

Diagnostic performance of the de Morton Mobility Index versus the Barthel Index in identifying self-care dependency among older adults in long-term care

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Article

Keywords: aged, DEMMI, long-term care, mobility limitation, self care dependency, diagnostic accuracy

Posted Date: July 24th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-9701034/v1>

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Additional Declarations: No competing interests reported.

Abstract

Maintaining independence in self-care is a major objective in geriatric long-term care; however, commonly used assessment tools may have limited sensitivity in individuals with severe mobility impairment. Although the Barthel Index is widely applied in clinical practice, its ability to differentiate among older adults with substantial functional decline remains uncertain. This cross-sectional study examined the diagnostic performance of the de Morton Mobility Index (DEMMI) and the Barthel Index in 83 residents of long-term care facilities, using the Katz Index as the reference standard for self-care dependency. Receiver operating characteristic analysis identified optimal cut-off values of 38.5 for the DEMMI and 52.5 for the Barthel Index for distinguishing between independent older adults and those requiring moderate or substantial assistance in self-care. Both instruments demonstrated good-to-excellent discriminative ability, although the DEMMI showed a slightly higher area under the curve (90.9%) than the Barthel Index (86.8%). A floor effect was observed only for the Barthel Index, whereas the DEMMI demonstrated a broader distribution of scores at lower mobility levels. These findings suggest that, despite comparable overall discriminative performance, the DEMMI may provide advantages in assessing older adults with severe mobility limitation, thereby supporting more precise individualized care planning and interdisciplinary decision-making in long-term care settings.

Introduction

The quality of life for older adults is strongly influenced by their ability to maintain independence in self-care. One of the central prerequisites for self-care is safe and effective mobility, which can be defined as the capacity to change body position and to move from one place to another [1, 2].

Within the framework of the World Health Organization's International Classification of Functioning, Disability and Health (ICF), mobility refers to changes in the body's position or location [3–5].

This concept encompasses a continuum of abilities, ranging from basic postural adjustments (e.g., turning in bed, moving from lying to sitting) to more complex forms of locomotion and movement within the broader physical environment [6].

In clinical and long-term care settings where older adults with restricted mobility, particularly bedridden patients, receive care, healthcare professionals such as nurses and physiotherapists primarily aim to preserve or restore basic mobility functions. Their work focuses on maintaining or improving essential mobility abilities, including movement in bed, mobility while seated, and the ability to change position within the limited space around the bed [7, 8].

In geriatric care, maintaining mobility is a key objective of multidisciplinary teamwork and is commonly assessed using a range of standardized instruments and scales. However, many traditional assessment tools show limited discriminatory power among individuals with very low levels of mobility and often exhibit a floor effect. In such cases, the instruments are not sensitive enough to detect small but

clinically meaningful differences in residual movement capacity for those with marked mobility decline [9, 10].

Today, the Barthel Index is widely used in geriatric practice to assess independence and the mobility skills that underlie it, such as transferring and walking [11, 12].

However, it may demonstrate a floor-effect in individuals with severely limited mobility, as it is insufficiently sensitive to detect residual functional capacity in this population [13].

In contrast, the de Morton Mobility Index (DEMMI), developed in 2007, provides a broader assessment range, as it can be applied not only to ambulatory individuals, but also to those who are chair-bound or bedridden [14].

Within the framework of evidence-based nursing and patient care, the adoption of new measurement instruments should primarily be guided by evidence regarding their measurement properties and diagnostic accuracy [15].

The measurement properties of the DEMMI have been extensively examined across different language versions and clinical settings, with studies consistently demonstrating strong validity and reliability [16–20].

Despite this evidence, important gaps remain regarding the clinical utility of the DEMMI for care planning and resource allocation. In particular, limited information is available on its sensitivity in identifying older adults who require moderate to substantial assistance with self-care (e.g., individuals with a Katz Index score below 5, considered functionally dependent and typically associated with higher care needs), as well as on its specificity in identifying those who remain independent in self-care (e.g., individuals with a Katz Index score of at least 5, who generally require little or no external support) [21].

