

## Functional capacity analysis using the Six Minute Walk Test (6MWT) in chronic renal patients

### Análise da capacidade funcional pelo *Six Minute Walk Test* (6MWT) em doentes renais crônicos

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**RESUMO | INTRODUÇÃO:** A doença renal crônica (DRC) é caracterizada por alterações na função ou estrutura renal durante 3 meses ou mais, levando a perda funcional dos rins e a diminuição da capacidade funcional. **OBJETIVO:** Avaliar a capacidade física de pacientes doentes renais crônicos no estadiamento 5, através do six minute walk test (6MWT), e comparar a distância percorrida e prevista de acordo o gênero. **MÉTODOS:** Trata-se de um estudo transversal, de caráter analítico descritivo. Foram incluídos indivíduos com DRC no estadiamento 5, de 18 a 59 anos, de ambos os gêneros e excluídos pacientes com deformidades em membros inferiores, tabagistas, etilistas e com doença pulmonar obstrutiva crônica. Os participantes foram submetidos ao six minute walk test. Foram realizados os cálculos de média e desvio padrão, os testes de Pearson e T-student, respeitando o valor de significância < 0,05 para análise estatística através do software SPSS 20.0 para Windows. **RESULTADOS:** Dos 139 pacientes em hemodiálise, 30 foram elegíveis, sendo que destes 12 (doze) eram do gênero feminino e 18 (dezoito) do gênero masculino, com idade média em anos de 42,33±15,58 e 39,27±12,22. A distância prevista em metros para o gênero feminino foi de 763,10±63,62 e gênero masculino 840,82±52,42. A média de distância percorrida pelo gênero feminino foi de 325,33±78,31 (r=0,1, p=0,00), do gênero masculino 389,67±95,80 metros (r=0,98, p=0,00). **CONCLUSÃO:** Indivíduos renais crônicos no estadiamento 5, apresentam desempenho inferior ao previsto de acordo com a distância prevista e percorrida através 6MWT independente do gênero, indicando uma menor capacidade funcional desta população.

**PALAVRAS-CHAVE:** Doença renal crônica. Atividades cotidianas. Teste de caminhada.

**ABSTRACT | INTRODUCTION:** Chronic kidney disease (CKD) is characterized by changes in kidney function or structure for 3 months or more, leading to functional loss of the kidneys and decreased functional capacity. **OBJECTIVE:** To evaluate the physical capacity of patients with chronic kidney disease during stage 5, using the six minute walk test (6MWT), and to compare the distance covered and predicted according to gender. **METHODS:** This is a cross-sectional, descriptive analytical study. Individuals with CKD were included in stage 5, aged 18 to 59 years, of both genders and patients with lower limb deformities, smokers, alcoholics and chronic obstructive pulmonary disease were excluded. Participants underwent the six minute walk test. Mean and standard deviation calculations were performed, as well as the Pearson and T-student tests, respecting the significance value <0.05 for statistical analysis using the SPSS 20.0 software for Windows. **RESULTS:** Of the 139 patients on hemodialysis, 30 were eligible, of which 12 (twelve) were female and 18 (eighteen) male, with a mean age in years old of 42.33 ± 15.58 and 39.27 ± 12, 22. The predicted distance in meters for females 763.10 ± 63.62 and males 840.82 ± 52.42. The average distance covered by the female gender was 325.33 ± 78.31 (r = 0.1, p = 0.00), male 389.67 ± 95.80 meters (r = 0.98, p = 0.00). **CONCLUSION:** Chronic renal individuals undergoing staging 5, perform less than expected according to the predicted distance and traveled through 6MWT regardless of gender, indicating a lower functional capacity of this population.

**KEYWORDS:** Chronic kidney disease. Daily activities. Walk test.

## Introduction

According to the National Kidney Foundation, chronic kidney disease (CKD) is characterized by changes in function or renal structure for 3 months or more, asymptomatic and progressive, leading to loss of function of the kidneys, being necessary to perform replacement therapy for with peritoneal dialysis or hemodialysis, establishing a metabolic and nutritional balance<sup>1,2</sup>.

It is estimated that in Brazil, about more than two million people have some renal dysfunction, and a hundred thousand of them perform kidney replacement therapy, early detection is critical because it acts in the natural course of the disease decreasing the complications and needs performing replacement therapy<sup>3</sup>. According to Brazilian Society of Nephrology, 91.4% of people in need of renal replacement therapy (RRT) are undergoing hemodialysis, which although providing improvements to the patient in critical condition, may cause other complications, such as hemodynamic instability, catheter venous bleeding due to heparin administration, in addition to restrictions and limitations of daily activities of the patient at the time treatment is started<sup>4,5</sup>.

