



Short Communication

Is body weight or muscle strength correlated with the Malnutrition Inflammation Score (MIS)? A cross-sectional study in hemodialysis patients

Ana C.B. Marini, Gustavo D. Pimentel*

Clinical and Sports Nutrition Research Laboratory (Labince), Faculty of Nutrition, Federal University of Goiás, Goiânia, GO, Brazil

ARTICLE INFO

Article history:

Received 5 May 2019

Accepted 19 July 2019

Keywords:

Muscle strength
Inflammation
Malnutrition
Hemodialysis

SUMMARY

Background & aims: In hemodialysis (HD) patients, malnutrition and sedentary habits increase physical disability that contributes the loss of skeletal muscle mass. This vicious cycle contributes to poor quality of life and premature death. Therefore, considering that body weight is an item from the Malnutrition Inflammation Score (MIS) questionnaire, we hypothesize that body weight is an anthropometric marker that is just as important as muscle strength measurements in predicting changes in MIS. Thus, our study aimed to evaluate if there is a correlation between body weight and muscle strength measurements with the MIS in HD patients.

Methods: A cross-sectional design study was conducted with patients who were enrolled at two HD clinics. Body weight (kg), height (m), body mass index (BMI-kg/m²); handgrip strength (HGS-kg) using a dynamometer, 1 repetition maximum (1RM) leg extension and MIS were used to present clinical history and physical examinations of the patient.

Results: From 60 patients, 12.6% (n = 21) had MIS ≥ 6, classified as malnutrition. The patients studied had a median age of 39 (19–59) years and were mostly men (n = 41), who had, on average, the nutritional status for the eutrophic BMI (23.76 ± 5.31 kg/m²) and muscle strength of HGS 33.10 ± 10.17 kg on average, as well as 1 RM leg extension 73.03 ± 27.34 kg. In addition, MIS was similarly correlated with body weight (r = -0.46; p = 0.0002), HGS (r = -0.44; p = 0.0004) and 1 RM leg extension (r = -0.49; p < 0.0001).

Conclusions: Although, HGS and 1 RM leg extension were correlated with MIS, we found that body weight also was associated with MIS. Therefore, in clinical practice with the lack of equipment to measure muscle strength and inflammatory cytokines, a simple evaluation of body weight may be sufficient to predict malnutrition and MIS in HD patients.

© 2019 European Society for Clinical Nutrition and Metabolism. Published by Elsevier Ltd. All rights reserved.

1. Introduction

Chronic Kidney Disease (CKD) is a systemic disease in which its progression is related to other consequences caused by energy imbalance, innate immunity and uncontrolled neuroendocrine. Renal insufficiency increases the risk of developing inflammation, malnutrition, altered autonomic and central nervous system activity, cardiopulmonary, vascular and bone disease [1].

In hemodialysis (HD) patients, the presence of malnutrition and poor physical performance increases physical disability that contribute to sedentary behavior and loss of skeletal muscle mass [2]. This vicious cycle contributes to poor quality of life and premature death [3].

The inflammatory processing CKD has multiple causes, such as a low glomerular filtration rate, deterioration of nutritional status, uremic toxins, genetic factors and inflammatory factors related to dialysis [4–6]. Inflammatory cytokines such as tumor necrosis factor alpha, interleukin 6, interleukin 1 beta and interferon gamma (TNF- α , IL-6, IL-1 β and IFN- γ) cause muscle mass loss due to signaling of the Nuclear Factor Kappa B (NF κ B), which attenuates

* Corresponding author. Faculdade de Nutrição, Universidade Federal de Goiás, Rua 227, Quadra 68 s/n, Setor Leste Universitário, CEP: 74605080, Goiânia, GO, Brazil.

E-mail address: gupimentel@yahoo.com.br (G.D. Pimentel).

protein synthesis and inhibits myocyte differentiation leading to muscle atrophy [4–6].

An easy and cheap instrument to measure malnutrition is the Malnutrition Inflammation Score (MIS) [7], that is based on subjective global assessment and involves three additional items, body mass index (BMI), serum albumin concentrations and total iron binding capacity (TIBC) [7–9]. MIS showed a significant positive correlation for hospitalization and mortality rates, as well as malnutrition, inflammation and anemia in HD patients [10].

