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Original article

Quality of life and grip strength in patients with CKD

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Abstract

Context: Patients with chronic kidney disease are more likely to develop anemia and alteration of calcium and phosphorus concentrations, highlighting the marked muscle deterioration due to increased catabolism and the development of sarcopenia, which directly impacts the deterioration of muscle strength and therefore, functionality. This deterioration has been measured and quantified through the prehensile force; information that may be related to greater functional limitation and loss of independence, generating alterations in well-being and health-related quality of life.

Objective: To determine the relationship between health-related quality of life and muscle strength in patients attending the renal unit at the Alma Mater Hospital of Antioquia.

Methodology: This study was conducted in a clinical setting, in a Renal Unit in the city of Medellín. It is a quantitative, observational study, cross-sectional design with analytical intention. The population consisted of 47 patients, including 32 men and 15 women. A convenience sample was used, as the conditions for blinding the population during hemodialysis were not met. Data collection included sociodemographic information, quality of life assessment using the KDQOL-36 scale, and measurement of grip strength using the Biometrics system for dynamometry. Grip strength was assessed bilaterally in the standard position, with the elbow flexed, and with the arm flexed and the elbow extended.

Keywords: Renal insufficiency, chronic, mobility, independent living, muscular weakness.

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Results: From a total of 47 patients evaluated, it was found that the manual grip strength with a flexed arm is significantly associated with the physical health dimension of the KDQOL SF 36 renal scale. The manual grip test with an extended arm is also highly associated with the physical health dimension of the KDQOL SF 36 renal scale.
Conclusions: The greater the manual grip, the higher the score in the physical health dimension of the KDQOL SF 36 scale, both in the standard position with the elbow flexed at 90° and with the elbow extended at 0°.

Calidad de vida y fuerza de prensión en pacientes con ERC

Resumen

Contexto: los pacientes con enfermedad renal crónica tienen una mayor probabilidad de desarrollar anemia y alteración en las concentraciones de calcio y fósforo, lo que resalta el marcado deterioro muscular debido al aumento del catabolismo y el desarrollo de sarcopenia. Esto impacta directamente en el deterioro de la fuerza muscular y, por lo tanto, en la funcionalidad. Este deterioro ha sido medido y cuantificado a través de la fuerza de prensión, una información que podría estar relacionada con una mayor limitación funcional y pérdida de independencia, generando alteraciones en el bienestar y en la calidad de vida relacionada con la salud.
Objetivo: determinar la relación entre la calidad de vida relacionada con la salud y la fuerza muscular en pacientes que asisten a la unidad renal del Hospital Alma Mater de Antioquia.
Metodología: este estudio se llevó a cabo en un entorno clínico dentro de la unidad renal en la ciudad de Medellín. Es un estudio cuantitativo, observacional, con un diseño transversal y un enfoque analítico. La población estuvo conformada por 47 pacientes, incluyendo 32 hombres y 15 mujeres. Se utilizó una muestra por conveniencia, ya que no se cumplían las condiciones para cegar a la población durante la hemodiálisis. La recolección de datos incluyó información sociodemográfica, evaluación de la calidad de vida mediante la escala KDQOL-36 y la medición de la fuerza de prensión utilizando el sistema Biometrics para dinamometría. La fuerza de prensión fue evaluada bilateralmente en la posición estándar, con el codo flexionado, y con el brazo y el codo extendidos.
Resultados: de un total de 47 pacientes evaluados, se encontró que la fuerza de prensión manual con el brazo flexionado está significativamente asociada con la dimensión de salud física de la escala renal KDQOL SF-36. El test de prensión manual con el brazo extendido también muestra una alta asociación con la dimensión de salud física de la misma escala.
Conclusiones: a mayor fuerza de prensión manual, mayor es el puntaje en la dimensión de salud física de la escala KDQOL SF-36, tanto en la posición estándar con el codo flexionado a 90° como con el codo extendido a 0°.

Palabras clave: insuficiencia renal crónica, movilidad, vida independiente, debilidad muscular.

Introduction

In Colombia, according to data from the high-cost account in Colombia [1], in 2018 a total of 35,363 Colombians were diagnosed with stage 5 chronic renal insufficiency (CRI),

being prevalent in people over 30 years of age. In the period between 2019-2020, 152,354 new cases were reported. In addition to chronic kidney disease (CKD), people develop other complications simultaneously. Regularly, people with stage 1 to 4 CKD have a higher prevalence of coronary heart disease, heart failure, and cardiovascular risk factors. The percentage of patients with CKD who die from cardiovascular diseases (CVD) is higher than those who progress to a stage of CKD requiring renal replacement therapy (RRT). In addition, CKD patients are more likely to develop anemia, altered calcium and phosphorus concentrations, and delayed bone remodeling. Consequently, the occurrence of bone fractures and extra skeletal manifestations such as vascular calcification increases. Energy and protein malnutrition can also be triggered [2]. Furthermore, people in the last stages of CKD must periodically undergo renal replacement therapy (RRT), with hemodialysis being the most commonly used method. This treatment is performed approximately 3 times a week for 3 to 4 hours, and due to the lengthy, painful and restrictive nature of this therapy, combined with the progression of the disease along with other underlying pathologies, patients often report a decline in health-related quality of life (HRQOL), comprising physical, mental, social, and emotional well-being [3].

