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Title: VALIDITY AND RELIABILITY OF THE TURKISH VERSION OF THE LONDON CHEST ACTIVITY OF DAILY LIVING SCALE IN OBSTRUCTIVE LUNG DISEASES

Short Title: Turkish London Chest Activity of Daily Living Scale

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Abstract

Purpose: The London Chest Activity of Daily Living Scale (LCADL) is a simple, useful, and comprehensive measure of dyspnea perception in activities of daily living. This study was conducted to determine the validity and reliability of the Turkish version of the LCADL.

Methods: A total of 64 patients with obstructive lung disease (24 COPD, 20 asthma, and 20 bronchiectasis) were included. The Turkish LCADL was evaluated for inter-observer reliability, test-retest reliability, and criterion validity. Two different observers applied the scale with an interval of 10 minutes to assess inter-observer reliability. The second observer applied the scale twice at an interval of 10-15 days to assess test-retest reliability. Criterion validity was assessed using the 6-minute walk test (6MWT), Nottingham Health Profile (NHP), and Saint George Respiratory Questionnaire (SGRQ).

Results: The inter-observer validity of the scale was very high (r_s=0.985, $p<0.05$). The Cronbach's alpha coefficient for total score was 0.976 and intraclass correlation coefficient was 0.953. These results indicate that the Turkish LCADL has high reliability. Correlation between LCADL and 6MWT was moderate 0.503 (p=0.002). LCADL total score was weakly correlated with NHP total score (r=0.370, p=0.04) and SGRQ total score (r=0.367, p=0.004).

Conclusion: The Turkish version of the LCADL scale is reliable and valid in obstructive lung disease. The LCADL scale will be beneficial in existing pulmonary rehabilitation programs aiming to improve functional status. We believe using the Turkish LCADL scale as an outcome measure in pulmonary rehabilitation programs will serve as an indicator of rehabilitation efficacy for individual patients.

Key Words: Obstructive Lung Disease, London Chest Activities of Daily Living Scale, Activities of Daily Living.

INTRODUCTION

Obstructive lung diseases (OLD) are common cause of mortality and morbidity throughout the world (1). Airway obstruction in OLD leads to air trapping, which in turn leads to dyspnea, limitation of activities of daily living (ADL), and a decrease in health-related quality of life (QOL). Systemic inflammation and pulmonary dysfunction are key features common to OLD. Pulmonary dysfunction and activity limitation due to these conditions bring about skeletal muscle weakness. This results in physical inactivity, restriction of ADL, and subsequent decline in these patients' QOL (2-5).

The main goal in the treatment of pulmonary diseases is to increase patients' functional capacity, thereby improving their QOL in ADL. Therefore, determining ADL capacity in pulmonary diseases and the extent of impact on ADL serves as a guide for the development and implementation of interventions to increase functional capacity.

ADL involve caring for oneself and one's environment, moving in the house and in the community, and engaging in social interaction (6, 7). Performance of ADL is often evaluated in the clinical setting by asking patients to imitate the activities as they would perform them at home (5). However, this assessment is not useful in large populations. For this reason, surveys are considered more useful methods for assessing ADL and are commonly used (8).

The currently available tools for specific evaluation of ADL in OLD are insufficient. Tools that assess general functional status are utilized, but the results of this general assessment do not accurately reflect the outcomes of OLD. Other functional status scales, such as the Chronic Respiratory Questionnaire or the Pulmonary Functional Status Scale, are disease-specific but have limited utility and applicability in assessing ADL capacity (9). One of the most common tools used to

detect ADL dysfunction in OLD is the London Chest Activity of Daily Living Scale (LCADL). Several valid translations of the LCADL scale have been completed. This scale is specifically developed to assess the effect of dyspnea on ADL. Moreover, the LCADL is a simple, practical assessment that does not require much time (10). To date, none of the tools developed to evaluate ADL in pulmonary patients have been shown to be valid and reliable in the Turkish population. Scales that assess general functional status and basic ADL scales are used (11, 12).

The aim of our study was to improve the Turkish version of the LCADL and investigate the reliability and validity of the scale in the evaluation of ADL in patients with OLD.

