

1 **Impact of chronic kidney disease on handgrip strength: a cross-sectional**
2 **study in Ha'il, Saudi Arabia**

4 **ABSTRACT**

5 **Background:** in chronic kidney disease (CKD) patients, there is a loss of muscle
6 mass due to chronic inflammation, nutritional deficiencies, and metabolic acidosis,
7 these factors lead to decreased physical fitness and poor clinical outcomes.
8 Handgrip strength (HGS) is an index for physical function, the aim of our study
9 was to investigate the relationship between CKD and handgrip strength (HGS) in
10 Ha'il, Saudi Arabia.

11 **Methods:** We conducted a cross-sectional study consisting of 251 CKD patients in
12 Ha'il, Saudi Arabia. 132 males and 119 females, aged between 25 and 65 years.
13 Renal function (creatinine, and blood urea nitrogen) and Hand grip strength (HGS)
14 were recorded for all patients.

15 **Results:** 3.2 kg/BMI for males and 1.8 kg/BMI for women were the average
16 relative HGS (kg/BMI). In both sexes, HGS was inversely correlated with age and
17 height and positively correlated with body weight and BMI, whereas the opposite
18 was true for relative HGS.

19 **Conclusions:** Relative HGS is an effective way to quantify muscle strength in
20 chronic renal disease patients based on their body mass. As a result, relative HGS

may be a valuable and cost-effective method for the detection of kidney disorders that are chronic in nature.

Keywords: Handgrip strength, chronic kidney disease, Ha'il, Saudi Arabia

INTRODUCTION

In the Kingdom of Saudi Arabia, there are over 20,000 patients on dialysis and 9,810 patients undergoing follow up after kidney transplantation [1].

Chronic kidney disease patients (CKD) were been reported with low physical performance than other populations. Due to sedentary lifestyle which is commonly in early stages of chronic kidney diseases, and leads to a decrease in physical performance. In addition, CKD has other systemic effects such as anemia, chronic inflammation, and loss of appetite, all of which contribute to a loss of muscle mass and decreased physical function [2-4].

There are several factors associated with the deterioration of physical activity in patient with CKD which are: cardiovascular disorders are most commonly, increasing the chance of heart attack and stroke, which in turn lowers one's quality of life and, ultimately, reduces one's ability to engage in regular physical exercise. decreased physical fitness because of muscle catabolism and loss of muscle strength and size [5].

In patients with chronic kidney disease, muscle weakness is frequent, and it affects around 40% of dialysis patients [1,6]. It has also been found that patients

with chronic kidney disease (CKD) have a higher prevalence of muscle wasting than those who do not require dialysis. Muscle wasting is caused by pathophysiologic changes associated with chronic kidney disease (CKD), as well as decreased appetite, a low-protein diet, and decreased physical activity. Muscle wasting is caused by direct muscle deterioration and prevention of muscle regeneration [7].

Handgrip strength (HGS) is a simple, practical, and non-invasive method for assessing strength and function in the general population. It is often used to reflect overall muscle strength in the general population because it is straightforward to measure and interpret [8]. In this study, we aimed to evaluate the association between HGS and CKD.

METHODS

Participants

This cross-sectional study was conducted between October 2020 and March 2021. Data collection done from hail region hospitals. assessment were done for all participants for (demographic data, renal function and hand grip strength). Patient eligibility requirements included being above the age of 20 years, being a Saudi citizen living in the Hail region, having a history of chronic renal disease, being on hemodialysis, and signing an informed consent form. And patients with an unstable myocardial infarction, unstable angina, uncontrolled arrhythmias,

uncontrolled hypertension, diabetes, or neurological problems were barred from participating in the trial. Age, gender, body mass index (BMI), and length of disease are all considered to be baseline information. According to the Department of Physical Therapy's local institutional ethics committee, this study was allowed to proceed (PT/020/0083).

Assessment of Handgrip strength

HGS of both hands has been assessed digitally by a hand dynamometer (JAMAR Hydraulic hand dynamometer and a pinch gauge, 5030J1, CANADA). HGS of each hand has been evaluated in three occasions whilst standing in a straight line with full stretched arm laterally outward without catching the torso. When requested to squeeze the dynamometer to its maximum capacity for up to 3 seconds, patients were instructed to relax for at least 30 seconds before taking another measurement. Absolute HGS was estimated by adding up the maximum bilateral HGS in kilos and dividing it by two. The relative HGS was computed by division of the absolute HGS by the body mass index (BMI).