Brazilian studies [11,12] have shown a negative correlation between MIS and anthropometric measurements, Silva and Collaborators (2011) found a correlation between MIS and handgrip strength (HGS), that was confirmed by Amparo and Collaborators two years later (2013). Thus a strong connection between these measurements in pre-dialysis and dialysis patients [11,12], lead our group to consider that one repetition maximum (1RM) leg extensions could also correlate with MIS; however, no study has yet investigated this relationship. Additionally, no evidence has reported that the simple measurement of body weight *per se* can be linked to MIS. Therefore, considering that body weight is an item from the MIS questionnaire, we hypothesize that body weight is an anthropometric marker as important as muscle strength measurements in predicting changes in MIS. Thus, our study aimed to evaluate if there is a correlation between body weight and muscle strength measurements (if handgrip strength-HGS or 1 repetition maximum-1RM) with MIS in HD patients.

2. Methods

2.1. Design and study population

A cross-sectional design study was conducted with patients who were enrolled at two HD clinics as previous demonstrated [13].

Regarding the ethical procedures, this study was approved by the Research Ethics Committee under the protocol 1.919.324/2017, and all the patients signed the Free and Informed Consent Form according to the “Research Involving Beings the Health Council of the Ministry of Health”.

2.2. Evaluation of anthropometric measures and body composition

Socioeconomic data were obtained through standard questionnaires. Dry body weight (kg) was obtained using a portable balance calibrated scale (Filizola®) and height (m) using a portable stadiometer (SECA®). Next, the BMI (kg/m²) was calculated. All anthropometric assessments were taken three times and were done by trained nutritionists as previous demonstrated [13].

2.3. Malnutrition Inflammation Score (MIS)

MIS presents clinical history and physical examination of the patient. The clinical data consists of dry body weight reduction in the last six months, changes in dietary intake, presence of gastrointestinal symptoms and functional capacity related to nutritional status. Physical examination includes features such as subcutaneous fat loss, muscle loss, the presence of edema resulting from malnutrition and ascites which are defined as normal, mild, moderate or severe.

Upon completion of MIS with clinical, physical, and biochemical markers, a final classification was made in which the results range from 1 to 30 by summing the items according to the MIS value form and then making the classification of nutritional status. A score less than or equal to six equals normality; however, any score higher than six equals a high malnutrition score [7–9].

2.4. HGS and 1RM leg extension

Muscle strength was measured by handgrip strength (HGS) and 1 repetition maximum (1RM) leg extension. HGS (kg) was assessed in the dominant hand using a dynamometer (Takei® Scientific Instruments) [13].

One RM test was applied to the simultaneous extension of the anterior thigh muscles, performed in an extensor chair. This method measures the maximum force that an individual can exert once while performing the normal range of motion allowed by the joints, without impairing or altering proper posture and technique [14]. The patients were instructed by the trained physical educator. After a warm-up period, the 1 RM test began with lifting an expected weight close to the maximum limit supported, to avoid fatigue per repetition, with 30 s rest between movements. The first series used a load estimated at 40–60% of the maximum that the subject could lift. In the second series, the load was raised to 60–80% of the estimated maximum for 3 to 5 repetitions. After a rest interval of three minute, the last test was carried out to evaluate the maximum load [14].

2.5. Statistical analyses

Data was expressed as mean and standard deviation. Pearson's correlation was used to assess the MIS values with body weight, HGS and 1RM leg extension. Statistical tests were performed in the Prism® software version 5 and the significant difference was set at 5%.

3. Results

The characteristics of the patients are represented in Table 1. From 60 patients, 12.6% (n = 21) had MIS ≥ 6, classified as malnutrition. The patients studied had a median age of 39 (19–59) years and were mostly men (n = 41), who had, on average, the nutritional status for the eutrophic BMI (23.76 ± 5.31 kg/m²) and muscle strength we found an average of HGS 33.10 ± 10.17 kg and 1 RM leg extension 73.03 ± 27.34 kg. In addition, MIS was similarly correlated with body weight, HGS and 1RM leg extension (Fig. 1A–C).

4. Discussion

In the present study, we found 12.6% (n = 21) of patients with MIS ≥ 6. Additionally, negative correlation of the MIS with body weight, 1RM leg extension and HGS, demonstrating that a simple measurement of dry body weight is able to closely predict malnutrition in HD patients. This relationship was also found in a study conducted by Reis and Colleagues on kidney transplantation patients that evaluated the adductor pollicis muscle thickness and body weight with muscle mass and found similar associations for both methods, that is, body weight prediction showed greater probability for muscle mass in relation to APMT [15].