Kidney disease has high survival rates, however, is considered a highly intrusive illness due to complications and restrictions that can provide, along with the uncertainty of their prognosis, these factors are added together and exacerbated due to family instability, personnel and labor in which the patient is (3.6). The CKD in 5 stages which are classified according to the disease stage and its cause, in addition to abnormalities in urine sediment examination of changes in renal imaging and determination of glomerular filtration rate (GFR)<sup>1,7</sup>. The last phase, known as chronic is represented by the incompatibility of kidneys life, totally loses its function and control with the internal environment, it is necessary to perform or renal transplantation replacement therapy, comprising a lower GFR at 15 ml / min / 1.73 m<sup>2</sup>.

The most patients with CKD are between stages 3 and 5, where the decline in GFR is linked to decreased physical performance, leading to submit changes of physical function due to disease, with deconditioning and low tolerance activities and reduction in capacity functional. However, after starting hemodialysis it is common manifest, fatigue, cramps and prostrations (3.8). In addition to cases of sarcopenia<sup>5,9,10</sup>. Generating an impact on the musculoskeletal system, leading to atrophy, muscle atrophy and even generalized weakness affecting functionality, independence and overall well-being of individuals<sup>11</sup>.

The assessment of physiological changes can be performed from the six minute walk test (6MWT), which is a widely used tool for assessing the functional capacity of active people, sedentary and those with chronic diseases. This test evaluates the sufficient intensity to achieve maximum aerobic capacity from the distance, where the oxygen consumption (VO<sub>2</sub>) corresponds to a submaximal exercise in which VO<sub>2</sub> reaches a plateau, but does not reach a maximum value, providing an answer integrated all the systems involved to perform an exercise<sup>12,14</sup>.

However, currently in the literature there are few data to support or not the correlation between the lower figures in the 6MWT compared to that expected in the test and the dysfunctions caused due to CKD. The objective of this study was to evaluate the performance of chronic renal failure patients in staging patients 5 through the 6MWT and correlate with their physical capacity and compare the completed distance with the predicted distance according to gender.

## Materials and Methods

This is a cross-sectional, descriptive analytical study, approved by the Research Ethics Committee (under protocol 69175717.8.0000.5083), Which was developed in a Center Uro-nephrology, where patients answered a sociodemographic questionnaire and underwent 6MWT in predialysis time to assess functional capacity in the period from September to December 2018.

Patients with CKD were included in staging 5, 18 to 59 years old, of both genders, hemodynamically stable and have stable clinical conditions that would allow the realization of the physical test. Were excluded from the study, patients with lower limb deformities, smokers, alcoholics, chronic obstructive pulmonary disease shown no weight gain between dialysis > 2.5 kg.

The test was performed on a minimum length of corridor 30 meters long, flat and free transit of persons, with familiarity and recognition of the course before the start of 3 demarcations were held in three meters and was also made available a chair case the need to support patient before finishing all the way<sup>14,15</sup>.

