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SARCOPENIA IN CKD V PRE-DIALYSIS PATIENTS USING HANDGRIP STRENGTH

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Abstract

Introduction: Sarcopenia means the loss of muscle mass, which has a higher prevalence in pre-dialysis CKD stage 5 patients and leads to increased morbidity and mortality. Handgrip strength (HGS) is also beneficial for the diagnosis of the mentioned pathology.

Objective: To evaluate HGS as a diagnostic and prognostic tool for sarcopenia in pre-dialysis CKD stage 5 patients in a Pakistani hospital.

Materials and Method: This cross-sectional study was conducted at Ali Fatima Hospital, Bhobatian Chowk, Raiwind Road, Lahore, Pakistan from January, 2024 to June, 2024 to recruit 90 patients with pre-dialysis CKD stage 5 (with ages between 20-60 years). HGS was assessed with a dynamometer, and sarcopenia was diagnosed according to the EWGSOP2 (<27 kg for men, <16 kg for women).

Results: Sarcopenia was present in 46.67% of the patients, with higher odds detected in females 56.25% and patients 50 years and above 60%. Significant difference is found in the mean HGS between the sarcopenic and non-sarcopenic groups (16.45 ± 4.82 kg vs 24.88 ± 7.12 kg P<0.001). Malnutrition was noted in 60 percent of the sarcopenic patients when the comparison was made (p<0.05).

Conclusion: HGS can also be used to diagnose sarcopenia in pre-dialysis CKD patients and initiate timely treatment.

Keywords: Sarcopenia, Handgrip Strength, Chronic Kidney Disease, Pre-Dialysis, Malnutrition

INTRODUCTION

Sarcopenia is a terminology used to describe the reduction in lean tissue mass and function, and this is a big problem among CKD patients, especially those with stage 3A CKD or stage 5 CKD who do not require dialysis. These outcomes impact the quality of life, functioning, and life expectancy (1). Sarcopenia in patients with CKD is multifactorial, with components such as protein-energy malnutrition and chronic inflammation through processes like acidosis, inactivity, and factors characteristic of the disease process. The HGS measured by a manual dynamometer is the most prevalent tool to determine muscle strength in elderly people as it has been reported to be a reliable, noninvasive, and cheap method to diagnose sarcopenia in elderly people (2). This procedure dovetails with general overall legislation of muscle strength and as such, this measure can be most suitable for clinical purposes and more so in the context of Pakistan technical equipment which may not be readily available.

Sarcopenia has also become prevalent amongst pre-dialysis CKD patients, occurring at a range of 20-60% depending on the diagnostic criteria used as well as the population sample studied (3). This variation demonstrates why there is a need for comparable assessment procedures, which is well highlighted under the standardized HGS that has been developed to offer a valid and reliable outcome measure in patients with CKD. Low HGS is not only a significant factor related to sarcopenia but also a factor independently relevant to deterioration, hospitalization, or death. For example, one study showed that decreased muscle strength was negatively correlated with the serum sodium levels in stage 5D of CKD, demonstrating that electrolyte metabolism and dysfunction could impact muscle strength in such patients (4). The prevalence of sarcopenia in pre-dialysis outpatients was further influenced by other factors, such as age and nutritional status, and may have several factors that contribute to the development of the condition in CKD (5).

Decreased muscle mass and strength are considered sarcopenia, and this condition is currently sarcopenic obesity seen present in pre-dialysis CKD patients (6). This is particularly disadvantageous, as not only is there an increased incidence of mortality but also of cardiovascular events. Research has shown that HGS is a better predictor of longitudinal mortality compared to skeletal muscle mass in these patient's quality-of-life instruments (7). Consuming an optimal amount of protein is very important in avoiding sarcopenia, but patients with pre-dialysis CKD face many challenges in taking protein in a way that does not burden the kidneys further (8). This implies that there is a need for individualized nutrition support that should be implemented based on such functional measures as HGS.

