Original Article

Development and Psychometric Evaluation of a Short-Form Barthel Index for Older Patients Undergoing Abdominal Surgery

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ABSTRACT

Objectives: To develop and evaluate psychometric properties of a short-form of the Barthel Index.

Study design: Retrospective study.

Setting: A university hospital in Thailand.

Subjects: Patients aged 60 or over who had abdominal surgery and were enrolled in the Siriraj Integrated Perioperative Geriatric Excellent Research Center studies between January 2017 and August 2021.

Methods: Electronic medical records of patients were retrospectively reviewed and 96 patients were recruited. Items from the Barthel index were chosen for the short-form based on importance as determined from the index of overall superiority which was obtained from each item's total correlation score and the effect size of the item. The psychometric properties of the short-form were analyzed.

Results: The mean Barthel index score dropped from 92.8 at the time of surgery to 87.6 four weeks post-surgery. The five items with the highest ranking in the index of overall superiority were toilet use, stair climbing, bathing, mobility, and dressing. The psychometric properties of the 3-item and the 5-item versions included internal consistency (Cronbach's alpha coefficients 0.72 and 0.84), intraclass correlation coefficient (0.72 (95%CI 0.60-0.80) and 0.74 (95%CI 0.61-0.83), and responsiveness to change (effect size 0.69 and 0.52), respectively. The 5-item version showed higher internal consistency, while the 3-item version had superior responsiveness to change.

Conclusions: We recommend the use of the 3-item version as a screening tool for detecting functional changes in older adults undergoing abdominal surgery because of its superior responsiveness to change. Additionally, it requires less assessment time and is more practical for use in clinical practice.

Keywords: geriatrics, Barthel index, abdominal surgery, short-form Barthel Index

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Introduction

As Thailand transitions toward an aging society, the proportion of patients undergoing surgery consists increasingly of older adults. Older patients are more vulnerable to functional decline and are slower to recover after surgery. Following abdominal surgery, some older patients lose their independence, can no longer engage in self-care activities[1] and require rehabilitation training or post-acute care to regain their previous level of function.[2,3]

Various tools are used to assess patients' abilities in performing self-care tasks. The Barthel index, which assesses ten areas of performance in activities of daily living (ADL), is one of the best known and most widely used tools, including used by older patients.[4-6] In theory, different illnesses can negatively affect patients differently. For example, a study of intensive care unit patients found that the abilities that underwent the most significant decline after an operation were stair climbing, walking, and toilet use.[7] The most degraded abilities in patients following surgery for bone and muscle tumors included stair climbing, walking, and bathing.[8] Numerous studies have investigated the functional decline of older adults undergoing surgery[1,9-16] but most have reported functional decline as a total score without specifying which aspects of ADL were most affected.[9,11-13,15,16] The present study investigated in which of the ten areas in the Barthel index older patients saw a decline or loss after abdominal surgery.

After identifying the most affected items, the short-form versions of the Barthel index were developed. The short-form versions are more practical for use in clinical practice, are less time-consuming, and enhance patient cooperation in answering questions. Previous short-form versions of the Barthel index developed for use with patients with neurological diseases have reported good consistency[17] and responsiveness to change,[18] results similar to the original 10-item Barthel index.

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The present study aimed to identify the items of the Barthel index that showed a decline or loss after undergoing abdominal surgery, to develop short-form versions of the Barthel index and to examine the psychometric properties of those versions.

Materials and methods

Study design

This study was a retrospective chart review. The protocol for this study was approved by the Siriraj Institutional Review Board (SIRB) (COA no. SI 654/2021) and conforms to the ethical principles in the Helsinki Declaration of 1964 and subsequent amendments.

Participants

All patient data were obtained from electronic medical records in the database of the Siriraj Integrated Perioperative Geriatric Excellent Research Center (SiPG), a multidisciplinary research group at Siriraj Hospital, Mahidol University. Records of older patients (age ≥ 60) enrolled in SiPG studies from January 2017 through August 2021 were reviewed. To be eligible for inclusion in this study, participants had to be aged 60 or over (male or female), have undergone elective abdominal surgery (except gastrostomy or jejunostomy), and had to have Barthel index assessments both prior to and at four weeks after surgery. Patients with severe dementia (Thai mental state examination (TMSE) ≤ 10[19]); severe depression (Thai version PHQ-9 assessment[20] ≥ 19[21]); a pre-operative Barthel index score of less than 10, incomplete data in the Barthel index pre- or post-surgery; orthopedic or neurologic conditions interfering with activities of daily living (such as paralysis or amputation); and those not having recovered from a coma and/or who were unable to communicate were excluded due to possible negative impact on ADL performance.