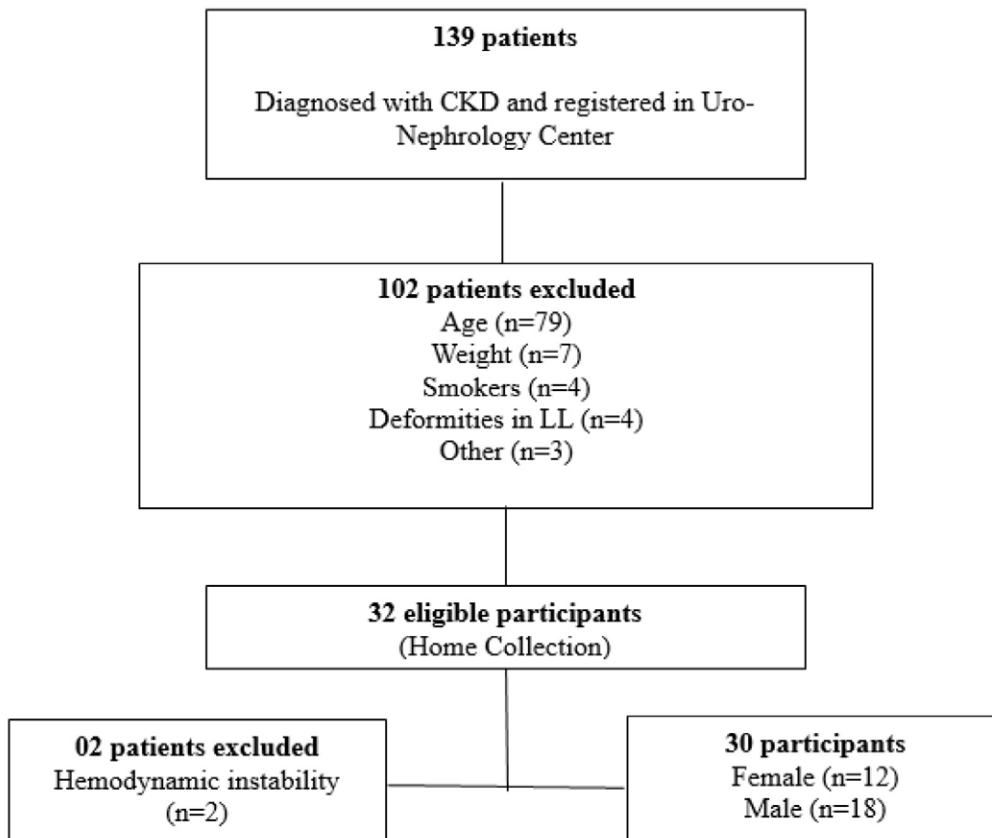
At the beginning and end of test variables was assessed heart rate (HR), respiratory rate (RR), distance (PD), subjective sensation of dyspnea applied to modified Borg scale<sup>15</sup>. The predicted walk distance (%) in the 6MWT was calculated according to the equation for the Brazilian population developed by Britto<sup>14</sup>.

After collecting the data, the statistical tests were performed using SPSS version 20.0 software for Windows. Data are presented as mean (+) standard deviation (-). To analyze the normality of the data was applied to the Shapiro-Wilk test and was later used for comparison analyzes Student's t test. For correlation analysis was used the Pearson test. It was considered statistically significant p-value <0.05.

## Results

Of the 139 patients on hemodialysis the Jataí-GO hemodialysis Center, 30 were ineligible (Figure 1), aged 18 to 59 years, and of these twelve (12) are female and 18 (eighteen) of the males (Table 1).

Figure 1. Sample Recruitment Flowchart



**Table 1.** Sample characterization concerning a population of 30 subjects with CKD, distributed according to gender, age, height, weight and dialysis time in 2018

VARIABLE	Gender Female N = 12	P <0.05	Gender Male N = 18	P <0.05
Age	42.33 ± 15.58	0.00	39.27 ± 12.22	0.00
Height cm	153.41 ± 9.95	0.00	170.94 ± 7.36	0.00
hemodialysis time (months)	44.09 ± 37.64	0.03	38.77 ± 27.00	0.00
Weight in kg	56.58 ± 11.45	0.00	71.11 ± 13.13	0.00
Dry Weight kg	55.18 ± 10.85	0.00	69.52 ± 13.06	0.00
BMI dry weight	23.54 ± 4.83	0.00	23.77 ± 4.07	0.00

Legend: kg - kg, m - meters. T-Test student.

When performed the related distribution to genders and performed the pairing variables described in Table 2 and the 6MWT, we see the results in meters to the distance specified for females  $763.10 \pm 63.62$  and males  $840.82 \pm 52.42$ , and for which the average distance traveled by females was  $325.33 \pm 78.31$  ( $r = 0.1$ ,  $p = 0.00$ ) and the average distance in males was  $389.67 \pm 95.80$  ( $r = 0.98$ ,  $p = 0.00$ ). Note that the distance values below shows predicted distance, regardless of gender, as shown in Table 2.

When analyzing the sample distribution according to sex and paired with the 6MWT (Table 2), it is noted that the results of the distance covered are lower than the expected distance for the variables studied. It was also possible to observe a moderate negative correlation between the distance covered in meters and the age of both sexes. When the BMI was paired and the values of the same test, there was a moderate negative correlation for women and a weak one for men.

It can be seen therefore, that regardless of gender, dialysis individuals have a distance less than the distance predicted when subjected to 6 MWT and evaluated according to Brazilian equation, thus indicating a lower functional capacity of these individuals.

**Table 2.** Paired samples according to gender and 6MWT 30 individuals with CKD in 2018

VARIABLE	Gender Female N = 12	R	P <0.05	Gender Male N = 18	R	P <0.05
Distance planned	$763.10 \pm 63.62$		0.00	$840.82 \pm 52.42$		0.00
Distance traveled (m)	$325.33 \pm 78.31$	0.16	0.00	$389.67 \pm 95.80$	0.98	0.00
Height cm	$71.91 \pm 78.77$	0.17	0.00	$218.72 \pm 94.23$	0.25	0.00
Dry Weight (kg)	$270.15 \pm 83.17$	-0.39	0.00	$320.14 \pm 99.50$	-0.20	0.00
Weight (kg)	$268.75 \pm 83.44$	-0.39	0.00	$318.56 \pm 99.32$	-0.22	0.00
Age	$283.00 \pm 86.80$	-0.47	0.00	$350.39 \pm 101.32$	-0.40	0.00
BMI	$301.10 \pm 80.50$	-0.45	0.00	$365.89 \pm 97.35$	-0.36	0.00
Dialysis time (months)	$283.54 \pm 93.34$	-0.10	0.00	$350.89 \pm 97.74$	0.06	0.00

Legend: kg - kg, m - meters. Pearson test and T-Test student.

## Discussion

Although the sample of this study is small, the results demonstrate that the 6MWT is apt to evaluate the functional capacity of individuals with CKD.

Previous studies have shown that functional capacity, which is defined by the conditions necessary for the individual to live independently and to perform satisfactorily the activities of daily living, undergoes changes associated with the state of uremia in dialysis patients, including muscle weakness and disorders respiratory mechanics<sup>16,17</sup>.

Compared the distance with the predicted distance, there were lower values the latter variable. It was also possible to observe that regardless of gender, values driven are smaller, although the distance traveled by males was higher when compared to women. This can partly be explained by Tissue damage caused by oxidative stress<sup>18</sup>.

In other studies, also noted the reduction of distances traveled by dialysis patients, in agreement with our findings. Thus suggesting that the dialysis itself is a contributing factor to the reduction of physical functional capacity in dialysis patients, because the majority of these individuals you present decreased heart rate variability (HRV) and comorbidities arising from disease and treatment, such as decreased muscle strength, cramping and fatigue, which are limiting for physical activity<sup>4,8</sup>.

BMI data were analyzed in relation to the distance covered in the 6MWT, which indicate that the lower this ratio, the greater the distance covered on the test, since it corresponds to fat-free mass in the individual, directly influencing the physical capacity<sup>19,20</sup>. Suggesting the existence of major losses in the distance with high levels of BMI. However, even with the sample presented a lower BMI, the distance was still below the predicted distance justified by the fact dialysis present reduced fitness and functional capacity<sup>20</sup>.

This study also demonstrated that the lower the age, the greater the distance traveled, which is assigned due to existing functional decline occurs as advancing

age, promoting a reduction in muscle strength as a result of the natural aging process<sup>21</sup>. This presents factors lead to change in type II muscle fibers, and reduction of the capillary vascular bed, reduced local blood flow, thereby contributing to muscle disorders<sup>22</sup>.

Thus, the metabolic changes in patients undergoing hemodialysis generate, carrying, impaired functional capacity<sup>23</sup>. Since the DRC affects selectively nerve fibers of large caliber<sup>17</sup>. The retention of uremic toxins goes beyond muscle overload, demonstrating musculoskeletal dysfunction, loss of capillary action, loss of contractile proteins and decrease in muscle mass<sup>24,25</sup>.

This study has limitations that should be considered. In our research we can mention the small sample size and the lack of a control group without CKD.

## Conclusion

The 6MWT is a mean evaluation method, easy to apply, inexpensive and can be used to evaluate the functional capacity of chronic renal patients. With this study it can be seen that staging the CKD subjects 5 show inferior performance to the expected considering the distance on the 6MWT, regardless of gender, indicating a lower functional capacity of this population

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## Author contributions

Franco FS participated in the conception, design, acquisition and statistical analysis of the research data, interpretation of the results and writing of the scientific article. Fleury MEFC participated in the interpretation of the data, writing of the article. Moreira MM participated in the writing of the scientific article. Agostinho PLS participated in the conception, design, data acquisition. Gardenghi G participated in the writing of the scientific article.

## Competing interests

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

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