Original Article

Body composition is associated with the risk of falls and fear of falling in hemodialysis patients

A composição corporal está associada com o risco de quedas e medo de cair em pacientes em hemodiálise

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ABSTRACT | INTRODUCTION: Patients with chronic kidney disease (CKD) on hemodialysis (HD) experience musculoskeletal and body composition changes that may lead to reduced balance, gait speed and ability to perform activities of daily living, thus increasing the risk of falls. **OBJECTIVE:** To investigate the association between body composition with the risk of falls and fear of falling in HD patients. **METHODS:** Cross-sectional study of 40 patients on HD. Fear of falling and risk of falls were assessed with the International Efficacy Scale of Falls and the QuickScreen Clinical Falls Risk Assessment. The sample was stratified at the 50th percentile to compare body composition according to the risk of falls and fear of falling. For comparison between groups, the independent Student t test was used and Spearman's correlation to associate the risk of falls and fear of falling with body composition. The level of significance was $p<0.05$ **RESULTS:** Moderate positive correlation between body fat with fear of falling ($r=0.47$) and risk of falling ($r=0.42$), and moderate negative correlation between lean mass with fear of falling ($r=-0.51$) and risk of falls ($r=-0.45$). The group with the highest risk of falls had higher body fat (36.8±8.2 vs 30.9±6.9; $p=0.043$). The group with the highest fear of falling had less lean mass (41.6±9.2 vs 52.0±7.6; $p=0.004$). **CONCLUSION:** Body composition is associated with the risk of falls and the fear of falling in patients with CKD on HD.

KEYWORDS: Accidental falls. Body composition. Muscle strength. Adiposity. Chronic renal insufficiency.

RESUMO | INTRODUÇÃO: Pacientes com doença renal crônica (DRC) submetidos à hemodiálise (HD) apresentam alterações musculoesqueléticas e de composição corporal que podem levar à redução do equilíbrio, velocidade de caminhada e capacidade de realizar as atividades de vida diária, aumentando o risco de quedas. **OBJETIVO:** Investigar a associação da composição corporal com o risco de quedas e medo de cair em pacientes com DRC submetidos à HD. **MATERIAIS E MÉTODOS:** Estudo transversal com amostra de 40 pacientes em HD. Para o medo de cair e risco de quedas foram aplicados a Escala Internacional de Eficácia de Quedas e o *QuickScreen Clinical Falls Risk Assessment*. A amostra foi estratificada no percentil 50 para comparação da composição corporal de acordo com o risco de quedas e medo de cair. Para comparação entre os grupos, empregou-se o teste t de *Student* independente, e a correlação de *Spearman* para associar o risco de quedas e medo de cair com a composição corporal. O nível de significância adotado foi de $p<0,05$. **RESULTADOS:** Correlação moderada positiva entre a gordura corporal com o medo de cair ($r=0,47$) e risco de quedas ($r=0,42$) e correlação moderada negativa entre a massa magra com o medo de cair ($r=-0,51$) e risco de quedas ($r=-0,45$). O grupo com maior risco de quedas apresentou maior gordura corporal (36,8±8,2 vs 30,9±6,9; $p=0,043$). O grupo com maior medo de cair obteve menor massa magra (41,6±9,2 vs 52,0±7,6; $p=0,004$). **CONCLUSÃO:** As variáveis de composição corporal associaram-se ao risco de quedas e ao medo de cair em pacientes com DRC submetidos à HD.

PALAVRAS-CHAVE: Acidentes por quedas. Composição corporal. Força muscular. Adiposidade. Insuficiência renal crônica.

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Introduction

Chronic kidney disease (CKD) patients undergoing hemodialysis (HD) have musculoskeletal and body composition disorders that can lead to reduced ability to perform activities of daily living (ADL). Decreases in strength and muscle mass, as a consequence of CKD, results in reduced balance, walking speed, and increased risk of falls[1,2].