Clarifying these diagnostic performance characteristics is not merely a methodological issue. Accurate identification of care needs is essential for the effective allocation of limited human and material resources: ensuring that individuals who require support receive it, while avoiding unnecessary interventions for those who remain independent. Accordingly, mobility assessment tools used in geriatric care should demonstrate adequate sensitivity and specificity to support both clinical decision-making and efficient service planning [22].

Mobility represents a key resource for self-care and is closely linked to older adults' independence, identity, and quality of life. In long-term care settings, an important goal is to maintain independence in everyday activities – such as getting out of bed, walking short distances, toileting, dressing, and participating in meals – for as long as possible. However, multimorbidity, frailty, cognitive decline, and environmental barriers may limit mobility and increase the need for assistance, often leading residents to become progressively more dependent over time [23, 24].

The core principles of person-centred care are grounded in promoting care users' well-being and safeguarding their autonomy by enhancing their ability to participate in decisions regarding their own care. This approach also emphasizes the relational aspects of care, fostering respect, trust, and mutual understanding between care users and caregivers. Person-centred care involves recognizing the individual beyond the diagnosis and tailoring care to personal needs, preferences, values, and daily routines. When care is delivered in this way, it contributes to the preservation of dignity and the improvement of quality of life. Mobility plays a crucial role in maintaining independence, self-esteem, participation in everyday life, and the ability to retain control over personal life choices. Therefore, a person-centred nursing approach actively seeks to preserve and promote mobility in order to support individuals' freedom and independence for as long as possible [25].

Quick and accurate assessment of mobility is crucial in long-term care, since mobility can change rapidly and even small declines may lead to falls, loss of confidence, and increased dependence. A timely and reliable evaluation provides staff with a clear, shared understanding of what a person can safely do at a given time, ensuring that the level of support is appropriate – neither insufficient nor unnecessary restrictive. In practice, however, delivering truly individualized, person-centred care can be challenging [7, 26, 27].

Many long-term care facilities face structural challenges, including staffing shortages, high turnover, and a workforce that may include less experienced or insufficiently trained staff. These factors can reduce the time available for care, weaken continuity, and make teamwork and shared learning more difficult – particularly when it comes to recognizing changes in residents' conditions and adjusting support accordingly.

Despite these challenges, regular mobility assessments using a precise, rapid, and standardized scale remains a practical and effective strategy. It can provide structure for care processes, support teamwork in setting priorities, facilitate appropriate care planning, and enable the monitoring of functional changes over time. In this way, mobility assessment contributes to greater consistency and safety of care while supporting person-centred practice by tailoring assistance to each resident's current abilities and needs.

Therefore, our study was guided by the following research questions (RQ):

- RQ1: Using the DEMMI and the Barthel Index, what cut-off values best distinguish between older adults who are independent in self-care and those requiring moderate or substantial assistance?
- **RQ2: Which instrument distinguishes between these two groups with greater accuracy?**
- RQ3: Which instrument provides more detailed assessment of mobility in older adults living in long-term care facilities?

Based on these research questions, the research objectives (RO) were as follows:

- RO1: to determine the DEMMI and Barthel Index cut-off values that distinguish independent older adults from those requiring moderate or substantial assistance with the highest possible sensitivity and specificity.
- RO2: to compare the diagnostic performance of the DEMMI and Barthel Index, including sensitivity, specificity, and overall diagnostic accuracy.
- RO3: to determine the floor effect of the DEMMI and the Barthel Index. Previous studies have reported floor effects ranging from 0 to 18.2% for the Barthel Index and from 0 to 39% for the DEMMI.

Methods

Sample

Participants in this cross-sectional study were recruited from residents aged 60 years and older living in three long-term care facilities.

Participants were excluded if they: 1) had sensory aphasia; 2) had documented contraindications to mobilization; 3) were in isolation due to infection; 4) had sensory or cognitive communication impairments preventing understanding or execution of test instructions; or 5) were expected to die in the near future.

Eligible participants were randomly selected and provided written informed consent after receiving detailed information.

