

## Evaluation of the properties of WHODAS-12 measurements in individuals with Chagas disease in Brazil

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### ABSTRACT

Numerous tests employed to predict cardiac and functional status are expensive and not widely accessible for a considerable number of patients, particularly those diagnosed with Chagas disease (CD) residing in remote and endemic regions. To date, there is no knowledge of studies that have validated instruments that address functionality in an expanded way, including the biopsychosocial factors in patients with CD. This study aims to evaluate the psychometric properties of the World Health Organization Disability Assessment Schedule (WHODAS 2.0), in its 12-item shortened version (WHODAS-12) when applied to patients with CD. This is a cross-sectional study of a prospective cohort that follows individuals with CD (SaMi-Trop). Data collection took place between October 2019 and March 2020. In the interviews, sociodemographic information, life habits, clinical information, and indicators of disability measured by WHODAS-12 were collected. Descriptive analysis, internal consistency and construct validity of the instrument were performed. A total of 628 patients with CD were interviewed, most were women (69.5%), their mean age was of 57 years, and most declared an average self-perception of health (43.4%). The 12 items of WHODAS-12 were distributed into three factors, which together account for 61% of the variance. The Kaiser–Meyer–Olkin (KMO) index was 0.90, indicating adequacy of the sample for factor analysis. The internal consistency of the global scale showed  $\alpha = 0.87$ . The percentage of incapacity was 16.05%, indicating mild incapacity for the evaluated patients. WHODAS-12 is a valid and reliable measure to assess the disability of the Brazilian population with CD.

**KEYWORDS:** Validation study. Disability and health. Chagas disease. International Classification of Functioning. Epidemiology.

### INTRODUCTION

More than a hundred years after its discovery, Chagas disease (CD) continues to be a health problem for most Latin American countries and non-endemic countries<sup>1,2</sup>. CD has two clinical phases, one acute and one chronic. The acute phase is characterized by mild or nonspecific symptoms of fever, malaise, hepatosplenomegaly, and in some cases, it may be accompanied by skin nodules, generalized pain and Romana's sign<sup>1,2</sup>. The chronic phase can be asymptomatic for long periods and even for life, but when symptomatic, it can present cardiac and digestive changes as well as physical, emotional, and social impacts that can affect both the patient and their family members<sup>3</sup>. In the Brazilian context, CD has an incidence rate of 1.85% and approximately 20 to 30% progress to chronic

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Chagas cardiomyopathy, which is the most severe form of the disease<sup>1-3</sup>.

Cardiac alterations resulting from CD are associated with functional impairment, which can negatively interfere with individuals' daily life activities, especially at work and in patients' quality of life<sup>4,5</sup>. Many instruments are used to assess the cardiac and functional condition of this population, such as the cardiopulmonary exercise test and the treadmill test, the first being the gold standard used for this assessment<sup>5</sup>. However, both tests have a high financial cost in addition to their low availability in remote regions, a reality for many patients, especially those with CD<sup>6,7</sup>.

Thus, the use of simple tools such as scales and questionnaires has been increasingly used in clinical practice and in research that assesses the functionality of patients<sup>8</sup>. These instruments are low-cost and practical, and they are capable of assessing the patient's performance, perception of health, quality of life and day-to-day functional limitations<sup>4,9</sup>.

Functional impairment is considered a multidimensional construct and the result of the interaction of biological, personal, and social factors<sup>9</sup>. Since 2001, the World Health Organization (WHO) has proposed a biopsychosocial model as a theoretical basis for the International Classification of Functioning, Disability and Health (ICF)<sup>10</sup>. This model incorporated these premises and promoted a combination of biomedical and social models, addressing the interaction of different components that influence the performance of daily life activities<sup>9</sup>, such as household chores, going to the supermarket, or maintaining a friendship. Human functionality is defined as the result of the interaction between health conditions at a given time and contextual, environmental, or personal factors<sup>10</sup>. In this sense, it is important to identify the instruments that encompass the theoretical and conceptual model of functionality, as well as those that can properly assess the impact of the health condition on the functionality of individuals<sup>9,10</sup>.