In the older people, falls and associated adverse outcomes are a substantial health problem associated with a significant mortality risk[3]. In HD patients falls have also become increasingly prevalent, whether in elderly or not[4-7]. Risk factors associated with increased risk of falls in patients with CKD include the high prevalence of comorbidities, multiple drug therapies, hemodynamic and metabolic instability induced by the frequency of treatment, and frailty syndrome[8,9].

There is much evidence about physical function, such as muscle strength and postural balance, and its association with increased risk of falls and fear of falling in several special populations, including CKD[10-13]. However, the literature is not clear about the role of body composition in the physiological mechanisms of the occurrence of falls, and the little existing evidence in the elderly shows conflicting results[14].

Likewise, to date, there is no evidence that elucidates the relationship between body composition and falls in patients with CKD on HD. Thus, the present study aimed to investigate the association between body composition with the risk of falls and fear of falling in HD patients.

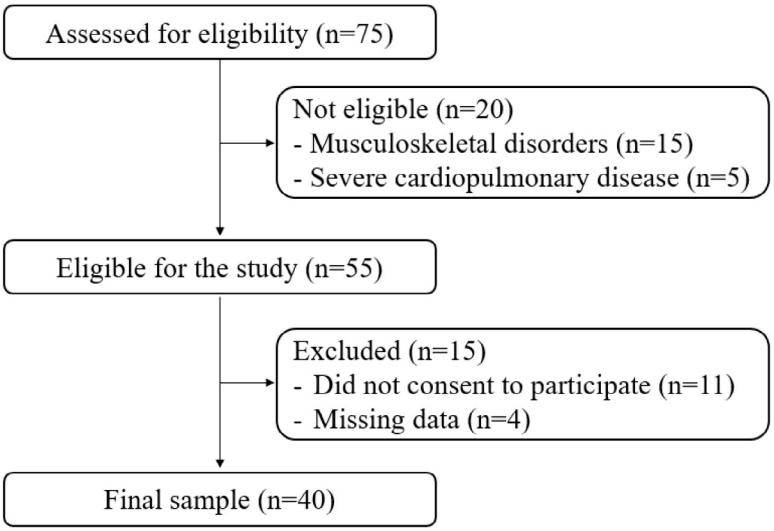
Methods

This is a cross-sectional study in a private HD clinic in the city of Brasília, Brazil, between January and March of 2018. This study was approved by the Research Ethics Committee of the Catholic University of Brasília, number 2.497.191/2018.

Study Population

Participants were invited by the researchers and the clinic's medical staff during HD sessions. Those who were undergoing HD treatment for more than three months, released from the medical team, ≥ 18 years old, and signed the informed consent form (ICF) were eligible for the study. Patients with a severe cardiopulmonary disease (for example, recent myocardial infarction or unstable angina), who missed the last HD session before the start of evaluations and those with musculoskeletal disorders that impaired the tests from being performed were excluded. The eligible population consisted of 55 patients, of whom 40 agreed to participate in the study (figure 1).

Figure 1. Flowchart of patients' recruitment



General Procedures

The assessments were performed during two visits to the HD clinic. In the first visit, the objectives, procedures, benefits, and possible risks of the study were detailed explained to all patients. After, patients signed the ICF and answered the sociodemographic questionnaire. One week later, on the second visit, the included participants carried out the following evaluations, divided into three moments: I) anthropometric and body composition assessments; II) handgrip strength (HGS) and; III) Falls Efficacy Scale-International (FES-I) e QuickScreen Clinical Falls Risk Assessment to assess the risk of falls[15,16]. All evaluations were performed at the end of the HD session due to convenience reasons by an expert evaluator in a climatized room.

Stratification of Groups

The groups were stratified by the upper and lower 50th percentile through the results obtained by the FES-I and the QuickScreen. The upper 50th percentile result for both assessments was considered to be the group with the highest fear of falling and the risk of falls. On the other hand, the bottom 50th percentile result was considered as the group with the lowest fear of falling and risk of falls, respectively.