Statistical analyses

All statistical analyses were carried out with the help of the IBM SPSS program (version 23.0; SPSS, Chicago, IL, USA). The chi-squared test was used to compare the relationship between HGS and chronic illnesses between males and females. The association between specific renal function measures and absolute or

relative HGS was investigated using correlation coefficients to estimate the relationship. When the P-value for the main effect variable was less than 0.05, the variable was considered significantly in all analyses.

RESULTS

Among 251 participants there were 132 male with 52.5% and with mean age, BMI and duration of illness 53.6 ± 27.8 , 29.5 ± 5.2 , 28.6 ± 7.3 respectively ,And there were 119 female with 47.4% and with mean age, BMI and duration of illness 48.7 ± 28.5 , 28.8 ± 4.9 , and 26.9 ± 7.8 respectively and the distribution of absolute and relative HGS was 65.9 ± 0.4 kg and 3.2 ± 0.0 kg/BMI for males and 42.6 ± 0.3 kg and 1.8 ± 0.0 kg/BMI for females, correspondingly (Table 1).

In Table 2 and figure 1, HGS is divided into two groups based on gender. HGS was negatively connected with age and positively correlated with height in both sexes, although body weight and body mass index (BMI) were favorably interrelated with absolute HGS but depressingly linked with relative HGS. The concentrations of creatinine and blood urea nitrogen were found to be negatively connected with absolute HGS and positively connected with relative HGS.

Table 1: Differences in baseline characteristics according to genders

	Males (n=132)	Females (n=119)	p-value
Age, years	53.6 ± 27.8	48.7 ± 28.5	0.381
BMI, Kg/m ²	29.5 ± 5.2	28.8 ± 4.9	0.651
Duration of CKD, m	28.6 ± 7.3	26.9 ± 7.8	0.465
Co morbid conditions			
Hypertension %	82.6 %	7.2%	0.000
Diabetes	52.3%	29.6%	0.000

ischemic heart disease	41.7%	32.09%	0.000
Abs. HGS (kg)	65.9 ± 0.4 ***	42.6 ± 0.3	0.000
Rel. HGS (kg/BMI)	3.2 ± 0.0 ***	1.8 ± 0.0	0.000

CKD: chronic kidney disease; Abs. HGS: absolute hand-grip strength; Rel. HGS: relative hand-grip strength; BMI: body mass index.

Table 2: Difference between participants according genders

	Males		Females	
	Abs. HGS	Rel. HGS	Abs. HGS	Rel. HGS
Age (years)	−0.521 ***	−0.433 ***	−0.523 ***	−0.483 ***
Height (cm)	0.297 ***	0.247 ***	0.310 ***	0.309 ***
Weight (kg)	0.321 ***	−0.293 ***	0.204 ***	−0.388 ***
BMI (kg/m²)	0.184 ***	−0.476 ***	0.072 *	−0.564 ***
Creatinine (mg/dL)	0.060 *	−0.043	0.092 **	0.022
Blood urea nitrogen	0.063 *	−0.017	0.014	−0.021
Abs. HGS (kg)	—	0.781 ***	—	0.77 ***
Rel. HGS (kg/BMI)	0.79 ***	—	0.76 ***	—

Statistical significance is defined as *P<0.05, **P<0.01, and ***P<0.001. Abs. HGS: absolute hand-grip strength; Rel. HGS: relative hand-grip strength; BMI: body mass index.