Measures used in the study

1. **The Thai version of the Barthel index** (score range: 0-100)

The Barthel index is an assessment tool used to evaluate patients' ability to help themselves in everyday activities. It is divided into ten basic tasks, each rated according to the level of help required.[22] The Barthel index assessment is widely used with older adults,[4-6,23] and has demonstrated acceptable reliability and good responsiveness.[23] A study of the Thai version of the Barthel index among older patients with hip fractures was found to have good accuracy and reliability.[24] In the present study, Barthel index scores were obtained via a face-to-face interviews pre-operatively and by phone interviews conducted by research coordinators four weeks post-surgery. The telephone interviews had excellent agreement with the face-to-face interviews (report weighted k = 0.9).[25]

2. **The Thai mental state examination (TMSE)**[26]

The TMSE is the Thai version of the Mini-Mental Status Examination (MMSE). The TMSE has been used extensively in the Thai population to screen for cognitive impairment and dementia. However, as dementia can negatively affect an older person's ability to help themselves and because the Barthel index may not accurately represent the abilities of patients with severe dementia,[28,29] the present study excluded older adults with severe dementia (TMSE ≤ 10).[27]

3. **The Thai version of the Patient Health Questionnaire (PHQ-9)**[20]

The PHQ-9 is used to screen for and classify the severity of depression. When used with older adults, the PHQ-9 can detect depression with results that are close to the 15-item Geriatric depression scale.[30] PHQ-9 scores range from 0 to 27. According to criteria set by the Department of Mental Health, Thailand, classifies depression as severe when the PHQ-9 score is ≥ 19.[21] The influence of depression on ADL ability in older adults has been found to be harmful when the depression was severe,[31] while the impact was less apparent when the degree of depression was unclassified.[32] Accordingly, older adults with a severe degree of depression were excluded from the study.

4. **The Thai version of the EuroQOL-5D-5L Questionnaire**

The EuroQOL-5D-5L Questionnaire, used to assess quality of life, is divided into two parts. The first part, the EQ-5D descriptive system, assesses perceived problems in five domains: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. The score of this section is reported as the EQ-5D-5L utility score (EQ-US). Scoring of this section was derived from an evaluation study of a set of the Thai population.[33] The second part, the EQ visual analog scale (EQ VAS), assesses a patient's overall health, and has a score range of 0-100.

Barthel index scores were recorded for 10 items pre-surgery and again four-weeks post-surgery. PHQ-9, TMSE and EuroQOL scores were recorded only before surgery. Other information collected included general baseline characteristics, type of surgery, and length of hospital stay.

Development of short-form versions of the Barthel index

The method used to develop the short-form version followed the procedure for developing an index for stroke patients used in a study by Hobart and Thompson.[17] The process of identifying items to be included in the short-form was as follows:

1. *Find corrected item-total correlations*

Corrected item-total correlations are the correlations between the item of interest and other items in the scale. For example, the corrected item-total correlation of "feeding" is the correlation between a "feeding" score and the sum of scores of nine other items. The items of interest, e.g., feeding, were excluded to ensure the correlations were unbiased. The correlations were computed using inter-item correlation reliability analysis. A high correlation indicates that the item correlates well with the construct measured by the Barthel index.

2. *Find the effect sizes of each item*

An effect size is a standardized change score which can be calculated from a mean change score per standard deviation (SD) of scores before and after surgery. A paired t-test was used to calculate the mean change score. A large effect size indicates good sensitivity to the responsiveness to change.

$$\text{Effect size} = \frac{\text{mean change score}}{\text{SD of a score before surgery}}$$

3. *Find the index of overall item superiority*

To develop an index of overall item superiority, values of corrected item-total correlations and effect sizes were arranged in descending order, with items with the highest value ranked first (a high corrected item-total correlation indicates a good correlation, and a high effect size represents good responsiveness). Then, cross-products of rank numbers of corrected item-total correlations and effect sizes of each item were calculated to create an index of overall item superiority. The cross-product with lower numbers indicates better items, so the lowest items were selected to be included in the short-form Barthel index.

Statistical methods

Data analysis was performed using the PASW Statistics version 18 for Windows (SPSS, Inc., Chicago, IL, USA).[34] Demographic and clinical data are presented as descriptive statistics. Categorical data are shown as numbers and percentages. Continuous data that were normally distributed are given as mean ± standard deviation, and those that were non-normally distributed are given as median and range. A paired t-test was used to calculate mean differences between pre-and post-surgery; results are presented with 95%CI. Categorical data were analyzed with a chi-square test. As changes in the Barthel index score can differ among the three types of surgery, the number of patients with negative score changes in each of the three surgery types was compared using the Fisher's Exact Test.

Because the total score of the original versions and the developed short-form versions differed, each form's total score needed to be equalized to enable direct comparisons among the tests. For that reason, the scores from all versions were re-calculated to have a maximum score of 20 using the formula;

$$\text{Transformed score} = \frac{\text{actual score X 20}}{\text{maximum possible score}}$$

To evaluate the psychometric properties of the newly developed short-form, internal consistency, representing reliability, was analyzed using Cronbach's alpha coefficients. An analysis of agreement between the short-form and the original version was conducted using the intraclass correlation coefficient (ICC). EQ-5D utility and VAS scores were chosen as a reference to find convergent validities. Pearson's correlation coefficient or Spearman's correlation coefficient were used to finding convergent validities, depending on the normality of data distribution. The ability of each form to respond to changes over time was determined by calculating mean differences between pre-and post-surgery using a paired t-test. Effect sizes and standardized response means were also calculated. Effect size is the mean difference divided by the standard deviation of Barthel index scores pre-surgery.[35] The standardized response mean is mean differences divided by the standard deviation of change scores. Results were considered statistically significant if the $p < 0.05$.

Results

The database of Siriraj Integrated Perioperative Geriatric Excellent Research Center (SiPG) registry during the study period included 1,523 older patients. Of those patients, 563 were scheduled for elective abdominal surgery, and 96 of those met the criteria and were included in the study.

The mean age of the participants was 70, and nearly two-thirds were male. Hypertension, musculoskeletal pain, dyslipidemia, and diabetes were the most prevalent co-morbidities. Most participants who screened positive for depres-

Table 1. Demographic and health characteristics of participants (N=96)

Characteristics	
Age (years), mean±SD	70.2±6.7
Female gender, n (%)	34 (35)
Co-morbidities*, n (%)	
Hypertension	63 (66)
Musculoskeletal pain (either at the hip or knee)	36 (38)
Dyslipidemia	34 (35)
Diabetes	29 (30)
Cardiac diseases	13 (14)
Previous stroke	7 (7)
CKD stage 4 or 5	3 (3)
Deep vein thrombosis	1 (1)
Other underlying diseases	39 (41)
No underlying diseases	2 (2)
ASA classification, n (%)	
2	60 (62)
3	36 (38)
Type of operation, n (%)	
Upper abdominal surgery	33 (34)
Lower abdominal surgery	28 (29)
Urological surgery	35 (37)
Length of stay (days), median (IQR**)	7 (5-11)
Pre-admission PHQ9 score, mean±SD	3.59±3.56
Score < 7, n (%)	81 (84)
Score 7-12, n (%)	12 (13)
Score 13-18, n (%)	3 (3)
EQ-5Dutility, mean±SD	0.87±0.15
EQ-5DVAS, mean±SD	71.27±16.17

CKD, Chronic kidney disease; ASA, The American Society of Anesthesiologists (ASA) physical status classification; SD, standard deviation
*No patients had pre-existing illnesses of dementia, asthma, or COPD
**IQR, interquartile range

sion were in the mild severity category. The health characteristics of participants are presented in Table 1.

Elective abdominal operations were classified into three main categories: upper abdominal surgery, lower abdominal surgery, and urological surgery; 34%, 29%, and 37% of patients, respectively, underwent each type of surgery which was not statistically significantly different. Of the upper abdominal surgeries, 82% (27/33) were hepatobiliary surgery. Other upper abdominal surgeries included pancreatic (3%, 3/33), small intestine (2%, 2/33), and gastric surgery (1%, 1/33). All patients who underwent lower abdominal surgery had colorectal surgery. Urological surgery operations included bladder (40%, 14/35), prostate (31%, 11/35), renal (26%, 9/35), and adrenal surgery (3%, 1/35).

