Journal of Nursing Measurement

Psychometric Testing of the Life Changes in Epilepsy Scale

--Manuscript Draft--

Manuscript Number:	JNM-D-15-00072R1
Full Title:	Psychometric Testing of the Life Changes in Epilepsy Scale
Article Type:	Original Study
Keywords:	epilepsy; quality of life; psychometrics; tool development
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Abstract:	Purpose: Three aims were addressed: (1) Evaluate properties of the items comprising the Life Changes in Epilepsy Scale - Pilot (LCES-P). (2) Use item analysis to optimize the scale. (3) Evaluate construct and criterion-related validity of the optimized LCES. Methods: The LCES-P was administered to 174 adults with epilepsy. Item analysis and exploratory factor analysis were performed. Internal consistency reliability, construct validity, and criterion-related validity were evaluated. Results: 17 items were retained in the optimized LCES. Internal consistency reliability was supported. Path analysis was used to evaluate construct validity. Criterion-related validity was supported by correlations with the SF-36 General Health Subscale and a criterion variable. Conclusions: The optimized version of the LCES can serve as a valuable outcome measure in clinical and research environments.

This is the author's manuscript of the article published in final edited form as:

Miller, W. R., Weaver, M., Bakoyannis, G., Bakas, T., Buelow, J., & Sabau, D. (2017). Psychometric Testing of the Life Changes in Epilepsy Scale. Journal of Nursing Measurement, 25(1), 41–55. https://doi.org/10.1891/1061-3749.25.1.41

Psychometric Testing of the Life Changes in Epilepsy Scale

Introduction

Epilepsy is a leading chronic neurological condition in the United States. More than 2 million American adults currently live with a diagnosis of epilepsy, and 150,000 more receive an epilepsy diagnosis each year. Epilepsy is a chronic disease that results from abnormal surges in electrical signals in the brain, causing recurring seizures. There are numerous causes of epilepsy, though in most cases the cause is unknown. For most people, there is no cure for epilepsy, and thus the disorder must be managed over a lifetime. Adult-onset epilepsy is common, with those aged 18 and older having the highest incidence of new-onset epilepsy in the United States (Epilepsy Foundation, 2015). Adults with epilepsy report a lower quality of life (QoL) and perceived health status than those without the disorder, and commonly experience negative life changes such as unemployment, poor social relationships, and poor physical functioning (Unger & Buelow, 2009; Zhao et al., 2012; Miller, Bakas, & Buelow, 2013).

The Institute of Medicine, in its 2012 report on epilepsy, highlighted the need for behavioral interventions to improve epilepsy-related outcomes in persons of all ages. The development and testing of such self-management interventions for adults with epilepsy is impeded by the lack of a sensitive, patient-centered outcome measure. Several epilepsy-specific QoL measures have been published in the literature, and many have evidence of satisfactory reliability and validity. However, these measures lack sensitivity, as they fail to measure perceived changes in QoL caused by epilepsy; existing measures are not designed to detect a person's perceived life changes experienced *as a result of having epilepsy*. Recent patient-centered outcomes research involving persons with adult-onset epilepsy has revealed that adult-onset epilepsy causes undesired life changes, including alterations in social functioning, somatic health, and well-being (Miller, 2014). A tool that can be easily used in clinical practice to measure these life changes resulting from having epilepsy is needed to

prioritize and guide the development of interventions for adults with epilepsy, and to provide a more comprehensive and sensitive assessment of outcomes for adults with epilepsy.

The purpose of this study was to psychometrically test a pilot version of the Life Changes in Epilepsy Scale (LCES), which was designed to measure adults' perceived life changes since being diagnosed with epilepsy. Evidence of the content and face validity of the LCES has been reported elsewhere (Miller et al., 2015). Specific aims of the current study were:

Aim 1: Evaluate the properties of 35 items comprising the Life Changes in Epilepsy Scale - Pilot (LCES-P), a preliminary 35-item scale to measure life changes resulting from epilepsy.

Aim 2: Use item analysis results to optimize the scale in terms of subject burden and interpretability.

Aim 3: Evaluate construct and criterion-related validity of the optimized LCES (LCES-O).

Background

Considerable evidence exists to suggest that epilepsy is a life-altering chronic disease. Adults with epilepsy report unpleasant emotional and physical symptoms, and also have a higher incidence of psychiatric co-morbidities when compared to their epilepsy-free counterparts. Adults with epilepsy also suffer decrements in social relationships and physical functioning, as well as high rates of unemployment (Epilepsy Foundation, 2015).

