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Technical Notes

Construct and criterion validity of the Malaysia version of Lower Extremity Functional Scale (LEFS)



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ABSTRACT

Objective: The objective of this study is to translate the Lower Extremity Functional Scale (LEFS) into the Malay language and to validate the resulting version.

Methods: A two-stage observational study was conducted. The LEFS was initially cross-culturally adapted to Malay language through double forward and backward translation. The finalized version of Malay LEFS (M-LEFS) was subsequently validated for both construct validity and criterion validity. Participants (n = 208) with normal lower limb condition and various lower limb conditions completed the M-LEFS.

Results: Reliability of M-LEFS revealed excellent Cronbach's alpha value of 0.98. Construct validity, evaluated using exploratory factor analysis, exhibited good factor loadings (>0.6) of all 20 items. Interestingly, we extracted 2 components which was not reported elsewhere. With a cut-off point of 60, the sensitivity of the scale was 99% and the specificity was 81%.

Conclusions: The M-LEFS had very good psychometric properties among the studied population. Further studies are needed to enhance these preliminary outcomes in Malaysia.

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Introduction

Lower Extremity Functional Scale (LEFS) is one of the most widely used scales. The scale was developed by Binkley in 1999 with the aim to measure the lower limbs function. It is a simple scale and user friendly. It has been widely used to assess wide range of patients with lower extremity problems. Its development was inspired following several limitations when generic health status measures or disease-specific measures were being utilized.¹

The hassle of needing to administer variety of measures when treating knee condition, for example, has led Binkley to develop the LEFS. In her study, it was demonstrated that the LEFS has admirable psychometric properties when compared to the SF-36.¹

Ever since the establishment of the LEFS, it has been modified from its original English version and validated in other languages across the world, such as in German,² Italian,³ Dutch,⁴ Persian,⁵ Brazilian Portuguese⁶ and Greek⁷ languages to name a few. In all of these studies, the cross-culturally adapted LEFS remains to

possess good psychometric profile in terms of reliability and validity and can readily be used to measure function in patients in the respective population or country with musculoskeletal dysfunction of lower extremity.

The aims of this study are to translate the LEFS and to validate it by using construct validity (exploratory factor analysis) and criterion validity.

This study fills the gap on various aspects. First, there is no validated scale in Malaysian language and we need to develop one. Second, we also aimed to establish an acceptable cut-off point, which is relevant to Malaysian population by producing a Bahasa Malaysia version of Lower Extremity Functional Scale with equally admirable psychometric profile, in terms of its reliability and validity, as the original version, and applicable in Malaysian population.

Materials and methods

The study is conducted in two phases namely the translation phase and the validation phase. Each phase is carefully conducted so as to eliminate bias and to produce reliable results. The aim of

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this study is to cross culturally adapt the LEFS into Malay language speaking population so that it can be used by other researchers or even clinicians throughout Malaysia.

Prior to commencement of the translation work of LEFS, a written approval from the original author (Dr Jill M Binkley) was obtained. Approval from the International Islamic University Malaysia ethical committee (NMRR-17-469-34833), as well as research committee had also been obtained.

The process of translation and validation of the scale is summarized in Fig. 1.

Translation procedure

The process of translation of English version of LEFS was performed according to a guideline proposed by Guillemin et al.⁸ Two forward- and two back-translations were done in parallel by 4 bilingual independent translators, which include Malaysian Institute of Translation and Books, an orthopedic surgeon, a surgical registrar and a psychiatrist. This method is performed to ensure the translated version is grammatically sound and the terms used are correct. At the same time the meaning and contents of original LEFS are well preserved.

The two forward and back translations were reconciled and sentence-by-sentence revision was performed. Good translations were reflected by the production of 2 English back translations, which are almost similar to the original English version. At the end of this process we came to a harmonized version of Malay LEFS.

Study population

The initial target number for respondents for validation of the 20-item LEFS was set at 210. Additional 10 participants were for the drop off sample due to incomplete or duplicate answers or consent refusal. The participants were selected from the Orthopedic Clinic of Hospital Tengku Ampuan Afzan, Kuantan Malaysia.

The study period was set as 10 months duration, from September 2015 until June 2016. Participants who were eligible for this study were informed about the purpose of the study and the methodology. Once they have given the written consent, questionnaire was handed to them to fill up. The participants were ensured of the confidentiality of the study.

Since one of the main objectives of this study is to validate the

Malay version of the Lower Extremity Functional Scale (M-LEFS) using Criterion validity, the respondents were divided into 2 groups. These 2 groups were patients suffering from any lower limb injuries as a case group, and participants in the control group were those who did not had any lower limb dysfunction. The healthy respondents in control group were mainly among patients' relatives who accompanied the patients, staff nurses, house officers and medical officers.

Inclusion criteria include those respondents proficient in Malaysian language and at least more than 18 years old. Those refused to provide written consent and suffer from cognitive impairments such as dementia, traumatic brain injury and mental retardation were excluded.

Statistical analysis of both participating groups was compared and analyzed using SPSS software. The finalized M-LEFS was tested for its reliability and validity. Reliability in this study is determined by good Chronbach alpha values, while validity is determined by good factor analysis of all 20 items in the questionnaire (Factor loadings of 0.4 or more were considered good). For this study, we are also looking at the criterion validity by testing this scale against the clinical judgment as our gold standard. The adequacy of sample size, which is 208, is tested using the Keiser-Meyer-Olkin and Hotelling's T-squared values through the Statistical Package for Social Science (SPSS) software version 24.

Results

We approached 240 participants and 30 participants refused to give written consent hence a total of 210 questionnaires were administered after getting the consent. A total of 208 questionnaires were completely filled, hence included in the analyses. A total of 101 (48.7%) participants were from the case group, and 107 (51.4%) participants were from the control group.

Participants in the case group were known to have lower limb problems originating from the hip, thigh, knee, leg, ankle or foot.

Participants' socioeconomic information is summarized in Table 1. Out of 208 participants, 95 (45.7%) were male, 184 (88.5%) were Malay, 105 (50.5%) had completed at least secondary school. The mean age of the participants was 34.8.

Reliability

We obtained Cronbach's alpha of 0.98 indicating excellent reliability.

We also obtained "Cronbach's alpha value if the item deleted"

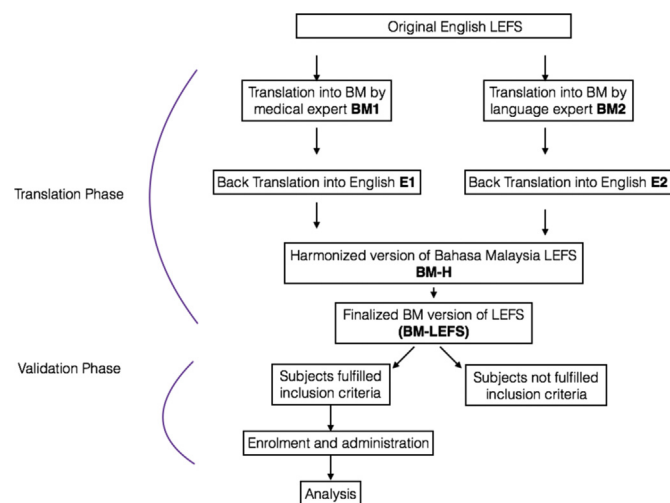


Fig. 1. Overview of the whole process of cross-cultural adaptation and validation of LEFS.

Table 1
Socio-demographic data.

	No.	%	Total
Age			
34.8 years (SD ± 15.44)			208
Race			
Malays	184	88.4	208
Chinese	12	5.8	
Indians/others	12	5.8	
Gender			
Male	95	45.7	208
Female	113	54.3	
Household Income			
< RM 1000	82	39.4	208
RM 1001-5000	105	50.4	
> RM 5000	21	10.2	
Levels of Education			
Primary school	10	4.8	208
Secondary school	95	45.7	
Tertiary education	103	49.5	

remains high for all 20 items (between 0.97 and 0.98). This further supports the fact that internal consistency of this M-LEFS is good and none of the item should be deleted.

Construct validity

Kaiser-Meyer-Olkin value obtained was 0.96 which is statistically significant ($p = 0.0001$). Similarly Hotelling's T-squared value measured was 238.5 with $p = 0.001$. Therefore, these measurements indicate the adequacy of sample size in this study.

The Construct validity of the M-LEFS was determined by using Exploratory Factor Analysis (CFA). The unforced analysis using Varimax rotation revealed there were 2 extracted components. When we further analyzed the pattern we could identify these 2 components were classified according the intensity of the activities (easy and difficult activities). Component 1 is referring to low intensity activity whereas Component 2 refers to high intensity activity. Based Table 2, all items scored factor loading of more than 0.62.

As displayed in Table 2, all items exhibited good results. All items had very high factor loadings and they were nicely loaded into their respective domains. There were 2 domains identified in the analysis. The lowest value of factor loading was item 15 (0.54). Although it is the lowest, the value was still considered good.

The item 15, "Sitting for 1 hour" should score high factor loading for low intensity domain, but it scored higher value for high intensity domain. We believe the reasons possible was because it was not clearly specified whether the item was referring to sitting on the floor or sitting on a chair.

Criterion validity

In terms of criterion validity, we tested the scale against the clinical judgment as our gold standard. Healthy participants without any lower limb injury were used as our normal subjects. Those scored high total LEFS score were considered as having normal lower limb function.

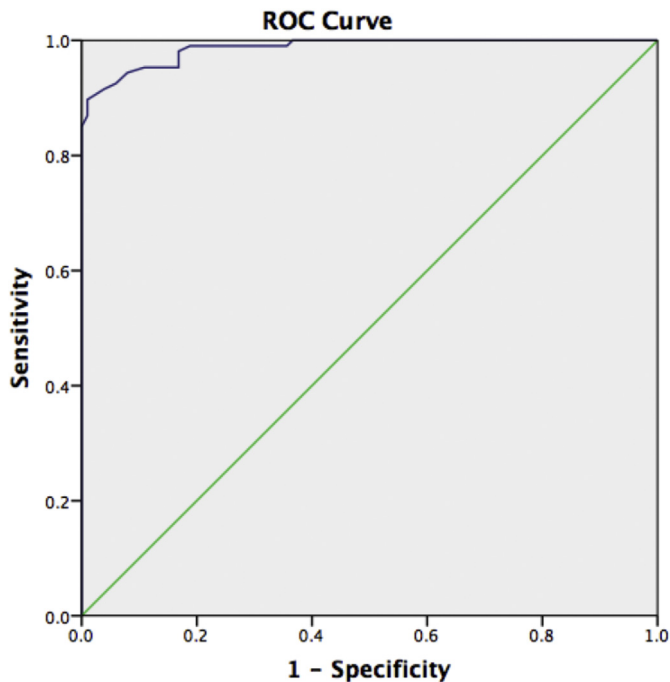
Based on this analysis, we recommend the cutoff point of the total LEFS score was to be 60. With this cutoff score, we obtained the sensitivity of the scale was 99% and the specificity was 81%. In other words, with the cutoff point of 60 and below, the ability of the scale to detect true a person of having lower limb problem was 99% accuracy (Fig. 2).

Discussion

There is a need for an instrument to measure health related quality of life, especially concerning lower limb. It is for this reason

Table 2
Factor loading of each item in questionnaire.

Item	Component	
	Factor 1 (High intensity activity)	Factor 2 (Low intensity activity)
Q1 Kerja harian, kerja rumah atau aktiviti sekolah. <i>Any of your usual work, housework or school activities</i>	0.60	0.66
Q2 Hobi, aktiviti rekreasi atau sukan yang biasa dilakukan <i>usual hobbies, recreational or sporting activities</i>	0.76	0.42
Q3 Masuk atau keluar dari bilik mandi <i>Getting into or out of the bath</i>		0.84
Q4 Berjalan dari bilik ke bilik <i>Walking between rooms.</i>		0.87
Q5 Memakai kasut atau stoking <i>Putting on your shoes or socks.</i>		0.76
Q6 Mencangkung atau bertenggong <i>Squatting.</i>	0.76	
Q7 Mengangkat barang contohnya beg berisi barang dapur dari lantai. <i>Lifting an object, like a bag of groceries from the floor</i>	0.58	0.66
Q8 Menjalankan aktiviti ringan di rumah. <i>Performing light activities around your home</i>		0.75
Q9 Menjalankan aktiviti berat di rumah. <i>Performing heavy activities around your home</i>	0.79	
Q10 Menaiki dan keluar dari kereta. <i>Getting into or out of a car.</i>		0.75
Q11 Berjalan sejauh 250 meter <i>Walking 2 blocks.</i>	0.68	0.57
Q12 Berjalan sejauh satu batu. <i>Walking a mile.</i>	0.78	0.47
Q13 Menaiki atau menuruni sepuluh anak tangga (kira-kira 1 larian tangga) <i>Going up or down 10 stairs (about 1 flight of stairs).</i>	0.78	
Q14 Berdiri selama 1 jam. <i>Standing for 1 hour.</i>	0.72	
Q15 Duduk selama 1 jam. <i>Sitting for 1 hour.</i>	0.54	
Q16 Berlari di atas tanah yang rata. <i>Running on even ground.</i>	0.81	
Q17 Berlari di atas tanah yang tidak rata. <i>Running on uneven ground.</i>	0.88	
Q18 Membelok tajam ketika berlari dengan pantas. <i>Making sharp turns while running fast.</i>	0.87	
Q19 Melompat. <i>Hopping.</i>	0.87	
Q20 Berguling di atas katil. <i>Rolling over in bed.</i>		0.62



Diagonal segments are produced by ties.

Fig. 2. Receiver operating characteristic (ROC) curve.

that this study is conducted. Being a self-report questionnaire, LEFS provides us an important applicability in both clinical and educational settings. Therefore it is important to employ a validated health related outcome measures. Adaptation may be required to ensure it is both culturally and linguistically appropriate.⁸

In its original development of LEFS,¹ its reliability and validity were determined with statistical analysis and those values were compared to that of SF-36 scores. In our present study, the methodology was different but the results were excellent, with very good factor loading values for all 20 items. In other words, we can say that all 20 items listed in the LEFS questionnaire are valid questions to measure lower limb function in various aspects. The original author of the LEFS did not mention it, but we were able to extract two domains from all 20 items in the questionnaire. One of the domains appear to consist of high intensity activity (Questions 6, 9, 12, 13, 14, 16, 17, 18 and 19) and the other domain seems to be involving low intensity activity (Questions number 3, 4, 5, 8, 10 and 20). Questions number 1, 2, 7, 11 and 15 may be perceived to be both high and low intensity activities, but all are scoring high factor loading of more than 0.4, with the exception of item number 15 as stated previously. In both the study of the development of original LEFS and in our study, the Chronbach's alpha values measure 0.96 and 0.98, respectively, which were excellent. In other words, the ability of LEFS questionnaire to differentiate between lower limbs with good function and those with problems or disease is very good in the original Binkley, as well as our study.

One of the strength of our study is the excellent measure of internal consistency, the Cronbach's alpha value, of $R = 0.98$. When compared to another cross cultural adaptation study converting English version of LEFS into Dutch version of the questionnaire,⁹ their overall Cronbach's alpha value for the whole 20 items was 0.96.

Another strength of this study is its adequate sample size as shown by the statistically significant Kaiser-Meyer-Olkin and Hotelling's T-squared values, thus implying good power of analysis.

In this study, Chinese and Indian were underrepresented with a

percentage of 5.8% and 4.8% from the total participants, as compared to 24.6% and 7.3% respectively based on Malaysian Statistics Department Census (2010).¹⁰

This present study provides a preliminary step for the future development of Bahasa Malaysia version of LEFS where some changes may need to be modified in order to be culturally adapted across the whole of Malaysia. For example, 'sitting for one hour' in the context of Malaysian population may mean sitting on a chair or sitting cross-legged on the floor or even kneeling on the floor. Furthermore, with the existing multiple dialects in Malaysia itself pose distinctive challenges in the applicability of this questionnaire.

It has been well established that the SF-36 is widely used as a standard measurement in validation studies, and a Malay version of the SF-36 is available.¹¹ Perhaps this study can be extended to test the M-LEFS psychometric properties against that of the Malay language version of the SF-36 as many authors consider as standardized comparison tool for cross cultural adaptation process.

Future research work is also needed to look into the development of this questionnaire in other languages spoken by other ethnic groups like Chinese and Indians.

Conclusion

The LEFS has been cross culturally adapted into Malay language for the first time. The psychometric properties of the M-LEFS are reported to be excellent particularly in the areas of internal consistency, reliability and validity. It can be used to measure function in patients who speak Malay language with lower extremity musculoskeletal dysfunction.

Declaration of interest

Authors declare there is no financial or other form of interest in conduction of this study and all authors made significant contributions to this manuscript.

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