Anthropometric Assessments

Initially, body mass was measured using a portable digital scale (FilizolaTM, Beyond Technology, PL - 200, São Paulo, Brazil), with a resolution of 0.1 kilograms (kg). In this procedure, participants were asked to remove any accessories that could influence the measure (example: ring, earrings, caps, watch, and others), bare feet, and the weight distributed equally on both legs, the weight was recorded in kg. Height was measured using a 1 cm centimeter wall stadiometer (FilizolaTM, Beyond Technology, PL - 200, São Paulo, Brazil). For this measure, the anatomical position was used, keeping feet together, heels, buttocks, and trunks leaning against the wall, palms facing forward and head positioned on the Frankfurt plane. Body mass index (BMI) was calculated using the following formula: BMI = weight/height*height. All anthropometric assessments were carried out in an air-conditioned room, separate from the HD area, respecting the recommendations imposed by the manufacturers.

Body Composition

Body composition was measured using tetrapolar bioimpedance (Byodinamics, ®310e, São Paulo, Brazil). To perform the procedure, patients were asked to remain in the supine position, thus, it was possible to place the electrodes on the distal parts of the right feet and hands. For patients with pacemakers, the procedure was not performed, respecting the manufacturer's recommendations. The measurements of lean mass (kg), fat mass (kg), body fat (%) and basal metabolic rate (BMR) were obtained.

Handgrip Strength

For HSG evaluation, the equipment used was an analog hydraulic dynamometer, previously calibrated (Jamar, J00105, Illinois, USA). Participants were positioned seated, following the recommendations of the American Society of Hand Therapists, in which the hips and knees are flexed at 90º, shoulder adducted in a neutral position, elbow flexed at 90º, and forearm in semi-pronation. The grip on the dynamometer was individually adjusted according to the size of the volunteers' hands, comfortably. The measurement was made in the non-fistulated or dominant arm for those with access via a catheter. Three attempts were performed, and the participants were asked to apply the greatest possible strength during 4 seconds for each attempt. The measure of greatest result among attempts was considered for analysis. During the test, the participants received verbal encouragement. For each attempt, an interval of 30 seconds was given. The results were recorded in kg/f[17].

Falls Efficacy Scale-International

To assess the fear of falling, FES-I was used. Falling was defined as an unintentional act of falling to the ground or below your level. The FES-I is a questionnaire containing 16 domains with different activities of daily living with four possible answers and respective scores from 1 to 4 (“Not at all concerned” to “Extremely concerned”). The total score may vary from 16 to 64 (absence of concern to extreme concern) concerning falls during the performance of the specific activities of the questionnaire[15].

QuickScreen Clinical Falls Risk Assessment

The QuickScreen Clinical Falls Risk Assessment is an internationally validated questionnaire containing eight items: occurrence of falls in the previous year, the number of drugs in use (excluding vitamins), use of psychotropics, assessment of visual acuity, the test of peripheral sensitivity, assessment of balance, time of reaction and strength that verify the presence or absence of risk factors that can lead to a fall, revealing results in percentage (%) that indicate the probability of falling in the next 12 months. In the presence of 0 or 1 factor, the probability of falling is 7%, 2 or 3 factors 13%, 4 or 5 factors 25% and 6 or more factors have a 49% probability of falling[16].

Biochemical Analyses

Blood collection and biochemical analyzes of urea, creatinine, and albumin were performed by a specialized private laboratory, as part of the patients' clinical routine. The procedures were performed at the beginning of HD, in the morning and afternoon during the month of patient evaluation.