Within the physical well-being component, marked muscle deterioration stands out, due to increased catabolism and the development of sarcopenia, consequently, a stage of dynapenia. This stage of dynapenia has been studied to a large extent in other diseases such as CVD and cancer and has been measured and quantified through dynamometry for the measurement of prehensile strength, demonstrating the inversely proportional relationship between lower prehensile strength and higher risk of morbidity and mortality [4–6]. Additionally, dynapenia is associated with greater functional limitations and loss of independence, leading to alterations in well-being and HRQOL.

Understanding the perception of the quality of life of CKD patients is fundamental as it causes psychological damage and alters their daily lives [7]. For this study, the term “quality of life” is used concerning health, because it is a multidimensional concept that includes domains related to physical, mental, emotional, and social functioning. In addition, as an important element of functional status, we have muscle strength as an important referent of the efficient movement of the different body segments, necessary for the performance of basic activities of daily life. The prehensile strength of the hand is an essential function for the performance of basic activities of daily living. Likewise, using a dynamometer is an essential tool for the measurement of primary muscles, where the evaluator plays a crucial role in minimizing error to ensure reliable results [8]. In addition to this, few studies analyze the association between prehensile strength and quality of life in people with CKD, therefore, this study aims to deter-

mine the relationship between the quality of life associated with health and muscle strength of patients who attend the renal unit at the Alma Mater Hospital of Antioquia, in the city of Medellín.

Methods

This is a descriptive research with a cross-sectional design, a quantitative approach, and an associative phase. The convenience sample [9] consisted of 47 participants between the ages of 16 and 82 years, who attended the hemodialysis service at the Alma Mater Hospital of Antioquia (Medellin), and who freely and voluntarily agreed to participate.

Inclusion criteria covered individuals of both genders, including patients over 16 years of age, those who consulted the hemodialysis service in the renal unit at the Alma Mater Hospital of Antioquia, and those who accepted voluntarily, and through written informed consent to participate in the study. The exclusion criteria included participants with cognitive impairment confirmed by the treating physician, patients with hypoacusis that did not allow them to adequately answer the survey, and patients with hearing loss.

Before the start of the fieldwork, a pilot test was carried out to standardize the measurements that were taken. Through this test, errors were corrected (a technical measurement error was found with values <5 %), and the time required for the application of the questionnaire was estimated [10]. In addition to this, the instrument did not undergo significant changes and the evaluation time per patient was standardized at 15 minutes.

Data collection was carried out between April and September 2021. For this process, anthropometric measurements were taken through a questionnaire designed by the researchers in addition to the application of the KDQOL SF 36 questionnaire and dynamometry. Weight was measured with a SEKA® model 807 floor scale with a resolution of 0.100 kg, previously calibrated [2]. The sociodemographic variables measured in this study were: sex, age, comorbidities, time undergoing hemodialysis, physical activity before CKD, and laterality.

Health-related quality of life (HRQOL) was assessed through the Kidney Disease Quality of Life-Short Form (KDQOL-SF TM) questionnaire 1.3 version, developed by the RAND cooperation (CA, USA) [11], which has been culturally adapted [12], modified, and translated into Spanish [13]. This version of the questionnaire has been confirmed as a valid and reliable instrument for assessing the quality of life of patients with CKD [14]. The instrument consists of two components: a specific component for kidney disease and the SF-36 [15]. For this

study, the reliability of the KDQOL SF 36, assessed by Cronbach's alpha [16], was 0.89 [16]. After obtaining the scores for each subscale, HRQoL was categorized as good ($\geq$50 point or poor quality ($<$50 points) according to the cutoff points proposed by Vilagut in 2005 [17].

The prehensile strength was measured using a Biometrics G200 manual dynamometer, this instrument measures the prehensile strength of a person providing a report in kilograms. This evaluation is carried out with the subject seated on a chair with a backrest, shoulders adducted, and without rotation, elbow in 90º flexion, forearm in neutral position and wrist in neutral position (in extension between 0-30º and with an ulnar deviation of 0º-15º), with both feet resting on the floor and with the back resting on the backrest [18, 19]. The assessed arm was not supported on any surface and the dynamometer was used in an upright position. The participant performed a maximum grip force for 5 seconds, resting for 1 minute between each repetition, making three attempts. In this study, prehensile strength was measured bilaterally, even in patients with arteriovenous fistula. It should be noted that no adverse events occurred during the dynamometry measurements.

Subsequently, the protocol was modified to include a variant of position, performing it with the shoulder in 90° flexion and elbow extended to 0°, a position that has been used in previous studies, compared to the standard position [20,21]. This position was chosen because patients with CKD experience conditions that affect proximal strength, both in the upper and lower extremities. This is a consequence of metabolic myopathies, inflammatory myopathy, and rhabdomyolysis, which can be a cause or consequence of CKD. The conditions directly impact muscle strength, proximal muscle weakness, myalgias, and myoglobinuria, affecting muscle strength and exercise tolerance [22–24].

Once the dynamometry protocol was completed using the Biometrics equipment, the raw unprocessed data was extracted and exported from the equipment's software. The generated information corresponds to a point on the graph and each piece of data represents a measurement in kilograms of force applied to the dynamometer. This graphical representation has morphological characteristics.

All the data were included in the database in the SPSS software version 25.0 to perform the respective statistical analysis. Initially, an exploratory analysis was performed to ensure the quality of the data and types of variables and detection of outliers, then, a descriptive analysis was carried out through means and standard deviations in the continuous variables, and percentages in the case of the categorical variables. Next, the internal reliability of the questionnaire was evaluated using Cronbach's alpha coefficient, first for the total score, then

for each individual question, and finally by examining how the alpha value changed when excluding each questionnaire item. A Cronbach's alpha value above 0.70 was considered acceptable for the questionnaire's reliability.

