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Research Article

Cross-Cultural Adaptation and Psychometric Testing of the Lower Extremity Functional Scale to Urdu Language

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Abstract

The standardization of outcome measurements across studies, conducted in various contexts, is facilitated by the cross-cultural adaptation of questionnaires. It is advised that the procedure should adhere to the standardized methods. In addition to addressing cultural and linguistic issues, the psychometric features of the modified version should be investigated. The purpose of this study was to translate and culturally adapt the Lower Extremity Functional Scale (LEFS) into Urdu and evaluate the reliability, validity, and responsiveness of the Urdu version of the Lower Extremity Functional Scale (LEFS-U). The original version of LEFS was translated and cross-culturally adapted using established worldwide standards. All the participants underwent baseline administration of LEFS-U, 36-item Short Form Health Survey (SF-36), Visual Analogue Scale for Pain (VAS-pain), and Visual Analogue Scale for Disability (VAS-disability), followed by a second administration to the patients' group after receiving 3 weeks of the intervention. The Global Rate of Change Scale (GROC) was also administered at that time. Furthermore, factor analysis, reliability, validity, and responsiveness of LEFS-U, all were assessed. The LEFS was found internally consistent with Cronbach's alpha of 0.99 and excellent test re-test reliability, evaluated by Intraclass correlation coefficient (ICC) was 0.98 (95% CI: 0.96-0.99). The LEFS-U has a one-factorial structure, which constitutes 67.85% of the total variance. A significant difference in LEFS-U total score was found between patients and healthy controls ($p<0.001$). Moreover, Pearson's correlation coefficient showed a moderate correlation between LEFS-U and SF-36 Physical Function (0.54), Role Physical (0.58), Body Pain (0.61), VAS-pain (-0.50), and VAS-disability (-0.45). The results show that LEFS-U is a reliable, valid, and responsive questionnaire to measure disability in patients with lower extremity disorders.

Keywords: Lower extremity disorders, reliability, responsiveness, translations, validity

1. Introduction

Lower extremity musculoskeletal conditions are very common. In addition to impairing mobility, musculoskeletal problems of the lower limbs substantially impact everyday chores, jobs, and leisure activities (Grabovac and Dorner 2019). Numerous studies have shown that a variety of occupational factors influence how back and lower limb diseases develop (Russo et al. 2020). Moreover, research indicates that factors like gender, age, marital status, and work experience significantly influence how people experience pain in their lower limbs (Mekonnen 2019). The likelihood of developing lower extremity musculoskeletal disorders is further predicted by workplace variables such as working hours, job tenure, type of activity (static and/or dynamic), shift work, safety training, working posture, rest breaks, and psychosocial variables such as job satisfaction, and stress. Moreover, behavioral patterns that increase the risk of lower limb issues include body mass index (BMI) and levels of physical activity (Mekonnen 2019). The Lower Extremity Functional Scale (LEFS) is one of only a few regional single kinetic chain criteria measures for measuring lower-

Table 1. Participants' demographic & clinical characteristics.

	Patients(n=200)		Healthy Participants(n=75)	
Variables	**Mean ± SD**	**N/ %**	**Mean ± SD**	**N/%**
Age, mean (SD), year	41.07 ± 14.4		31.46 ± 8.74	
Body Mass Index (BMI)	23.51 ± 6.47		24.09 ± 4.62	
Sex				
Male		91/53.5		30/40
Female		79/46.5		45/60
Educational level				
Primary		23/13.5		-
Matric		31/18.2		2/0.03
Intermediate		46/27.1		49/65.33
Graduate		48/28.2		24/34.6
Postgraduate		22/13		-
Occupation				
Employed		107/62.95		26/35
Unemployed		63/37.05		49/65
Marital status				
Single		57/33.5		50/66
Married		112/65.9		25/34
Widowed		1/0.6		-
Site of pain				
Hip and thigh, Knee and leg, Ankle and foot		33/19.41 82/48.23 55/32.35		N/A

limb function. The LEFS, a 20-item self-reporting tool, is intended to evaluate patients with lower extremity problems in terms of their functional status. The ratings for the items range from 0 (severe difficulty/unable to execute activity) to 4 (no trouble), enabling us to assess the challenges in performing physical activities arising from lower extremity issues. The overall score ranges from 0 to 80, where higher scores indicate higher function(Binkley et al. 1999).

The LEFS was originally developed in English and has been translated into various languages, including Dutch, Portuguese, Turkish, Chinese, Persian, German, Italian, Finnish, Greek, Malay, Gujarati, Filipino, Spanish, and Arabic.(Cacchio et al. 2010, Binkley et al. 1999, Citaker et al. 2016, Cruz-Diaz et al. 2014, Dell'Era et al. 2016, Hoogeboom et al. 2012, Hou, Yeh, and Liang 2014, Korakakis et al. 2019, Naal et al. 2015, Negahban et al. 2014, Pereira et al. 2013, Repo et al. 2017, Rupareliya and Shukla 2022, Stasi et al. 2012, Yunus, Musa, and Nazri 2017, Zhang et al. 2020)

A questionnaire for assessing the activity restrictions brought on by lower extremity musculoskeletal problems does not yet exist in Urdu. Therefore, the objectives of this study were to describe the process of translating and cross-culturally adapting the original LEFS to Urdu, followed by an evaluation of the

Table 2. Mean, Reliability, and Measurement Error Results of the LEFS-U.

Items LEFS	1ST Measurement Mean ± SD	2nd Measurement Mean ± SD	ICC	CI	SEM	SDC
ITEM 1	1.67 ± 1.20	2.15 ± 0.97	0.87	0.77-0.93	0.43	1.2
ITEM 2	1.75 ± 1.25	2.15 ± 0.94	0.90	0.82-0.94	0.39	1.07
ITEM 3	1.40 ± 1.12	1.75 ± 1.08	0.86	0.75-0.92	0.41	1.15
ITEM 4	1.70 ± 1.06	1.80 ± 1.04	0.93	0.88-0.96	0.28	0.76
ITEM 5	1.77 ± 1.09	1.90 ± 1.00	0.94	0.90-0.97	0.26	0.72
ITEM 6	1.45 ± 1.13	1.67 ± 1.40	0.87	0.77-0.93	0.41	1.13
ITEM 7	1.65 ± 1.16	1.70 ± 1.15	0.98	0.96-0.99	0.16	0.45
ITEM 8	1.15 ± 1.13	1.57 ± 1.10	0.99	0.98-0.99	0.11	0.31
ITEM 9	1.67 ± 0.99	1.72 ± 0.93	0.97	0.95-0.98	0.53	1.48
ITEM 10	1.72 ± 1.01	1.75 ± 1.05	0.98	0.97-0.99	0.14	0.39
ITEM 11	1.52 ± 1.39	1.60 ± 1.37	0.96	0.94-0.98	0.28	0.77
ITEM 12	1.55 ± 1.17	1.60 ± 1.19	0.98	0.96-0.99	0.16	0.45
ITEM 13	1.45 ± 1.17	1.47 ± 1.17	0.99	0.98-0.99	0.12	0.32
ITEM 14	1.55 ± 0.93	1.57 ± 0.93	0.98	0.97-0.99	0.13	0.36
ITEM 15	1.52 ± 1.21	1.57 ± 1.19	0.98	0.96-0.99	0.17	0.47
ITEM 16	1.57 ± 1.17	1.60 ± 1.21	0.99	0.98-0.99	0.12	0.32
ITEM 17	1.70 ± 1.20	1.80 ± 0.20	0.97	0.97-0.99	0.65	1.79
ITEM 18	1.60 ± 1.19	1.63 ± 1.02	0.99	0.98-0.99	0.12	0.33
ITEM 19	1.52 ± 1.08	1.620 ± 1.00	0.98	0.96-0.99	0.15	0.42
ITEM 20	1.60 ± 1.21	1.65 ± 1.34	0.98	0.96-0.99	0.17	0.47
TOTAL	31.95± 18.93	34.17± 18.57	0.98	0.96-0.99	1.89	8.56

psychometric properties of LEFS-U for clinical use with Urdu speakers.

We hypothesized that LEFS-U would show a moderate to strong correlation with SF-36's physical function (PF), role physical (RP), body pain (BP), VAS pain, and VAS disability. Additionally, we also anticipated that the LEFS-U would have strong content validity, test-retest reliability, and internal consistency.

2. Materials & Methods

Convenience sampling was used to choose male and female patients between the ages of 18 and 65 who suffered from lower extremity disorders and could read Urdu, from two hospitals and one rehabilitation centre in Islamabad, and Rawalpindi, Pakistan. For general psychometric testing, a sample size of ten individuals per instrument item was required, as indicated by (Kyriazos 2018). Consequently, given the twenty items on the LEFS-U, the sample size for this study was calculated to be 200. Patients who had a history of lower limb fractures or surgery or lower back pain within the previous three months, neurological or vascular problems, or pregnancy were disqualified from the study. Similarly, patients with recognized psychiatric illnesses were not allowed to participate. Finally, 75 healthy individuals between the ages of 18 and 65, who had no prior history of lower extremity disorders, were chosen from among the employees and students at the Margalla Institute of Health Sciences in Rawalpindi, and written informed permission was acquired from each subject. The Margalla Institute of Health Sciences' ethics review committee in Rawalpindi assented to this project. (ERC Ref No. RR/99/21).

Furthermore, the research was carried out between March 2021 and January 2022 and a self-structured questionnaire was used for demographic data and disease-related questions. Patients were asked to fill out LEFS-U, The 36-item short-form health survey questionnaire (SF-36), the Visual Analog Scale for pain (VAS-pain), and the Visual Analog Scale for disability (VAS-disability). After 2-3 weeks, Patients were asked to fill out all the above questionnaires along with the GROC scale.

a. Translation and Cross-cultural Adaptation

The translation and cultural adaptation procedures were initiated with the author of the original LEFS's permission. The Consensus-based Standards for the Selection of Health Status Measurement Instruments (COSMIN) criteria and the international standards were followed during these procedures (Mokkink et al. 2010). The entire procedure consisted of five steps. Two native Urdu speakers who were also proficient in English independently translated the LEFS from English into Urdu. One of the translators was a Professor in physical therapy, while the other was a linguistic expert.

The directive to translate, with a thematic focus rather than a literal translation, was provided to both translators. The translators and researcher produced a consensus version by integrating the conclusions of the two translated versions and addressing discrepancies. The translation back into English was then done using the consensus version. Moreover, two bilingual translators created the back-translations. These two translators, one of whom was a Professional translator and the other an English professor, had no prior knowledge of the subject matter, being looked into in this study. An expert committee evaluated the original questionnaire, the translations, and the back translations to identify any differences. The committee was made up of two senior physical therapists, translators, and researchers. Following the agreement, a pre-final LEFS-U was achieved. In addition, forty lower extremity disorder patients were enlisted to examine the face validity of the LEFS-U's pre-final version. The questionnaire was given to the patients to complete. Afterward, one by one, every question on the questionnaire was discussed with the patients, they were asked to describe how well they understood each question and the answers to it. Patients were also asked if the items were related to their conditions**.** At this stage, the expert committee reviewed the findings of the adaptation process, reaching a consensus before finalizing the LEFS-U.

b. Analysis of Reliability

Analysis of internal consistency, test-retest reliability, and measurement error were used to assess LEFS-U's reliability (Kennedy 2022). To explore test-retest reliability, while minimizing recall bias and variations in clinical condition, LEFS-U was given twice to 40 randomly selected patients, with a 48-hour gap between each administration. Test-retest reliability was evaluated using a 95% confidence interval and an Intraclass correlation coefficient (ICC) (Terwee et al. 2007). The range of ICC is 0.00 to 1.00, with values between 0.60 and 0.80 indicating acceptable reliability, and values above 0.80 denoting excellent reliability (Terwee et al. 2007). Furthermore, Cronbach's alpha was employed to calculate internal consistency, and values between 0.70 and 0.95 on Cronbach's alpha are considered indicative of high internal consistency (Terwee et al. 2007, Naz et al. 2023). Measurement error was determined by calculating the smallest detectable change (SDC) and the standard error of measurement (SEM), using the formulas SEM × 1.96 × √2 and SD × √(1–ICC) respectively (Mokkink et al. 2021).

c. Analysis of Content Validity

The extent of item response completion, distribution of scores, and sizes of ceiling and floor effects are all examined by content validity. More than 15% of respondents had to receive either the highest or lowest score in order for floor and ceiling effects to be considered

Table 3. Correlations among LEFS-U, SF-36 (Physical function, Role physical, Bodily pain), VAS-pain, and VAS-disability.

Instruments	LEFS-U r	P- value
SF36 Physical Function	0.54	<0.001
SF36 Role Physical	0.58	
SF36 Bodily Pain	0.61	
VAS-pain	– 0.50	
VAS-disability	– 0.45	

existent.(Terwee et al. 2007, Naz et al. 2023, Farooq et al. 2023)

d. Factor Analysis

The factor loading of each item was calculated, and principal component analysis was used to verify the one-factor model, as suggested by the original authors. To evaluate the suitability of factor analysis, both Bartlett's sphericity test and Kaiser-Meyer-Olkin's sample adequacy (KMO) were applied (Kyriazos 2018). With varimax rotation, the principal component analysis served as the extraction technique. The number of factors kept was calculated using the scree-plot and Kaiser's rule (Eigenvalue larger than 1) (Kyriazos 2018).

e. Analysis of Construct Validity

The association between LEFS-U and SF-36, as well as VAS-pain and VAS-disability, was calculated using Pearson's correlation coefficients in order to assess construct validity. The SF-36 is a valid and reliable general health status questionnaire with eight subscales measuring different aspects of health: physical function, physical role, physiological pain, general health, vitality, social function, emotional role, and mental health. Each subscale has a value that extends from 0 to 100, with higher scores denoting healthier conditions.(LoMartire et al. 2020). VAS-pain and VAS-disability were used for lower extremity pain and disability assessment, respectively, usually presented as a 100-mm horizontal line, with a patient marking their pain/disability level on a point between the extremes of "no pain/ restriction" and "worst possible pain/ restriction" (Begum and Hossain 2019, Shafshak and Elnemr 2021).

The values of correlation coefficients between 0.00 and 0.09, 0.10 to 0.39, 0.40 to 0.69, 0.70 to 0.89, and 0.90 to 1.00, denote an insignificant, weak, moderate, strong, or very strong relationship respectively (Schober, Boer, and Schwarte 2018). Moreover, an independent t-test was used to evaluate the discriminative validity of the construct by comparing overall LEFS-U scores between patients and healthy subjects (Terwee et al. 2007, Naz et al. 2023, Farooq et al. 2023). It was expected that these two groups' total scores would differ significantly from one another.

f. Analysis of Responsiveness

The GROC, a 15-point scale, was utilized to gauge a patient's self-assessment of the progression or alleviation of their pain over time. The subjects were asked to rate their lower extremity condition from a score of -7 (very much worse) to +7 (very much better) since the beginning of their treatment (Bobos et al. 2019). The level of responsiveness was analyzed by comparing the change scores for LEFS-U, SF-36, VAS-pain, and VAS-disability (Mokkink et al. 2021, Naz et al. 2023, Farooq et al. 2023).

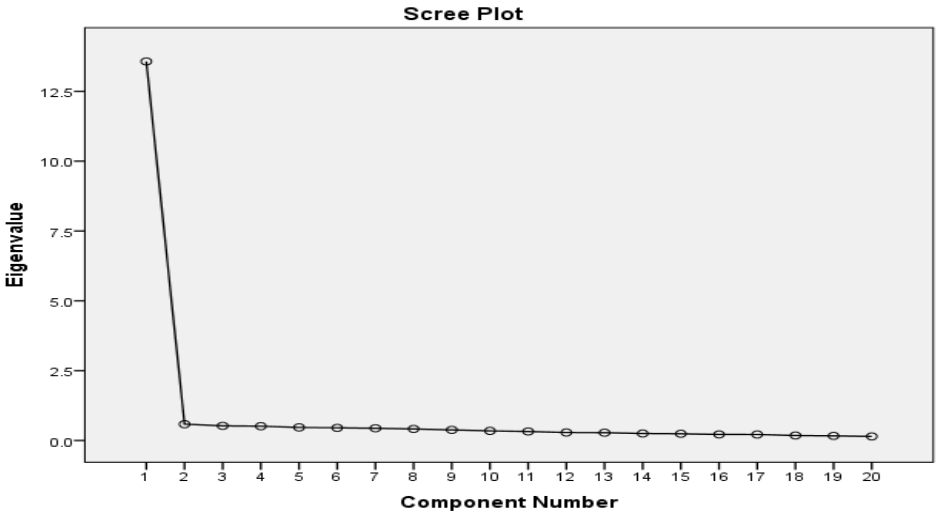

Figure 1: Displays a single-factor structure.

The Statistical Package and Service Solution (SPSS) (version 25) was used for data analysis. At 0.05, the significance level was established.

3. Results

a. Translation and Cross-Cultural Adaptation

Every item in the LEFS-U scale underwent a meticulous forward and backward expert translation, ensuring that each item retained the original meaning. No further concerns arose during the translation, expert review, and pilot-testing phases. The translated version of the LEFS did not contain any variations in vocabulary or meaning, according to the results of the pilot-testing phase. Moreover, no modifications were made to the translated version.

We approached 230 patients, however, 25 of them declined to provide written consent; as a result, 205 questionnaires were handed out following the consent. Out of these, 170 questionnaires fulfilled the inclusion criteria making them eligible for analysis. In addition, this study comprised 75 healthy participants. The demographic and clinical characteristics of the subjects are shown in Table 1.

b. Internal Consistency and Test Re-Test Reliability

The results demonstrate excellent test re-test reliability for all items with ICC= 0.98 (95% CI: 0.96-0.99), and excellent internal consistency with Cronbach's alpha (0.99). The result depicted that the SDC was 8.56, whereas the LEFS-U SEM was 1.89. The mean, reliability, and measurement error results for the individual items and total LEFS-U scores are shown in Table 2.

c. Content Validity

The questionnaire was completed in less than 10 minutes. No missing responses or multiple answers were found, and no floor and ceiling effects on the total score of LEFS-U were present.

d. Factor Analysis

Results found that KMO value was high (0.97) and Bartlett's test was significant ($p<0.001$). Only one factor was explained by variance (67.85%). A scree plot also revealed a one-factor structure (*Figure 1*).

e. Construct Validity

Moderate correlations were found between LEFS-U, SF-36 (Physical function, Role physical, Bodily pain), VAS-pain, and VAS-disability as represented in Table 3. The LEFS-U total score between the patient and the healthy group showed a statistically significant difference ($p <$

0.001) in the results, demonstrating discriminating validity.

f. Responsiveness

The outcomes showed a significant difference in LEFS-U change scores between the two groups ($p < 0.001$), with the improved group (25.78±.9.21, n = 152) having a greater change score than the stable group (18.75± 4.36, n = 18). There were moderate relationships observed between the change scores of LEFS-U, SF-36 (Physical function, Role physical, bodily pain), VAS-pain, and VAS-disability, as indicated in Table 4.

4. Discussion

The main goal of this study was to translate and adapt the LEFS questionnaire in order to produce a legitimate and reliable Urdu version of it. The translation process was completed without any difficulties, the original LEFS structure was preserved, and all of the components were included. In addition, no issues with the method of questionnaire administration were identified by the participants.

The LEFS-U's Cronbach's alpha coefficient was 0.99, demonstrating excellent internal consistency as reported in earlier versions (Cacchio et al. 2010, Citaker et al. 2016, Cruz-Diaz et al. 2014, Dell'Era et al. 2016, Hoogeboom et al. 2012, Hou, Yeh, and Liang 2014, Korakakis et al. 2019, Naal et al. 2015, Negahban et al. 2014, Pereira et al. 2013, Repo et al. 2017, Stasi et al. 2012, Yunus, Musa, and Nazri 2017, Zhang et al. 2020, Binkley et al. 1999). The LEFS-U ICC was 0.98 (95% CI: 0.96-0.99), which is a high level of test-retest reliability. This outcome is comparable to that of prior versions (Cacchio et al. 2010, Citaker et al. 2016, Cruz-Diaz et al. 2014, Dell'Era et al. 2016, Hoogeboom et al. 2012, Hou, Yeh, and Liang 2014, Korakakis et al. 2019, Naal et al. 2015, Negahban et al. 2014, Pereira et al. 2013, Repo et al. 2017, Stasi et al. 2012, Yunus, Musa, and Nazri 2017, Zhang et al. 2020, Binkley et al. 1999).

The results of the current study depicted that the minimum detectable change with 95% confidence was 8.56, whereas the LEFS-U's SEM was 1.89. Moreover, the results demonstrated a total LEFS-U score difference of 8.56 points between baseline and post-treatment, used as the cut-off point to determine a clinically significant change, excluding measurement error. Yeung et al. identified an MDC of 8.2 points; in addition, the results resemble those that were reported for the original (9.0), Italian (9.0), and Arabic (9.2) versions However, the MDC indicated in the Dutch, Portuguese, and Chinese versions were high (9.6-10). We posit that this divergence may stem from variations in the severity of the participants' conditions and the influence of multiple patient selection parameters on these outcomes (Binkley et al. 1999, Cacchio et al. 2010, Hoogeboom et al. 2012, Pereira et al. 2013, Zhang et al. 2020, Korakakis et al. 2019, Yeung et al. 2009).

The total LEFS-U score did not exhibit any floor or ceiling effects, consistent with earlier published findings except the Finnish version, which reported a 17% ceiling effect. This might have happened because surgical patients were included in the Finnish study, which may have contributed to the higher score (Zhang et al. 2020, Citaker et al. 2016, Hoogeboom et al. 2012, Naal et al. 2015, Negahban et al. 2014, Binkley et al. 1999).

One significant factor in the LEFS-U was discovered using a factor analysis. The LEFS-U retains the same fundamental one-factor structure as the previous versions, including the original in English, Dutch, Chinese, Malay, and Arabic (Binkley et al. 1999, Hoogeboom et al. 2012, Zhang et al. 2020, Korakakis et al. 2019, Yunus, Musa, and Nazri 2017) While the Persian and German versions reported a 2-factor structure (Naal et al. 2015, Negahban et al. 2014). This divergence in outcomes may be explained by variations in cultural perceptions of functional status.

Table 4. Correlations among the Change Scores of LEFS-U, SF-36 (Physical Function, Role Physical, Bodily Pain), VAS-pain, and VAS-disability.

Instruments	LEFS-U Change Score R	P- value
SF36 Physical Function Change Score	0.59	
SF36 Role Physical Change Score	0.60	
SF36 Bodily Pain Change Score	0.54	
VAS-pain Change Score	– 0.60	
VAS-disability Change Score	– 0.55	P<0.001

LEFS-U scores were significantly associated with bodily pain, physical role, and physical functioning of SF-36 in line with earlier publications (Binkley et al. 1999, Cacchio et al. 2010, Cruz-Diaz et al. 2014, Zhang et al. 2020, Hou, Yeh, and Liang 2014, Dell'Era et al. 2016). There was a moderate correlation between LEFS-U and VAS-pain, as recorded in the Dutch version. (Hoogeboom et al. 2012) Additionally, the findings of this study, which are in line with those of the original and the Dutch versions, showed a significant difference in the LEFS-U total score between patients, and healthy controls (P<0.001)(Binkley et al. 1999, Hoogeboom et al. 2012).

The study's findings show that LEFS-U has good responsiveness as a tool for evaluating outcomes, and can track changes in health problems over time. The results of German, Dutch, and Italian versions were reported to be similar (Cacchio et al. 2010, Hoogeboom et al. 2012, Naal et al. 2015). There were significantly moderate correlations between LEFS-U change scores and change scores of SF-36 physical role, physical functioning, and bodily pain. Similar results were also shown for the SF-36 subscales in the original version, but the Dutch version revealed a weak association between the LEFS-U change score and the VAS pain change score (Hoogeboom et al. 2012, Binkley et al. 1999). The employment of a convenient sample technique was identified to be a constraint of this study. The findings of this study support the innovative LEFS adaptation for the Urdu-speaking community and the psychometric assessment of LEFS-U. Additionally, standards-based criteria were used in the translation of the instrument and analysis of its psychometric characteristics.

5. Conclusion

In conclusion, our study supports the reliability and validity of the Urdu version of LEFS as a single-dimensional tool for assessing lower extremity functionality in individuals with lower extremity disorders.

Conflict of Interest

All the authors declare no conflicts of interest.

Funding

There were no funding contributions for this research from any source.

Study Approval

This study was approved by the Margalla Institute of Health Sciences, Islamabad, Pakistan.

Consent Forms

Every participant signed a consent form before participating in the research.

Authors Contributions

SN conceptualized the study, SN MNF, NG, and RR did the experimental part and analysis of the results, SN supervised the whole project and wrote the final manuscript.

Data Availability

All the data relevant to this study is with the authors.

Acknowledgments

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Supplementary File: The Urdu version of LEFS has been attached.

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