We informed them of their right to withdraw from participation at any stage of the research. This study was conducted in accordance with the principles of the 2008 revision of the Declaration of Helsinki and was approved by the Regional Research Ethics Committee of Semmelweis University (approval number: SE RKEB: 132/2023).

Measurements

Data collection was conducted between June and August 2024. Sociodemographic (age, sex, length of stay) and health-related data (body weight, height, Mini-Mental State Examination [MMSE] scores, and comorbidities used to calculate the Charlson Comorbidity Index) were retrospectively extracted from routine nursing documentation. MMSE scores were used exclusively for descriptive characterization of the sample and the MMSE was not administered by the research team as part of the present study [28,29].

To compare the diagnostic performance of the Barthel Index and the DEMMI, participants' mobility was assessed using both instruments.

The Barthel Index consists of 10 items assessing independence in activities of daily living, including feeding, personal hygiene, toileting, bathing, and dressing. It also evaluates basic mobility functions (walking on flat ground, stair climbing), as well as bowel and bladder continence. Although some items overlap with the Katz Index, the Barthel Index extends beyond basic daily activities to include mobility, particularly walking and stair use. Each item is scored on a 2- or 3-point scale, with total scores can ranging from 0 to 100, where higher scores indicate greater independence. Information on self-care performances was obtained from care staff [30,31].

The DEMMI comprises 15 items of increasing difficulty and assesses mobility across bed-based mobility, chair-based, and ambulatory activity, as well as static and dynamic balance. Eleven items are scored dichotomously (0 or 1), while four tasks are scored on a three-point scale (0 – 2) based on predefined criteria. The raw ordinal score (0–19) is converted to an interval scale ranging from 0 to 100 using a standardized conversion table [14,20].

Self-care ability was assessed using the six-item Katz Index, which bathing, dressing, using toileting, transferring, continence, and feeding. Each item was scored dichotomously: 1 for independent performance and 0 for dependence, based on the predefined criteria [32].

Each item was scored dichotomously: 1 for independent performance and 0 for dependence, based on the predefined criteria. Total scores (0–6) were used to dichotomize participants. Those scoring 5 or 6 were classified as independent (Katz Index ≥ 5), requiring no or minimal assistance, while those scoring below 5 were classified as dependent (Katz Index < 5), requiring moderate or substantial assistance [21].

The measurements were performed by a physiotherapist with 25 years of experience in geriatric physiotherapy, with the assistance of a physiotherapy student.

Statistical analyses

Continuous variables are presented as medians with first and third quartiles due to skewed distributions, while categorical variables are reported as absolute and relative frequencies.

Group differences in demographic (sex, age, length of stay) and clinical characteristics (BMI, MMSE score, Charlson Comorbidity Index, and use of assistive devices), as well as in mobility scores (Barthel Index and DEMMI), were analysed between participants classified as independent (Katz Index ≥ 5) and dependent (Katz Index < 5) using Mann–Whitney U tests or chi-square tests, as appropriate.

Receiver operating characteristic (ROC) analysis was performed to evaluate the ability of the DEMMI and the Barthel Index to discriminate between independent and dependent participants. Optimal cut-off values for both instruments were determined by maximizing the Youden index (sensitivity + specificity –

1), identifying the threshold that provided the best balance between sensitivity and specificity. Discriminative ability was further assessed by calculating the area under the ROC curve (AUC) [33].

Based on ROC-derived cut-off values, contingency tables were constructed for both instruments. True positives were defined as participants classified as dependent by the DEMMI or Barthel Index (scores below the cut-off) and by the Katz Index ($Katz < 5$). True negatives were defined as participants classified as independent by both the index test (scores above the cut-off) and the Katz Index ($Katz \geq 5$). False positives were those classified as dependent by the DEMMI or Barthel Index but independent according to the Katz Index, while false negatives were those classified as independent by the DEMMI or Barthel Index but dependent according to the Katz Index (Table 1) [34].