WHO Disability Assessment Schedule (WHODAS 2.0) is an instrument developed on the basis of a comprehensive set of categories included in the ICF structure, with the purpose of assessing health, functionality, and disability, and can be used in the clinical and research context<sup>11</sup>. It has been validated by WHO in several countries<sup>11,12</sup> and its psychometric characteristics have been evaluated. The results of the studies indicated a stable factor structure that can be applied in different countries and population groups, with a unidimensional structure and good characteristics of validity and reliability<sup>11</sup>.

WHODAS 2.0 has already been validated in 47 languages and was translated into Portuguese in 2015<sup>12-15</sup>. In addition to the 36-item version, the instrument also has

other smaller formats with 12 items. The 12-item version is indicated when the application time is short, such as in surveys or some clinical contexts<sup>11</sup>. WHODAS-12 has test-retest reliability with an intra-class coefficient of 0.69–0.89 at the item level; 0.93–0.96 at the domain level; and 0.98 at the general level, and internal consistencies at the domain and general levels range from 'acceptable' to 'very good'<sup>11,16</sup>. In Brazil, two types of validation were performed in a cohort of postpartum women without comorbidity<sup>17,18</sup>. This instrument was also selected to be part of the suggested toolkit to assess disability and morbidity in patients with neglected tropical diseases, including CD<sup>19</sup>. However, WHODAS-12 was not evaluated in relation to its psychometric properties for CD patients.

Knowing the functional impairment of patients with CD will enable interventions to be carried out to improve their usual activities, such as work and leisure. These functionality indicators can be used not only in research but also for clinical and public health decision-making.

Numerous studies have previously been conducted with the objective of evaluating the functional performance of patients with CD, but so far there is no knowledge of investigations that used instruments that refer to the biopsychosocial model of limitation in daily activities and restriction in social participation in a large sample. In this context, it becomes relevant to evaluate the validity characteristics of WHODAS-12 in an endemic area of Brazil.

## MATERIALS AND METHODS

This study was conducted using data obtained from a prospective cohort study named SaMi-Trop (Sao Paulo–Minas Gerais Center for Research in Tropical Medicine). SaMi-Trop is designed to follow Chagas disease (CD) progression in patients from an endemic area of Brazil. This research initiative has been made possible due to the collaborative efforts of four public universities, namely the University of Sao Paulo (USP), Federal University of Minas Gerais (UFMG), Federal University of Sao Joao del-Rei (UFSJ), and State University of Montes Claros (UNIMONTES). The study baseline was performed in 2013–2014 (n = 1951) and the follow-up visits (V1 and V2) were performed in 2015–2016 (n = 1585) and 2019–2021 (n = 628 preliminary). Baseline inclusion criteria were patients aged 18 years or older who self-reported CD and had an ECG recorded in a telehealth database. This State-wide telehealth program has a technological infrastructure that facilitates data acquisition in primary health care settings, cloud storage, and automatic recognition of ECG patterns<sup>20</sup>.

The serology of these patients was performed in this first stage and only participants who were seropositive for *T. cruzi* remained in the study. All surviving participants of V1 were contacted by letter or telephone and were invited to participate in V2. The study includes patients from 21 municipalities in the Minas Gerais State. More details are described in previous publications<sup>7,21,22</sup>. The SaMi-Trop V2 was interrupted by the COVID-19 pandemic and resumed later. For this validation study, we included data from all patients participating in the SaMi-Trop cohort of the first stage of V2, that is, from patients who had their data collected before the COVID-19 pandemic, from October 2019 to March 2020. Those participants who did not respond to WHODAS-12 were excluded.

WHODAS-12 and the information collected in the interview, considering sociodemographic data, lifestyle habits, and self-perception of health, were analyzed. WHODAS-12, similarly to the full version (36 items), predicts the level of functionality in six domains, described as follows: 1) Cognition; 2) Mobility; 3) Self-care; 4) Interpersonal relationships; 5) Life activities; and 6) Participation<sup>10,11</sup>.

The population included in this study consisted of individuals who answered the interviews in stage 1 of V2 from October 2019 to March 2020. WHODAS-12 and a questionnaire containing sociodemographic information, lifestyle habits and self-perception of health were instruments used in the interview.