Regarding the data obtained in the sociodemographic questionnaire and the KDQOL SF 36, once the information was collected, it was exported to the SPSS (25th version) statistical package for analysis. Once the database was structured with the necessary information, normality tests were performed using the Shapiro-Wilk test to identify parametric and nonparametric variables. For the nonparametric variables, Spearman's statistic was used (maximum prehensile strength with flexed and extended arm, KDQOL SF 36 dimensions such as disease burden, effect of renal disease, physical and mental health, and gender).

Finally, the maximum grip force average was calculated, in flexion and extension (taking the average of the maximums), this was tested for normality, and depending on the result, the corresponding statistic was applied, and the crossover of variables was analyzed.

Results

The results of the research are presented below, where a total population of 47 patients was obtained, 32 men representing 64.2 % and 15 women representing 35.8 %. The age ranged between 16 and 82 years, where 63.8 % were older than 56 years. The most predominant marital status was "single" with 36.2 %. In addition, 47.2 % were unemployed and 43.4 % were retired. In terms of schooling level, 48.9 % had a high school degree. The majority of participants belonged to the subsidized system, representing 73.6 %. Finally, the right-handed population were predominant with a value of 97.9 %.

In relation to the pathological history of the studied population, it was found that 75.5 % had a history of HT, 34 % had a history of type 2 diabetes mellitus, and 18.9 % had some type of heart disease. The average time undergoing hemodialysis for all patients was 6.42 years.

The results analysis was performed through Cronbach's alpha in the different dimensions from 0.94 to 0.71 and indicates that for each dimension the items are coded, aggregated, and transformed into a scale that has a range from 0 (the worst health status for this dimension) to 100 (the best health status); scores above or below 50 indicate better or worse health status respectively [26]. Thus, we found that the symptoms/problems dimension with a 76.06 score had a high HRQoL, as well as the kidney disease effects dimension with a 58.78 score and SF12 physical health with a 51.10 score. However, for the renal disease burden, the score was

34.66 showing a low HRQOL, and likewise for the SF12 mental health dimension with a 40.81 score. In addition, the results from the application of the Kidney Disease and Quality of Life Questionnaire (KDQOL TM-36) [12] revealed that the majority of the participants were male and also had low HRQOL (Table 1).

Table 1. Data of health-related quality of life HRQoL

Variable		Male			Female			Total		
		Average	DS	CI 95	Average	DS	CI 95	Average	DS	CI 95
Dimension Symptoms/ problems		77,08	5,17	71,78–82,37	74,23	20,53	64,33-84,12	76,06	17,14	71,33–80,78
Renal disease burden		33,63	22,92	25,6-41,6	36,51	32,7	20,7-52,3	34,66	25,58	27,34-41,99
Kidney disease effects		58,54	22,32	50,7-66,3	59,21	25,09	47,1-71,3	58,78	23,11	52,78-65,15
SF12 Physical health		50,73	24,51	42,1-59,2	51,75	24,52	39,1-63,5	51,10	24,28	44,40-57,79
SF12 Mental health			33,05	37,2-60,3	51,57	31,13	36,5-66,5	40,81	32,10	40,96-58,66
		Male			Female			Total		
		Frequency	%	CI	Frequency	%	CI	Frequency	%	CI
Final quality of life	Low QOL	22	68,8	49,99–83,88	8	53,3	26,58-78,73	30	63,8	48,52–77,32
	High QOL	10	31,2	16,11-50,00	7	46,7	21,26–73,41	17	36,2	22,67–51,48

Note. CI: Confidence interval.
Source: Author's elaboration.

Among the results obtained, the flexed elbow test with the right hand showed an average grip strength of 23.92 kg for men and 19.49 kg for women. For the left upper extremity, the averages were 19.28 kg for men and 17.66 kg for women. In the extended elbow test, the right upper extremity averaged 15.84 kg for men and 10.32 kg for women, while the left upper extremity was 12.27 kg for men and 8.12 kg for women (Table 2).

When performing the Spearman correlation analysis between the dimensions of the KDQOL SF 36 and the prehensile strength, both with flexed and extended arm, correlation was found only with the physical health dimension, demonstrating a directly proportional relationship where the greater the prehensile strength, the better the physical health. On the other hand, this correlation is not evident with the disease burden, disease effect, or mental health dimensions (Tables 3 and 4).

Table 2. Prehensile strength data

Variable		Male			Female			Total		
		Average	DS	CI 95	Average	DS	CI 95	Average	DS	CI 95
Flexed elbow test	Right hand	23,92	8,87	20,48-27,36	19,49	8,82	15,1-23,8	22,19	9,02	19,51–24,86
	Left hand	19,28	9,36	15,65-22,91	17,66	8,19	13,59-21,7	18,54	8,86	16,01–21,28
Extended elbow test	Right hand	15,84	6,66	13,39–18,28	10,32	4,19	7,9–12,74	14,12	6,49	12,16–16,07
	Left hand	12,27	6,23	9,98–14,55	8,12	3,71	5,97-10,26	10,97	5,96	9,21– 12,74

Note. CI: Confidence interval; SD: standard deviation.
Source: Author's elaboration.