Table 1. Cross tabulation of DEMMI / Barthel Index and Katz Index results

		Katz Index	
		positive	negative
DEMMI / Barthel Index	positive	true positive	false positive
	negative	false negative	true negative

Diagnostic performance was assessed using sensitivity, specificity, overall diagnostic accuracy, and discriminative ability, quantified as the area under the receiver operating characteristic curve (AUC). Confidence intervals (95%) were calculated for all diagnostic performance measures.

In general, sensitivity reflects the ability of a measurement instrument to correctly identify individuals with the condition of interest. In the present study, sensitivity indicates how accurately the DEMMI and the Barthel Index identify older adults who are dependent in self-care, i.e., whose who require external assistance ($Katz < 5$ points).

Specificity, in contrast, reflects the ability of an instrument to correctly identify individuals without the condition of interest. In this study, specificity indicates how accurately the DEMMI and the Barthel Index identify older adults who are independent in self-care, i.e., those requiring no or only minimal assistance. ($Katz \geq 5$ points) [33].

Diagnostic accuracy represents the proportion of correctly classified cases, indicating how accurately the DEMMI and the Barthel Index distinguish between older adults who require moderate or substantial assistance in daily life and those who require no or minimal support. AUC values were interpreted as excellent (≥ 0.9), good (0.8–0.9), acceptable (0.7–0.8), poor (0.6–0.7), or fail (< 0.6) [35].

Floor effects were assessed by calculating the proportion of participants achieving the lowest possible score on each instrument; values exceeding 15% were considered indicative of a floor effect. Violin plots with embedded box plots were used to visualize score distributions and to support the identification of potential floor effects [36].

Statistical analyses and visualizations were performed using IBM SPSS Statistics (Version 18.0; IBM Corp., Armonk, NY, USA) and JASP (Version 0.19.3). AUC values were compared using MedCalc Software (MedCalc Software Ltd., Ostend, Belgium) [37].

Sample size was estimated using an online calculator. Assuming a sensitivity of 85%, a prevalence of dependence of 71%, a dropout rate of 10%, and a type I error of 5%, a minimum sample size of 84 participants was required [38–40].

The level of statistical significance was set a priori at 0.05.

Results

Descriptive analyses

A total of 732 individuals were assessed for eligibility. Of these, 275 were excluded based on the exclusion criteria: 13 had sensory aphasia, 8 had documented contraindications to mobilization, 138 had sensory or cognitive impairment that precluded completion of the assessments. 18 had active infections, and 32 were considered to be in the terminal phase of illness. In addition, 66 individuals declined participation. Following eligibility assessment, 457 individuals met the inclusion criteria, of whom 90 were randomly enrolled in the study. Subsequently, 7 participants withdrew before completion of the assessments, resulting in a final analytical sample of 83 participants.

A total of 55.4% of participants (n=46) were classified as dependent in self-care. The dependent group had a significantly lower BMI, and a significantly higher proportion of non-ambulatory individuals (Table 2).

Table 2. Characteristics of the participants and comparisons between the groups of participants (dependent versus independent).

	Dependent Katz Index < 5 n=46	Independent Katz Index ≥ 5 n=37	P value
Age (years); <i>Mdn</i> (Q_1 ; Q_3)	79 (76; 87)	79 (76; 87)	0,143
LOS (month) <i>Mdn</i> (Q_1 ; Q_3)	26,5 (12; 57,75)	30 (13; 56,5)	0,378
Female, n (%)	13 (23%)	20 (54%)	0,024
BMI ^c , kg/m ² ; <i>Mdn</i> (Q_1 ; Q_3)	23,5 (19,8; 26,3)	27,3 (24,5; 31,5)	0,003
MMSE ^d , scores <i>Mdn</i> (Q_1 ; Q_3)	25 (19; 28)	26 (22,5; 29)	0,484
CCI (scores) <i>Mdn</i> (Q_1 ; Q_3)	6 (4,75; 7)	5 (4; 7)	0,086
Use of walking aids			
Able to walk without aids, n (%)	0 (0%)	19 (51%)	< 0,001
Stick; n (%)	0 (0%)	7 (19%)	0,002
Frame /rollator; n (%)	6 (13%)	11 (30%)	0,312
Unable to walk; n (%)	37 (80%)	0 (0%)	< 0,001