Review of existing quality of life measures. Table 1 provides a summary of six QoL scales that are commonly used as outcome measures in the epilepsy population (Davies et al., 2009). These measures include the Medical Outcomes SF-36 Survey (SF-36), Personal Impact of Epilepsy Scale, The Quality of Life Index-Epilepsy (QoLI-epilepsy), the Quality of Life in Epilepsy (10-, 31-, and 89-item versions) (QoLIE-10, 31, 89), and the Patient Reported Outcomes Information System (PROMIS) Impact of Illness Scales. The SF-36 is a global QoL measure with ample evidence of reliability and validity in multiple chronic disease populations, including epilepsy (Ware & Sherbourne, 1992). Though it is the most commonly used general

QoL measure used in the epilepsy population, the SF-36 does not measure QoL in the context of epilepsy. The SF-36 was administered to 3,520 persons with epilepsy and, though it demonstrated evidence of reliability and validity, the scale had significant ceiling effects in all subscales (Davies et al., 2009). The SF-36 also does not address the need for a measure that is sensitive to change.

The Personal Impact of Epilepsy Scale (PIES) (Fisher et al., 2015) is epilepsy-specific and appropriately patient-centered. However, the PIES has demonstrated evidence of reliability and validity in a potentially inadequate sample (50 participants completed the 152-item scale, and 40 participants completed the follow-up 40-item scale). It is also unclear if the PIES asks respondents to answer items in relation to how aspects of their lives have changed due to epilepsy (Fisher et al., 2015). The QoLI-epilepsy scale and all versions of the QoLIE have evidence of reliability and validity, and are epilepsy-specific. However, these scales do not measure perceived changes in health-related QoL (Cramer et al., 1998), and thus do not remedy the gap in measurement tools for this population described earlier. The Patient Reported Outcomes Measurement Information System (PROMIS) is a system of patient-reported measures for physical, mental, and social well-being. The PROMIS has demonstrated evidence of reliability and validity in a variety of chronic disease populations. This system includes two instruments that measure the impact of a chronic condition (illness impact negative or positive) (PROMIS, 2011). This system has not, however, been used in a population of those with epilepsy, and the illness impact scales lack epilepsy-specific items. Epilepsy is a complex condition and is characterized by its unique effects on those who suffer from it. Thus, an epilepsy-specific measure is needed to adequately capture life changes due to epilepsy.

Conceptual framework. We endeavored to develop an epilepsy-specific, patient-centered, and theory-based outcome measure for adults with epilepsy. Specifically, we sought to render this measure capable of detecting perceived life changes that have occurred since epilepsy onset. The Life Changes in Epilepsy Scale, Pilot version (LCES-P) was thus developed

based on existing epilepsy- and chronic disease self-management literature and portions of Lazarus and Folkman's Theory of Stress, Coping, and Adaptation (1984). In their theory, Lazarus and Folkman posit that three adaptational outcomes—social functioning, somatic health, and subjective well-being—are met to varying degrees as a result of the coping process. Based on qualitative research in which adults with epilepsy identified epilepsy-related outcomes of importance to them, we submit that the adaptational outcomes included in Lazarus and Folkman's theory are representative of patient-centered outcomes in adults with epilepsy. The LCES-P was developed based on the conceptual framework depicted in Figure 1. The framework is based on a review of the literature and the Theory of Stress, Coping, and Adaptation. Adults with epilepsy experience symptoms due to the disease. In the framework, epilepsy variables (seizure characteristics and behaviors) influence the occurrence of symptoms. These symptoms are proposed to lead to undesirable life changes due to epilepsy (LCES-P) among other more global adaptational outcomes (general health).

Procedures for Instrument Development

Details regarding the development and content and face validity testing of the LCES-P have been reported elsewhere (Miller et al., 2015). Initially, we generated 41 epilepsy-specific items that were designed to measure life changes in the areas of social functioning, somatic health, and subjective well-being since epilepsy onset. These items were developed based on qualitative data collected from adults with epilepsy (Unger & Buelow, 2009; Miller, 2014), as well as a review of the epilepsy literature and in congruence with the underlying theoretical framework discussed earlier. After testing the content and face validity of the LCES, the number of items on the scale was reduced to 35, plus an additional criterion item (item number 36).

Description, Administration, and Scoring of the LCES-P

A sample of the LCES-P is included in Figure 2. The response format for the LCES was adapted from Bakas and colleagues' (Bakas et al., 2006) Bakas Caregiver Outcomes Scale (BCOS), on which responses are measured via a 7-point Likert scale (*Changed for the worst=-3*

to *Changed for the best*=+*3*). The -3 to +3 ratings are recoded to 1 to 7 so that positive numbers can be used for analysis. Total LCES-P scores can range from 35 to 245, with higher scores indicating more positive outcomes. The LCES-P can be self-administered, or administered by a provider in person or via phone. The format of the LCES-P could also be easily adapted to an online format.

Methods

Recruitment

Following approval of the study by the university and hospital Institutional Review Boards, 174 adults with epilepsy were recruited to the study. Inclusion criteria were: 1) age 18 years or older; 2) diagnosis of epilepsy; 3) prescription of at least one anti-epileptic drug; 4) able to speak and read English; 5) access to a telephone; 6) community-dwelling; 7) diagnosed with epilepsy at age 16 or older; and 8) cognitively intact as measured by the 6-item cognitive screener. Three methods of recruitment were utilized. The primary method of recruitment involved at-a-distance techniques as described by Miller and colleagues (2013). Two physicians (one epileptologist, one neurologist) and their staff identified patients who met the initial inclusion criteria of being age 18 and older and diagnosed with epilepsy at age 16 or later; the physicians mailed letters to potential participants informing them of the study and that they would be contacted by a researcher via phone in the next 10 days. The letters also included a number for patients to call in the event they did not wish to be contacted regarding the study. Members of the research team contacted potential participants by phone; those interested were screened against inclusion criteria prior to being admitted to the study. A total of 153 participants were recruited using this method. A secondary method of recruitment involved an epileptologist providing patients with study materials during clinic visits. Ten participants were recruited using this method. The final method of recruitment was via Epilepsy Foundation newsletters and online message boards. Potential participants recruited via this method contacted the researcher via contact information provided. Participants received two copies of

the informed consent statement via mail; participants signed one copy of the consent and returned it to the researcher via mail, and the other copy was kept by participants for their records. Eleven participants were recruited using this method.

Procedure and Measures

As part of a parent study of which the current study is a sub-study, 11 measures were administered to participants by telephone (See Table 2). Participants were also asked to provide demographic information (See Table 3). Research assistants recorded participants' responses on paper, and these answers were later entered into an electronic database and were double-checked for accuracy. Data collection calls ranged in length from 23 to 90 minutes, with a mean of 42 minutes. Completion time of the LCES-P ranged from 5-21 minutes, with a mean time of 9 minutes. Measures of interest in the current study included the LCES-P and the SF-36, as they were used to fulfill the aims of this sub-study.

Data Analysis

Scale scoring, examination of missing value patterns, value distributions, and estimation of coefficient alpha were performed using SAS version 9.3. Factor analyses and testing construct validity were performed with Mplus version 7.11 (Muthen & Muthen, 2012). Mplus was chosen for factor and construct validity analyses due to its capability to (1) employ full information maximum likelihood (FIML), which uses all available data (that is, an observation is not summarily dropped if there are missing data); (2) appropriately accommodate the ordered category measurement level of the LCES-P items; (3) perform parallel analysis to provide data-based guidance for identifying number of factors; and (4) utilize Bayesian analysis methods, which performs better with smaller samples and non-normal distributions than maximum likelihood methods (Gelman et al., 2004; Hayton, Allen, & Scarpell, 2004; Muthen & Asparouhov, 2012).

Aim 1 was addressed by exploring the factor structure, Cronbach's alpha, and item-total correlations of the LCES-P. Ferketich's criterion for an acceptable item-total correlation range

(.30-.70) was used to identify items for potential removal (Ferketich, 1991). Parallel analysis (Allen & Scarpello, 2004) was used to identify the number of factors reflected in the LCES-P. Exploratory factor analysis, using the WLSMV estimator and an oblique geomin rotation, was used to test factor loadings for LCES-P items. Fit of the model was assessed by examining model fit χ^2, Root Mean Square Error of Approximation (RMSEA), and the Cumulative Fit Index (CFI). Aim 2 was addressed by examining Cronbach's Alpha and item-total correlations for the LCES-P. Aim 3 was addressed by (1) examining model fit for the measurement model of the optimized LCES scale (LCES-O) and (2) testing correlations between scores on the LCES-O, the SF-36 General Health subscale and LCES-P Item 36. Due to the ordered category scale of Item 36, a Bayes approach was used to estimate correlations among those three measures. Non-informative priors were used to start the estimation algorithm. Convergence and model fit were evaluated using trace and autocorrelation plots for the parameter estimates as well as the potential scale reduction and the posterior predictive p-value. Posterior credibility intervals (CI) for individual parameter estimates were evaluated for inclusion of a value of zero, which was interpreted as there being no substantive association.

Results

Sample and Measures

One hundred seventy four participants completed the study. Sample characteristics are displayed in Table 3. The sample was predominantly female, married, White, and unemployed. The means, variances, and ranges for the LCES-P and SF-36GH are displayed in Table 4.

LCES-P Psychometrics

Total scale Cronbach's Alpha, item means, standard deviations, item-total correlations, and Alpha if item removed are presented in Table 5. Item means ranged from 2.25 (*my financial well-being*) to 4.11 (*my ability to achieve personal goals*). There was satisfactory variability in relation to the means (SDs ranged from 1.03 to 1.53). Item means indicate that financial well-being and experience of unpleasant symptoms were rated lowest by respondents, while

relationships with immediate family members and ability to achieve personal goals were rated the highest.

Item-total correlations ranged from 0.22-0.80. A total of 20 items with item-total correlations outside the acceptable 0.30 – 0.70 range were considered for deletion.

Results of the exploratory factor analysis of the LCES-P appear in Tables 6 and 7. There were six missing data patterns: 169 observations had complete data, while 4 observations had missing data for a single item, and 1 observation had missing data for 2 items. Covariance coverage ranged from 100% to 98.9%, adequate for good performance of FIML estimation methods. Based on the parallel analysis (Table 6), an exploratory analysis extracting two factors was performed on the 35 items (Table 7). Fit of the 2-factor model was poor, based on the χ^2, RMSEA, and CFI values. Only three items (LCES14, LCES15, and LCES17) loaded primarily on Factor 2, and there was a weak correlation between the two factors.

LCES Optimization

Based on the initial item analysis and exploratory analysis of the LCES-P, several items were considered for elimination, as was the possibility that the items represented a one-dimensional construct. Of the 35 items, 21 had item-total correlations outside the 0.30 – 0.70 range. Eighteen of those items were dropped, and three items (LCES24, LCES28, and LCES29) were retained due to their conceptual importance. The resulting 17-item optimized scale exhibited a good internal consistency (Cronbach's Alpha = .92), and the one-factor model demonstrated adequate fit to the data (Table 8).

Optimized LCES Scale Criterion-Related Validity

Bayes-estimated correlations among LCES-O, SF-36 General Health, and LCES-P scales, along with the corresponding 99% credibility intervals are presented in Table 9. The model was consistent with the observed data, as evidenced by the model fit statistics. All correlations were greater than zero, as predicted by theory. Additionally, the strongest correlation was observed between the LCES-O and the LCES36 item, an epilepsy-specific criterion item, which asked participants to rate perceived changes in

their lives overall since epilepsy onset. That observation is also consistent with theoretical expectations, given that the SF-36 General Health subscale is not specific to epilepsy-related health.

Discussion

Epilepsy is a life-changing disease that can lead to negative changes in social functioning, somatic health, and subjective well-being. There is a need for the development and testing of epilepsy self-management interventions designed to prevent or minimize these negative changes as much as possible (IOM, 2012). However, the lack of a sensitive outcome measure has impeded the development and testing of such interventions. The LCES-P was developed to address this need.

Item analysis of the LCES-P revealed several important findings. There were few ceiling/floor effects, and missing data were minimal. The scale demonstrated good variability in relation to means. Examination of the item level of the LCES-P helps identify potential priority areas for interventions. Financial well-being and experience of unpleasant symptoms were rated lowest by respondents, suggesting that nurses and other healthcare professionals provide information about how to find financial assistance/manage finances and treatment of symptoms, including seeking appropriate referrals from epilepsy providers.

LCES-P items were designed to measure changes in three specific areas: social functioning, somatic health, and subjective well-being. Thus, a three-dimensional scale was anticipated. However, the resulting unidimensionality of the LCES-P is not entirely surprising, given that the scale as a whole was designed to measure overall life changes. Bakas and colleagues (2006), in testing the psychometric properties of their caregiving outcomes scale aimed at measuring the same three concepts as the LCES-P also found a unidimensional scale. Focusing on the item level, the LCES might be used as an assessment tool to determine how to best address individual problems experienced by adults with epilepsy in the three different areas. At the scale level, the LCES could be used as a total score to measure overall outcomes in adults with epilepsy, as well as to serve as an important outcome measure in research.

The initial, 35-item LCES-P was reduced to a 17-item scale following optimization. The resultant LCES-O is a brief measure with strong evidence of reliability and validity. The items removed from the LCES-P to form the LCES-O were deleted, based on item-to-total correlations, due to being irrelevant or redundant. The three items with item-to-total correlations outside the acceptable range that were retained were kept due to important conceptual relevancy. These items were related to respondents' perceived changes in ability to lead a successful life, ability to take care of him/herself, and ability to live a normal life. Prior literature has indicated that these three specific areas are often negatively affected in persons with epilepsy (Unger & Buelow, 2009; Institute of Medicine, 2012; Miller, Bakas, & Buelow, 2013; Miller, 2015).

FIML estimation revealed strong evidence of construct validity of the LCES-O, and Bayes-estimated correlations reveal evidence of criterion-related validity of the scale. These findings are in accord with the theoretical framework that guided development of this tool.

The optimized version of the LCES is a brief measure with strong evidence of internal consistency reliability, as well as construct and criterion-related validity, and is suitable for use in both clinical and research settings. Clinically, the LCES can be used to provide a quick, epilepsy-focused QoL assessment in patient-centered areas. A total LCES score can supply the provider with an overall picture of how a person's life is being affected by epilepsy; scores on individual items can guide nurses and other providers in choosing appropriate interventions for people living with epilepsy. Clinicians may find the LCES particularly helpful in assessing problematic areas in the lives of persons newly-diagnosed with epilepsy, as this population is at especially high risk of experiencing negative life changes (Unger & Buelow, 2009). As an outcome measure, the LCES is in accord with IOM recommendations for the measurement of patient-centered QoL, and could be easily used to measure changes in these outcomes due to intervention.

Limitations

The cross-sectional nature of this study limits generalizability of findings. A longitudinal study is needed to assess the performance of the LCES over time. The lack of diversity in the sample is also limiting—participants were predominantly female and Caucasian, and most were from the Midwest. There is thus a need to test the LCES in more diverse contexts. Additionally, the LCES was not developed or tested with pediatric participants. It is possible that it could be adapted for use in younger teenagers who are capable of remembering—and thus assessing—differences in their lives pre- and post-epilepsy. The LCES specifically targets persons diagnosed with epilepsy in early adulthood or later, and is less useful in persons who have had epilepsy since birth or very early in life.

Conclusions

The optimized version of the LCES represents a unique, change-sensitive, patient-centered outcome measure for people with epilepsy that demonstrates excellent evidence of reliability and validity and is not cumbersome for respondents. The LCES can thus be implemented into both clinical and research settings to measure life changes in adults with epilepsy.

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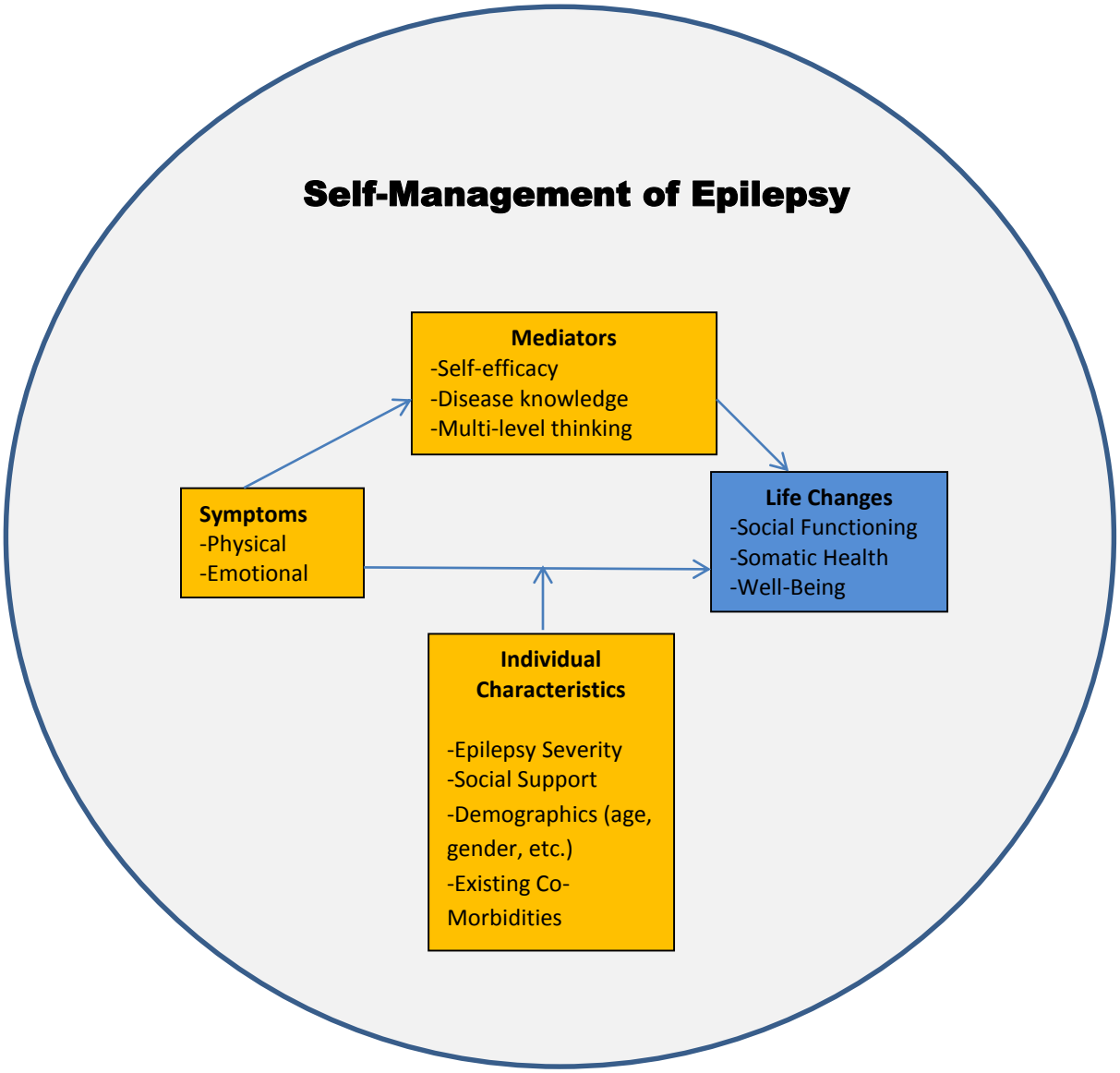
Figure

Figure 2. Sample LCES Items and Response Scale

Sample Item	Response Scale						
	Changed for the Worst				Changed for the Best		
My happiness in general	-3	-2	-1	0	+1	+2	+3
My memory	3	-2	-1	0	+1	+2	+3
The number of worries in my life	3	-2	-1	0	+1	+2	+3
Instruction: For each possible change listed, circle the number indicating the degree of change you have experienced since being diagnosed with epilepsy. The numbers indicating the degree of change range from -3 ("Changed for the worst") to +3 ("Changed for the best"). The number 0 means "Did not change."							

Figure

Figure 1. Conceptual Framework



Table

Table 1. Critique of Existing Instruments				
Instrument	Epilepsy-Specific	Theory-Based	Measures Perceived Changes	Reliable and Valid
SF-36 Health Survey		●		●
Personal Impact of Epilepsy Scale	●	●		
QoLIE/QoLIE-31	●	●		●
PROMIS Illness Impact Negative Scale		●	●	●
PROMIS Illness Impact Positive Scale		●	●	●

Table

Table 2. Instruments Administered to Participants				
Construct	Measure	Number of Items	Scoring	Reliability
Adaptational Outcomes: Life changes	Life Changes in Epilepsy Scale (LCES)	35	↑	TBD
Adaptational Outcomes: General Health	Medical Outcomes SF-36 Health Survey General Health Subscale (SF-36GH) *Used as criterion measure.*	36	↑	.72-.94† .80*
Adaptational Outcomes: Impact of illness	PROMIS Impact Illness Positive Scale PROMIS Impact Illness Negative Scale	8 8	↑ ↓	.87-.89† .82-.85†
Seizure characteristics	Seizure Severity Questionnaire (SSQ)	11	↓	0.74*
Self-management behaviors	Epilepsy Self-Management Scale (ESMS)	38	↑	.81-.86†
Self-management self-efficacy	Epilepsy Self-Efficacy Scale (ESES)	33	↑	.91-.93†
Affective symptoms	PROMIS Anxiety Scale PROMIS Depression Scale PROMIS Anger Scale Patient Health Questionnaire PHQ-9	8 8 8 9	↓ ↓ ↓ ↓	.82-.90† .89-.92† .86-.93† 0.86-.89† 0.84*
Cognitive symptoms	PROMIS Applied Cognition Concerns Scale PROMIS Applied Cognition Abilities Scale	8 8	↓ ↑	.86† .80†
TBD = scale to be developed; ↓= lower scores indicate better outcomes; ↑ = higher scores indicate better outcomes; † = internal consistency reliability; * = test-retest reliability				

Table

Table 3. Sample Characteristics

	Gender		
	Male	**Female**	**Overall**
	N (%)	**N (%)**	**N (%)**
Marital status			
Married	24 (38.1)	50 (45.0)	74 (42.5)
Single	25 (39.7)	23 (20.7)	48 (27.6)
Other	14 (22.2)	38 (34.2)	52 (29.9)
Type of Epilepsy			
Complex Partial	10 (15.9)	23 (20.7)	33 (19.0)
Tonic Clonic	12 (19.0)	20 (18.0)	32 (18.4)
Both	12 (19.0)	19 (17.1)	31 (17.8)
Other	7 (11.1)	10 (9.0)	17 (9.8)
Unknown	22 (34.9)	39 (35.1)	61 (35.1)
Income			
Comfortable	15 (23.8)	44 (39.6)	59 (33.9)
Just enough to make ends meet	27 (42.9)	49 (44.1)	76 (43.7)
Do NOT have enough to make ends meet	21 (33.3)	18 (16.2)	39 (22.4)
Employment Status			
employed full-time	12 (19.0)	26 (23.4)	38 (21.8)
employed part-time	2 (3.2)	11 (9.9)	13 (7.5)
homemaker	0 (0.0)	10 (9.0)	10 (5.7)
retired	3 (4.8)	13 (11.7)	16 (9.2)
unemployed	23 (36.5)	18 (16.2)	41 (23.6)
Other (specify)	3 (4.8)	6 (5.4)	9 (5.2)
Disability	20 (31.7)	27 (24.3)	47 (27.0)
Seizure Frequency			
At least monthly	16 (25.4)	35 (31.5)	51 (29.3)
Bi-monthly	13 (20.6)	15 (13.5)	28 (16.1)
At most semi-annually	34 (54.0)	61 (55.0)	95 (54.6)
Ethnicity			
White	48 (78.7)	88 (83.8)	136 (81.9)
African American	10 (16.4)	12 (11.4)	22 (13.3)
Other	3 (4.9)	5 (4.8)	8 (4.8)
	Median (IQR)	**Median (IQR)**	**Median (IQR)**
Age (years)	48.0 (31.0, 56.0)	46.0 (33.0, 60.0)	47.0 (33.0, 57.0)
Age at Diagnosis (years)	28.0 (21.0, 47.0)	30.0 (22.0, 41.0)	29.0 (22.0, 42.0)
Time since Diagnosis (years)	6.0 (4.0, 14.0)	9.0 (4.0, 20.0)	8.0 (4.0, 18.0)
Years of education	12.0 (12.0, 16.0)	14.0 (12.0, 16.0)	13.0 (12.0, 16.0)

Table

Table 4. Descriptive Statistics of LCES-P and SF-36GH

Measure	Mean (SD)	Range
LCES-P	49.43(13.74)	18-97
SF-36GH	49.31(23.12)	1-100

Table

Table 5. Item analysis results – full 35 item scale using cases with complete data (N=169).

Item	Mean	SD	Item-Total Correlation	Alpha if Item Deleted
LCES01	2.93	1.28	0.72	0.962
LCES02	2.74	1.29	0.71	0.962
LCES03*	2.74	1.05	0.54	0.963
LCES04*	2.25	1.13	0.66	0.962
LCES05*	2.32	1.04	0.56	0.963
LCES06	2.54	1.20	0.71	0.962
LCES07	2.95	1.15	0.66	0.962
LCES08*	2.95	1.09	0.68	0.962
LCES09	2.65	1.20	0.69	0.962
LCES10	3.07	1.07	0.74	0.962
LCES11*	3.04	1.23	0.68	0.962
LCES12	2.81	1.12	0.69	0.962
LCES13*	2.54	1.16	0.68	0.962
LCES14*	3.90	1.53	0.33	0.965
LCES15	4.11	1.53	0.22	0.966
LCES16	3.28	1.20	0.65	0.962
LCES17*	3.66	1.37	0.47	0.964
LCES18*	2.82	1.27	0.59	0.963
LCES19	2.62	1.35	0.70	0.962
LCES20	2.89	1.20	0.76	0.962
LCES21	3.02	1.17	0.69	0.962
LCES22*	2.72	1.16	0.68	0.962
LCES23*	2.78	1.32	0.59	0.963
LCES24*	2.92	1.32	0.77	0.962
LCES25	2.85	1.24	0.72	0.962
LCES26	2.71	1.11	0.76	0.962
LCES27	3.06	1.03	0.57	0.963
LCES28*	3.11	1.16	0.72	0.962
LCES29*	2.69	1.25	0.80	0.961
LCES30	3.02	1.17	0.69	0.962
LCES31	3.25	1.16	0.67	0.962
LCES32*	2.64	1.35	0.70	0.962
LCES33*	3.50	1.26	0.54	0.963
LCES34	2.69	1.26	0.77	0.962
LCES35*	2.83	1.06	0.70	0.962

Notes:

Scale Alpha = 0.96

* = Item retained in optimized 17-item scale

Table

Table 6. Observed and Parallel Analysis-Derived Average Eigenvalues (first 6 out of 35) for LCSES-35 scale.

Factor	Sample Eigenvalue	Parallel Average Eigenvalue
1	16.35	1.97
2	2.08	1.84
3	1.68	1.74
4	1.34	1.66
5	1.16	1.59
6	0.95	1.52

Table

Table 7. Rotated factor loadings from exploratory analysis of LCSES-35.

Item	Factor 1 Rotated Loading	Factor 2 Rotated Loading
LCSES01	0.620*	0.331*
LCSES02	0.709*	0.135*
LCSES03	0.740*	-0.224*
LCSES04	0.718*	0.074
LCSES05	0.546*	0.207*
LCSES06	0.776*	0.008
LCSES07	0.729*	-0.014
LCSES08	0.833*	-0.095
LCSES09	0.841*	-0.052
LCSES10	0.786*	0.042
LCSES11	0.526*	0.432*
LCSES12	0.702*	0.101
LCSES13	0.689*	0.141*
LCSES14	0.013	0.664*
LCSES15	-0.143	0.688*
LCSES16	0.506*	0.360*
LCSES17	0.196*	0.599*
LCSES18	0.756*	-0.121*
LCSES19	0.690*	0.221*
LCSES20	0.574*	0.484*
LCSES21	0.631*	0.238*
LCSES22	0.733*	0.075
LCSES23	0.506*	0.258*
LCSES24	0.681*	0.343*
LCSES25	0.661*	0.226*
LCSES26	0.644*	0.305*
LCSES27	0.633*	0.043
LCSES28	0.868*	-0.139*
LCSES29	0.882*	-0.050
LCSES30	0.779*	-0.044
LCSES31	0.613*	0.215*
LCSES32	0.930*	-0.236*
LCSES33	0.546*	0.065
LCSES34	0.883*	-0.084
LCSES35	0.787*	-0.016

Loadings differing from 0 at $p < .05$ are indicated by *.

Inter-Factor Correlation: 0.355 ($p<.05$)

Model Fit:

χ^2 (DF=526)=1220.3, $p<.001$

RMSEA = .087 (90% CI: 0.081 0.093)

CFI = 0.947

Table

Table 8. Model Fit and Factor Loadings for Optimized 17-Item 1-Factor Scale.

Item	Loading	p
LCSES03	0.627	<0.001
LCSES04	0.724	<0.001
LCSES05	0.630	<0.001
LCSES08	0.780	<0.001
LCSES11	0.694	<0.001
LCSES13	0.745	<0.001
LCSES14	0.316	<0.001
LCSES17	0.424	<0.001
LCSES18	0.717	<0.001
LCSES22	0.775	<0.001
LCSES23	0.576	<0.001
LCSES24	0.796	<0.001
LCSES28	0.788	<0.001
LCSES29	0.879	<0.001
LCSES32	0.812	<0.001
LCSES33	0.579	<0.001
LCSES35	0.761	<0.001

Model Fit:

χ^2 (DF = 114) = 240.2, p <.001

RMSEA = 0.08 (90% CI = 0.066 - 0.094)

CFI = 0.976

Table

Table 9. Bayes-estimated correlations (99% credibility interval) among optimized LCSES, SF-36 general health, and LCSES36 scales.

	Optimized LCES	SF-36 General Health	LCES36
Optimized LCSES	1.0		
SF-36 General Health	0.479 (0.10, 0.618)	1.0	
LCSES36	0.789 (0.698, 0.854)	0.338 (0.153, 0.502)	1.0

Model Fit:

95% Confidence Interval for Observed-Replicated Chi Squared Values: -11.8, 12.8

Posterior Predictive p value: 0.47

Psychometric Testing of the Life Changes in Epilepsy Scale

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Acknowledgements: This work was supported by the Indiana University School of Nursing Center for Enhancing Quality of Life