Table 1
Characteristics of patients undergoing hemodialysis.

| Variables | Mean ± SD |
|---|---------------|
| Age (years) | 39 (19–59) |
| Sex (n, %) | |
| Male | 41 (67.2) |
| Female | 20 (32.7) |
| Dry body weight (kg) | 64.01 ± 16.10 |
| Handgrip strength (kg) | 33.10 ± 10.17 |
| 1 RM leg extension (kg) | 73.03 ± 27.34 |
| Malnutrition–Inflammation Score (score) | 5.00 ± 2.94 |

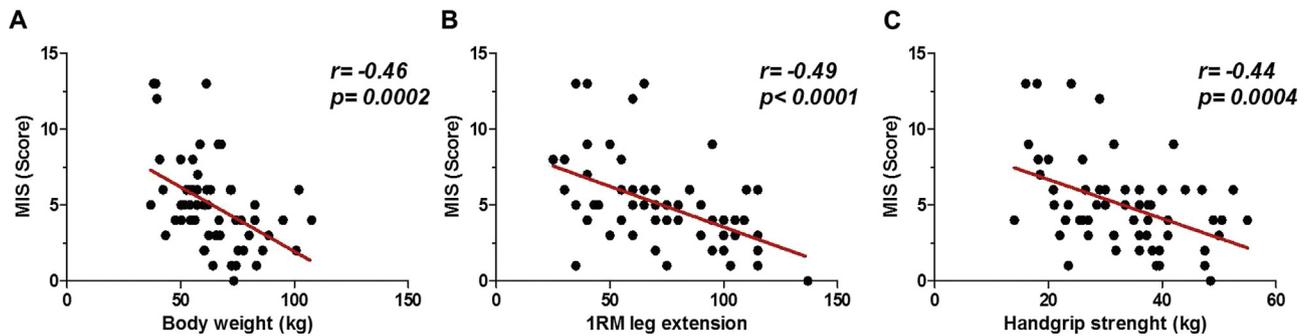


Fig. 1. Pearson's correlation.

The Malnutrition–Inflammation Complex Syndrome (MICS) of HD patients can be evaluated in different ways. Some of these markers clinical, anthropometric (weight, BMI, circumference, etc.) and biochemical (albumin and C-reactive protein), are effective for identification of the nutritional status, however, several limitations may be affected by nutritional factors such as edema, presence of other comorbidities and chronic inflammation [10,16].

The nutritional and inflammation status are often neglected by professionals working with patients on dialysis; however, these markers are of great importance for the treatment and quality of treatment. In this study, we found that HGS was associated to the nutritional status of the patient, being a low-cost and easy-to-apply method [10,16]. A study conducted in China by Chen et al. (2013) with 75 adult HD patients found that malnutrition can be effectively assessed by anthropometry, finding a negative correlation between mid-arm circumference and MIS [16].

In a cohort of 36 months in a population of 129 conservative patients, it was found that patients with $MIS \geq 7$ had a significant increase in IL-6 and C-reactive protein. Moreover, MIS and C-reactive protein were predictors of mortality. These data leads us to reflect on the importance of regularly evaluating the malnutrition and an inflammation marker in this population in order to prevent malnutrition and associated-medical and treatments complications [6].

A study of 190 conservative patients found a negative correlation between HGS and MIS, showing that the MIS has a strong connection between muscle strength measurements in pre-dialysis patients [12]. Another study that corroborates the results of the present research was conducted by Silva and collaborators (2011) with 274 men and 162 women, who observed that an inverse correlation between HGS and MIS in women and men [11]. Although, in the present study, HGS and 1 RM leg extension were correlated with MIS, we concluded that a simple measurement of body weight is able to associate with MIS. The main limitation of the study was the small size and recruitment of patients from only two HD clinics. Therefore, in clinical practice with the lack of equipment to measure muscle strength and inflammatory cytokines, a simple evaluation of body weight may be acceptable to predict malnutrition and/or MIS in HD patients.

Statement of authorship

ACM and GDP wrote the manuscript. ACM collected all data. ACM and GDP conducted the conception, design of the study and drafted the paper. Both authors read and approved the final manuscript.

Conflict of interest statement

None.

Funding sources

No funding was received for this manuscript.

Acknowledgements

We would like to thank all the participants of hemodialysis clinics. Capes, Brazil for scholarship of ACBM. We thank Mike Salazar for proofreading and editing.

References

- [1] Zoccali C, Vanholder R, Massy ZA, Ortiz A, Sarafidis P, Dekker FW, et al. The systemic nature of CKD. *Nat Rev Nephrol* 2017;13:344–58. <https://doi.org/10.1038/nrneph.2017.52>. Epub ahead of print.
- [2] Hirai K, Ookawara S, Morishita Y. Sarcopenia and physical inactivity in patients with chronic kidney disease. *Nephrourol Mon* 2016;8:e37443.
- [3] Pereira RA, Cordeiro AC, Avesani CM, Carrero JJ, Lindholm B, Amparo FC, et al. Sarcopenia in chronic kidney disease on conservative therapy: prevalence and association with mortality. *Nephrol Dial Transplant* 2015;30:1718–25.
- [4] Cheung WW, Paik KH, Mak RH. Inflammation and cachexia in chronic kidney disease. *Pediatr Nephrol* 2010;25:711–24.
- [5] Carrero JJ, Chmielewski M, Axelsson J, Snaedal S, Heimbürger O, Barany P, et al. Muscle atrophy, inflammation and clinical outcome in incident and prevalent dialysis patients. *Clin Nutr* 2008;27:557–64.
- [6] Jagadeswaran D, Indhumathi E, Hemamalini AJ, Sivakumar V, Soundararajan P, Jayakumar M. Inflammation and nutritional status assessment by malnutrition inflammation score and its outcome in pre-dialysis chronic kidney disease patients. *Clin Nutr* 2018;38:341–7.
- [7] Kalantar-Zadeh K, Kopple JD, Block G, Humphreys MH. A malnutrition-inflammation score is correlated with morbidity and mortality in maintenance hemodialysis patients. *Am J Kidney Dis* 2001;38:1251–63.
- [8] Enia G, Sicuso C, Alati G, Zoccali C. Subjective global assessment of nutrition in dialysis patients. *Nephrol Dial Transplant* 1993;8:1094–8.
- [9] Steiber AL, Kalantar-Zadeh K, Secker D, McCarthy M, Sehgal A, McCann L. Subjective Global Assessment in chronic kidney disease: a review. *J Ren Nutr* 2004;14:191–200.
- [10] Kalantar-Zadeh K, Kopple JD, Humphreys MH, Block G. Comparing outcome predictability of markers of malnutrition-inflammation complex syndrome in haemodialysis patients. *Nephrol Dial Transplant* 2004;19:1507–19.
- [11] Silva LF, Matos CM, Lopes GB, Martins MTS, Martins MS, Arias LU, et al. Handgrip strength as a simple indicator of possible malnutrition and inflammation in men and women on maintenance hemodialysis. *J Ren Nutr* 2011;21:235–45.
- [12] Amparo FC, Cordeiro AC, Carrero JJ, Cuppari L, Lindholm B, Amodeo C, et al. Malnutrition-inflammation score is associated with handgrip strength in nondialysis-dependent chronic kidney disease patients. *J Ren Nutr* 2013;23:283–7.
- [13] Marini AC, Motobu RD, Freitas ATV, Laviano A, Pimentel GD. Pre-sarcopenia in patients undergoing hemodialysis: prevalence and association with biochemical parameters. *Clin Nutr ESPEN* 2018;28:236–8.
- [14] Taaffe DR, Duret C, Wheeler S, Marcus R. Once-weekly resistance exercise improves muscle strength and neuromuscular performance in older adults. *J Am Geriatr Soc* 1999;47:1208–14.
- [15] Reis AS, Santos HO, Limirio LS, de Oliveira EP. Adductor pollicis muscle thickness has a low association with muscle mass and lean mass in kidney transplantation patients. *Clin Nutr ESPEN* 2018;28:110–3.
- [16] Chen J, Peng H, Zhang K, Xiao L, Chen J, Wang Z, et al. The insufficiency intake of dietary micronutrients associated with malnutrition-inflammation score in hemodialysis population. *PLoS One* 2013;8:4–9.