Abbreviations: LOS, Length of Stay (in the institution); BMI, body mass index; CCI, Charlson Comorbidity Index; MMSE, Mini-Mental State Examination; *Mdn*, Median Note: Q_1 , lower quartile; Q_3 , upper quartile

A significant and large between-group difference was observed in the DEMMI scores. Older adults requiring moderate or substantial assistance in self-care (Katz Index < 5) had significantly lower DEMMI scores than those who were independent or required only minimal assistance (Katz Index ≥ 5) ($U = 237$; $Z = -5.688$; $p < 0.001$; $r = 0.624$) (Table 3).

Table 3. Mobility features of dependent and independent groups

	Independent Katz Index ≥ 5 N=37	Dependent Katz Index < 5 N=46	P value
DEMMI (scores) <i>Mdn</i> (Q_1 ; Q_3)	67 (47; 74)	30 (24; 33)	$p < 0,001$
Barthel Index (scores) <i>Mdn</i> (Q_1 ; Q_3)	80 (42,5; 92,5)	10 (0; 30)	$p < 0,001$

Mdn, Median Note: Q1, lower quartile; Q3, upper quartile

In line with these findings, the distribution of DEMMI scores (Figure 1) showed a broader spread within the dependent group, indicating that the instrument captures variability even at lower levels of mobility.

Similarly, a significant and large between-group difference was observed for the Barthel Index. Participants requiring moderate or substantial assistance in self-care (Katz Index < 5) had significantly lower Barthel Index scores than those who were independent or required only minimal assistance (Katz Index ≥ 5) (U = 218; Z = -5.837; p < 0.001; r = 0.640) (Table 3).

Visual inspection of the score distribution (Figure 2) revealed a marked clustering of values at the lower end among dependent participants, supporting the presence of a floor effect.

Results for Research Question 1 (RQ1): *What cut-off values should be used for the DEMMI and the Barthel Index to distinguish between older adults who are independent in self-care and those requiring moderate or substantial assistance?*

The ROC analysis identified optimal cut-off value of 38.5 for the DEMMI and 52.5 for the Barthel Index. Participants scoring below these thresholds were classified as positive.

Diagnostic performance of the DEMMI

Using the Katz Index as the reference standard, the DEMMI classified 51 participants as positive (42 true positives and 9 false positives) and 32 as negative (28 true negatives and 4 false negatives) (Table 4).

Table 4. Cross tabulation of DEMMI and Katz Index results

		Katz Index		
		Positive	Negative	Total
DEMMI	Positive	42	9	51
	Negative	4	28	32
Total		46	37	83

The DEMMI demonstrated a sensitivity of 0.913 (95% CI: 0.792–0.975) and a specificity of 0.757 (95% CI: 0.588–0.882) for identifying participants classified as dependent (Katz Index < 5). Discriminative ability was excellent, with an area under the curve (AUC) of 0.909 (95% CI: 84.5–97.2), and the overall diagnostic accuracy was 84.3% (95% CI: 77.81-90.78) (Table 5).

The ROC curve differed significantly from the reference line, indicating that the area under the curve was significantly greater than 0.5 (Figure 3).

Table 5. Diagnostic performance of DEMMI and the Barthel Index

Instrument	Sensitivity	Specificity	Accuracy (%)	AUC
DEMMI	0.913	0.756	84.3	0.909
Barthel Index	0.869	0.729	80.7	0.868

Diagnostic performance of the Barthel Index

According to the Barthel Index classification, 50 participants were classified as positive (40 true positives and 10 false positives), while 33 were classified as negative (27 true negatives and 6 false negatives) (Table 6).