The individual's degree of functionality in each item is evaluated on a five-point ordinal scale, where 0 (zero) means no difficulty and 4 (four) means that the individual cannot perform the activity. The evaluated items take into account the effort, discomfort or pain, slowness and/or changes in the way in which the person performs the activity. The total score is calculated as the sum of all responses ( $\Sigma$  of all answers  $\times$  12 questions = maximum 48 points) divided by 48 and multiplied by 100. A score of 0% represents no impairment of functionality and independence, while a score of 100% represents the lowest level of functionality with full dependence<sup>11</sup>. WHODAS-12 assesses disability over the previous 30 days, and can be self-applied or interviewer-applied. For this study, considering the low education level of the population, the instrument was applied by an interviewer<sup>10,11</sup>.

Participants' sociodemographic characteristics were described using descriptive statistics such as frequency, measures of central tendency, and dispersion. The construct validity of WHODAS-12 was evaluated by means of exploratory factor analysis in order to define the optimal count of latent variables. Factors were extracted by the Varimax method with Kaiser's rule using the

minimum value  $\geq 1.0$  for retention<sup>22</sup>. The instrument's internal consistency was assessed using Cronbach's alpha coefficient<sup>16,23-25</sup>. To assess the functional capacity, we used an available syntax for the global score<sup>10</sup>, and WHODAS-12 averages were calculated by domain as well. The SPSS statistical software (version 22.0, SPSS Inc., Chicago, IL, USA) was used for all calculations.

SaMi-Trop was approved by the Research Ethics Committee, (National Research Ethics Commission [Comissao Nacional de Etica em Pesquisa – CONEP]) under N° 179685/2012. Participants signed the Free and Informed Consent Term (FICT) prior to the interviews. The study was conducted in accordance with the Resolutions of the National Health Council (Conselho Nacional de Saude – CNS) N° 510/2016 and N° 466/2012.

## RESULTS

A total of 695 patients returned for the V2. However, 67 (9.6%) did not answer WHODAS-12. At the end, 628 CD patients participating in the SaMi-Trop cohort were included in this study (Table 1). Most were women (69.5%), aged between 51 and 65 years (44.9%), married (65.1%), and 70% of the sample had not completed elementary school. Regarding lifestyle habits, 44.9% reported that they performed physical activity more than three times per week, and most denied having ever smoked (68.6%). Self-perception of health was classified as average for 43.4%.

### WHODAS-12 measurement qualities

#### Construct validity

Dimensional structure – After the factor analysis, the 12 items of the WHODAS-12 scale were distributed into three factors, which together accounted for 61% of the variance, with initial eigenvalues of 5.04 for Factor 1, 1.17 for Factor 2, and 1.05 for Factor 3 (Table 2). The dimensional structure of the WHODAS-12 scale was distributed as follows: Factor 1) Six items that assess 'Mobility, Life Activity, Participation and Cognition' (items S1–S4, S7 and S12); Factor 2) Four items that included 'Interpersonal Relationships and Cognition' (S5, S6, S10 and S11); and Factor 3) Two items that assess the 'Capacity for Self-care' (items S8–S9). The factor loading in the respective factors ranged from 0.44 to 0.87. The Kaiser–Meyer–Olkin (KMO) index was 0.90, indicating adequacy of the sample to perform the factor analysis.

#### Internal consistency

Table 3 shows the results of internal consistency for each item, factor, and global scale that were evaluated

**Table 1** - Descriptive analysis of sociodemographic characteristics and life habits of Chagas disease carriers (n = 628\*), 2019.