Table 3. Association between health-related quality of life and prehensile strength

Variables		Symptoms/ problems	Renal disease burden	Renal disease effects	SF12_physical Health	SF12_Mental health
Fz_prehensil flex	correlation coefficient	0,109	0,018	0,02	,320*	0,057
	Sig. (bilateral)	0,467	0,904	0,895	*,029	0,702
	N	47	47	47	47	47
Fz_prehen il_flex	correlation coefficient	0,02	-0,075	0,043	,444*	0,063
	Sig. (bilateral)	0,894	0,614	0,774	*,039	0,674
	N	47	47	47	47	47

Note. * Sig. <0,05: Statistically significant association; statistic test used: Spearman
Source: Author's elaboration.

The following graph presents the analysis for the non-parametric test through the Mann-Whitney U statistic, showing the interquartile ranges for prehensile strength. The median grip strength for women is 16.83 kg, while for men it is 27.36 kg, indicating that women undergoing hemodialysis have lower strength compared to men (Figure 1).

Likewise, the variables of prehensile strength and HRQOL were crossed with laterality, where no statistically significant correlation was found, demonstrating that laterality does not influence performance in prehensile strength or HRQOL.

Table 4. Association of prehensile strength and KDQOL SF 36 with age and time on dialysis

	Pressure_flex_ final	Pressure_exte_ final	Symptoms/ problems	Renal disease burden	Renal disease effects	SF12_physical health	SF12 Mental health
Coefficient correlation	-,205	-,162	-,041	,041	,229	-,060	-,063
Sig. (bilateral	,166	,278	,784	,784	,122	,687	,673
N	47	47	47	47	47	47	47
Coeficient correlation	,040	,130	,014	,031	,086	,181	-,057
Sig. (bilateral)	,789	,385	,925	,835	,563	,222	,702
N	47	47	47	47	47	47	47

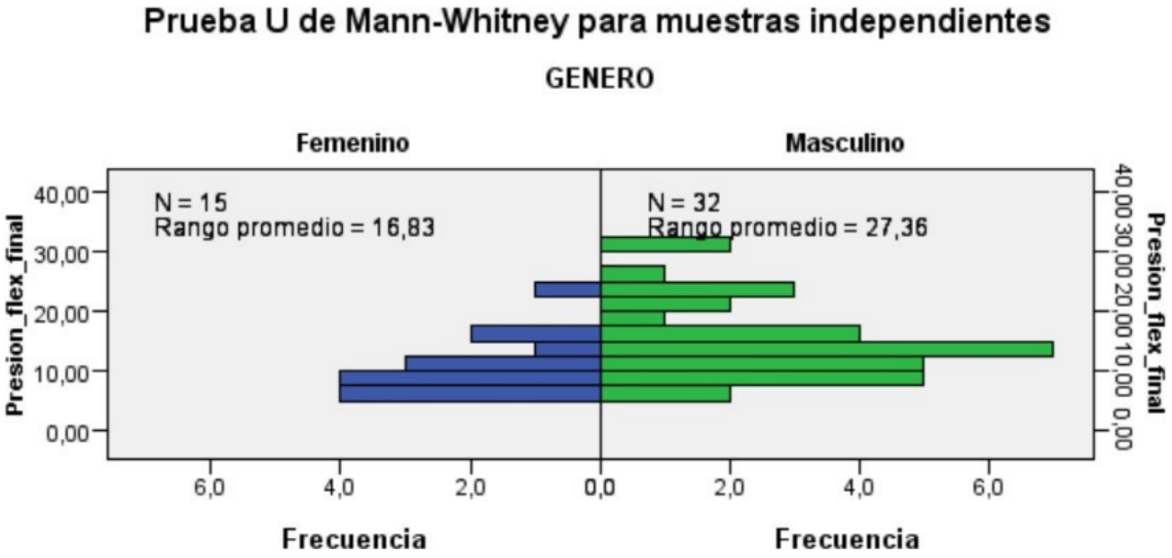

Figura 1. Histogram of association between prehensile strength and gender

Source: Author's elaboration.

In addition, the same variables of prehensile strength and HRQOL were crossed with time on dialysis, with no correlation found, demonstrating that time on dialysis does not influence prehensile strength or HRQOL.

Finally, the process was carried out with the sociodemographic variables such as age, marital status, occupation, educational level, RSSS, and socioeconomic stratum, but no correlation was found.

Discussion

Sociodemographic

The present investigation analyzed the association between prehensile strength and health-related quality of life. The results of this research have a great impact on the intervention of these users during hemodialysis, considering not only the physical deterioration developed throughout the course of the renal disease [27] but also the different components that are part of the health-related quality of life. In addition, this study helps to identify key factors to improve the rehabilitation and support processes in the field of physiotherapy, minimizing risk factors associated with the population under study [28–30].

However, it is important to mention that prehensile strength has been widely used as a predictor of mortality, length of hospital stay, and physical functioning [31], especially in older adults. The population participating in our study is mostly within this age range, where 63.8 % are older than 56 years. When comparing the reference values of prehensile strength for the Colombian population, we found in a study conducted by Ramirez Velez, *et. al* [32], that the normative values from 6 years to 64 years of age, discriminated by gender, indicate that the results of our participants are well below those expected in a healthy adult. Thus, considering the reference values indicated for healthy adults between the age of 60-64 years, we found a value of 33.8 kg for men and 21.1 kg for women. This value is one of the lowest found in the study by Ramírez Velez, *et al.* since it belongs to the normal range for healthy adults between 60-64 years of age. Therefore, when compared with the participants of our research, it is found that they are below these ranges, with values of 23.92 kg for men and 19.49 kg for women for the right upper extremity (dominant extremity for 97.9 % of the patients), and 19.28 kg for men and 17.66 kg for women for the left upper extremity.