Table 6. Cross tabulation of Barthel Index and Katz Index results

		Katz Index		
		Positive	Negative	Total
Barthel Index	Positive	40	10	50
	Negative	6	27	33
	Total	46	37	83

The Barthel Index demonstrated a sensitivity of 0.869 (95% CI: 0.737–0.951) and a specificity of 0.729 (95% CI: 0.558–0.862) for identifying participants classified as dependent (Katz Index < 5). Discriminative ability was good, with an area under the curve (AUC) of 0.868 (95% CI: 79.1–94.5), and the overall diagnostic accuracy was 80.7% (95% CI: 73.65–87.75) (Table 5).

The ROC analysis showed that the curve deviated significantly from the reference line, with the area under the curve significantly greater than 0.5 (Figure 3)

Results for Research Question 2 (RQ2): *Which instrument distinguishes between these two groups with greater accuracy?*

The diagnostic performance of the DEMMI and Barthel Index, as well as the results of the ROC analysis, are presented in Figure 3 and summarized in Table 5. Comparison of the AUC values showed no statistically significant difference between the two instruments ($z=0.725$, $p=0.468$), indicating comparable overall discriminative ability.

Results for research question 3 (RQ3): *Which instrument provides more detailed assessment of mobility in older adults living in long-term care facilities?*

Using the Barthel Index, a floor effect was detected. As for the Barthel Index, 13 participants (16% of the sample) out of a sample of 83 received a score of 0, while in the case of DEMMI, none of the participants received a score of 0. Consistent with these results, the distribution plots (Figures 1–2) demonstrated a

broader spread of DEMMI scores across lower mobility levels, whereas the Barthel Index showed clustering at the lower end, indicating a floor effect.

Discussion

Within the framework of evidence-based nursing and patient care, the implementation of a new measurement instrument in clinical practice should be guided not only by its measurement properties, but also by its diagnostic performance. Accordingly, the present study aimed to examine the diagnostic characteristics of the DEMMI, a mobility assessment tool with previously established psychometric robustness.

In line with these aims, optimal cut-off values were first identified for both the DEMMI and the Barthel Index to distinguish between older adults who are independent in self-care and those requiring moderate or substantial assistance. The results indicated that 38.5 points for the DEMMI and 52.5 points for the Barthel Index provided the best balance between sensitivity and specificity.

Comparison of diagnostic performance revealed no statistically significant differences between the two instruments. Nevertheless, the DEMMI demonstrated a more favourable balance between sensitivity, specificity, as well as a numerically higher overall diagnostic accuracy. Importantly, a floor effect was observed only for the Barthel Index, whereas the DEMMI showed no such limitation. This is also reflected in the distribution of scores, where the DEMMI preserved variability in lower ranges, unlike the Barthel Index. Together, these findings suggest that, despite comparable overall discriminative ability, the DEMMI may offer advantages in differentiating among individuals with very low levels of mobility, including those with impaired bed-mobility and greater dependency in self-care. This enhanced resolution may support more individualized assessment and care planning, which are central to person-centred care in long-term care settings.

Mobility is a key determinant of self-care ability and therefore plays a central role in defining the level of nursing and caregiving needs. Accurate assessment of residents' functional independence is of particular importance in clinical decision-making and resource allocation [41–43].

While extended observation may provide the most comprehensive understanding of functional status, the DEMMI, requiring only a short administration time, can already provide a highly sensitive and specific indication of expected care needs even when only limited information is available about a newly admitted resident [41–43].

From a clinical perspective, accurate identification of individuals requiring assistance is critical. High sensitivity ensures that those in need of support are correctly identified, while adequate specificity reduces the risk of unnecessary interventions. In this context of person-centred care, such precise assessment is essential for tailoring interventions to individual functional capacities and needs. The diagnostic characteristics observed for the DEMMI therefore support its applicability in optimizing individualized care planning and improving the allocation of human and material resources [41–43].

Mobility is closely linked to independence in activities of daily living and overall quality of life in long-term care populations [44,45].

Declining mobility accelerates functional deterioration and increases care dependency, thereby contributing to greater care complexity and workload. Regular and precise mobility assessment is therefore essential for preserving functional capacity and preventing avoidable decline [46].

