

# Correlation of Gait Speed with Handgrip Strength in Patients Undergoing Cancer Treatment

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*Correlação da Velocidade da Marcha com Força de Preensão Palmar de Pacientes em Tratamento Oncológico*

*Correlación de la Velocidad de la Marcha con la Fuerza de Presión Manual en Pacientes en Tratamiento Oncológico*

Rúbia Mara Giacchini Kessler<sup>1</sup>; Bárbara Reinert<sup>2</sup>; João Pedreira Duprat Neto<sup>3</sup>

## ABSTRACT

**Introduction:** Analytical cross-sectional observational study, carried out in public and private oncologic treatment services. **Objective:** To correlate gait speed with handgrip strength in patients undergoing chemotherapy or immunotherapy treatment. **Method:** The 4-meter gait speed test (4MGST) was performed to assess the gait speed. Next, handgrip muscle strength was evaluated using the Jamar dynamometer. The Spearman and Kendall parametric methods were applied for the statistical analysis of the data through descriptive analysis and to check clarity. **Results:** The sample consisted of 86 volunteers, 53.5% women and 46.5% men. The minimum age collected in the study was 21 years old and the maximum age was 84 years old. The mean age of the participants was 56.5 years. The treatments performed were immunotherapy (31.4%), and chemotherapy (22.1%). The mean of gait speed for the population was 1.42 m/s, with 98.8% experiencing no gait slowness. Regarding handgrip strength, the mean for the right hand was 56.67 and for the left hand, 55.31, showing no decrease in handgrip strength. **Conclusion:** The difference between gait speed and handgrip strength is moderate with  $p$  value on the right hand = 0.502 and  $p$  value for the left hand = 0.491, according to Spearman.

**Key words:** Gait Analysis/statistics & numerical data; Hand Strength; Oncology/statistics & numerical data.

## RESUMO

**Introdução:** Estudo observacional transversal analítico realizado nos serviços públicos e privados de tratamento. **Objetivo:** Correlacionar a velocidade da marcha com a força de preensão palmar em pacientes em tratamento com quimioterápicos ou imunoterápicos. **Método:** Participaram desta pesquisa todos os pacientes com cânceres sólidos em tratamento com quimioterápicos ou imunoterápicos no período da coleta de dados. Para avaliação da velocidade da marcha, foi realizado o teste de velocidade da marcha dos quatro metros (VM4M). Em seguida, foi realizada avaliação da força muscular de preensão manual, por meio do dinamômetro Jamar. A análise estatística dos dados foi feita por meio da análise descritiva e para verificar a correlação foram utilizados métodos paramétricos de Spearman e Kendall. **Resultados:** A amostra foi composta por 86 voluntários, sendo 53,5% mulheres e 46,5% homens. A idade mínima coletada no estudo foi de 21 anos e a máxima de 84 anos. A idade média dos participantes foi de 56,5 anos. Quanto aos tratamentos realizados, 31,4%, imunoterapia, 22,1%, quimioterapia. Em relação à velocidade da marcha, a média da população foi de 1,42 m/s e 98,8% não apresentaram lentidão de marcha e em relação à força de preensão palmar da população, a média da mão direita foi de 56,67 e da mão esquerda, 55,31, não apresentando diminuição da força da preensão palmar. **Conclusão:** A correlação entre velocidade da marcha e força de preensão palmar se mostrou moderada com  $p$  da mão direita = 0,502;  $p$  da mão esquerda = 0,491, de acordo com Spearman.

**Palavras-chave:** Análise da Marcha/estatística & dados numéricos; Força da Mão; Oncologia/estatística & dados numéricos.

## RESUMEN

**Introducción:** Estudio observacional analítico de corte transversal, realizado en servicios de tratamiento públicos y privados. **Objetivo:** Correlacionar la velocidad de la marcha con la fuerza de presión manual en pacientes sometidos a tratamiento contra el cáncer. **Método:** Participaron de esta investigación todos los pacientes con cáncer sólido sometidos a quimioterapia o inmunoterapia durante el período de recolección de datos. Para evaluar la velocidad de la marcha, se realizó la prueba de velocidad de la marcha de cuatro metros (VM4M). A continuación, se evaluó la fuerza de los músculos de presión manual utilizando el dinamómetro Jamar. El análisis estadístico de los datos se hizo mediante análisis descriptivo y para verificar la correlación se utilizaron los métodos paramétricos de Spearman y Kendall. **Resultados:** La muestra estuvo compuesta por 86 voluntarios, 53,5% mujeres y 46,5% hombres. La edad mínima recogida en el estudio fue 21 años y la edad máxima 84 años. La edad promedio de los participantes fue de 56,5 años. Respecto a los tratamientos realizados, el 31,4% fue inmunoterapia y el 22,1% quimioterapia. En cuanto a la velocidad de la marcha, el promedio poblacional fue de 1,42 m/s, siendo que el 98,8% no presenta lentitud en la marcha. Con relación a la fuerza de presión de la población, el promedio para la mano derecha fue de 56,67 y para la mano izquierda de 55,31, no presentando disminución en la fuerza de presión. **Conclusión:** La correlación entre la velocidad de la marcha y la fuerza de presión de la mano fue moderada con valor de  $p$  mano derecha = 0,502; valor  $p$  mano izquierda = 0,491, según Spearman.

**Palabras clave:** Análisis de la Marcha/estatística & datos numéricos; Fuerza de la Mano; Oncología/estatística & datos numéricos.

<sup>1,2</sup>Universidade do Vale do Itajaí. Itajaí (SC), Brasil. E-mails: rubia@univali.br; barbarareinert@hotmail.com. Orcid iD: <https://orcid.org/0000-0002-1271-0419>; <https://orcid.org/0000-0002-6884-1776>

<sup>3</sup>A. C. Camargo Cancer Center. São Paulo (SP), Brasil. E-mail: joao.duprat@accamargo.org.br. Orcid iD: <https://orcid.org/0000-0001-8968-4506>

**Corresponding author:** Rúbia Mara Giacchini Kessler. Universidade do Vale do Itajaí. Rua Uruguai, 458, bloco F5, Sala 213 – Centro. Itajaí (SC), Brasil. CEP 88302-9013. E-mail: rubia@univali.br



## INTRODUCTION

In addition to reaching tumor cells, cancer treatments can cause side and unwanted effects on the individual. The most recurrent symptoms are fatigue, nausea, vomits, sensitiveness, further to decline of strength and range of motion, postural changes and pain, impacting the autonomy and functional conditioning with consequences on the quality of life<sup>1,2</sup>.

Several variables can be evaluated to investigate the impact of cancer effects on the functional capacity and quality of life of the patients, among them the gait speed and handgrip strength.

Gait speed can be considered the sixth vital sign as predictor of the functional capacity as the repercussions are associated with fragility, functional dependence and capacity and even to measure mortality<sup>3,4</sup>. Other studies show that changes impact muscle strength and other adversities, which makes gait a complex activity, reducing the functional independence. There is correlation between gait speed with decline of autonomy and functional capacity, it is a good sign to evaluate cancer patients, an easy-to-understand and applicable tool<sup>3,5</sup>.

Handgrip strength and gait speed are predictors of functional capacity, some studies show it is utilized to detect physical-functional changes rapidly. It is related to global muscle strength, malnutrition, loss of muscle strength with direct consequences on the functional capacity and quality of life, it is a parameter to evaluate the disease progression as cancers and mortality<sup>6</sup>.

The relation between handgrip strength and gait speed is important for early evaluation of the decline of functional capacity of oncologic patients, especially when risk of sarcopenia exists and when other cardiorespiratory functional capacity tests are not viable.

Since neoplastic treatments cause direct effects on functional autonomy and capacity in addition to quality of life, and that there are parameters of evaluation to measure this decline, the research question was: "Do gait speed and handgrip strength hold correlation?" The objectives of this study were to analyze the correlation between gait speed and handgrip strength in patients in cancer treatment and compare the tests of functional capacity according to the type of systemic treatment.

## METHOD

Observational, cross-sectional analytical study conducted in two oncologic treatment services in the city of Itajaí, State of Santa Catarina which concurred with the study and attend to patients of the National Health System (SUS) and private institutions. The study sample

are patients in systemic cancer treatment as chemotherapy or immunotherapy.

The Institutional Review Board of "*Universidade do Vale do Itajaí*", report number 2.970.869, dated October 19, 2018 (CAAE (submission for ethical review): 97636818.9.0000.0120) approved the study and the amendment was approved on April 21, 2020, report number 3.983.054, in compliance with Directive number 466/2012<sup>7</sup> of the National Health Council for studies with human beings.

Data were collected between 2019 and 2021, with a population of 59 volunteers in chemotherapy treatment and 27 in immunotherapy treatment.

Inclusion criteria were adults older than 18 years of age, both sexes, in systemic chemotherapy or immunotherapy treatment with solid tumors and at least 20 thousand platelets.

The exclusion criteria were orthopedic limitation (pain while ambulating, osteoarticular diseases hampering ambulation or handgrip strength test) and cognitive impairment to submit to the test.

In the first stage, the study population responded to a questionnaire with identification, sociodemographic data and clinical history, including age, sex, marital status, education, cancer topography, staging, types of past and ongoing treatments performed (radiotherapy, adjuvant, neoadjuvant or palliative/relapse chemotherapy, immunotherapy or hormone therapy).

The next stage was to measure the handgrip strength with a Jamar<sup>®</sup> dynamometer, according to the guidelines of the clinical evaluation committee of the American Society for Surgery of the Hand<sup>8</sup>. According to the guidelines, the handle of the dynamometer was set at the second position while the participant remained seated with the upper limb to be evaluated in the neutral position, elbow flexed to 90 degrees and the forearm in neutral rotation without support. The other upper limb rested along the body. The participant was guided to perform handgrip strength three times at maximum force with one-minute interval one from the other according to Ordan *et al.*<sup>9</sup>.

At least three and maximum five attempts of handgrip should be ensured and each attempt kept for three seconds. The mean of three measures was calculated to analyze the results with lowest difference among them, that is, those with variation of up to 15% among the values obtained. During the evaluation, verbal encouragement was given to the participant to obtain the best score. Reference values for dynamometry were based on Bohannon *et al.*<sup>10</sup>.

At the end, the 4-minute gait speed test (4MGST) was applied, it is the most appropriate test of functional capacity for older adults and fragile individuals<sup>11,12</sup>. It is a fast tool to measure the functional capacity lasting

two minutes in an 8-meter long corridor, two meters for acceleration, four meters to measure the functional capacity and the two last to decelerate utilizing a stopwatch to time the test<sup>11,12</sup>.

The patient was guided to walk four meters in a straight line as fast as possible without running, timed by an investigator and repeated three times. The formula  $V = \Delta S / \Delta t$  was utilized to calculate the gait speed, being  $\Delta S$  in meters and  $\Delta t$  in seconds.  $\Delta S$  is always four meters. The gait is slow when the mean of the speed gait is  $< 0.80$  m/s. Low life expectancy is directly related to decline of the functional capacity<sup>11</sup>.

The ideal population size investigated was the proportion of one patient in immunotherapy for two patients in chemotherapy according to an earlier pilot project. Of the 102 patients invited during the systemic treatment, 86 accepted to join the study, with an acceptance rate of 84%.

Upon collection of the information, the data were analyzed through simple descriptive statistical analysis of the variables. The Wilcoxon-Mann-Whitney<sup>13</sup> test was utilized for non-parametric data to compare chemotherapy and immunotherapy groups and test  $t^{14}$  for parametric data. The Spearman and Kendall tests were utilized to analyze the correlation between gait speed and handgrip strength. For the present study, the values between 0 and 0.3 for Pearson's  $r$  and Spearman's  $\rho$  in module were considered biologically negligible; between 0.31 and 0.5, weak correlation; between 0.51 and 0.7, moderate; between 0.71 and 0.9, strong correlation and  $> 0.9$ , very strong according to Mukaka<sup>12</sup>. A simple linear regression was performed too. The software R Core Team (version 4.0.5)<sup>15</sup> was utilized and level of significance alpha of 0.05 for all the analyzes.

## RESULTS

The sample in systemic cancer treatment who met the inclusion criteria consisted in 86 volunteers, with 53.5% women and 46.5% men. The minimum age was 21 years and the maximum, 84 years. The median age was 60.9 years, of these, 65.1% were married, 15.1%, divorced, 5.8%, widow/er and 14%, single; 20.9% completed elementary school, 79%, high school or university (Table 1).

The most prevalent cancers were breast, 26.7%, chest, 18.6% and uro-gynecologic, 16.3%, 57% of which in stage IV. For the chemotherapy group, women predominated – 41.9%, being breast cancer the most incident with 20.9%, followed by abdomen, 17.4% and uro-gynecologic, 12.8%. Stage IV accounted for 35.3% (Table 1).

The treatments performed were: 31.4%, immunotherapy, 22.1%, adjuvant chemotherapy, 17.4%, neoadjuvant chemotherapy and 29.1%, relapse or palliative, totaling 68.6% in chemotherapy. Of those with drug intervention, 40.7% were not submitted to surgery, 57% had earlier submitted to surgery and 2.3% failed to report this data.

The mean 4-meter gait speed for the chemotherapy group was 1.41 m/s and for the immunotherapy group, 2.87 seconds while the median was 2.78 seconds. The overall speed mean was 1.42 m/s and the median, 1.43 m/s.

According to the cutoff, 98.8% of the patients did not present gait slowness. Per the Wilcoxon test with  $p = 0.4372$ , the type of treatment did not impact the gait speed of the chemotherapy and immunotherapy groups for this population (Table 2).

The mean of the handgrip strength of the right hand was 56.67 and of the left hand, 55.31, with no decline of this variable as portrayed in Table 3. The Wilcoxon-Mann-Whitney test ( $p = 0.05$ ) applied to analyze the influence of the group on the right handgrip strength was  $p = 0.1314$ , being possible to conclude that the variable was not influenced by the type of treatment (immunotherapy or chemotherapy). The comparison of the handgrip strength of the left hand for both groups with test  $t$  resulted in  $p = 0.1020$ , indicating that there is no influence of the type of treatment. The handgrip strength is not significantly different between the two groups, it is not influenced by the type of treatment as Table 3 shows.

The main goal of the study was to find whether a correlation between gait speed and handgrip strength exists utilizing the Spearman and Kendall methods (Table 4). It was found there is positive moderate correlation after application of these two methods as shown in Figure 1: as stronger both hands are, faster is the gait (Figure 1).

The simple linear regression of the gait explained by the handgrip strength was  $r^2 = 0.279$ , meaning that 28% of the variation of the gait speed is predicted by the handgrip strength. Similarly, the mean handgrip strength of the left hand accounts for 25% of the variation of the gait speed of the patients ( $r^2 = 0.252$ ) (Table 4). The regression reinforces the moderate correlation of the gait speed with handgrip strength for the study population.

## DISCUSSION

The variables gait speed and handgrip strength are moderately correlated as the present study has concluded.

Nagamatsu *et al.*<sup>16</sup> investigated the impact of speed gait on the evaluation of muscle dysfunction in chronic liver diseases and hepatocellular carcinoma in their study, utilizing the Gait Speed test and demonstrated the



Table 1. Sociodemographics, tumor topography, staging in relation to systemic treatment

Type of treatment	Total		Immunotherapy		Chemotherapy		P*
Variables	Frequency	percentage	Frequency	percentage	Frequency	percentage	
Sex							
Male	40	53.5 %	17	19.8%	23	26.7%	0.07
Female	46	46.5%	10	11.6%	36	41.9%	
Education							
Elementary	18	20.9%	3	3.5%	15	17.4%	0.10
High school	31	36.0%	11	12.8%	20	23.3%	
University, Master's or PhD	37	43.0%	13	15.1%	24	27.9%	
Marital status							
Married	18	20.9%	23	26.7 %	33	38.4 %	0.06
Divorced	31	36.0%	2	2.3 %	11	12.8%	
Widow/er	37	43.0%	1	1.2 %	4	4.7%	
Single	12	14.0%	1	1.2 %	11	12.8%	
Topography							
Breast	23	26.7%	5	5.8%	18	20.9%	< 0.01*
Chest	16	18.6%	10	11.6%	6	7.0%	
Uro-gynecologic	14	16.3%	3	3.5%	11	12.8%	
Central Nervous System	2	2.3%	0	0.0%	2	2.3%	
Head and Neck	4	4.7%	0	0.0%	4	4.7%	
Skin	8	9.3%	6	7.0%	2	2.3%	
Abdomen	18	20.9%	3	3.5%	15	17.4%	
Kaposi	1	1.2%	0	0.0%	1	1.2%	
Staging							
2	12	14.0%	2	2.4%	10	11.8%	0.19
3	20	23.3%	5	5.9%	15	17.6%	
4	49	57.0%	19	22.4%	30	35.3%	
Missed	4	4.7%	0	0.0%	4	4.7%	

\*Value of  $p$  of the chi-square test.

significant correlation between these two variables. The findings revealed that the decline of handgrip strength is more evident than of gait speed and that all the patients with decline of gait speed have also presented decline of handgrip strength<sup>16</sup>.

The study of Wieczorek *et al.*<sup>17</sup> aimed to analyze the handgrip strength and functional capacity of older adults and measured the functional capacity and gait speed with the 6-minute walk test; they concluded that handgrip strength can be associated with functional capacity for this group of patients<sup>17</sup>.

Gait speed and handgrip strength are important health predictors of oncologic patients. Barbalho<sup>18</sup> demonstrated in her study that the toxicity of neoplasms treatments causes adverse effects with repercussions on physical fitness and consequently, reduction of the strength and loss of muscle mass. The vulnerability of the system leads to more odds of surgical complications, increase of dependence, death and length of hospitalization. The study demonstrated that the decline of functionality is closely associated with worse prognosis. Dynamometer tests and gait speed tests are utilized to evaluate the functionality and reduction of the physical fitness<sup>19</sup>.

The systematic literature review by Pamoukdjianet *et al.*<sup>19</sup> showed that the gait speed is a strong predictor of mortality, utilizing the range 0.8-1 m/s to determine the survivorship and if a decline of 0.1 m/s during one year is detected, mortality increases and if this result improves, survivorship can extend for more than eight years. In addition, it also demonstrated that gait speed indicates impairments and fragilities when lower than 1 m/s<sup>20</sup>.

Handgrip strength is positively associated with global muscle strength and negatively with mortality. The study of Zhuang *et al.*<sup>20</sup> concluded that low handgrip strength is strongly associated with mortality of oncologic patients, in addition to relating low values to malnutrition and sarcopenia regardless of sex and that the decline is slow in women, meaning that low handgrip strength can have less impact<sup>20</sup>.

The data were collected during the COVID-19 pandemic with many interruptions and cancellation in public institutions, being allowed only in private hospitals, one of the study limitations, further to poor physical space to conduct the test of gait speed.

The present study can potentially help the evaluation of the functional capacity to rehabilitate patients in

**Table 2.** Comparison of the gait speed between the chemotherapy and immunotherapy groups

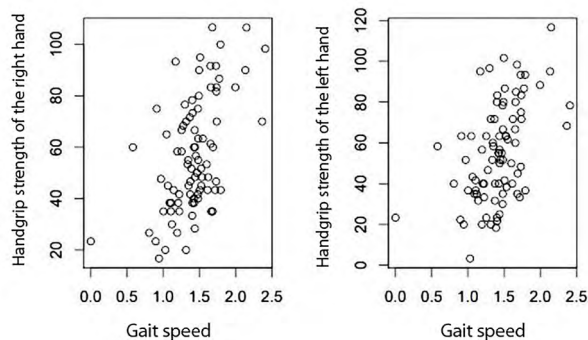
Speed (m/s)	Min	Median	Mean	Max	p
Immunotherapy Group	0	1.480	1.432	2.410	0.4372
Chemotherapy group	0.805	1.403	1.411	2.150	
Total	0	1.431	1.421	2.410	

**Table 3.** Comparison of the handgrip strength between chemotherapy and immunotherapy groups

	Hand	Min	Max	Median	Mean	p
Immuno Group	Right	20 .0	106 .6	66 .3	61 .9	0.102
	Left	20 .0	98 .3	63 .3	61 .7	
Chemo Group	Right	16 .6	106 .6	50 .8	54 .2	0.102
	Left	3 .3	116 .6	50 .8	52 .3	

**Table 4.** Correlation of the variables of gait speed and handgrip strength and coefficient of determination (simple linear regression)

	Hand	Correlation coefficient	p
Spearman	Right	$\rho = 0.502$	$< 0.01^{**}$
	Left	$\rho = 0.491$	
Kendall	Right	$\tau = 0.359$	$< 0.01^{**}$
	Left	$\tau = 0.344$	
Simple linear regression	Right	$r^2 = 0.279$	$< 0.01^{**}$
	Left	$r^2 = 0.251$	

**Figure 1.** Correlation between the variables gait speed and handgrip strength

oncologic treatment with greater number of patients in other cancer treatment sites. Its spin-off may contribute to expand the knowledge about evaluation of the functional capacity of oncologic patients, facilitating the selection of functional tests by physiotherapists and positively impact the strategies to treat the disease.

## CONCLUSION

Moderate correlation between gait speed and handgrip strength was found for the study population.

## CONTRIBUTIONS

Rúbia Mara Giacchini Kessler contributed to the study design, acquisition, analysis and/or interpretation of the data, wording and critical review. Bárbara Reinert contributed to the acquisition, analysis and interpretation of the data, wording and critical review. João Pedreira Duprat Neto contributed to the study design, acquisition, analysis and interpretation of the data. All the authors approved the final version to be published.

## DECLARATION OF CONFLICT OF INTERESTS

There is no conflict of interests to declare.

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