It is important to emphasize that in our study we applied the measurement protocol with the flexed arm, which is the most applied, as referenced in the studies by Real Delor *et al.* [33] and Karpenko Wilman, *et al.* [8]; where they also found in the results of prehensile strength measurement in CKD patients, that the participants were far below normal. This is due to the phenomenon of sarcopenia, which causes loss of mass and important muscular strength, being this of multifactorial etiology, where a deficit of intake, hormonal alterations, neuropathic damage, metabolic alterations, and presence of uremic toxins can intervene [8,34].

Likewise, concerning prehensile strength and dominance, grip strength was superior in men with respect to women in all decades, regardless of dominance. In addition, it should be noted that out of 47 participants only 1 person had left dominance. This variable did not

show a statistical correlation with the evaluation of prehensile strength [35]. The strength of the dominant hand is approximately 10 % greater than the non-dominant hand, and other studies have found that the percentage difference is less than 10 % in both men and women when the right hand is stronger than the left or the left hand is stronger than the right, as seen in our study in which there was no significant difference in the dominant hand versus the non-dominant hand.

Quality of life

Concerning the health-related quality of life assessed through the Kidney Disease and Quality of Life Questionnaire (KDQOL TM-36), low scores were found for the dimensions of kidney disease burden (34.66) and mental health (40.81), and high scores for the dimensions of symptoms/problems (76.06), effects of kidney disease (58.78) and physical health (51.10). The above equates with the findings in the article by De Abreu et al. which involved 350 participants subjected to at least one year of hemodialysis or peritoneal dialysis, where they compared the quality of life among them through the KDQOL-SF 36. Concerning the dimensions of KDQOOL-36, they found lower average scores compared to those of peritoneal dialysis, reflected in the dimensions of renal disease burden (40.3) of the specific component and physical health (33.4) and mental health (43.5) of the generic component [36].

Likewise, in the same study, De Abreu *et al.* found that age showed a significant correlation with the dimensions of kidney disease effects on daily life (0.238, $P = 0.03$) and the generic component of physical health (-0.242, $P = 0.03$). Also, having a paid job was positively correlated with the generic components of physical health (0.499, $P = 0.001$) and mental health (0.375, $P = 0.001$) [37]. These results were different in our study, as no correlation was found between the same sociodemographic variables and the results of the KDQOL-SF 36. For that reason, it should also be considered that the sample of our study was smaller, which could have compromised the results.

On the other hand, in the study conducted by Kim et al. using KDQOL-SF 36 [38] to evaluate the quality of life between two groups of hemodialysis and peritoneal dialysis patients, they reported scores for the physical health dimension (39.3 ± 9.7), mental health (44.6 ± 7.0), problem symptoms (69.6 ± 16.6), disease effect (59.5 ± 19.4) and disease burden (39.9 ± 27.7). Among these, the problem symptoms dimension had the highest score, similar to the findings in our study.

Considering the above, one of the most relevant findings in our study is the statistically significant correlation between prehensile strength and the physical health dimension of the

KDQOL TM-36 questionnaire. This is explained because prehensile strength is used as an effective tool to assess muscle function [39], and in patients with chronic kidney disease (CKD) and end-stage renal disease, the loss of muscle mass and strength, is associated with protein and energy wasting and consequently, decreased quality of life; consequences of sarcopenia [40], which generates functional impairment, increased risk of falls and increased mortality [41]. Currently, only exercise and nutritional support have proven to be effective as prevention and treatment strategies for sarcopenia [42].

Study limitations

According to what was obtained in this research, the different indexes and surveys applied are useful and reliable. The main limitation of the present study was the change of IPS providing the hemodialysis service, which led to a good number of users being transferred to another institution. However, with the sample available, it was possible to carry out the analysis suggested in the initial proposal. It is recommended for future research to intervene in the prehensile strength of CKD users and to measure more accurately the impact of therapeutic rehabilitation during hemodialysis in the Colombian population. Finally, it is proposed for future research the use of this study as a reference measurement for the clinical and functional situation of the CKD user in Colombia.

At the methodological level, it was not possible to randomize the sample due to the size of the population available for the study, for this reason, it was done at convenience. It is necessary that for future studies the size of the population and therefore the sample be larger. Similarly, it was difficult to ensure that the grouping by age was equitable. Additionally, blinding was not possible because all the participants were in the same physical space and at the same time, since the measurements were taken during hemodialysis therapy. Likewise, there were missing data in the measurement of grip strength, as some patients were in the post-surgical period following fistula creation, making any strength activity with that limb contraindicated. Despite these limitations, to our knowledge, this is the first study that seeks to correlate HRQOL measured with KDQOL-36 versus prehensile strength in patients during hemodialysis.

Conclusions

There is a statistically significant relationship between prehensile strength and the physical health dimension of the KDQOL SF 36 scale, both in the flexed elbow position and in the extended elbow position. The higher the manual grip, the higher the physical health score.

The greatest prehensile strength was observed in the male population with scores of 23.92 kg for men and 19.49 kg for women with the right upper extremity (dominant extremity for 97.9 % of the patients), and 19.28 kg for men and 17.66 kg for women for the left upper extremity.

Laterality did not influence prehensile strength performance or HRQoL. Time on dialysis did not influence either prehensile strength or HRQoL.

The difference in prehensile strength between dominant and non-dominant hands in men and women was similar.

There is a statistically significant relationship between grip strength and the physical health dimension of the KDQOL SF 36 scale, both in the flexed elbow position and in the extended elbow position. The greater the manual grip, the higher the physical health score. Therefore, physical therapy programs focused on strength training in people with CKD on hemodialysis can directly and positively influence perceived physical health.

Time on dialysis did not influence either grip strength or HRQoL. Therefore, it is important to identify ot

Conflicts of Interest

The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript.

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Ethical statement

This study is guided by the ethical standards of research in human beings CIOMS, resolution 8430 of 1993 according to which this is classified with minimum risk since no manipulations of variables are carried out in the subjects, but simple measurements that do not imply a potential risk to the life of people or their safety, this research is also governed by ethical principles: justice, beneficence, non-maleficence, autonomy.

This research had the ethical endorsement by the ethics committees of the Fundación Universitaria María Cano, project approval code 013008029-2020-311, 12 December 2020, Session 02 of 2020 of the Committee on Investigations; Hospital Alma Mater de Antioquia, in the city of Medellin, minutes session ordinary ethics committee #01-2021, assigned code IN42 2019, May 12, 2020, minutes 147.

Patients who met the eligibility criteria signed the informed consent detailing the risks and benefits of participating in the research and informing them that they are free and autonomous to make the decision whether to be a participant, in addition to agreeing that all data will be confidential and will only be used for academic purposes.

For the use of the validated scales, authorization was not needed because they are scales of free use, in addition in this research the intellectual property of the authors will be protected. As for the scientific feasibility, the project is viable, since it has the human, technical and technological resources for the execution of the project.

Authors contribution

Isabel Cristina Ángel Bustos: Conceptualization, Investigation, Methodology, Project Administration, Vaidation, Writing – original draft, Writing – review & editing; Adriana Campos: Conceptualization, Visualization,Writing – original draft, Writing – review & editing; Leidy Yohana Apolinar Joven: Conceptualization, Investigation, Methodology, Writing – original draft, Writing – review & editing; Osiris Maydé Bedoya: Investigation, Methodology, Writing – original draft; Sebastián Grajales Toro: Data curation, formal analysis; Iván Eusebio Bustos Zapata: Investigation, Data curation, formal analysis.

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References

[1] Ministerio de Salud y Protección Social - República de Colombia. Situación de la enfermedad renal crónica, la hipertensión arterial y la diabetes mellitus en Colombia 2020 | Cuenta de Alto Costo [Internet]. Colombia;2020 [cited 2024]. Available from: https://cuentadealtocosto.org/site/erc/

situacion-de-la-enfermedad-renal-cronica-la-hipertension-arterial-y-la-diabetes-mellitus\-en-colombia-2020/ ↑See Page 2

[2] Koppe L, Fouque D, Kalantar-Zadeh K. Kidney cachexia or protein-energy wasting in chronic kidney disease: facts and numbers. J Cachexia Sarcopenia Muscle. 2019 Jun;10(3):479-484. https://doi.org/10.1002/jcsm.12421 ↑See Page 3, 4

[3] Ramos-Alcocer JR, Salas-Nolasco OI, Villegas-Domínguez JE, Serrano-Vázquez CW, Dehesa-López E, Márquez-Celedonio FG. Calidad de vida y factores asociados en enfermedad renal crónica con terapia de sustitución. Arch Med Fam. 2021;23 (2):75-83. ↑See Page 3

[4] Lorca Parraguez L, Leao-Ribeiro I, Martínez- Mardones M, Plasser-Troncoso J, Vivallos-González J, Salas Ocaranza R, *et al.* Resultados funcionales de un programa de prehabilitación en cirugía electiva de cáncer colorrectal. Rev. Cirugia. 2022;74(3). https://doi.org/10.35687/s2452-454920220031399 ↑See Page 3

[5] Triana-Reina HR, Ramírez-Vélez R. Asociación de la fuerza muscular con marcadores tempranos de riesgo cardiovascular en adultos sedentarios [Association of muscle strength with early markers of cardiovascular risk in sedentary adults]. Endocrinol Nutr. 2013 Oct;60(8):433-8. https://doi.org/10.1016/j.endonu.2013.01.009 ↑See Page 3

[6] Pinzon- Ospina C, Solis- Lozano R. Correlación del porcentaje de pérdida de peso y la fuerza prensil del brazo medida por dinamometría en pacientes con cáncer de tracto gastrointestinal. Redises. 2021. ↑See Page 3

[7] Barros-Higgins L, Herazo-Beltrán Y, Aroca-Martínez G. Calidad de vida relacionada con la salud en pacientes con enfermedad renal crónica hemodializados y no hemodializados. Rev. Colomb. Nefrol. 2014 Jun;19:1(Supl. 1). ↑See Page 3

[8] Karpenko Wilman ID, Taylor MF, Malinar LM, Maltas S, Sarco FD, Braslavsky GJ, *et al.* Utilidad de la dinamometría en pacientes en hemodiálisis. Rev Nefrol Dial Traspl. 2017;36(3):163-9. ↑See Page 3, 10

[9] Kamisato CD, Rivas J, Navarro M. Estudio Comparativo de Calidad de Vida, Actividad Física y Fuerza Prensil entre Pacientes Sometidos a Peritoneodiálisis y Sujetos Sanos. Universidad de Chile. 2007. ↑See Page 4

[10] Perini TA, de Oliveira GL, dos Santos-Ornellas J, de Oliveira FP . Cálculo do erro técnico de medição em antropometria. Rev Bras Med Esporte. 2005;11(1):81-85. https://doi.org/10.1590/S1517-86922005000100009 ↑See Page 4

[11] Hays RD, Kallich JD, Mapes DL, Coons SJ, Carter WB. Development of the kidney disease quality of life (KDQOL) instrument. Qual Life Res [Internet]. 1994 Oct;3(5):329-38. https://doi.org/10.1007/BF00451725 ↑See Page 4

[12] Chaves K, Duarte A, Vesga J. Adaptación transcultural del cuestionario kdqol sf 36 para evaluar calidad de vida en pacientes con enfermedad renal crónica en Colombia. Rev Fac Med. Diciembre 2013; 21(2): 34-42. https://doi.org/10.18359/rmed.1170 ↑See Page 4, 7

[13] Carrillo-Algara AJ, Torres-Rodríguez GA, Leal- Moreno CS, Hernández- Zambrano SM. Escalas para evaluar la calidad de vida en personas con enfermedad renal crónica avanzada: revisión integrativa. Enferm Nefrol. 2018 Dic;21(4):334- 347. https://doi.org/10.4321/S2254-28842018000400003 ↑See Page 4

[14] Hays RD, Coons SJ, Kallich JD, Mapes DL, Amin N, Carter WB *et al.* Kidney Disease Quality of Life Short Form (KDQOL-SF), Version 1.3: A manual for use and scoring. PROMIS View project CAHPS (AHRQ); PCAR (NCI), CAM, PROMIS oral health View project. 1997. ↑See Page 4

[15] Abeywickrama HM, Wimalasiri S, Koyama Y, Uchiyama M, Shimizu U, Kakihara N, *et al.* Quality of Life and Symptom Burden among Chronic Kidney Disease of Uncertain Etiology (CKDu) Patients in Girandurukotte, Sri Lanka. Int J Environ Res Public Health. 2020 Jun 5;17(11):4041. https://doi.org/10.3390/ijerph17114041 ↑See Page 4

[16] Chaves-García M, Sandoval-Cuellar C, Calero-Saa P. Asociación entre capacidad aeróbica y calidad de vida en adultos mayores de una ciudad colombiana. Rev Perú Med Exp Salud Pública. 2017 Oct;34(4): 672-676. https://doi.org/10.17843/rpmesp.2017.344.2522 ↑See Page 5

[17] Ortega F, Rebollo P, Bobes J, González MP, Saiz P. Interpretación de los resultados de la calidad de vida relacionada con la salud de pacientes en terapia sustitutiva de la insuficiencia renal terminal. Nefrología (Madrid). 2000;20(5):431- 439. ↑See Page 5

[18] Sousa-Santos AR, Amaral TF. Differences in handgrip strength protocols to identify sarcopenia and frailty - a systematic review. BMC Geriatr. 2017 Oct 16;17(1):238. https://doi.org/10.1186/s12877-017-0625-y ↑See Page 5

[19] Vera V. Medición de la fuerza de agarre de mano con dinamometría en población adulta de la Región Metropolitana [Internet]. Santiago, Chile;2018 [Cited 2024]. Universidad de Chile - Facultad de Medicina. Available from: https://repositorio.uchile.cl/handle/2250/167723 ↑See Page 5

[20] Rubio-Lorente D. Estudio de la fuerza de prensión de la mano en diferentes posiciones de hombro y codo [Tesis de pregrado]. España: Repositorio Institucional de Documentos. Universidad de Zaragoza, EUCS; 2016. Recuperado de: https://zaguan.unizar.es/record/94889?ln=es ↑See Page 5

[21] Parvatikar VB, Mukkannavar PB. Comparative Study of Grip Strength in Different Positions of Shoulder and Elbow with Wrist in Neutral and Extension Positions. Int J Exerc Sci. 2009;5(2):67–75. ↑See Page 5

[22] Cortés R, Kleinsteuber K, Paz Vargas C, de Los Ángeles Avaria M. Miopatías metabólicas. Rev Med Clín Las Condes. 2018 Nov 1;29(6):622–35. https://doi.org/10.1016/j.rmclc.2018.09.004 ↑See Page 5

[23] Bertorini T, Meza K, Chunga N. Miopatías autoinmunes: revisión de diagnóstico y manejo. An Fac Med. 2019 Jul;80(3):362-371. https://doi.org/10.15381/anales.803.16274 ↑See Page 5

[24] Cortés R, Kleinsteuber K, Paz-Vargas C, de Los Ángeles-Avaria M. Rabdomiólisis metabólica: actualización. Rev Med Clín Las Condes. 2018;29(5):553-559. https://doi.org/10.1016/j.rmclc.2018.08.003 ↑See Page 5

[25] Ministerio de Salud y Protección Social - República de Colombia. Ciclo de Vida. [Internet]. Colombia [cited 2024]. Available from: https://www.minsalud.gov.co/proteccionsocial/Paginas/cicloVida.aspx ↑See Page

[26] Vilagut G, Ferrer M, Rajmil L, Rebollo P, Permanyer-Miralda G, Quintana JM. *et al.* El Cuestionario de Salud SF-36 español: una década de experiencia y nuevos desarrollos. Gac Sanit. 2005 Abr; 19(2):135-150. https://doi.org/10.1157/13074369 ↑See Page 6

[27] Jiménez-Prieto CM, González-Tamajón R, Crespo- Montero R. Beneficios del ejercicio físico en la sesión de hemodiálisis. Una revisión sistemática. Enferm Nefrol. 2020 Sep;23(3):233-243. https://doi.org/10.37551/S2254-28842020024 ↑See Page 10

[28] Pinzon Rios, I. Ejercicio en paciente con diálisis: una reflexión desde la fisioterapia. Rev Obs Deporte. 2020;6(1). ↑See Page 10

[29] Bernabeu-Wittel M, Díez-Manglano J, Nieto-Martín D, Ramírez-Duque N, Ollero-Baturone M. Simplification of the Barthel scale for screening for frailty and severe dependency in polypathological patients. Rev Clin Esp (Barc). 2019 Nov;219(8):433-439. https://doi.org/10.1016/j.rce.2019.04.005 ↑See Page 10

[30] Chavez K, Duarte A, Veja J. Adaptación transcultural del cuestionario KDQOL SF 36 para evaluar calidad de vida en pacientes con enfermedad renal crónica en Colombia. Rev Med. nov 2013;21(2):12-7. https://doi.org/10.18359/rmed.1170 ↑See Page 10

[31] Bohannon RW. Muscle strength: clinical and prognostic value of hand-grip dynamometry. Curr Opin Clin Nutr Metab Care. 2015 Sep;18(5):465-70. https://doi.org/10.1097/MCO.0000000000000202 ↑See Page 10

[32] Ramírez-Vélez R, Rincón-Pabón D, Correa-Bautista JE, García-Hermoso A, Izquierdo M. Handgrip strength: Normative reference values in males and females aged 6-64 Years old in a Colombian population. Clin Nutr ESPEN. 2021 Aug;44:379-386. https://doi.org/10.1016/j.clnesp.2021.05.009 ↑See Page 10

[33] Real Delor RE, Roy-Torales T, Brítez-Mendoza JD, Encina-Villagra DG, Giménez JL, Gómez MJ, *et al.* Fuerza muscular en pacientes adultos con insuficiencia renal crónica del Hospital Nacional y Hospital Militar en 2021. Medicina Clínica y Social. 2022 May 5;6(2):45–52. https://doi.org/10.52379/mcs.v6i2.253 ↑See Page 10

[34] Pérez-Torres A, González Garcia ME, San José-Valiente B, Bajo Rubio MA, Celadilla Diez O, López-Sobaler AM, *et al.* Síndrome de desgaste proteico energético en la enfermedad renal crónica avanzada: prevalencia y características clínicas específicas. Nefrología. 2018 Mar 1;38(2):141-51. https://doi.org/10.1016/j.nefro.2017.06.004 ↑See Page 10

[35] Bustos-Viviescas BJ, Acevedo-Mindiola AA, Lozano-Zapata RE. Valores de fuerza prensil de mano en sujetos aparentemente sanos de la ciudad de Cúcuta, Colombia. MedUNAB. Jun 2019;21(3):363-77. https://doi.org/10.29375/01237047.2791 ↑See Page 11

[36] De Abreu MM, Walker DR, Sesso RC, Ferraz MB. Health-related quality of life of patients recieving hemodialysis and peritoneal dialysis in São Paulo, Brazil: a longitudinal study. Value Health. 2011 Jul-Aug;14(5 Suppl 1):S119-21. https://doi.org/10.1016/j.jval.2011.05.016 ↑See Page 11

[37] Hall RK, Cary MP, Washington TR, Colón-Emeric CS. Quality of life in older adults receiving hemodialysis: a qualitative study. Qual Life Res. 2020 Mar;29(3):655-663. https://doi.org/10.1007/s11136-019-02349-9 ↑See Page 11

[38] Kim JY, Kim B, Park KS, Choi JY, Seo JJ, Park SH, *et al.* Health-related quality of life with KDQOL-36 and its association with self-efficacy and treatment satisfaction in Korean dialysis patients. Qual Life Res. 2013 May;22(4):753-8. https://doi.org/10.1007/s11136-012-0203-x ↑See Page 11

[39] Bakkal H, Dizdar OS, Erdem S, Kulakoğlu S, Akcakaya B, Katırcılar Y, *et al.* The Relationship Between Hand Grip Strength and Nutritional Status Determined by Malnutrition Inflammation Score and Biochemical Parameters in Hemodialysis Patients. J Ren Nutr. 2020 Nov;30(6):548-555. https://doi.org/10.1053/j.jrn.2020.01.026 ↑See Page 12

[40] Cha RH, Lee GS. Steady exercise improves hand grip and leg muscle strength in hemodialysis patients. J Exerc Rehabil. 2021 Dec 27;17(6):435-443. https://doi.org/10.12965/jer.2142616.308 ↑See Page 12

[41] Hanna RM, Ghobry L, Wassef O, Rhee CM, Kalantar-Zadeh K. A Practical Approach to Nutrition, Protein-Energy Wasting, Sarcopenia, and Cachexia in Patients with Chronic Kidney Disease. Blood Purif. 2020;49(1-2):202-211. https://doi.org/10.1159/000504240 ↑See Page 12

[42] Morley JE. Treatment of sarcopenia: the road to the future. J Cachexia Sarcopenia Muscle. 2018 Dec;9(7):1196-1199. https://doi.org/10.1002/jcsm.12386 ↑See Page 12