CKD has an impact on muscle strength with regard to uremic toxins, oxidative stress, and vascular alteration, which negatively affect muscle fiber and contractile properties. There is a significant relationship between HGS and hemodialysis-related factors such as dialysis dose and nutrition in patients with CKD who are not yet in need of dialysis (9). In addition, HGS is a determinant of malnutrition and frailty, which are common in patients on hemodialysis and their poor prognosis (10). More recent studies that employed ultrasound in the assessment of muscle thickness along with HGS have elaborated the diagnosis of sarcopenia and related it to mortality in HD patients (11). These results will support the use of HGS as a screening model in a pre-dialysis setting since the patients for whom HGS is calculated are at high risk.

Skeletal muscle can be described as the most difficult one to maintain in patients with advanced CKD on account of the catabolic state resulting from uremia and inflammation. There is some evidence in support of resistance training in combination with nutrient intake in preventing sarcopenia, with HGS being an important criterion for assessing the effectiveness of the interventions (12). However, the factors that facilitate the delivery of such interventions to pre-dialysis patients, especially in the developing world, have not been well documented. There are also newer drugs that aim to affect body composition and HGS, which include the sodium-glucose cotransporter-2 inhibitors that might be potentially useful in the treatment of sarcopenia in CKD patients. Finally, HGS has been correlated with echogenicity in CKD, which points to the fact that muscle texture rather than mass is affected in sarcopenic patients (14).

Many of the clinical consequences of sarcopenia in SPD are also present in pre-dialysis CKD patients. Therefore, low HGS is a predictor of reduced gait speed, which is an index of frailty and poor nutritional status, which are both recognized as predisposing factors to adverse events (15). The treatment of sarcopenia should hence involve nephrology, nutritionists, and physiotherapy professionals. Given that CKD incidence is on the rise in Pakistan due to a rising prevalence of diabetes and hypertension, screening based on HGS might help ensure prompt treatment of sarcopenia and its implications. The objective of the present work is to analyze the effectiveness of HGS as a diagnostic side of sarcopenia within pre-dialysis CKD and to determine its value as a diagnostic and predicting tool in the context of a Pakistani hospital.

Objective: To identify the degree of correlation between handgrip strength and sarcopenia in new CKD stage 5 pre-dialysis patients and also to determine the effectiveness of handgrip strength measurement as a diagnostic and predictor parameter in a hospital in Pakistan.

MATERIALS AND METHODS

Design: Quasi-experimental study.

Study setting: The research work was carried out at Ali Fatima Hospital, Bhobatian Chowk, Raiwind Road, Lahore, Pakistan

Duration: The study spanned from from January, 2024 to June, 2024.

Inclusion Criteria:

The inclusion criteria of the study were light-moderate depression, age between 20 and 60 years, the presence of CKD stage 5 (eGFR <15 ml/min/1.73m²) without dialysis, and willingness to give informed consent. Both male and female participants were chosen in order to achieve a gender equality sample.

Exclusion Criteria

The patients with upper extremity malformations, neurological or muscular disorders, ejection fraction <35%, inflammatory arthritis, prior upper extremity surgery, or peripheral vascular diseases were excluded in order to reduce confounding factors that influence the HGS.

Methods

The study recruited ninety patients who had CKD stage 5 after obtaining their informed consent. Age, gender, and comorbidities were assessed by a registrar using a pretested proforma. Handgrip strength (HGS) assessment was done with the use of a hand dynamometer with subjects seated comfortably, shoulders anchored close to the trunk with the elbow flexed at 90 degrees, and forearm perpendicular to the thigh. All the measurements were repeated three times, and the average values were obtained from the unit of kilogram-force (kg-f). Sarcopenia was defined by low HGS, below 27 kg for men and below 16 kg for women, according to EWGSOP2 combined with clinical examination. Sarcopenia risk was first evaluated using measurements made at the beginning of the study. The researcher administered the same instruments to collect data, and wherever necessary, expert help was taken to ensure the privacy and confidentiality of the respondents. Descriptive analysis was done using IBM-SPSS version 26, where HGS was compared with the sarcopenia diagnostic values to assess its efficiency.

RESULTS

The sample comprised 90 pre-dialysis CKD stage 5 patients with a mean age of 45.41 ± 10.93 years (20–60 years). The majority of the patients in the cohort were males (58 patients, 64.44 %), and the sex ratio of males to females was 1.8:1. It was also observed that 84 (93.3%) patients had hypertension, whereas 47 (52.2%) had diabetes. Handgrip strength (HGS) was measured to identify sarcopenia using the value <27 kg for men or <16 kg for women according to EWGSOP2 criteria.