Statistical Analyses

Data were expressed using the mean and standard deviation (±) values. The Kolmogorov-Smirnov test was used to verify the normality of the data. The independent Student t-test was used to compare body composition according to groups stratified for the variables risk of falls and fear of falling. Additionally, Spearman's correlation test was adopted to verify possible associations between body composition and HGS variables in the risk of falls and fear of falling. The level of significance was set at 95%. All statistical analyzes were performed with the Statistical Package for the Social Sciences (SPSS) program, version 22.0 (SPSS Inc., Chicago, IL, EUA).

Results

Table 1 presents the results regarding the sociodemographic and clinical characteristics of the participants.

Table 1. Characterization of the hemodialysis patients (n=40)

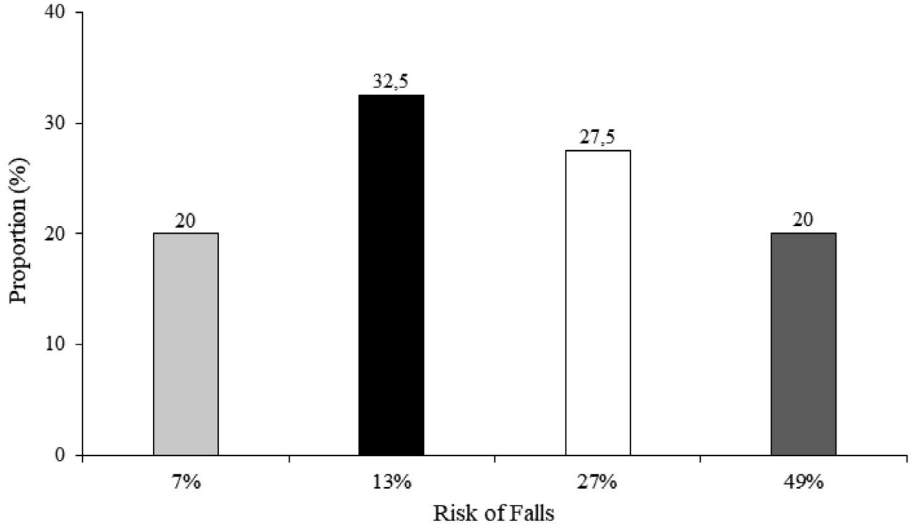
Variables	Mean ± SD
Age (years)	53.6±16.0
Body Weight (kg)	68.5±15.1
Height (m)	1.64±0.1
Waist Circumference (cm)	97.5±13.3
Body Mass Index (kg/m^2)	30.1±5.6
Lean Mass (kg)	45.6±9.9
Fat Mass (kg)	23.8±8.8
Body Fat (%)	33.8±8
Basal Metabolic Rate (kcal)	1383.4±305.4
Dialysis Vintage (months)	29.7±28.7
Handgrip Strength (kgf)	25.4±10.1
Fear of Falling (FES-I)	23.6±10.7
Urea pre-HD (mg/dL)	132.7±30.8
Urea post-HD (mg/dL)	56.1±21.7
Creatinine (mg/dL)	9.0±3.4
Albumin (g/dL)	4.1±0.6

HD = hemodialysis.

A total of 40 participants took part in the study. Most were men (60%; n = 24), treatment time of 29.7±28.7 months, and mean age of 53.6±16.0 years.

Figure 2 shows the risk of falls in 12 months according to the QuickScreen Clinical Falls Risk Assessment.

Figure 2. Risk of falls in hemodialysis patients according to the QuickScreen (n=40)



Only 20% have a low risk of falls (7%), the same value for the highest risk of falls (49%). Adding the risks of 27 and 49%, there is a total of 47.5% of the sample with a high risk of falls.

Table 2 presents the data from the correlation between body composition and HGS with the fear of falling and the risk of falls.

Table 2. Correlation between body composition and muscle strength according to the risk of falls and fear of falling in hemodialysis patients (n=40)

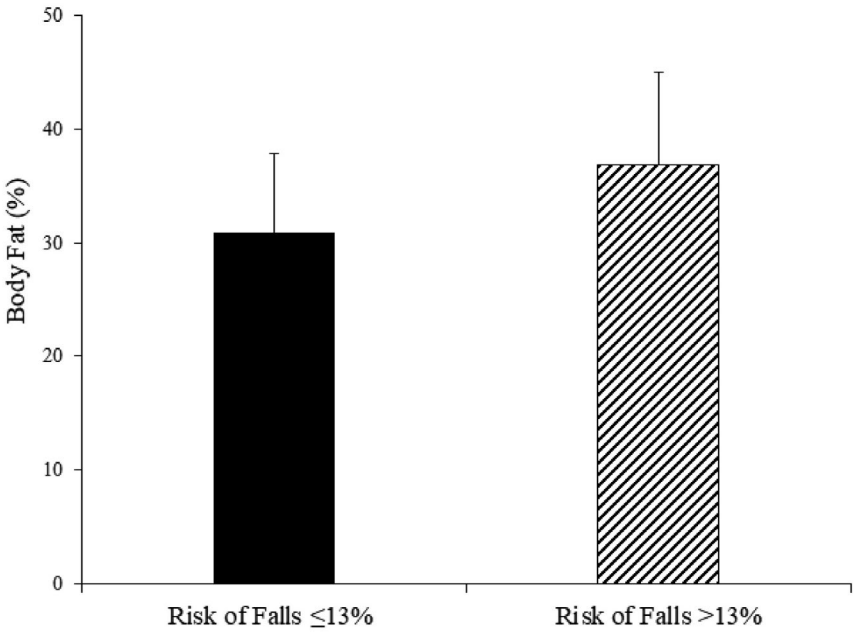
Variables	Fear of Falling	Risk of Falls
Lean Mass (kg)	-0.551*	-0.450*
Fat Mass (kg)	0.093	0.124
Body Fat (%)	0.473*	0.422*
Basal Metabolic Rate (kcal)	-0.553*	-0.446*
Handgrip Strength (kgf)	-0.406*	-0.155

*$P<0.05$.

Findings in table 2 show negative associations between lean mass, BMR, and HGS with the fear of falling and risk of falls, however, HGS was only significant with fear of falling. Also, body fat showed positive associations with fear of falling and the risk of falling.

Figure 3 shows a comparison of the body fat between the groups with the lowest and highest risk of falls.

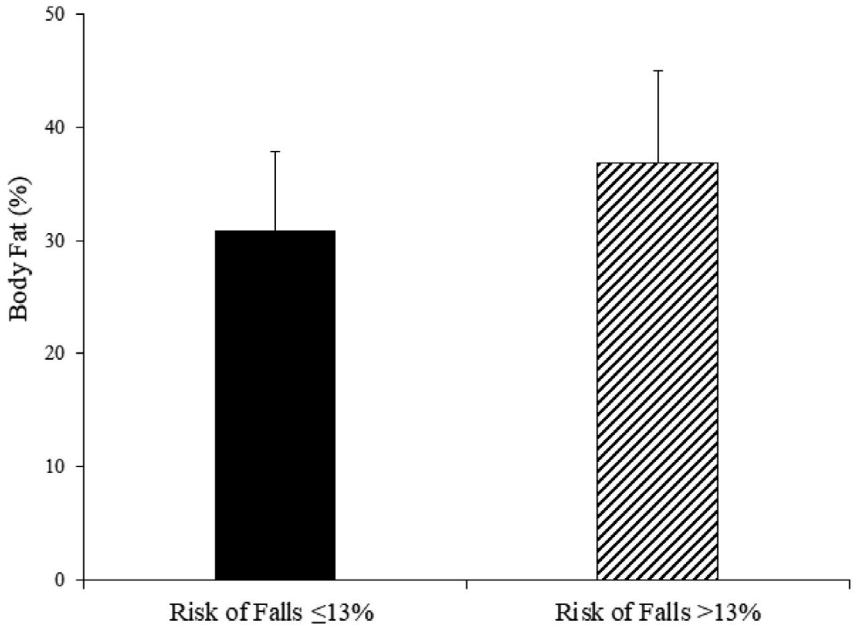
Figure 3. Comparison of body fat according to the risk of falls in hemodialysis patients (n=40)



As seen in figure 3, the group with the lowest risk of falls has lower body fat when compared to the group with the highest risk of falls (36.8±8.2 vs 30.9 ± 6.9; p = 0.043).

Figure 4 shows a comparison of lean mass between the groups with the lowest and highest fear of falling.

Figure 4. Comparison of lean mass according to the risk of falls in hemodialysis patients (n=40)



The group with the greatest fear of falling has a lower value of lean mass compared to the group with the lowest fear of falling (41.6 ± 9.2 vs 52 ± 7.6; p = 0.004).

Discussion

The findings confirm the association between body composition with the fear of falling and the risk of falls in CKD patients on HD. The risk of falls showed a moderate association with lean mass, body fat, and BMR. Nevertheless, fear of falling was moderately associated with lean mass, body fat, BMR, and HGS.

Evidence indicates an increased risk of falls associated with HD patients[2,18]. Our findings are in line with the literature, and it was observed that 47.5% of the sample had an increased risk of falls. Fall is one of the major problems of morbidity and mortality in elderly people with CKD, with a prevalence of fractures ranging from 26.9 to 55%[19]. Factors such as age, sex, muscle strength, and comorbidities imply an increase in this risk, besides, elderly people with CKD have an 81% higher risk of falls when compared to those who do not have the disease[2]. Lópes-Soto et al. show an increased risk of falls for older HD patients[20], additionally, the authors highlight that patients on HD have greater functional dependence, which leads to a reduction in muscle mass and strength, consequently increasing the risk of falls[21].

Most studies investigating falls in patients with CKD point only to associations with functional variables, such as muscle strength, balance, and physical function, with a gap for understanding the role of body composition in this phenomenon[13,22]. In the elderly, previous studies show other variables that are associated and explain the risk of falls and fear of falling, such as body composition, especially body fat[10,23–25]. These variables corroborate the findings of our study, with negative associations between lean mass and BMR with fear of falling and risk of falls, and body fat with positive associations with fear of falling and risk of falls. Moreover, the group with the lowest risk of falls had lower body fat when compared to the group with the highest risk of falls, a similar finding for the group with higher fear of falling, which had lower lean mass values compared to the group with the lowest fear of falling.

As noted, lean mass was more associated with falls when compared to body fat. Strategies for maintaining and increasing lean mass in HD patients should, therefore, be encouraged to prevent possible falls. Thus, exercise interventions, especially strength training, appear as possible modifiers of body composition variables associated with the risk of falls and fear of falling[21].

The study has limitations due to its cross-sectional design, which does not allow cause-effect inferences. Thus, follow-up investigations are necessary to establish temporal relationships between body composition, risk of falls, and fear of falling. The number of participants was relatively small, reflecting the difficulty of access to the HD population. Practical applications can be understood through the findings of the present study, where simple measures of body composition, of low cost, can be factually applied in the clinical routine to evaluate HD patients who normally are at high risk of falls and fear of falling.

Conclusion

Our results showed an association between the body composition with the risk of falls and fear of falling in CKD patients on HD. Therefore, body composition assessments must be viewed with attention by health professionals and, also, it is important to implement interventions capable of reducing the risk of falls and fear of falling in this population.

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Author contributions

Ribeiro HS participated in the conception, design, data analysis and writing of the article. Carvalho HL, Dourado G, Almeida LS, and Duarte MP participated in the data collection and writing of the article. Gadelha AB participated in the writing and final approval of the article. Inda-Filho A and Ferreira AP participated in the conception, design of the method, and approval of the article.

Competing interests

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

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