Variables	N valid and frequency	%
<b>Sex</b>	-	-
Female	437	69.58
<b>Mean age (years)</b>	57.0	-
<b>Age range</b>	-	-
18 to 50 years	208	33.13
51 to 65 years	282	44.90
66 or more	138	21.97
<b>Schooling</b>	-	-
Never attended school	187	29.68
Incomplete elementary school	255	40.48
Completed elementary school	109	17.30
Completed high school	31	4.92
Completed university degree	8	1.59
<b>Marital status</b>	-	-
Single/divorced	98	15.65
Married	408	65.18
Widowed	120	19.17
<b>Physical activity</b>	-	-
≤ 3 days	315	50.16
> 3 days	313	49.84
<b>Smoking habit</b>	-	-
Currently smokes	33	5.25
Used to smoke but not anymore	164	26.11
Never smoked	431	68.63
<b>Drinking habit</b>	-	-
Did not drink in the last 30 days	500	79.49
Less than once per week	69	10.97
1 to 2 times per week	43	6.84
3 or more times per week	17	2.7
<b>Self-perception of health</b>	-	-
Bad	76	12.42
Average	273	43.47
Good	77	44.11

\*Variation of n in some variables is due to loss of information.

using Cronbach's alpha coefficient. The first factor, which encompasses physical capacity with six items, presented internal consistency with an alpha of 0.84. Item S2, which assesses household activities, was better correlated with the others in this factor, with a correlation of 0.76. The second factor, with four items that assess emotional function and cognition, had an alpha of 0.65; while the third factor, composed of two items aimed to assess self-care, showed an internal consistency with an alpha of 0.79, with item/total

correlations of 0.65 for both. The internal consistency of the global scale, including the 12 items, showed alpha = 0.87, and the item/total correlations for the scale ranged from 0.37 to 0.72.

### Assessment of functional disability

Table 4 shows the averages of items, domains, and the global score obtained on the WHODAS-12 scale for the evaluated CD patients. The global mean score of WHODAS-12 was 16.05 points (CI: 14.70 to 17.34). The lowest score was in 'self-care' (0.44) (CI: 0.34 to 0.53) and the highest score was in the 'mobility, emotion and cognition' domain (5.20) (CI: 4.48 to 5.62).

## DISCUSSION

We analyzed the WHODAS-12 psychometric properties in individuals diagnosed with CD residing in an endemic area in Brazil. Despite not being the first investigation using this instrument to assess the functionality of a population with CD, it is the first to assess the psychometric properties of the instrument. Our results indicate that WHODAS-12 is a valid and reliable tool to be used with this population. However, it is important to emphasize that, according to our results, the number of domains should be reduced from six to three, when used in a similar population.

Factor analysis showed that data fitted better in three factors. In the first factor, items related to physical functioning and activities were adjusted, while the items related to interpersonal relationships and self-care were loaded in factors 1 and 3 respectively. A participation and cognition item was loaded in factors 1 and 2. Cognition has been described with positive correlations for physical performance, such as balance, mobility and walking<sup>26,27</sup>. We believe that cognition can have a positive response in mobility and participation.

Previous research has already verified the validity of the construct<sup>16,23-25,28</sup>. Structures of three, two and one factors were previously found in validation studies of WHODAS-12. A study carried out with data from the World Health Organization Longitudinal Study on global aging and adult health, with samples collected from six countries (South Africa, China, Ghana, India, Russia, Mexico) also found three factors for WHODAS-12<sup>28</sup>, just like this investigation. The three factors adjusted similarly, with 'mobility', 'life activities', and 'participation in society' loaded in one factor, and 'interpersonal relationships' and 'personal care' heavily loaded in two other factors. The two studies by Saltychev *et al.*<sup>23,29</sup> of a population with musculoskeletal pain and chronic musculoskeletal pain found two factors for WHODAS-12. A single-factor

**Table 2** - Results of factor analysis\* and factor loadings of the items on the WHODAS-12 scale using the Kaiser–Meyer–Olkin index (n = 628).

Global scale and factors	Factor 1	Factor 2	Factor 3
Eigenvalues	5.04	1.17	1.05
<b>Mobility, life activity, participation and cognition</b>	-	-	-
S1 – Remain standing	0.76	-	-
S2 – Household responsibilities	0.82	-	-
S3 – Learning new tasks	0.57	-	-
S4 – Activities in the community	0.52	-	-
S7 – Walking long distances	0.73	-	-
S12 – Day-to-day work/school	0.65	-	-
<b>Interpersonal relationships and cognition</b>	-	-	-
S5 – Emotional functions	-	0.41	-
S6 – Concentration and attention	-	0.51	-
S10 – Interaction with unknown people	-	0.76	-
S11 – Maintaining friendships	-	0.73	-
<b>Self-care</b>	-	-	-
S8 – Taking a shower	-	-	0.87
S9 – Getting dressed	-	-	0.86
<b>Variance</b>	28.93	17.18	14.47
<b>Cumulative variance</b>	42.02	51.78	60.58

\*Values below 0.20 were suppressed; \*\*KMO (Kaiser–Meyer–Olkin) = 0.90

**Table 3** - Cronbach's alpha coefficients for the factors and for the global scale, and correlations of the items with the factor and with the WHODAS-12 scale (n = 628).

Factors and global scale	Cronbach's alpha coefficient	Correlation item total	Cronbach's alpha if the item is excluded
<b>Mobility, life activity, participation and cognition</b>	<b>0.84</b>		
S1 – Remain standing		0.60	0.82
S2 – Household responsibilities		0.76	0.79
S3 – Learning new tasks		0.56	0.83
S4 – Community activities		0.55	0.83
S7 – Walking long distances		0.62	0.82
S12 – Day-to-day work/school		0.63	0.82
<b>Interpersonal relationships and cognition</b>	<b>0.65</b>		
S5 – Emotional functions		0.40	0.58
S6 – Concentration and attention		0.46	0.51
S10 – Interacting with unknown people		0.48	0.50
S11 – Maintaining friendships		0.37	0.61
<b>Self-care</b>	<b>0.79</b>		
S8 – Taking a shower		0.65	-
S9 – Getting dressed		0.65	-
<b>Global scale</b>	<b>0.87</b>		

structure was observed for a Spanish population with depression<sup>24</sup> and an Italian population after neurosurgery<sup>25</sup>.

The literature suggests that the interpretation of factors

and domains should consider the new compositions after factor analysis for each population studied. Thus, considering the analyses of this study, the three factors

**Table 4** - Assessment of functional disability, according to WHODAS-12 items, domains, and global scale.

Dimensions	Mean scale (0–48)	(±SD*)	CI (95%)
<b>Mobility, life activity, participation and cognition</b>	<b>5.20</b>	<b>(5.37)</b>	<b>(4.78–5.62)</b>
S1 – Remain standing	0.92	(1.25)	(0.83–1.02)
S2 – Household responsibilities	0.84	(1.16)	(0.75–0.93)
S3 – Learning new tasks	0.92	(1.19)	(0.82–1.01)
S4 – Community activities	0.58	(1.04)	(0.50–0.86)
S7 – Walking long distances	1.28	(1.41)	(1.16–1.39)
S12 – Day-to-day work/school	0.64	(1.08)	(0.56–0.72)
<b>Interpersonal relationships and cognition</b>	<b>2.05</b>	<b>(2.49)</b>	<b>(1.86–2.25)</b>
S5 – Emotional functions	0.94	(1.16)	(0.85–1.03)
S6 – Concentration and attention	0.55	(0.96)	(0.47–0.62)
S10 – Interacting with unknown people	0.44	(0.88)	(0.37–0.51)
S11 – Maintaining friendships	0.11	(0.48)	(0.08–0.15)
<b>Self-care</b>	<b>0.44</b>	<b>(1.19)</b>	<b>(0.34–0.53)</b>
S8 – Taking a shower	0.20	(0.62)	(0.15–0.25)
S9 – Getting dressed	0.23	(0.69)	(0.17–0.28)
<b>Global scale (0–100%)</b>	<b>16.05</b>	<b>(16.47)</b>	<b>(14.76–17.34)</b>

\*SD = standard deviation; CI = confidence interval.

found can be analyzed separately from the general score<sup>23,29</sup>. This analysis may raise indicators to support rehabilitation planning or assess treatment outcomes. Schiavolin *et al.*<sup>24</sup> state that the WHODAS-12 instrument was sensitive to different health states, comparing the responses of those without symptoms, mild symptoms, or severe symptoms.

This study showed a high internal consistency for WHODAS-12 on the global scale ( $\alpha = 0.87$ ). Similar Cronbach alpha values were obtained for a Spanish population with depression (0.89)<sup>27</sup>, an Italian population after neurosurgery (0.87)<sup>24</sup> and a general Portuguese population over 55 years old ( $\alpha = 0.86$ )<sup>15</sup>. A systematic review of 2019, with 14 studies, reported generally high alpha estimates, ranging from 0.81 to 0.96<sup>16</sup>. While the Cronbach's alpha for the 'Interpersonal Relations and Cognition' domain ( $\alpha = 0.65$ ) was slightly below the recommended threshold for adequate internal consistency ( $\alpha < 0.70$ ), this domain, with its two items, still presented an important contribution to the global alpha of WHODAS-12.

Despite not being the focus of this study, attention was drawn to the low prevalence of functional disability, according to the WHODAS-12 global score. Despite the highest average being for the 'Mobility, Life Activity, Participation and Cognition' domain, it was expected that patients with CD would have had more difficulties, especially in the domains related to physical exertion. Cardiac alterations can result in dyspnea and fatigue on exertion, leading to restrictions in life activities and mobility<sup>1,2,30</sup>. Significant functional limitations in a variety

of WHODAS domains were observed in patients with cardiovascular disease in New Zealand with no gender differences in the degree of disability<sup>31</sup>. In the work by van 't Noordende *et al.*<sup>19</sup>, carried out in an endemic region in Brazil, a low global score was also observed for patients with CD. Participants also reported the highest levels of disability in mobility, participation and life activities, such as school and work. Some studies<sup>30,32</sup> have already shown that functional impairment is only detectable in patients with CD in the presence of advanced cardiomyopathy.

This result of low functional disability in the present study may be related to the fact that it is a population with broad participation in activities of daily living, in addition to physical activity and a high level of social involvement, characteristics generally widely present in small cities located in remote regions. This social cohesion may have been reflected in items related to emotion and cognition. The lowest score on questions related to interpersonal relationships can be explained by the fact that they are more subjective when compared to more objective questions, such as those assessed in the domains of mobility and activities<sup>19</sup>. To minimize this problem, the authors suggest associating the short P scale with WHODAS-12<sup>19</sup>. The P-scale assesses the participation of individuals with diverse health conditions and different cultural environments<sup>33</sup>.

Another factor that may contribute to the good results obtained in our sample is age. The mean age was below 60 years, which favors a better physical performance, despite the presence of CD in its chronic form<sup>34,35</sup>.

However, it is necessary to consider that CD contributes to an excessive risk of death in seropositive patients when compared with those seronegative for *Trypanosoma Cruzi*<sup>36</sup> and a lower life expectancy<sup>35,37</sup>. In a cohort that followed the elderly in a CD-endemic region in the central-western part of the Minas Gerais State, a three-fold greater risk of death was observed among people who had four or more impaired functions of daily living activities than those without any limitation<sup>21</sup>. It is important to note that the profile of the SaMi-Trop cohort is patients coming from primary health care and not patients from specialty centers, as in the aforementioned study, and who are usually more severely ill patients. These data may partly explain the fact that populations with lower severity are survivors.

This study presented the measurement properties of an instrument with great potential for assessing the functional disability of the population with CD in Brazil, but it is important to discuss certain aspects here. Firstly, we did not assess the temporal stability of the instrument through the test-retest; this was not possible in view of the cross-sectional design of the study. Secondly, the interruption of data collection due to the COVID-19 pandemic may have interfered with the results, although there was no previous selection of these patients. In contrast, the sample size was five times larger than necessary according to the recommendation by Nunnally<sup>38</sup>, which suggests, as an ideal number for carrying out a factor analysis, the proportion of 10 individuals for each item of the instrument.

Despite these considerations, the WHODAS-12 instrument has been widely used in various populations, including those with different physical, psychological, and social changes due to its ease and low cost of application. In addition, the instruments that assess disability according to the ICF are limited. This study brings some positive points to be highlighted, the first being the fact that it has an adequate sample to perform the factor analysis, which reinforces the finding of adequate reliability of WHODAS. Secondly, we emphasize that the studied cohort probably represents the diversity of people living with CD.

## CONCLUSION

WHODAS-12 presents itself as a valid and reliable tool to assess the functional disability of the population with CD. Future investigations can be carried out to assess how CD may affect the functionality of these individuals.

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