The mean Barthel index score before surgery was 92.8, but it declined to 87.6 by four weeks post-surgery. The mean negative score change was -5.2 (95% CI -7.4 to -3.0, $p < 0.001$). Categorizing scores according to the degree of dependency[36] found the percentage of independent older patients (BI = 100) fell from 54.2% to 33.2%. Of the ten dependency items, those with statistically significant negative mean changes, in descending order, were stair climbing, bladder, toilet use, mobility, and bathing (Table 2).

As the type of surgery can influence changes in Barthel index scores, a comparison of the three types of surgeries was performed. When considering the total Barthel index score, the number of patients with negative score changes was predominant in urological operations (statistical significance p = 0.006). Each of the ten items was analyzed separately. The number of patients with negative score changes was similar or minimally different, but not statistically significant ($p > 0.05$) for all items except the bladder which statistically significantly worsened following urological operations (p = 0.001). Details of the urological surgeries were then explored. Among the 15 cases with bladder problems, six had undergone ileal conduit surgery, seven had received prostatectomy, and one had received a radical cystoprostatectomy with ileoneobladder, all of which can disrupt bladder function. After removing bladder operations from total Barthel index scores, there was little difference among the three categories of surgery (p = 0.89). Thus, the impact of surgery on the functional decline of each item could be considered equivalent.

The next step was to identify items to be included in the short-form. Corrected item-total correlations and effect sizes of each item were calculated and ranked as described in the method section. Then the cross-products were used to develop an index of overall item superiority (Table 3). Items with the lowest values in the index of overall item superiority were incorporated into the 3-item and the 5-item versions of the Barthel index. Both the 3-item and 5-item versions included toilet use, stair climbing, and bathing, while the 5-item version included two additional items: mobility and dressing. The scores of the fourth and fifth items were nearly identical, so the 4-item version was not studied.

Table 2. Barthel index scores at pre-surgery and four weeks post-surgery

Items in the BI (score range)	Pre-surgery mean±SD	Four weeks post-surgery mean±SD	Mean difference (95%CI)	p-value
Total BI score (0-100)	92.8±11.1	87.6±16.4	-5.2 (-7.4, -3.0)	< 0.001*
Toilet use (0-10)	9.8±0.9	9.2±2.4	-0.6 (-1.0, -0.2)	0.002*
Stair climbing (0-10)	9.3±2.5	7.6±4.2	-1.7 (-2.5, -0.9)	< 0.001*
Bathing (0-5)	4.7±1.1	4.3±1.7	-0.4 (-0.7, -0.1)	0.01*
Mobility (0-15)	14.3±2.4	13.8±3.5	-0.5 (-1.0, 0.0)	0.049*
Dressing (0-10)	9.8±1.0	9.6±1.3	-0.2 (-0.3, 0.0)	0.08
Bladder (0-10)	7.3±4.0	6.3±4.6	-1.1 (-2.0, -0.2)	0.02*
Feeding (0-10)	9.9±0.7	9.7±1.3	-0.2 (-0.4, 0.1)	0.26
Transfer (0-15)	14.6±1.9	14.5±2.1	-0.1 (-0.4, 0.2)	0.48
Grooming (0-5)	5.0±0.5	4.9±0.7	-0.1 (-0.2, 0.1)	0.32
Bowels (0-10)	8.0±3.7	7.6±4.0	-0.4 (-1.0, 0.2)	0.24

[a]Paired t-test, *$p < 0.05$

BI, Barthel index

Table 3. Analysis of the Barthel index score in the development of the short-form

BI items	Item-total correlations[a]		Effect size[b]		Overall item superiority	
	Value	Ranking	Value	Ranking	Value	Ranking
Toilet use	0.62	2	0.71	1	2	1.5
Stair climbing	0.63	1	0.66	2	2	1.5
Bathing	0.49	5	0.37	3	15	3
Mobility	0.51	4	0.22	5	20	4
Dressing	0.58	3	0.16	7	21	5
Bladder	0.24	10	0.27	4	40	6
Feeding	0.34	7	0.22	6	42	7
Transfer	0.43	6	0.06	10	60	8
Grooming	0.26	8	0.10	8	64	9
Bowels	0.25	9	0.10	9	81	10

The pattern of this table is from "The five-item Barthel index" in a study of Hobart and Thompson[9]
[a]Inter-item correlation reliability analysis, [b]mean difference divided by a standard deviation of Barthel index scores pre-surgery
BI, Barthel index

