepostas sobre o membro em extensão, numa tentativa de tocar nos dedos dos pés (expirar na descida). Deve manter a posição máxima por 2 segundos. Realizar-se-ão as medições 3 vezes.

Por fim serão aplicadas as escalas de Berg (14 itens) e o BESTest (27 itens) em simultâneo, estas consistem em avaliar o equilíbrio através das restrições biomecânicas, dos limites de estabilidade/verticalidade, das transições/antecipatório, das respostas posturais reativas, da orientação sensorial e da estabilidade na marcha.

Quais são os efeitos secundários dos procedimentos do estudo?

Não existem efeitos secundários de participar no estudo.

Quais são as possíveis desvantagens e riscos se resolver participar?

Não existem quaisquer desvantagens ou riscos de participar no estudo.

Quais são os possíveis benefícios da minha participação?

Não existem benefícios diretos de participar no estudo. No entanto, a informação que obtivermos através do estudo permitirá identificar o que está preservado ou alterado no equilíbrio das pessoas idosas, informando futuras intervenções para prevenção de quedas nesta população.

A participação será confidencial?

A informação recolhida durante o estudo será confidencial. Os dados recolhidos para a base de dados não serão gravados com o nome dos participantes, mas sim com um código, para que ninguém os identifique. As bases de dados estarão num computador protegido com palavra-passe e só os investigadores do estudo terão acesso às mesmas.

O que acontecerá aos resultados do estudo?

Os resultados do estudo serão analisados e integrarão as dissertações de Mestrado, podendo ser publicados como estudos científicos. Contudo, em nenhum momento será identificado.

Contactos para mais informações sobre o estudo

Se ficou com alguma dúvida ou se pretende obter mais informações sobre o estudo, pode telefonar ou escrever para:

Alda Sofia de Dias Marques, Joana Carvalho Santos e Sara Isabel Lebre de Almeida.

Escola Superior de Saúde da Universidade de Aveiro,
Universidade de Aveiro,
Campus de Santiago,
Edifício III, 3810-193, Aveiro
Telefone: 234 247 113 ou 234 372 462
e-mail: joanacarvalhosantos@ua.pt; saralebre@ua.pt; amarques@ua.pt

Muito obrigada por ter lido esta informação.

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Se pretender obter uma cópia de qualquer relatório ou publicação, por favor indique o seu contacto de e-mail no espaço seguinte:

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Appendix II – Informed Consent

universidade de aveiro essua escola superior de saúde

Termo de Consentimento Livre e Esclarecido do Participante

Título do Projeto: Avaliar os diferentes sistemas responsáveis pelo equilíbrio na população idosa.

Nome do investigador principal: Alda Marques

Por favor leia e assinale com uma cruz (X) os quadrados seguintes.

1. Eu confirmo que percebi a informação que me foi dada e tive a oportunidade de questionar e de me esclarecer. ☐

2. Eu percebo que a minha participação é voluntária e que sou livre de desistir, em qualquer altura, sem dar nenhuma explicação, sem que isso me afete de alguma forma. ☐

3. Eu compreendo que os dados recolhidos durante a investigação são confidenciais e que só os investigadores do projeto da Universidade de Aveiro têm acesso a eles. Portanto, dou autorização para que os mesmos tenham acesso a esses dados. ☐

4. Eu percebo que os resultados do estudo serão publicados numa dissertação de mestrado e jornais e/ou conferências científicas sem que a minha identidade (e.g., nome e idade) seja revelada. E dou portanto, autorização para a utilização dos dados para esses fins. ☐

5. Eu concordo então em participar no estudo. ☐

____________________	__________	____________________
Nome do Participante	Data	Assinatura
____________________	__________	____________________
Nome da Testemunha	Data	Assinatura
____________________	__________	____________________
Nome do Investigador	Data	Assinatura