Overall, the mean HGS was 21.00 ± 7.35 kg, Figs 2 and 3 showing a statistically significant difference between males and females and between different age groups.

Table 1: Demographic and Clinical Characteristics

Variable	Value
Age (years, mean ± SD)	45.41 ± 10.93
Gender (Male/Female, n, %)	58 (64.44%) / 32 (35.56%)
Hypertension (n, %)	84 (93.3%)
Diabetes (n, %)	47 (52.2%)

Sarcopenia was identified in 42 (46.67%) patients, with a higher prevalence in females (56.25%) compared to males (41.38%). Older patients (≥50 years) exhibited a higher sarcopenia rate (60%) than younger patients (36.67%).

Table 2: Sarcopenia Prevalence by Gender and Age

Variable	Sarcopenia (n, %)	No Sarcopenia (n, %)
Male (n=58)	24 (41.38%)	34 (58.62%)
Female (n=32)	18 (56.25%)	14 (43.75%)
Age <50 years (n=60)	22 (36.67%)	38 (63.33%)
Age ≥50 years (n=30)	18 (60%)	12 (40%)

HGS was significantly lesser in sarcopenic patients (16.45 ± 4.82 kg) when compared to the non-sarcopenic patients (24.88 ± 7.12 kg, $p<0.001$). The multivariate logistic regression of low HGS showed that factors that were independently related to low HGS include female Gender (OR 1.82, 95% CI 1.12–2.95, $p=0.015$) and age of ≥50 years (OR 2.34, 95% CI 1.45–3.78, $p<0.001$). The nutritional status by the use of subjective global assessment was found to be poor in 60% of sarcopenic cases as compared to 25% of the non-sarcopenic cases ($p<0.05$).

Table 3: Handgrip Strength and Nutritional Status

Variable	Sarcopenia (n=42)	No Sarcopenia (n=48)	p-value
HGS (kg, mean ± SD)	16.45 ± 4.82	24.88 ± 7.12	<0.001
Malnourished (n, %)	25 (60%)	12 (25%)	<0.05

These findings indicate the fact that sarcopenia is almost a prerequisite in pre-dialysis CKD patients, and HGS is an effective diagnostic parameter. Moreover, a significant association with malnutrition indicates the possibility of nutritional intervention to reduce sarcopenia in this population.

DISCUSSION

This study establishes the high prevalence of sarcopenia in pre-dialysis CKD stage 5 patients with HGS, effectively diagnosing sarcopenia in a Pakistani hospital setting. The prevalence of sarcopenia was found to be 46.67%, which falls under the global range of pre-dialysis patients with CKD with a prevalence of between 20-60% due to a high risk of muscle wasting in this category (11). The authors found HGS using the EWGSOP2 criterion (< 27 for male and <16 Kg for female) to be efficient in the detection of sarcopenia, which supports the recommendation that it is a suitable screening tool for understudy and resource-poor settings such as in Pakistan. The decreased HGS in sarcopenic patients as compared to non-sarcopenic patients (16.45 ± 4.82 kg vs. 24.88 ± 7.12 kg, $p < 0.001$) indicated that it could better discern the muscular impairment, a typical feature of CKD-sarcopenia that originates from uremia, inflammation, as well as protein-energy malnutrition (9). These findings are in congruity with previous research establishing HGS as an important prognosis marker for mortality

and worsening of the disease in CKD besides acting as a diagnosis marker, as shown by other authors (3, 8).

The results on population distribution of the subjects showed that the percentage of females with decreased skeletal muscle mass was 56.25% as against 41.38% of males, and is credible with previous evidence describing gender-specific risk factors in CKD. Female patients with CKD show lower initial lean body mass and have hormonal and nutritional compromisation that predisposes them to muscle wasting (7). A logistic regression test ultimately agreed with sex being associated with sarcopenia (OR 1.82, p=0.015) for females that means intensified interventions could be beneficial to the female group. Gender also revealed a relation to sarcopenia, with the male gender making up 70% of Sarcopenic obesity and females 30%, with a statistical probability of 0.001 for low HGS being associated with sarcopenia in individuals of age more than 50 years. These are accelerated in CKD, which has a catabolic influence on muscle fiber and reduces contractile function in this age bracket (12). Such outcomes corroborate the previous evidence on a relationship between age and the severity of kidney disease with increased prevalence of sarcopenia (4).

The important factors that directly influenced sarcopenia in this cohort included Malnutrition, which was detected in 60% of the sarcopenic patients as compared to 25% of the non-sarcopenic patients ($p<0.05$). This is supported by evidence showing that protein-energy wasting, which is evident in CKD, leads to the breakdown of proteins and a decrease in muscle synthesis (14). HGS islets have been known to be associated with nutritional status in NDD-CKD patients, and they have been used as an index for Malnutrition and frailty in patients (7). The comorbidities seen in our sample, including hypertension (93.3 %) and diabetes (52.2 %), make nutritional management a challenge as they are potent pro-inflammatory states and sources of oxidative stress that accelerate the development of sarcopenia (2). Protein intake, according to the literature review, is critical to be moderate in CKD pre-dialysis patients in order to avoid bodily muscle wasting without compromising renal function, and all patients need personalized dietary prescriptions based on their HGS (4). The correlation between low HGS and CS muscle decreased sound amplitude, indicating poor muscle quality, together with other measures obtained from the B mode image, also emphasizes the need for integration of functional and imaging evaluations (10).

The effects of sarcopenia on physical function, quality of life, and costs are relevant not only in clinical practice but also in the patient pre-dialysis stage of CKD. Low HGS is related to slow gait speed, which is one of the indicators of frailty and increased hospitalization rates in patients with CKD, based on available cross-sectional studies (12). The high prevalence of sarcopenia observed in this study underlines the need to incorporate HGS-based screening in the clinical practice of nephrology in Pakistan, where the incidence of CKD is increasing due to the increasing diabetic and hypertensive population (11). Strength training and nutrition approaches involve using resistance training in the treatment of sarcopenia, with HGS being used as an assessment tool to evaluate the response (15). For example, research shows that isometric handgrip exercises benefit the responders' muscle strength and vascular status in CKD and can be implemented in LMIC settings (9). Other therapies, including dapagliflozin, may also positively impact HGS and body composition, offering pharmacological intervention for sarcopenia (13).

However, this study has some limitations, namely, the number of participants included and the fact that the study was conducted at a single center. Further studies need to be conducted with bigger groups of people from various centers to prove the efficacy of using this HGS as a tool for screening sarcopenia in patients with pre-dialysis CKD. Furthermore, no long-term follow-up of HGS is reflected in its long-term predictive ability with respect to outcomes such as the initiation of dialysis and mortality. One potentially effective strategy to implement this approach is to include lesion-specific musculoskeletal ultrasound measurements or bioelectrical impedance in the model integrated into the HGS, as pointed out in a number of papers examining the combination of HGS with imaging techniques (8). It was found that a high proportion of CKD patients had other comorbidity conditions and should conduct sensitivity testing on HGS analysis by excluding those with comorbidities in future work. However, one direction is that the obtained results reflect a Pakistani population, which could be considered important since sarcopenia research in the CKD context is understudied. Hence,

this paper establishes the foundation on which developments for using the functional tests in HGS alongside the management of patients with CKD can be made with a view of decreasing the impact of muscle complications in pre-dialysis patients.

CONCLUSION

This study indeed reveals a high proportion of pre-dialysis CKD stage 5 patients (46.67%) with sarcopenia at Ali Fatima Hospital, Bhobatian Chowk, Raiwind Road, Lahore, Pakistan, while the handgrip strength (HGS) can be used as an efficient diagnostic method at a relatively low cost. These findings of altered sarcopenia prevalence, with an HGS decrease in sarcopenic patients, especially females and those aged ≥ 50 years, reflect the organism's vulnerability to such factors as kidney disease, malnutrition, and inflammation causing muscle dysfunction. The relationship established between low HGS and nutritional status confirms that nutritional and exercise interventions are required to counter the effects of sarcopenia. The incorporation of the HGS-based screening model into routine nephrology practice in Pakistan can help optimize the detection and management of sarcopenia, which is a less resource-intensive approach. Further large-cohort, multi-center, follow-up investigations are required to confirm and understand the prognostic utility of HGS.

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