Effective management of mobility requires close interdisciplinary collaboration between nurses and physiotherapists. While physiotherapists primarily focus on the assessment, improvement, and rehabilitation of movement capacity, nurses play a key role in integrating mobility into daily care activities [47].

This collaboration relies on shared conceptual frameworks and coordinated communication, which can be effectively supported by standardized assessment tools. In this context, structured mobility assessment contributes to a common professional language, thereby facilitating person-centred, interdisciplinary care planning [48,49].

Collaborative work between nurses and physiotherapists constitutes a fundamental component of person-centred care, which is increasingly recognized as a key approach in maintaining quality of life among older adults in long-term care settings [50].

In this context, important conceptual differences exist between the instruments examined. The Katz Index primarily assesses care dependency through basic activities of daily living, whereas the Barthel Index extends this evaluation by incorporating selected mobility-related tasks. However, this partial overlap may obscure the distinction between functional dependency and mobility when the two instruments are used together.

In contrast, the DEMMI provides a focused and comprehensive assessment of mobility across a wide functional spectrum, ranging from bed mobility to higher-level balance and ambulation. Consequently, the combined use of the DEMMI and when used alongside the Katz Index, it allows for may offer a clearer conceptual separation between care dependency and mobility capacity.

The present findings indicate that, although the diagnostic performance of the DEMMI is comparable to that of the Barthel Index, the DEMMI provides more detailed information on mobility in older adults with substantial functional decline. This added granularity may enhance clinical decision-making and support more targeted intervention planning.

Limitations

This study has several limitations. First, the cross-sectional design precludes causal or predictive inferences regarding functional decline or recovery. Second, the sample was drawn from three long-term care facilities, which may limit the generalizability of the findings.

Third, the exclusion of individuals with contraindications to mobilization, as well as those with severe communication or cognitive impairments (including sensory aphasia) that limited their ability to understand or perform the assessment tasks, may have introduced selection bias, thereby restricting the applicability of the results to more complex or clinically vulnerable populations.

Conclusion

The present findings of this study suggest that the DEMMI represents a clinically valuable instrument for the assessment of mobility in older adults residing in long-term care settings. Its application may contribute to more precise identification of functional and rehabilitation needs, thereby supporting more efficient allocation of limited healthcare resources.

The use of the DEMMI may also support the implementation of function-oriented care models by providing objective and detailed information on mobility performance. In addition, it facilitates improved coordination between nursing and physiotherapy staff, thereby enhancing the quality of care and the effectiveness of rehabilitation processes.

Although the DEMMI demonstrated diagnostic performance comparable to that of the Barthel Index, its more favourable balance between sensitivity and specificity, together with the absence of a floor effect, suggests potential advantages in clinical practice. In particular, its ability to capture a wider range of mobility functions indicates that it may be better suited for assessing individuals with severe impairment, including those with limited bed mobility and greater dependence in self-care.

Based on these findings, the DEMMI may be considered a valuable complementary or alternative instrument to the Barthel Index in long term care settings, particularly when used alongside the Katz Index to support a more differentiated assessment of mobility and dependency.

Beyond its diagnostic performance, the use of the DEMMI may also support the implementation of person-centred, function-oriented care models by providing objective and detailed information on individual mobility profiles.

Declarations

Author contributions:

K.L. was involved in the study design, execution and data collection of the study.

A.S. was involved in the study conception, statistical analysis design and/or execution and interpretation, preparing the first draft of the manuscript and critical revision of the manuscript.

ZS.GY. was involved in the study conception and design, execution and data collection of the study.

J.S. was involved in the study conception and design, execution, and data collection of the study and critical revision of the manuscript.

A.ZS.K. was involved in the study conception and design and critical revision of the manuscript.

É.K. was involved in the study conception and design, participated in statistical analysis design and execution and interpretation and prepared the first draft of the manuscript.

Funding: Open access funding provided by Semmelweis University. This research did not receive any specific grant from funding agencies in the public, commercial, or not for profit sectors.

Competing interests: The authors declare no competing interests.

Ethics approval and consent to participate: The study protocol was approved by the Semmelweis University Regional and Institutional Committee of Science and Research Ethics (SE RKEB: 132/2023). We conducted the study in accordance with ethical principles and the Helsinki Declaration. All participants gave written informed consent after being informed of the aims and procedures of the study.

Consent for publication: Not applicable.

Additional information

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References

1. Jung, H., Tanaka, S., Iwamoto, Y., Yamasaki, M. & Tanaka, R. Relationship between mobility-related activities of daily living and health-related quality of life among healthy older adults: a cross-sectional study using structural equation modeling. *Gerontol Geriatr. Med* **7**, (2021).
2. Mayo, N. E. & Mate, K. K. V. Quantifying mobility in quality of life in Quantifying Quality of Life - Incorporating Daily Life into Medicine (eds Wac, K. & Wulfovich, S.) (Springer Cham, (2022).
3. Boonen, A. & Maksymowych, W. P. Measurement: function and mobility (focussing on the ICF framework). *Best Pract. Res. Clin. Rheumatol.* **24**, 605–624 (2010).
4. González-Seguel, F., Corner, E. J. & Merino-Osorio, C. International classification of functioning, disability, and health domains of 60 physical functioning measurement instruments used during the adult intensive care unit stay: a scoping review. *Phys. Ther.* **99**, 627–640 (2019).
5. *International Classification of Functioning, Disability and Health: ICF*. (World Health Organization, Geneva, (2001).
6. Moulton, E., Wilson, R. & Deluzio, K. Movement and mobility. *Adv. Nurs. Sci.* **42**, E11–E23 (2019).
7. Narsakka, N., Suhonen, R., Groot, B. & Stolt, M. Promoting activity and mobility in long-term care environments: a photo-elicitation study with older adults and nurses. *J. Clin. Nurs.* **32**, 8078–8094

- (2023).
8. Yang, Y. et al. Recreational therapy to promote mobility in long-term care: a scoping review. *J. Aging Phys. Act.* **29**, 142–161 (2021).
 9. Soubra, R., Chkeir, A. & Novella, J. L. A systematic review of thirty-one assessment tests to evaluate mobility in older adults. *Biomed Res. Int.* 1–17 (2019). (2019).
 10. Soares Menezes, K. V. R., Auger, C., de Souza Menezes, W. R. & Guerra, R. O. Instruments to evaluate mobility capacity of older adults during hospitalization: a systematic review. *Arch. Gerontol. Geriatr.* **72**, 67–79 (2017).
 11. Caronni, A. & Scarano, S. Generalisability of the Barthel index and the functional independence measure: robustness of disability measures to differential item functioning. *Disabil. Rehabil.* **47**, 2134–2145 (2025).
 12. Martín Moreno, V. et al. Proposal for a revised Barthel index classification based on mortality risk assessment in functional dependence for basic activities of daily living. *Front Public. Health* **12**, (2025).
 13. de Morton, N. A., Berlowitz, D. J. & Keating, J. L. A systematic review of mobility instruments and their measurement properties for older acute medical patients. *Health Qual. Life Outcomes.* **6**, 44 (2008).
 14. de Morton, N. A., Davidson, M. & Keating, J. L. The de Morton mobility index (DEMMI): an essential health index for an ageing world. *Health Qual. Life Outcomes.* **6**, 63 (2008).
 15. Swan, K. et al. Measuring what matters in healthcare: a practical guide to psychometric principles and instrument development. *Front Psychol* **14**, (2023).
 16. Braun, T. et al. Reliability and validity of the German translation of the de Morton mobility index (DEMMI) performed by physiotherapists in patients admitted to a sub-acute inpatient geriatric rehabilitation hospital. *BMC Geriatr.* **15**, 58 (2015).
 17. Jans, M. P. et al. Reproducibility and validity of the Dutch translation of the de Morton mobility index (DEMMI) used by physiotherapists in older patients with knee or hip osteoarthritis. *Arch. Phys. Med. Rehabil.* **92**, 1892–1899 (2011).
 18. