Applicability of Activities of Daily Living Tests in Individuals with Heart Failure

EXERCISE AND SPORTS MEDICINE CLINIC

ORIGINAL ARTICLE

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ABSTRACT

Limitation in activities of daily living (ADL) caused by dyspnea is a common finding in patients with heart failure (HF), functional class III and IV. Specific assessment of ADL limitation could be used as a parameter of the disease progression and the therapy response. However, there is a shortage of instruments to assess ADL in this population. This study aimed to determine the applicability of the London Chest Activity of Daily Living (LCADL) and the Glittre ADL-test ($T_{Glittre}$), to evaluate functional limitations of individuals with HF functional class III and IV. Ten patients (57±9 years, 27.5±4.5kg/m^2) of both genders with a clinical diagnosis of HF functional class III and IV and left ventricle ejection fraction (LVEF) 34±7% participated in the study. Spirometry, body mass index (BMI), LCADL, six-minute walking test (6MWT), $T_{Glittre}$, Medical Research Council Scale (MRC) and SF-36 were performed. The patients had an average score of the $LCADL_{total}$ from 27.7±12.1 ($LCADL_{\%total}$: 41.5±16.9) and time of $T_{Glittre}$ 6.3±4.8 minutes. A positive correlation was found between them (r = 0.88, p<0.05). $LCADL_{\%total}$ correlated with 6MWT (r =-0.83), LVEF (r =-0.64), MRC (r =0.68) and Functional Capacity (functional capacity) of the SF-36 (r =-0.63) (p<0.05). $T_{Glittre}$ correlated with 6MWT (r =-0.90), LVEF (r =-0.66) and CF of the SF-36 (r =-0.69) (p<0.05). In conclusion, the LCADL scale and $T_{Glittre}$ have applicability in patients with HF class III and IV, demonstrating association with LVEF, distance on the 6MWT, degree of dyspnea and quality of life.

Keywords: heart failure, dyspnea, activities of daily living.

INTRODUCTION

Heart failure (HF) is a complex clinical syndrome of systemic character, defined as heart failure in providing suitable blood supply to the metabolic and tissue needs, or doing it only with increase of filling pressure[1]. Dyspnea is a common finding in the patients with HF functional class III and IV[2], limiting exercising, and consequently the activities of daily living (ADL). Such fact leads the individual to inactivity, progressively harming his/her cardiovascular and peripheral muscular functions. Specific assessment of dyspnea and limitation in the ADL should be used to assess the disease progression as well as the therapeutic response, such as to cardiac rehabilitation. However, studies which have developed instruments to evaluate the ADL specific to HF patients are scarce.

Dyspnea and ADL limitation are also commonly reported by patients with chronic obstructive pulmonary disease (COPD). Despite the differences in their primary physiopathology, similarities related to functional limitation both in HF and COPD have been observed. In both conditions abnormalities in structure, pulmonary function as well as peripheral compromising are observed[3]. Alterations in the ventilation-perfusion relation with consequent deficit in the gas exchange are present in the two groups, caused by the compromising of the cardiac bomb function, increase in the left atrial pressure and pulmonary congestion in the HF[4], and a result of the obstruction to the air flow and consequent hyper insufflation in the COPD[5,6]. Peripheral alterations, such as decrease in volumetric density of the mitochondria, density of the capillaries and quantity of oxidative enzymes, with consequent increase of the anaerobic glycolysis have also been found in patients with HF[7,8] and COPD[9,10], explaining hence dyspnea and exercise intolerance.

Considering the similarities related to the alterations in the pulmonary structure and function, peripheral alterations and functional limitations between these two diseases, it is believed that instruments able to assess the limitation to perform the ADL developed to patients with COPD can be useful in the assessment of patients with HF as well. Thus, this study aimed to assess the activities of daily living of individuals with HF functional class III and IV, testing in this population of patients the applicability of a scale and an ADL test, originally developed for patients with COPD.

METHODS

The present study was performed in the Exercise Laboratory in the University Center of the Triangle (UNITRI), in the period between February and December, 2007. The sample was triad from a public and a private cardiology services. Individuals of both sexes age 40 or older with clinical diagnostic of HF functional class III or IV confirmed by echocardiogram (left ventricular ejection fraction – LVEF < 45%) and clinical and hemodynamic stability in the last month which preceded the protocol performance were included. The patients with clinical or spirometric diagnostic (VEF_1/CFV < 70% in the spirometry) of COPD disease; articular and/or muscular problems which hampered the performance of the tests; illiteracy or visual impairment and those who did not perform any of the evaluations of the protocol were excluded.

Altogether, 13 patients met the study's inclusion criteria and three were excluded: two for presenting spirometric values compatible with COPD and one for presenting osteomyoarticular problems. Thus, a final sample of 10 patients was obtained (57 ± 9 years, 27.7 ± 4.5 kg/m^2), with five (50%) presenting isolate systolic HF and five (50%) systolic and diastolic HF; seven (70%) were in the HF functional class III and three (30%) in the functional class IV; six (60%) presented HF by ischemic etiology; two (20%) by Chagas disease; one (10%) by idiopathic etiology and one (10%) by valvular disease. The sample was predominantly composed of female patients (60%). The patients signed the Free and Clarified Consent Form after having received detailed description of the research procedures. The study protocol was approved by the Ethics in Research Committee of the Institution (# of the record: 605292), according to the norms established in the Resolution in the 196/96 of the National Health Bureau. All tests were performed in the morning shift. The individuals were guided to perform the tests with light clothes and suitable shoes and not to intake food two hours before the protocol application.

At the beginning, the individuals were weighted, measured and submitted to pulmonary function evaluation; immediately after, they performed the ADL Glittre test ($T_{Glittre}$) and answered the SF-36 quality of life questionnaire. Subsequently, they performed the six-minute walking test (6MWT), which was repeated after a 30-minute interval, and filled the *Medical Research Council* (MRC) and *London Chest Activity of Daily Living* (LCADL) scales. All protocol evaluations were applied by the same evaluator.

The anthropometric measurements were obtained with the individual barefoot and at erect position; weight was assessed on a digital scale brand name Filizola® (São Paulo, Brazil), previously calibrated and height was verified on an electronic scale Welmy®, model W300 (São Paulo, Brazil). Body mass index (BMI) as calculated through the division of the weight in kilograms by the square of the height in meters. Pulmonary function was evaluated using a spirometer brand name Easyone (NDD, Zurich, Switzerland), with calibration verified daily before the data collection. The tests followed the criteria standardized by the *American Thoracic Society* (ATS)[11].

The left ventricular ejection fraction (LVEF) was evaluated by echocardiogram, using the HDI-5000 apparatus by Philips Ultrasound (Oceanside, California, USA). The Teichholz method was applied, considering normal values above 53%[12].

The 6MWT was performed always by the same investigator, following the ATS criteria, being performed on a 30-meter plane corridor, using standardized verbal stimulus. The heart rate, Borg's scale and oxygen peripheral saturation variables were evaluated before, on the fourth minute and at the end of the test, on the second and fourth minute and at the end of the test, and the blood pressure at the beginning and at the end of the test[13].

The dyspnea level was assessed by the MRC dyspnea scale, with punctuation from 0 to 4, in which 4 means the highest limitation by dyspnea to the activities[14]. Health related quality of life was assessed through the questionnaire SF-36, *Short Form Health Survey* [15], applied to the patients as an interview.

In order to evaluate the ADL, the LCADL scale, developed and validated for patients with COPD[16] and translated to Portuguese was used[17]. It is composed of four domains related to personal care; domestic tasks; physical activities and leisure; enabling to evaluate the level of dyspnea of the patient and his/her response to a therapeutic intervention[18], being administered as an interview. ADL limitation was assessed by the $T_{Glittre}$ as well, originally validated for patients with COPD[19]. The test consisted in carrying a backpack on their backs with two and a half-kilo weight for women and five-kilo weight for men, completing a circuit with the following activity sequence: leaving sitting position; walking on flat surface a total distance of 10m, interrupted on its exact half (five meters) by a box with two steps to climb up and two steps to climb down, 17-cm high and 27-cm wide each; climbing up and down the steps, and after completing the remaining of the distance, moving three objects weighting one kilo each, placed on a bookshelf from the highest to the lowest shelf and then moving them to the ground; returning them to the middle shelf and to the highest shelf; and finally restarting the entire process, sitting again on the chair and restarting another lap. The test is composed of a total of five laps, in which the individuals were told to complete them in the shortest time possible. No verbal stimulus was given during the test.

STATISTICAL ANALYSIS

The Kolmogorov-Smirnov normality test was used to verify the normality of the variables. Means, standard deviations and medians were calculated. The Spearman test was used to verify whether there was correlation between the score of the LCADL scale and the variables: MRC scale score, distance completed in the 6MWT, time spent in the $T_{Glittre}$, LVEF and domains of the SF-36. The Pearson correlation coefficient was used to verify the association between the time spent in the $T_{Glittre}$ and the distance completed in the 6MWT and LVEF. The significance level adopted for the statistical treatment was of 5% ($p < 0.05$). The data were analysed with the *Statistical Package for the Social Sciences* (SPSS, version 13.0) for *Windows*.

RESULTS

The LVEF of the studied sample ranged between 23 and 43%, and the score of the dyspnea between two and four. The sample presented mean normal pulmonary function, as can be observed in table 1. The distance completed in the 6MWT ranged from 61 to 536 meters, and in mean it corresponded to 76.86% expected[20]. The time spent in the $T_{Glittre}$ ranged between 3.37 and 19.12 minutes. The performance in the tests can be observed in table 1. The patient who presented the worst time in the $T_{Glittre}$ (19.12 min) and had the worst score in the LCADL scale (81.5 % $_{total}$) presented LVEF of 24% and was also who one who completed the shortest distance in the 6MWT (61m) and presented the worst dyspnea score (MRC 4).

The results of the LCADL scale and of the questionnaire SF-36 are presented in table 2. The $LCADL_{total}$ ranged from 12 to 53 and the $LCADL_{\%total}$ ranged from 21.8 to 81.5%.

The time spent in the ADL-Glittre test presented negative correlation with the 6MWT (figure 1a), LVEF (figure 1b) and main functional capacity of the SF-36 ($p < 0.05$), as demonstrated in table 3. The score of the LCADL scale correlated with the 6MWT, LVEF, dyspnea index and domain functional capacity of the SF-36 ($p < 0.05$) (table 3, figure 2). The $T_{Glittre}$ and the $LCADL_{\%total}$ positively correlated between them, with $r = 0.88$ ($p < 0.05$). The LVEF presented strong negative correlation with the dyspnea index ($r = -0.79$; $p < 0.05$).

Table 1. Means, standard deviations (SD), confidence interval (CI95%) of the studied variables.

	Mean ± SD	Median	CI (95%)	
			Lower threshold	higher threshold
BMI (kg/m²)	27.5 ± 4.5	27.9	24.2	30.7
Pulmonary function				
VEF_1%prev	87.1 ± 13.4	84.2	77.5	96.7
CVF%prev	85.9 ± 13.4	83.3	76.3	95.4
VEF_1/CVF	83.5 ± 9.7	81.4	76.6	90.5
LVEF (%)	34.9 ± 6.9	36.0	29.9	39.9
d6MWT (m)	395.4 ± 143.0	438.0	293.1	497.8
d6MWT %prev	76.9 ± 27.7	81.4	57.0	96.7
MRC	2.4 ± 0.7	2.0	1.9	2.9
$T_{Glittre}$ (min)	6.3 ± 4.8	4.3	2.8	9.8

Mean ± SD – Mean ± standard deviation; CI (95%) – confidence interval 95%; BMI (kg/m²) – Body mass index (kilograms/height to the square); VEF_1%prev – Percentage of the expected value of the expiratory volume at the first second; CVF%prev – Percentage of the expected value of the forced vital capacity; VEF_1/CVF – VEF_1/CVF ratio; LVEF – left ventricular ejection fraction, d6MWT – Distance in the six-minute walking test in meters; d6MWT%prev – Percentage of the expected distance of the six-minute walking test; MRC – *Medical Research Council Scale*; TGlittre – ADL-Glittre test.

Table 2. Means, standard deviations (SD) and confidence interval (CI 95%) of the domains personal care, domestic activities, physical activity and leisure of the LCADL scale and the domain functional capacity of the questionnaire SF-36.

	Mean + SD	Median	CI (95%)	
			threshold/higher	threshold
$LCADL_{total}$	27.7 ± 12.1	25.5	19.0	36.4
$LCADL_{\%total}$	41.5 ± 16.9	40.0	29.5	53.7
Domains LCADL				
Personal care	6.8 ± 2.9	7.0	4.7	8.9
Domestic activities	9.9 ± 6.2	10.5	5.4	14.3
Physical activity	4.4 ± 1.7	4.0	3.2	5.6
Leisure	5.0 ± 2.5	5.0	3.2	6.8
Functional capacity of the SF-36	49.0 ± 19.4	55.0	35.1	62.9

Mean ± SD – Mean ± Standard deviation; CI (95%) – Confidence interval 95%; $LCADL_{total}$ – means of the total scores of the London Chest Activity of Daily Living scale; $LCADL_{\%total}$ – means of the percentage of the total score of the London Chest Activity of Daily Living scale; SF-36 CF – Domain functional capacity of the questionnaire SF-36.

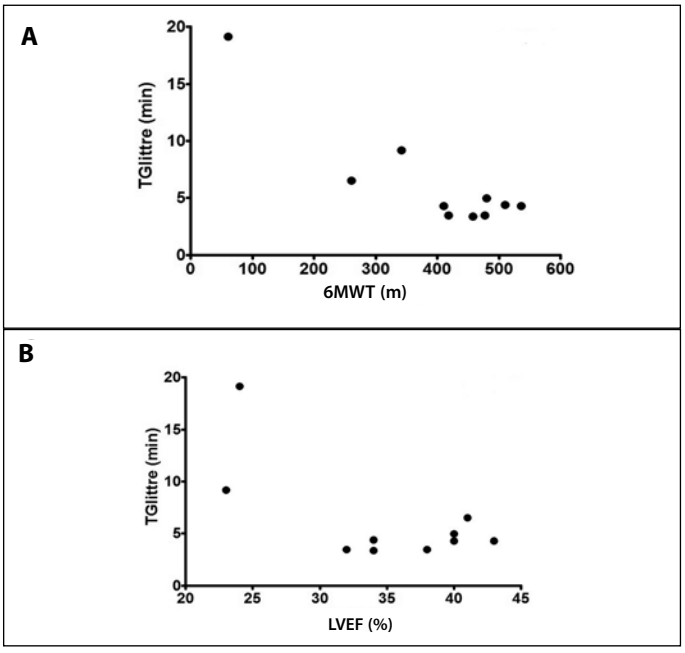

Figure 1. Correlations between the time spent in the ADL-Glittre test (TGlittre) and (A) the distance completed in the 6-minute walking test (6MWT) ($r = -0.90$; $p<0.05$); and (B) the left ventricular ejection fraction (LVEF) ($r = -0.66$; $p<0.05$).

Table 3. Correlation coefficients (r) of the variables: LVEF, 6MWT, TGlitrre, Scale MRC, LCADLtotal, LCADL%total and domain functional capacity of the questionnaire SF-36 CF.

	LVEF	6MWT	MRC	SF-36 CF
$T_{Glittre}$	-0.66*	-0.90*	0.47	-0.69*
$LCADL_{total}$	-0.71*	-0.67*	0.67*	-0.55
$LCADL_{\%total}$	-0.64*	-0.83*	0.68*	-0.63*

* $p < 0.05$; LVEF– left ventricular ejection fraction; 6MWT – six-minute walking test; MRC – *Medical Research Council Scale*; SF-36 FC – Domain functional capacity of the questionnaire SF-36; $T_{Glittre}$ – ADL-Glittre test; $LCADL_{total}$ – Means of the total scores of the *London Chest Activity of Daily Living scale*; $LCADL_{\%total}$ – Means of the percentage of the total score f the *London Chest Activity of Daily Living scale*.

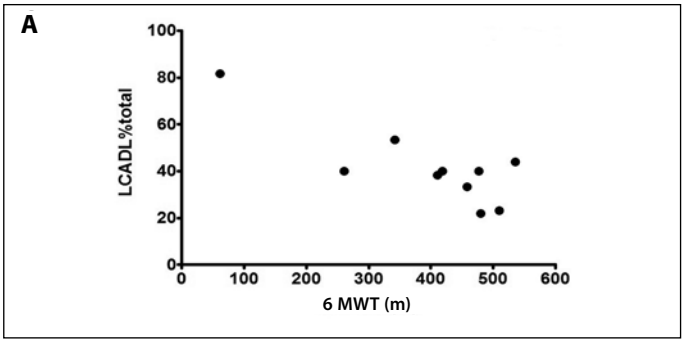

Figure 2a. Correlation between the total score of the LCADL (LCADL% total) and the distance completed in the 6-minute walking test (6MWT) ($r=0.83$; $p<0.05$).

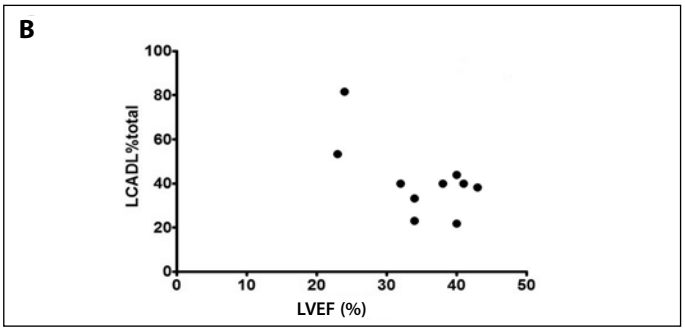

Figure 2b. Correlation between the percentage of the total score of the LCADL scale (LCADL%total) and the left ventricular ejection fraction (LVEF) ($r = -0.64$; $p<0.05$).

DISCUSSION

This study had the aim to assess whether two evaluation instruments, one scale and one test, constituted and validated to evaluate the limitation in the ADL in patients with COPD, could also be applied in the evaluation of patients with HF. Strong association of the performance in the $T_{Glittre}$ and the total score of the LCADL scale with performance in the 6MWT was observed, which until the present moment has been the chosen test in the evaluation of the functional capacity of these patients.

Strong correlations of the 6MWT have also been found in previous studies with the $T_{Glittre}$[19] and with the score of the LCADL scale[17] in patients with COPD. The 6MWT may be considered an instrument capable to indicate the prediction of the disease. Distances shorter than 300 meters indicate low level of functional capacity and are considered predictor of mortality and morbidity for patients with asymptomatic left ventricular dysfunction and for those with light, moderate[21] and severe levels[22].

Bittner *et al.* (1993) found mortality rate of 10.23% in patients who completed distances shorter than 300 meters in the 6MWT. Two patients of the present study presented completed distances shorter than 300 meters, and one of them also presented longer time to perform the $T_{Glittre}$ and the highest values in the total and percentage of the total punctuation of the LCADL scale[21].

Moreover, the existence of strong association between performance in $T_{Glittre}$ and score of the LCADL scale, found in the present study, suggests the concordance between the test and the scale concerning the ADL assessment in these patients. Although the first one directly tests the limitation in the ADL by the performance of physical activities which reproduce the common daily tasks and the second performs an evaluation through a record of four domains of the daily life of the individual (personal care, domestic activities, physical activity and leisure), it was shown that both are able to translate the functional incapacity of the patients with HF. Possibly, the information extracted from the two evaluation methods compete each other, since although the performance in the $T_{Glittre}$ suffers the influence of dyspnea, one can only infer at what level it is a limiting factor using an associated dyspnea scale. On the other hand, the LCADL scale can grade dyspnea for specific activities; however, the patients do not experience them at the moment of the evaluation.

When the scores of the MRC scale were correlated with the scores of the LCADL scale, strong association was obtained, suggesting hence the concordance between them concerning the evaluation of the compromising level of the dyspnea in these patients. Nevertheless, it is worth highlighting that the MRC is not specific to dyspnea evaluation in the ADL. While the LCADL scale verifies the degree to which dyspnea limits performance of ADL[18], the MRC investigates the dyspnea level in activities of progressively lower intensities[23].

Two patients of the sample who had LVEF < 25% were the ones who presented the worst times in the $T_{Glittre}$ and the worst scores in the LCADL scale. The correlation found between the LVEF and performance in the $T_{Glittre}$ and also with the score of the LCADL scale seems to confirm that with disease progression and greater compromising of the cardiac function, consequent functional compromising is also observed. As LVEF decreases, reduction of the cardiac debt and of the blood flow to the periphery also occurs[24], being it responsible for the alterations in the peripheral muscle composition[25], already reported by other authors[26-28], which directly interferes in the performance in the ADL of these patients.

In the present study, alteration in the pulmonary function has not been observed, differently from what was found in the studies by Johnson *et al.* (2001)[29] and Forgiarini Junior *et al.* (2007)[30]. However, two patients of the sample presented borderline $CVF\%_{prev}$, of 69.9 and $70.6\%_{prev}$, and the first one presented the lowest LVEF of the sample (23%). According to Hosenpud *et al.* (1990) and Niset *et al.* (1993), alterations in the pulmonary function may be related to the increase of the cardiac area, in which the heart and lung may compete for space within the thoracic box[31,32]. Another possible hypothesis to explain alterations in the pulmonary function would be the pulmonary congestion observed in these patients as well as inspiratory muscular weakness, reducing the total pulmonary capacity[29,33].

The BMI is directly associated with the total body fat and risk of chronic diseases, including the cardiovascular ones[34], being considered overweight a BMI of 25 to 29.9 and from 30 obesity[35]. In the present study, the sample was compatible with overweight, a fact which has been demonstrated in other studies[36]. Trezza (2004) verified that the incidence of obesity in chronic cardiac patients functional class III and IV is low, and that they tend to present variable levels of malnutrition and can reach cachexia in the final stages. It is also highlighted that it is more frequent to find obese individuals with severe HF in acute cardiopathies[37]. Although the sample of the present study presents BMI with mean compatibility with overweight, it was not considered determinant to higher limitation to the ADL, since correlation of BMI with any of the assessed variables has not been observed.

Strong association between the closings which evaluated the limitation in the ADL ($T_{Glittre}$ and LCADL scale) and the domain functional capacity of the questionnaire SF-36 was also found, with no correlation with the remaining domains. Rosen *et al.* (1997) observed the perception of quality of life related to the functional status in patients with HF and concluded that the capacity to perform the daily tasks and the dyspnea symptom were more important in the determination of quality of life, compared to the emotional suffering, socioeconomical status and cognitive function[38].

The present study was able to demonstrate the applicability of a scale (LACDL) and a test ($T_{Glittre}$) which were originally standardized to evaluate the limitation in ADL in patients with COPD, in a group of patients with HF, showing association with closings commonly used to assess the functional capacity in this population of cardiac rehabilitation, observing the proprieties in the tests in assessing. Once the functional limitation of this group of patients is observed, it is essential to classify them through simple, low cost and of easy application tests in the clinical practice. Thus, the dyspnea evaluation by specific instruments will be able to be used as a parameter of disease evolution and therapeutic response. Additionally, identifying the ADL which limit the most the patients with HF through the LCADL scale allows adapting them to their individual needs, reducing inactivity, dependence and especially improving their quality of life.

The performance capacity of the ADL are better predicted through global tests than through tests aiming at isolate components of the functional activity[39]. The 6MWT, considered as a submaximal test, relatively intense for patients with HF and COPD though, is the mostly used test in the clinical field as in

research protocols. This test, besides being simple and easy to be incorporated to the clinical practice, has also been able to reflect the limitation to perform the activities of daily living [13]. Nevertheless, since this test consists of only a walking activity, it does not assess the limitation of the activities performed with upper limbs, which are generally very involved in the habitual ADL[17]. Based on this information, Skumlien *et al.* (2006) developed the ADL-Glittre test for individuals with COPD[19]. It consists of a more complete test in the ADL assessment since it presents activities which involve also the upper limbs. The $T_{Glittre}$ has been reproducible and reliable, besides representing the functional capacity of the individuals with COPD. In the study by Skumlien *et al.* (2006), the individuals took from 2.57 to 14.47 min to complete the test, being the mean 4.67 min and the median 4.16 min[19].

The present study may have represented some limitations. Firstly, the time of the disease evolution was not investigated, since this information was not made available in a standardized and reliable manner. The reduced number of the sample may have interfered in the statistical power and be responsible for the absence of some associations. However, important associations have been demonstrated, positively responding to primary issues present in the study.

Studies similar to this one or that have developed tests or instruments for assessment of ADL specific to patients with HF are not known so far, and there is even a shortage of information in the literature on the functional capacity related to ADL of these individuals. This study was a pioneer in demonstrating the association of these ADL assessment methods with the 6MWT, already widely used for the assessment of the functional capacity in individuals with HF. Further studies are necessary to assess the responsiveness of these evaluations to interventions, such as cardiac rehabilitation.

CONCLUSION

The results of this study let us conclude that the LCADL scale and the ADL-Glittre test are useful and applicable instruments to patients with HF functional class III and IV in the evaluation of the limitation to the ADL, presenting association with the LVEF, the distance completed in the 6MWT, the level of dyspnea and the quality of life.

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