METHODS

Sixty-four patients who were diagnosed with OLD in the XXXXX University Chest Diseases Department were recruited. 24 of the patients were diagnosed with chronic obstructive pulmonary disease (COPD), 20 with asthma, and 20 with bronchiectasis. Patients who received antibiotic treatment or with no drug changes within the last three weeks, those with orthopedic or neurological diseases, and those who could not understand the questionnaire or other evaluation methods were excluded. The study was approved by the XXXXX University ethics committee. The scope and purpose of the study was explained to all participants and written informed consent forms were obtained. Physical and sociodemographic data including age, body mass index, symptoms, duration of symptoms, smoking, drug usage, and pulmonary function test results were recorded for all patients.

The LCADL was developed by Garrod et al. as a simple and standardized questionnaire to assess dyspnea resulting from ADL in COPD patients (10). It consists of a total of 15 items within four domains: personal care (4 items), domestic (6 items), physical (2 items), and leisure (3 items).

Each item is graded from 0 to 5 with higher scores indicating more difficulty performing ADL. The scale can be evaluated as total score, domain scores, and item scores. There is also a single question that assesses to what degree dyspnea perception affects daily life in general. This item is answered by selecting one of three responses: 'a lot', 'a little', or 'not at all' (10).

The LCADL questionnaire was translated to Turkish by two native Turkish speakers proficient in English with permission to translate and use the questionnaires obtained from the authors of the original versions. A synthesis of the two translations was realized to end in a common version. The translation return (from Turkish toward English) was performed by an independent native English speakers proficient in Turkish.

To assess inter-observer reliability, the LCADL as applied by two different observers within 10 minutes of one another. For test-retest reliability, the questionnaire was repeated twice by the same observer at an interval of 10-15 days. Three different instruments were used to evaluate criterion validity: the Saint George Respiratory Questionnaire (SGRQ), which is used to assess ADL in patients with OLD; the Nottingham Health Profile (NHP), which is a general health-related QOL questionnaire; and the six-minute walk test (6MWT), which evaluates functional capacity.

The 6MWT was applied twice on the same day at an interval of 30 minutes to assess exercise capacity. The patient walks at their maximum possible walking speed for 6 minutes on a 30-meter straight corridor (13). Patients are told before starting the test that they may stop to rest if they feel short of breath during the test and that this time will be included in the test. Oxygen saturation level, heart rate, blood pressure, respiratory rate values, and modified Borg scores for fatigue and dyspnea perception were recorded before and after the test. The 6MWT distance was calculated and recorded as meters. Each patient's longer distance value from the two tests was used for statistical

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analysis (14). Normal ranges for 6MWT distance according to age and sex were used as a reference when interpreting the results (15).

The NHP was used to assess the patients' overall QOL. It is a general QOL questionnaire designed to measure perceived health problems and the extent to which these problems affect normal daily activities. It consists of 38 items in 6 dimensions (energy level, pain, physical mobility, emotional reactions, social isolation, and sleep) and can be completed independently by the respondent. A higher score indicates poorer QOL (16).

The SGRQ was used to assess disease-specific QOL. It consists of 76 items and yields a total score and three domain scores (symptom, activity, and physicosocial impact). Each item has its own weighted score. Overall scores range from 0 (no effect on quality of life) to a maximum score of 100 (maximum perceived distress); thus, a higher score reflects lower QOL (17).

Sample size

In validity and reliability studies, the sample size can be calculated as 2 to 20 patient per question according to Anthoine et al study (18). Our study was planned to have 4 patients for each question in the survey and a total of at least 60 patients.

Statistical analyses

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS 22.0, Chicago, IL, USA) statistical package program for Windows. The data were expressed as mean ± standard deviation (SD) for quantitative variables and as percentage (%) for categorical variables. The validity of LCADL was measured using correlation between the Turkish version of LCADL and 6MWT, NHP (total and subparameters scores) and SGRQ (total and subparameters scores). The internal consistency of LCADL was assessed using Cronbach's α coefficient. The intra-rater reliability was

measured using the intraclass correlation coefficients (ICC), which indicates stability of the instrument if ICC≥0.70. The kappa coefficient (k) was used to assess the reliability of the LCADL scale's single question item. The probability of error in statistical analyses was determined as $p < 0.05$.

RESULTS

The demographic and clinical data of the patients in the study are shown in Table 1.

Inter-observer reliability of the LCADL scale

For inter-observer reliability of LCADL, scale applied by the first observer and the second observer within 10 minutes on the same day. There is no statistically significant difference between the results obtained by the first and second observers ($p=0.985$). The observer reliability of the LCADL scale was found to be very high.

Test-retest reliability of the LCADL scale

To assess test-retest reliability of the LCADL, the second observer reapplied the scale after 10-15 days. The means and standard deviations of Test 1 and Test 2 are presented in Table 2. There was no statistically significant difference between the initial test and the retest.

Intraclass correlation coefficient (ICC) and Cronbach's alpha coefficient (α) were calculated as measures of reliability. The R_2, ICC, and 95% CI (confidence interval) values of the LCADL total scores and subscores are given in Table 3. Both the LCADL domain scores and total score have high reliability.

The internal consistency and CIs of the tests performed by the first and second observers are shown in Table 4. The comparison between the means of the scores obtained by the first and second observers revealed no statistically significant difference in terms of total score or percentage of total

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score. The same was true for the comparison of the mean scores obtained by the second observer in the initial test and the retest done 10-15 days later.

LCADL single question item reliability

Question 16 concerns the extent to which ADL performance is impaired by dyspnea, and patients answer by checking one of three multiple-choice responses: 'a lot', 'a little', or 'not at all'. A strong concordance between the two observers ($k = 0.728$; $p < 0.001$) and moderate intra-rater agreement ($k = 0.644$; $p < 0.01$) were observed for this question.

LCADL scale criterion validity

There was moderate correlation between 6MWT and LCADL total and self-care scores (r_s=0.503; p=0.002; r_s=-0.448; p=0.001, respectively). The relationship between 6MWT and LCADL total and domain scores is shown in Table 5.

LCADL total score was weakly correlated with NHP total score (r_s = 0.370; p = 0.01); the strongest association was between LCADL total score and NHP-energy level score (r_s = 0.428, p = 0.01). The NHP energy level domain score also correlated with all LCADL domain scores. Correlations between LCADL and NHP total and domain scores are presented in Table 5.

Weak correlation was observed between LCADL and SGRQ total scores (r_s=0.367; p=0.004), with the strongest association between LCADL and SGRQ activity domain (r_s=0.449; p=0.000). The SGRQ symptom and impact domains were more weakly correlated with LCADL (r_s=0.240; p=0.065 and r_s=0.324; p=0.012, respectively). Correlations between LCADL and SGRQ total and domain scores are shown in Table 5.

DISCUSSION

The present study demonstrates that the Turkish version of the LCADL has excellent reliability when applied by different observers and when applied by the same observer at different times. This version also proved to be valid, correlating with established measures of functional exercise capacity and general and health-related QOL. The results obtained with the Turkish version of the LCADL are very similar to those seen in validation studies of the original English version (10).

In inter-observer reliability and test-retest reliability analyses, there were no significant differences between LCADL results obtained by two different observers at 10 minute intervals nor between results obtained by the second observer at two different time points. The ICC of 0.97 for total score indicates excellent reliability. This ICC value was similar to that found by Garrod et al. (10). Our results show that the Turkish version of the LCADL is reliable.

We used the 6MWT when evaluating the validity of the Turkish LCADL. A strong correlation was found between 6MWT and LCADL total score in patients with obstructive pulmonary disease. As the patients' functional capacity decreased, the impact on ADL increased significantly due to dyspnea, in accordance with the literature. Similarly, Brazilian Portuguese, Dutch and Korean versions was found moderately correlate with in their studies (19-21). Also, Garrod et al. demonstrated that patients who scored higher on the LCADL exhibited lower exercise capacity, as determined using the shuttle walk test (10).

Because ability to perform ADL is one of the most important parameters affecting QOL, evaluations of QOL and ADL were also included in our study. NHP and SGRQ were chosen for the QOL questionnaires. Total scores of LCADL and NHP were significantly but weakly correlated. Among the NHP domains, only energy level score was correlated with LCADL. The presence of primary symptoms such as dyspnea and fatigue, which affect daily life, is expected to correlate with this parameter due

to a decrease in energy levels. There was a highly significant moderate correlation between the physical activity domain scores of the two instruments, though LCADL total score was not significantly associated with NHP physical activity domain. This may be a result of low physical activity levels and lack of regular exercise habits. In the LCADL validation studies, only the original study, Garrod et al used NHP. Although Garrod et al did not present the correlation results of the sub-parameter scores, NHP total and LCADL total scores were found correlated, similar with our study (10). In other validation studies, the scales used outside the SGRQ were more specific for the disease (such as COPD Assessment Test-CAT, Groningen Activities Restriction Scale-GARS, Modified Medical Research Council Scale-MMRC) and higher correlation values were obtained (20-22).

The SGRQ is a widely used validation tool in scientific research and was also used as a criterion validation method for the original English version of the LCADL. Since LCADL is a scale for dyspnea perception during activity, the strongest correlation among the SGRQ domains was with SGRQ activity score. Significant correlations were found between certain SGRQ domains and all domains of the LCADL in our study. However there was no relationship between SGRQ symptoms, similar to literature (10, 20). This is to be expected since the LCADL is predominantly concerned with dyspnoea whereas the SGRQ investigates other symptoms such as cough, sputum production and wheeze. The correlations observed in this study are similar to those in other studies using SGRQ for criterion validity (22-24).

An important issue to note regarding the implementation of the LCADL scale is that respondents who have never experienced some activities give these items a score of 0, resulting in a deceptively low total score when they gave 5 points for most other items. This situation was experienced when male subjects answering questions related to the sub-parameter of domestic. Since some domestic activities were never experienced by male subjects, 0 responses were given. In

order to avoid this problem, items with score 0 are disregarded and the percentage of the total score is used to interpret the scale. The same situation was also reported by Carpes et al (25). Another relevant point is that it is not possible to differentiate between exercise-induced dyspnea and allergy- or irritant-induced asthma during an activity. For example, it is not clear when using the LCADL whether a person who reports dyspnea during bathing perceives dyspnea due to the shampoo fragrance or overhead activity, or whether someone making the bed perceives dyspnea because of the physical exertion involved or because it introduces dust into the air. Therefore, further research is needed to assess the utility of the LCADL with asthmatic patients.

Evaluating the sensitivity of the Turkish LCADL to patient responses to therapeutic interventions was not within the scope of this study. Further research is needed in this area. Another limitation of our study is that we did not evaluate correlation with FEV_1 because we included three different disease groups with different respiratory function characteristics. However, Garrod et al. reported a lack of correlation between LCADL and FEV_1 in their study. FEV_1 has been the most common method of assessing disease severity, response to therapy, and (short-term) prognosis in OLD (10). Yet, the use of FEV_1 as the single best evaluation parameter has been questioned. Therefore, health-related QOL has become an established parameter to assess patients' subjective experience of the impact of disease. Since there is no strong association between FEV_1 and health-related QOL, both measures seem to highlight different aspects of the disease and therefore provide complementary information on the actual severity of the disease (26).

In conclusion, the Turkish version of the LCADL was found to be valid and reliable for assessing performance of ADL in patients with OLD in the Turkish population. The Turkish LCADL is expected to be clinically useful, as it is short and can be completed by the patients without any

assistance. Furthermore, it may serve as a guide for the development and revision of questionnaires and tests specific to Turkish society for validly and reliably evaluating ADL performance.

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Table 1 Demographic and clinical data of the cases

N=64	Mean±SD
Age (years)	51.29±13.94
Height (cm)	163.42±8.03
Weight (kg)	71.57±15.22
BMI (kg/m²)	26.72±4.95
Smoking (pack-years)	22.04±28.45
FEV_1 (%)	63.76±24.08
FVC (%)	73.53±22.97
FEV_1/FVC (%)	72.06±17.86
PEF (%)	66.28±27.59
6MWT distance (m)	534.77±97.81
MMRC score (0-4)	1.51±0.77

BMI: Body mass index, FEV1: Forced expiratory volume in 1s , FVC: Forced vital capacity , PEF: Peak expiratory flow , 6MWT: Six-minute walk test, MMRC: Modified Medical Research Council

Table 2. Test-retest reliability of the LCADL scale

	Test 1	Test 2	
	Mean±SD	**Mean±SD**	**p**
LCADL self-care	5.00±1.65	5.00±1.62	0.256
LCADL domestic	4.50±4.79	4.50±4.71	0.874
LCADL physical activity	4.00±1.06	4.00±1.15	0.102
LCADL leisure	4.00±1.14	4.00±1.11	0.376
LCADL total	18.10±6.37	18.35±6.55	0.560

*Wilcoxon paired-samples test

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Table 3. Test-retest correlation analysis of LCADL total and subscores

	α	ICC	%95 CI
LCADL total score	0.976	0.953	0.960-0.985
LCADL self-care score	0.913	0.839	0.856-0.947
LCADL domestic score	0.988	0.977	0.981-0.993
LCADL physical activity score	0.920	0.851	0.868-0.951
LCADL leisure score	0.887	0.797	0.814-0.931

ICC: Intraclass Correlation Coefficient, CI: Confidence interval

Table 4. Intraclass correlation analysis of the LCADL

LCADL	α	%95 CI
Observer 1	0.705	0.594-0.815
Observer 2 - initial test	0.720	0.594-0.815
Observer 2 - retest (10-15 days later)	0.736	0.618-0.826

LCADL: London Chest Activity of Daily Life scale, CI: Confidence interval

Table 5. Relationship between 6MWT distance, NHP, SGRQ and LCADL scores

	LCADL	**r value**	**p value**
6MWT	LCADL self-care	-0.448**	0.001
	LCADL domestic	-0.375*	0.036
	LCADL physical activity	-0.183	0.119
	LCADL leisure	-0.337*	0.049

	LCADL total	-0.503**	0.002
NHP energy level	LCADL self-care	0.355**	0.005
	LCADL domestic	0.304*	0.018
	LCADL physical activity	0.276*	0.033
	LCADL leisure	0.255*	0.050
	LCADL total	0.428**	0.001
NHP pain	LCADL self-care	0.068	0.611
	LCADL domestic	0.240	0.070
	LCADL physical activity	0.006	0.966
	LCADL leisure	-0.073	0.588
	LCADL total	0.240	0.070
NHP emotional reaction	LCADL self-care	0.316*	0.016
	LCADL domestic	0.009	0.946
	LCADL physical activity	0.230	0.083
	LCADL leisure	0.236	0.074
	LCADL total	0.197	0.138
NHP sleep	LCADL self-care	0.194	0.145
	LCADL domestic	-0.044	0.742
	LCADL physical activity	0.006	0.964
	LCADL leisure	0.054	0.686
	LCADL total	0.055	0.680
NHP physical activity	LCADL self-care	0.236	0.074
	LCADL domestic	0.050	0.711
	LCADL physical activity	0.405*	0.002
	LCADL leisure	0.259*	0.049
	LCADL total	0.213	0.108
NHP	LCADL self-care	0.236	0.075

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social isolation	LCADL domestic	0.076	0.573
	LCADL physical activity	0.209	0.115
	LCADL leisure	0.276*	0.036
	LCADL total	0.224	0.091
NHP total	LCADL self-care	0.395**	0.002
	LCADL domestic	0.193	0.143
	LCADL physical activity	0.260*	0.046
	LCADL leisure	0.260*	0.047
	LCADL total	0.370**	0.04
SGRQ symptom	LCADL self-care	0.238	0.068
	LCADL domestic	0.089	0.499
	LCADL physical activity	0.269*	0.038
	LCADL leisure	0.416**	0.001
	LCADL total	0.240	0.065
SGRQ activity	LCADL self-care	0.402**	0.001
	LCADL domestic	0.238	0.68
	LCADL physical activity	0.451**	0.000
	LCADL leisure	0.395**	0.002
	LCADL total	0.449**	0.000
SGRQ impact	LCADL self-care	0.284*	0.028
	LCADL domestic	0.194	0.137
	LCADL physical activity	0.424**	0.001
	LCADL leisure	0.503**	0.000
	LCADL total	0.324**	0.012
SGRQ total	LCADL self-care	0.342**	0.008
	LCADL domestic	0.199	0.128
	LCADL physical activity	0.437**	0.000

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	LCADL leisure	0.512**	0.000
	LCADL total	0.367**	0.004

Spearman correlation analysis * p> 0.05, ** p> 0.01

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