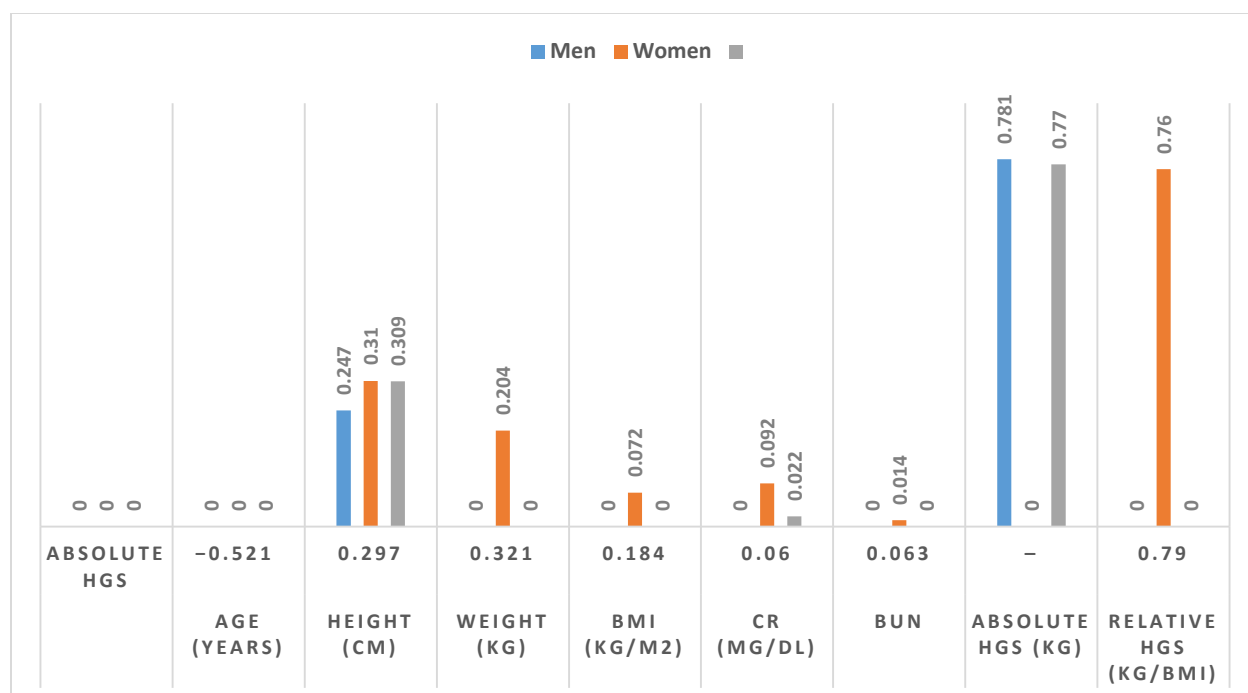


Figure 1. Comparison of subject results stratified by sex

DISCUSSION

The study's most important finding was that CKD was linked to poor HGS in both males and females, even after regulating the factors such as age, obesity, hypertension, and diabetes. A statistically significant link between HGS and eGFR was also found. The decrease of muscular strength and mass is common in CKD individuals. There is a connection between muscle mass and power, but this isn't always the case; muscle power can decrease even when muscle mass is either dropped or raised [9].

HGS has been shown to be a predictive factor of functional ability and strength in individuals with chronic kidney disease [10], and it is significantly

115 impacted by age and gender. It has been reported that HGS in chronic kidney
116 disease (CKD) patients is an interpreter of compound kidney findings distinct by
117 pre-dialysis development or mortality to end-stage renal disease (ESRD). There is
118 a significant relation between HGS and kidney function, and it is an useful and
119 straightforward index of muscle weakness [11,12].

120 Subjects with higher HGS were found to have a lower predominance of
121 CKD, and HGS was observed to be highly related to the reduced rate of CKD in
122 the study conducted by Cheng et al.,2021; however, very few survey studies have
123 reported the relationship between CKD and HGS in Chinese society individuals.
124 [13].

125 Latest evidence has previously proven that there is a favorable association
126 between muscle weakness and the incidence of chronic kidney disease (CKD). [14]
127 A study conducted in the United States utilizing data from the Third National
128 Health Nutrition Screening Survey revealed that the incidence of muscle weakness
129 rose significantly with diminishing renal function, though not statistically
130 significant. According to the findings of another study [15], a drop in body lean
131 mass was substantially related with a decrease in the glomerular filtration rate in
132 individuals with chronic kidney disease.

133 It should be noted that our study was conducted on a diminutive patients'
134 number of 251 with chronic kidney disease who have experienced dialysis, and

further research is needed to determine the relationship between kidney functions and HGS in more patient number that incorporates normal individuals as well as patients with CKD.

CONCLUSION

We believe that relative HGS is a useful metric that expediently characterizes muscle mass and strength, and that it can be used to assess the likelihood of developing chronic kidney and musculoskeletal disorders. Furthermore, it is possible that relative HGS has an impact on the development or worsening of chronic diseases. The results suggest that relative HGS may be a money-spinning and beneficial tool for viewing widespread persistent disorders among individuals with different age stages.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

Acknowledgments

This publication was supported by the Deanship of Scientific Research at Prince Sattam bin Abdulaziz University.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of

research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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