Table 4. Psychometric properties of the short-forms and the original Barthel index

	Pre-BI	Post-BI	Mean difference[a] (95%CI)	*p*-value	α[b]	ICC[c] (95%CI)	Convergent validity[d]		Effect sizes[e]	SRM[f]
							EQ-5D$_{utility}$, ρ	EQ-5D$_{VAS}$, ρ		
10-item BI (0-20)	18.6±2.2	17.5±3.3	-1.0 (-1.5, -0.6)	<0.001	0.67	-	0.25 (P=.01)	0.24 (P=.02)	-0.45	-0.48
5-item BI (0-20)	19.2±2.7	17.8±4.5	-1.4 (-2.0, -0.7)	<0.001	0.84	0.74 (0.61, 0.83)	0.26 (P=.01)	0.26 (P=.01)	-0.52	-0.41
3-item BI (0-20)	19.1±3.2	16.9±5.8	-2.2 (-3.1, -1.2)	<0.001	0.72	0.72 (0.60, 0.80)	0.19 (P=.06)	0.22 (P=.03)	-0.69	-0.46

[a]Paired t-test, [b]Cronbach's Alpha coefficients, [c]Intraclass correlation coefficient, [d]Spearman's rank correlation, [e]mean difference divided by a standard deviation of Barthel index scores pre-surgery, [f]mean differences divided by the standard deviation of change scores
BI, Barthel index; SRM, standardized response means

Psychometric properties of the short-form versions of the Barthel index

1. *Internal consistency*

The 10-item, 5-item, and 3-item Barthel indexes had Cronbach's alpha coefficients of 0.67, 0.84, and 0.72, respectively. Internal consistency of both short forms was superior to the original version, and both exceeded 0.70, which is considered acceptable.[37] This finding indicates that items in the short form version appear to be interrelated and hence, can measure the same constructs.

2. *Intraclass correlation coefficient (ICC)*

Agreement between the short-form and the original 10-item Barthel index version was analyzed using intraclass correlation coefficients. The ICCs of the 5-item version and the 3-item version are 0.74 (95%CI 0.61-0.83) and 0.72 (95%CI 0.60-0.80), respectively, which is a moderate degree of agreement (0.5-0.75).[38]

3. *Convergent validity*

Convergent validities of the Barthel index were determined by calculating correlations between EQ-5D-5L utility scores and VAS scores using Spearman's correlation coefficient as the data was distributed non-normally. The degree of correlation was interpreted as: < 0.3 = weak, 0.3-0.5 = fair, 0.6-0.8 = moderately strong, and ≥ 0.8 = strong.[39] All obtained correlation scores were within the range of 0.2-0.3, which is considered to indicate weak or negligible correlation.[40,41]

4. *Responsiveness to change*[35]

The degree of responsiveness to change was determined by calculating mean differences between pre-and post-surgery, effect sizes, and standardized response means (SRM). Effect sizes are mean differences divided by standard deviations of baseline scores, while SRMs are mean differences divided by standard deviations of change scores. Larger values reflect superior responsiveness. Both effect sizes and SRM were interpreted following Cohen: ≤ 0.2 = small, 0.5 = moderate, and ≥ 0.8 = large.[35,42] Effect sizes of both the short-forms were in the moderate range (effect size > 0.50).[35] The 3-item version had the largest effect size among the three versions (Table 4).

Discussion

We found that older adults showed a statistically significant decline in ADL four weeks after surgery compared to baseline. The most substantial drops were in stair climbing, bladder control, toilet use, mobility, and bathing. After statistically analysing the data, items with the best ranking in an index of overall superiority were identified and included in the short-form, including toilet use, stair climbing, bathing, mobility, and dressing. In terms of psychometric properties, both short-form versions demonstrated acceptable internal consistency, moderate agreement with the original version, and moderate responsiveness to change. However, both versions had weak convergent validities towards the quality-of-life score, similar to the original version.

Older people are at greater risk of physical deterioration and loss of functional independence after major surgery. The results of this study are in line with a study by Lawrence et al. which reported the largest drop in ADL summary scores occurring in the first week and continuing to decline approximately six weeks after surgery.[1] Older patients undergoing different surgeries/with different illnesses may lose the ability to perform different ADLs. The items with significant drops identified in this study were also commonly found in other conditions as well. Of the five items included in the short form, patients admitted to the intensive care unit were found to lose all five abilities.[7] In patients with acute medical illnesses, with the exception of stair climbing which was not included in the ADL assessment, the other four items were negatively affected.[43] In addition, after musculoskeletal tumor surgery patients showed a loss of ability to help themselves in mobility, bathing, and stair climbing.[8]

Internal consistency of both the short-forms exceeded the acceptable value and were superior to the original version. Items included in the short-form, particularly the first three items (toilet use, stair climbing, and bathing), require physical movement, may be proscribed after major abdominal surgery or profound deconditioning. This could help explain the higher degree of internal consistency of the short-form versions.

Agreement between the short-forms (5-item and 3-item) and the original version as measured by ICCs was moderate. The lower degree of agreement in this study could be due to the mean scores of the 10-item Barthel index being significantly lower than the 5-item and 3-item Barthel index ($p < 0.001$ and $p < 0.001$). In addition, the bowel and bladder function scores were relatively low, neither of which were included in the short-form versions, resulting in a significant mean difference between the original and the short-form and a lower ICC.

Convergent validities between the Barthel index and EQ-5D-5L scores were low or negligible (ρ 0.25, $p = 0.01$ for 10-item BI; ρ 0.26, $p = 0.01$ for 5-item BI; ρ 0.19, $p = 0.06$ for 3-item BI). Correlations between the Barthel index scores and EQ-VAS scores in older patients with hip fractures (r-value 0.28, $p < 0.001$)[44] and stroke patients (ρ 0.24, $p < 0.001$)[45] were also weak. The low correlation could result from the fact that the two tests do not measure the same aspects. While the Barthel index evaluates only physical functions, the EQ-5D-5L measures multiple domains, including physical functions (mobility, self-care, usual activities), anxiety/depression, and pain/discomfort. Anxiety/depression and pain/discomfort in the EQ-5D-5L were found to have a lower correlation to the Barthel index than domains related to physical function in reports of studies of stroke and older adult patients.[46,47] Eighty-six percent (83/98) of the study's participants were pre-operatively diagnosed with malignancy which may have affected patients' anxiety/depression and pain/discomfort scores, items not assessed in the Barthel index, resulting in lower convergent validities.

Responsiveness to change is defined as the ability of a test to detect changes over time. Effect sizes and standardized response means are both commonly used to statistically report the level of responsiveness to change. The responsiveness of the Barthel index has been investigated in various disease populations such as multiple sclerosis (effect size = 0.37),[48] stroke (effect size = 0.95),[48] and older patients with hip fractures (effect size = 2.13).[44] The responsiveness of that instrument might vary depending on the diseases being investigated. Effect sizes of the Barthel index were found to be more prominent in stroke patients than in multiple sclerosis patients.[48] However, the present study is the first to report the effect sizes of the Barthel index in older adults after abdominal surgery. Of the three versions, the 3-item version has the largest effect size, which is considered moderate (effect size = 0.69), and has an SRM value comparable to the original version, indicating that the 3-item version is the most responsive.

Assessing the ability to perform ADLs of older patients before and after surgery allows healthcare personnel to detect lost functions, provide treatment, and restore patients to a self-supporting state. In assessing patients, a concise assessment tool should be used in practice.

Assessing older patients' ability to perform ADLs before and after surgery assists healthcare personnel to detect lost functions, to provide appropriate treatment, and help restore patients to a self-supporting state. This study found that both the 5-item and the 3-item version can help in that regard. This study found that the 5-item version has higher internal consistency, while the 3-item version has superior responsiveness to change. Both versions have a comparable agreement with the original version.

In the effort to develop a shorter and more practicable assessment tool that could be used in older patients undergoing elective abdominal surgery, the new short form has some limitations. First, the short-form might only be applicable to older adults with near or total independence in self-care activities pre-operation as our mean Barthel index score was high. Second, the convergent validity of the Barthel index should be investigated using other measurements in addition to the EQ-5D-5L as it assesses multiple domains rather than just physical functions. Additionally, a prospective study investigating the practicability of the 3-item Barthel index and evaluating its psychometric properties in actual practice is needed.

Conclusion

We recommend the use of the 3-item Barthel index as a screening tool for detecting functional changes in older adults undergoing abdominal surgery because of its superior responsiveness to change. In addition, the short version requires less assessment time and is less of a burden on patients, making it more suitable for clinical use.

Disclosure

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