

Association between depressive symptoms and body fat in chronic kidney patients in hemodialysis

Associação entre os sintomas depressivos e a gordura corporal em pacientes com doença renal crônica em hemodiálise

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ABSTRACT | INTRODUCTION: Excess body fat causes complex metabolic changes that enhance the pathogenesis and progression of chronic kidney disease (CKD). Furthermore, negative behavioral aspects such as depressive symptoms and a sedentary lifestyle are common and may be associated with the accumulation of body fat in patients undergoing hemodialysis (HD) treatment. **OBJECTIVE:** To verify the association between depressive symptoms and body fat in HD patients. **METHODS:** This is a cross-sectional study that enrolled thirty-nine patients ($59,3 \pm 16,7$; age). The body composition was evaluated by bioimpedance tetrapolar. Beck's depression inventory was used to measure depressive symptoms. And, to analyze possible association between depressive symptoms and body fat, Spearman's correlation test was applied. **RESULTS:** A depression prevalence of 17.9% was observed. Depressive symptoms were positively correlated with body fat ($r = 0.42$; $p = 0.008$). **CONCLUSION:** Our results confirmed that depressive symptoms were associated with body fat in HD patients. These findings are important for the clinical practice of health professionals, especially in the dietary and psychological aspects; therefore, treatment initiatives for diagnosis, prevention are important to reduce these conditions.

KEYWORDS: Body Fat Distribution. Chronic Kidney Disease. Depression. Hemodialysis.

RESUMO | INTRODUÇÃO: O excesso de gordura corporal causa alterações metabólicas complexas que acentuam na patogênese e progressão da doença renal crônica (DRC). Além disto, os aspectos comportamentais negativos, como sintomas depressivos e o sedentarismo, são comuns e podem estar associados ao acúmulo de gordura corporal em pacientes que realizam tratamento em hemodiálise (HD). **OBJETIVO:** Verificar a associação entre os sintomas depressivos e a gordura corporal em pacientes com DRC em HD. **MÉTODO:** Trata-se de um estudo transversal de um centro clínico de HD em Brasília-DF. Trinta e nove pacientes foram incluídos ($59,3 \pm 16,7$; idade). A composição corporal foi avaliada por meio de bioimpedância tetrapolar. O inventário de depressão de Beck foi empregado para mensurar os sintomas depressivos. Para analisar a associação entre os sintomas depressivos e a gordura corporal foi adotado o teste de correlação de Spearman. **RESULTADOS:** Foi observado uma prevalência de depressão de 17,9%. Os sintomas depressivos foram positivamente correlacionados com a gordura corporal ($r = 0,42$; $p = 0,008$). **CONCLUSÃO:** Em nossos resultados, confirmamos que os sintomas depressivos estão associados à gordura corporal em pacientes com DRC em HD. Estes achados demonstram-se importantes para a prática clínica dos profissionais de saúde, sobretudo, nos aspectos dietéticos e psicológicos em pacientes com DRC, de forma que iniciativas de diagnóstico, prevenção e tratamentos sejam priorizadas com o objetivo de reduzir tais condições.

PALAVRAS-CHAVE: Distribuição da Gordura Corporal. Doença Renal Crônica. Depressão. Hemodiálise.

Introduction

Chronic kidney disease (CKD) is defined as abnormalities in the structure or function of the kidneys, present for more than three months, with health implications (KDIGO, 2013). In the end-stage, the patient presents an accumulation of waste, fluids, electrolyte, and acid-base imbalance that requires hemodialysis (HD) treatment. At this moment, patients are affected by an abrupt change in their routine due to the treatment schedule and, added to the complications of the disease and the need for family support, it creates a barrier to the acceptance of the new reality and condition, leading to a reduction in quality of life and the appearance of depressive symptoms (Shirazian, 2019).

Depression is a psychiatric disorder strongly associated with quality of life (Debnath et al., 2018). In this sense, behavioral aspects, such as functional dependence, absence from work activities, and biological changes and clinical complications adjacent to CKD contribute to the development of depressive symptoms. Thus, 20% of HD patients experience this disorder, higher than in the general population (Ćwiek et al., 2017; McDougall et al., 2018; Shirazian, 2019).

It is known that excess body fat in the general population has been increasing in recent years, and particularly in adults with CKD (Johansen & Carol, 2017; Ortega et al., 2017). Excess body fat results in complex and pervasive metabolic abnormalities that accelerate the progression of CKD (Hall et al., 2014; Hall et al., 2019; Silva et al., 2017). Among the most common alterations, hyper inflammation, insulin resistance, and dyslipidemia stand out, which hinder the effectiveness of the treatment.

Thus, the consequences of excess body fat become one more pathway capable of inducing the appearance of comorbidities and worsening the clinical condition, negatively influencing the quality of life and, consequently, increasing the severity or development of depression. On the other hand, depressive patients present harmful behaviors to health, such as a sedentary lifestyle, smoking, and poor adherence to diet, medications, and dialysis treatment itself, which, in turn, impact body composition (Katon, 2011).

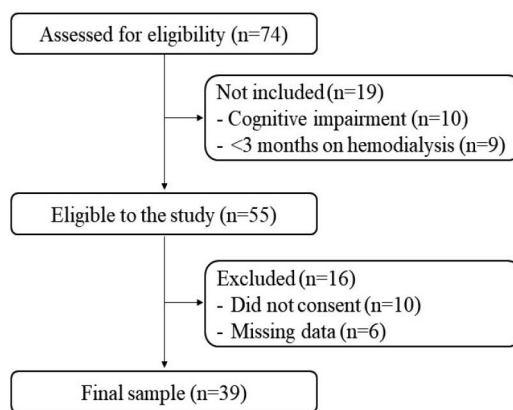
In this sense, it is important to understand that psychosomatic illnesses, such as depression, play an important role (Lee et al., 2016). However, the understanding of the association between depressive symptoms and body fat in HD patients is poorly explored. Thus, the present study aimed to verify the association of depressive symptoms with body fat in HD patients. Our hypothesis is that patients with depressive symptoms would have higher body fat.

Materials and methods

Study Design and Participants

This is a cross-sectional study, previously approved by the Research Ethics Committee of the Catholic University of Brasília (no. 2.497.191). Participants were recruited from a private clinic located in Brasília, Brazil. The study included patients on HD who signed the informed consent form, on HD ≥ 3 months, with medical approval to participate in the study and preserved cognitive function. Exclusion criteria were: cognitive deficit that affected their participation and physical inability to carry out the assessments, such as amputation of limbs and bedridden patients. All 74 patients were evaluated according to eligibility criteria, and figure 1 shows the study recruitment flowchart.

Figure 1. Flowchart of the study



General procedures

The sociodemographic characteristics of all participants were obtained from medical records. Participants were approached in two moments. At first, during HD sessions, the study's objectives, risks, and benefits were explained; later, they signed the consent form. Finally, the Beck Depression Inventory (BDI) was applied. Anthropometric and body composition evaluations were performed in a second moment after the HD session held in the middle of the week. Thus, this study complied with the Declaration of Helsinki (1964) and the Brazilian National Health Council resolutions 466/2012.

Beck Depression Inventory

The BDI consists of 21 multiple-choice items used to measure the severity of depressive symptoms. The score of each item varies according to the degree of symptom severity, being classified from 0 to 3 (0 = no symptom, 1 = mild, 2 = moderate, and 3 = severe symptom). The classification of the final score was as follows: <10 = no depression or minimal depression; 10–18 = depression, from mild to moderate; 19–29 = depression, moderate to severe; 30–63 = severe depression. The same evaluator with previous experience applied this questionnaire.

Anthropometry

Initially, body mass was measured using a portable digital scale (Filizola™, Beyond Technology, PL – 200, São Paulo, Brazil), with 0.1 kilograms (kg) resolution. In this procedure, participants were asked to be barefoot, and the weight was distributed equally on both legs. In the end, the weight was recorded in kg. Next, height was measured using a wall-mounted stadiometer with 1 cm resolution (Filizola™, Beyond Technology, PL – 200, São Paulo, Brazil). The anatomical position was used for this measurement, keeping feet together, heels, buttocks, and trunks leaning against the wall, palms facing forward, and the head positioned in the Frankfurt plane. Through the measurements of body mass (kg) and height (m), it was possible to calculate the body mass index (BMI) using the following formula: $BMI = \text{weight} \div \text{height}^2$. All anthropometric assessments were performed in an air-conditioned room, separate from the HD area, respecting the recommendations imposed by the manufacturers and an experienced evaluator.

Body Composition

Body composition was measured using tetrapolar bioimpedance (Byodynamics, @310e, São Paulo, Brazil). To perform the procedure, the patients were asked to remain in the supine position. Thus, it was possible to place the electrodes on the distal parts of the foot and right hand. Also, the removal of any metal could compromise the quality of the measurements as requested. Therefore, the procedure was not performed for patients who had a pacemaker, respecting the manufacturer's recommendations. The measurements obtained were: lean mass (kg), fat mass (kg), body fat (%), and basal metabolic rate (BMR).

Statistical Analyzes

Initially, data normality was verified using the Shapiro-Wilk test. The results were expressed as mean and standard deviation (\pm) values. To compare continuous variables between groups, Student's t-test for independent samples was used. For associations between depressive symptoms scores and body fat, Spearman's correlation test was used. The significance value adopted was $p < 0.05$. All statistical analyzes were performed using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) version 22.0 for Windows.

Results

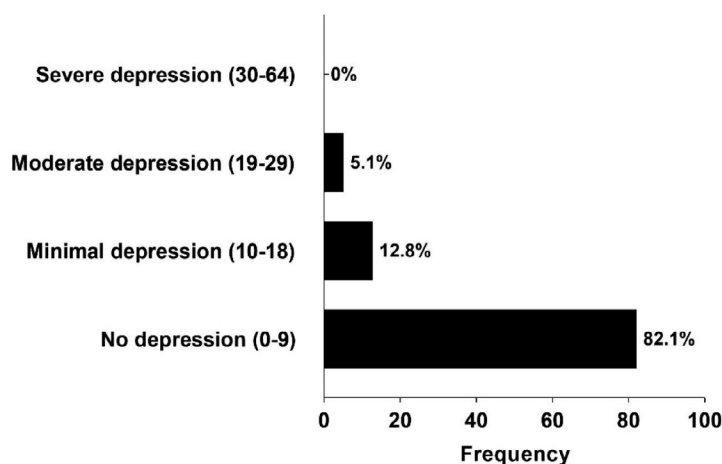
Initially, all 74 patients were evaluated according to eligibility criteria. The eligible population consisted of 55 patients, of which 39 agreed to participate in the study. Table 1 presents the descriptive characteristics and comparisons between the group with and without depression.

Table 1. Characterization of patients with chronic kidney disease on hemodialysis (n = 39)

Variables	All (n= 39)	Depressive (n= 7)	Non-depressive (n= 32)	p-value
Age (years)	59.3 \pm 16.7	66.4 \pm 12.7	57.6 \pm 17.2	0.213
Hemodialysis vintage (months)	25.3 \pm 23.8	16.5 \pm 14.5	18.7 \pm 16.0	0.137
Body composition and anthropometry				
Weight (kg)	70.2 \pm 14.5	68.9 \pm 10.3	70.4 \pm 15.5	0.808
Height (m)	1.64 \pm 0.1	1.60 \pm 0.1	1.65 \pm 0.1	0.175
Body mass index (kg/m ²)	30.9 \pm 6.4	32.5 \pm 6.2	30.5 \pm 6.5	0.479
Waist circumference (cm)	99.1 \pm 13.0	100.8 \pm 12.8	98.7 \pm 13.2	0.726
Lean mass (kg)	46.0 \pm 9.3	42.9 \pm 7.6	46.7 \pm 9.6	0.330
Fat mass (kg)	24.6 \pm 9.7	26.3 \pm 7.2	24.2 \pm 10.2	0.609
Body fat (%)	34.1 \pm 9.7	37.7 \pm 7.8	33.3 \pm 10.0	0.286
Basal metabolic rate (kcal)	1397.2 \pm 286.1	1.303 \pm 232.9	1.418 \pm 295.9	0.343
Depressive symptoms				
Beck Depression Inventory	6.4 \pm 5.8	16.7 \pm 3.5	3.8 \pm 2.9	<0.001

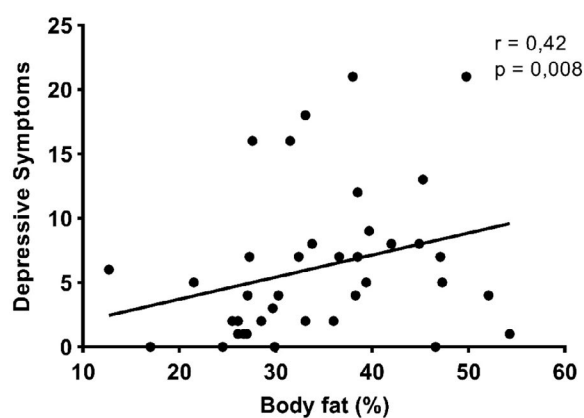
The mean age of participants was 59.3 ± 16.7 . Their mean treatment time was 25.3 ± 23.8 years, and the mean BDI score was 6.4 ± 5.8 points. No significant differences were observed between sociodemographic and body composition variables between the groups. Classifications according to depressive symptoms obtained using the BDI are shown in Figure 2.

Figure 2. Frequency according to depressive state classifications



The prevalence of depression was 17.9%. Patients with severe depression were not identified and the majority had absence or minimal depression (82.1%). The correlation analysis between depressive symptoms and relative body fat is shown in Figure 3.

Figure 3. Analysis of correlation between depressive symptoms and body fat



Through correlation analysis, a positive correlation ($r = 0.42$, $p = 0.008$) was found between depressive symptoms and relative body fat.

Discussion

The present study evaluated the association of depressive symptoms and body fat in HD patients. The results indicate a moderate association between body fat and depressive symptoms in these patients. The prevalence of depression found in the sample was 17.9%, and body fat was $34.1 \pm 9.7\%$.

The association between depressive symptoms and clinical illnesses is frequent, leading to a worse progression of both the psychiatric condition and the clinical illness, with less adherence to therapeutic guidelines, in addition to greater morbidity and mortality (Jantaratnotai et al., 2017; Milaneschi et al., 2019; Read et al., 2017). Results similar to ours were found in the study by Barros et al., where the depressive symptoms assessed by the BDI were higher in obese patients than patients with normal weight (Barros et al., 2016). However, in our stratified analysis, it was not possible to observe a difference in body fat between patients with and without depression.

Hemodialysis patients have several sources of stress, such as loss of independence when performing activities of daily living, fear, social isolation, appetite fluctuation, feeling of uncertainty about the future, and several other aspects related to the disease itself. These factors can trigger high levels of anxiety, which in turn has a strong association with various pathologies, while in CKD, the two main factors that contribute to its emergence are the chronicity of the disease and its strict treatment with a frequent stay in a hospital environment (Valle et al., 2013). In addition to these complications, there is also a change in body image caused by weight gain, which causes a devaluation of self-image and a decrease in self-esteem. As a result, the sense of well-being is reduced, and the sense of social inadequacy increases, which can trigger or worsen depressive and anxiety symptoms in these patients (Heymsfield & Wadden, 2017). This is evidenced in our findings through correlation analysis, where we found a moderate association between depressive symptoms and body fat.

Our findings differ from a study conducted in England using questionnaires with 8,889 individuals that demonstrated that the presence of obesity and/or overweight in patients with chronic diseases was

associated with a subjective decrease in physical well-being. However, it was not associated with emotional deterioration. On the other hand, subjects with chronic diseases without associated obesity presented a reduction of physical and emotional well-being (Doll et al., 2000). In this sense, HD individuals seem to have a more specific characteristic in the association between psychological aspects and the amount of body fat when compared to individuals who have other chronic diseases.

Several studies indicate that exercise can be considered the best non-pharmacological option for reducing depressive symptoms in active or sedentary patients with CKD (Wen et al., 2020). Intradialytic exercise is favorable in the reduction of depressive symptoms and weight. In addition, periodized protocols, with distinct moments between warm-up, strengthening, and cool-down phases, were considered to have important clinical relevance (Ferreira et al., 2021). The use of caloric restriction in conjunction with physical exercise intervention also showed favorable results for weight control, reduction in fat percentage, oxidative stress, and inflammatory response. In most cases, the findings indicate that healthy lifestyle interventions, alone or in combination, portray an indicated non-pharmacological strategy for improving these patients' mental and physical health status (Aydemir et al., 2020).

The present study has some limitations, including the fact that it was carried out in a single center, limiting the study's external validity. Furthermore, due to its cross-section design, inferences of causality should not be made. Thus, follow-up investigations are needed to establish temporal associations between depressive symptoms and body fat. Additionally, adipokine analyzes could better elucidate the association of these variables with depressive symptoms. However, they have a high cost and low feasibility in clinical routine.

Conclusion

The results observed in our study demonstrate that depressive symptoms are associated with body fat in HD patients. In this sense, interventions to improve depressive symptoms in this population should include dietary control, intradialytic exercise, and

extra stimuli for a healthy lifestyle. Furthermore, future studies with an interventional design should be conducted to understand better the role of body fat in depressive symptoms in HD patients.

Authors' contributions

Ribeiro HS participated in the study design, supervision, data collection, analysis, and final review. Ferreira TL participated in the supervision, data collection, data analysis, and final review. Duarte MP and Baião VC participated in data collection and writing. Inda-Filho and Ferreira AP participated in the study design, data analysis, and final review.

Competing interest

No financial, legal, or political conflicts involving third parties (government, companies, and private foundations, etc.) have been declared for any aspect of the submitted work (including, but not limited to grants and funding, advisory board participation, study design, preparation of the manuscript, statistical analysis, etc.).

References

Aydemir, N., Pike, M. M., Alsouqi, A., Headley, S. A. E., Tuttle, K., Evans, E. E., Milch, C. M., Moody, K. A., Germain, M., Lipworth, L., Himmelfarb, J., Ikizler, T. A., & Robinson-Cohen, C. (2020). Effects of Diet and Exercise on Adipocytokine levels in Patients with Moderate to Severe Chronic Kidney Disease. *Nutrition, Metabolism and Cardiovascular Diseases*. <https://doi.org/10.1016/j.numecd.2020.04.012>

Barros, A., Costa, B. E., Mottin, C. C., & D'Avila, D. O. (2016). Depression, quality of life, and body composition in patients with end-stage renal disease: A cohort study. *Revista Brasileira de Psiquiatria*, 38(4), 301–306. <https://doi.org/10.1590/1516-4446-2015-1681>

Ćwiek, A., Czok, M., Kurczab, B., Kramarczyk, K., Drzyzga, K., & Kucia, K. (2017). Association between depression and hemodialysis in patients with chronic kidney disease. *Psychiatria Danubina*, 29(Suppl 3), 499–503. <https://pubmed.ncbi.nlm.nih.gov/28953816/>

Debnath, S., O'Connor, J., Hura, C., Kasinath, B., & Lorenzo, C. (2018). Quality of Life and Depression Among Mexican Americans on Hemodialysis: A Preliminary Report. *Therapeutic Apheresis and Dialysis*, 22(2), 166–170. <https://doi.org/10.1111/1744-9987.12642>

Doll, H. A., Petersen, S. E. K., & Stewart-Brown, S. L. (2000). Obesity and Physical and Emotional Well-Being: Associations between Body Mass Index, Chronic Illness, and the Physical and Mental Components of the SF-36 Questionnaire. *Obesity Research*, 8(2), 160–170. <https://doi.org/10.1038/oby.2000.17>

Ferreira, T. L., Ribeiro, H. S., Ribeiro, A. L. A., Bonini-Rocha, A. C., Lucena, J. M. S., Oliveira, P. A., Amorim, F. R. S., Ferreira, A. P., Magno, L. A. V., & Martins, W. R. (2021). Exercise interventions improve depression and anxiety in chronic kidney disease patients: a systematic review and meta-analysis. *International Urology and Nephrology*, 53(5), 925–933. <https://doi.org/10.1007/s11255-020-02612-w>

Hall, J. E., Carmo, J. M., Silva, A. A., Wang, Z., & Hall, M. E. (2019). Obesity, kidney dysfunction and hypertension: mechanistic links. *Nature Reviews Nephrology*, 15(6), 367–385. <https://doi.org/10.1038/s41581-019-0145-4>

Hall, J., Juncos, L., Wang, Z., Hall, M., Carmo, J., & Silva, A. (2014). Obesity, hypertension, and chronic kidney disease. *International Journal of Nephrology and Renovascular Disease*, 7, 75. <https://doi.org/10.2147/IJNRD.S39739>

Heymsfield, S. B., & Wadden, T. A. (2017). Mechanisms, Pathophysiology, and Management of Obesity. *New England Journal of Medicine*, 376(3), 254–266. <https://doi.org/10.1056/nejmra1514009>

Jantaratnotai, N., Mosikanon, K., Lee, Y., & McIntyre, R. S. (2017). The interface of depression and obesity. *Obesity Research & Clinical Practice*, 11(1), 1–10. <https://doi.org/10.1016/j.orcp.2016.07.003>

Johansen, K. L., & Carol, L. (2017). Body composition in chronic kidney disease Kirsten. *Physiology & Behavior*, 176(10), 139–148. <https://dx.doi.org/10.1097%2F0000000000000120>

Katon, W. J. (2011). Epidemiology and treatment of depression in patients with chronic medical illness. *Dialogues in Clinical Neuroscience*, 13(1), 7–23. <https://doi.org/10.31887/DCNS.2011.13.1/wkaton>

KDIGO. (2013). KDIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. Kidney International Supplements. *Kidney International Supplements*, 3(1), 1–150. https://kdigo.org/wp-content/uploads/2017/02/KDIGO_2012_CKD_GL.pdf

Lee, M. C., Wu, S. F. V., Hsieh, N. C., & Tsai, J. M. (2016). Self-Management Programs on eGFR, Depression, and Quality of Life among Patients with Chronic Kidney Disease: A Meta-Analysis. *Asian Nursing Research*, 10(4), 255–262. <https://doi.org/10.1016/j.anr.2016.04.002>

- McDougall, K. A., Larkin, J. W., Wingard, R. L., Jiao, Y., Rosen, S., Ma, L., Usvyat, L. A., & Maddux, F. W. (2018). Depressive affect in incident hemodialysis patients. *Clinical Kidney Journal*, 11(1), 123–129. <https://doi.org/10.1093/ckj/sfx054>
- Milaneschi, Y., Simmons, W. K., van Rossum, E. F. C., & Penninx, B. W. (2019). Depression and obesity: evidence of shared biological mechanisms. *Molecular Psychiatry*, 24(1), 18–33. <https://doi.org/10.1038/s41380-018-0017-5>
- Ortega, F. B., Lavie, C. J., Bovet, P., Sui, X., & Chioloro, A. (2017). Trial of Tocilizumab in Giant-Cell Arteritis. *New England Journal of Medicine*, 377(15), 1493–1495. <https://doi.org/10.1056/nejmc1711031>
- Read, J. R., Sharpe, L., Modini, M., & Dear, B. F. (2017). Multimorbidity and depression: A systematic review and meta-analysis. *Journal of Affective Disorders*, 221, 36–46. <https://doi.org/10.1016/j.jad.2017.06.009>
- Shirazian, S. (2019). Depression in CKD: Understanding the Mechanisms of Disease. *Kidney International Reports*, 4(2), 189–190. <https://doi.org/10.1016/j.ekir.2018.11.013>
- Silva Junior, G. B., Bentes, A. C. S. N., Daher, E. D. F., & Matos, S. M. A. (2017). Obesity and kidney disease. *Jornal Brasileiro de Nefrologia*, 39(1), 65–69. <https://doi.org/10.5935/0101-2800.20170011>
- Valle, L. S., Souza, V. F., & Ribeiro, A. M. (2013). Stress and anxiety in chronic renal patients undergoing hemodialysis. *Estudos de Psicologia*, 30(1), 131–138. <https://doi.org/10.1590/s0103-166x2013000100014>
- Wen, X., Wang, Y., Zhao, Q., Zhang, H., Shi, H., Wang, M., & Lu, P. (2020). Nonpharmacological Interventions for Depressive Symptoms in End-Stage Renal Disease: A Systematic Review. *Western Journal of Nursing Research*, 42(6), 462–473. <https://doi.org/10.1177/0193945919857540>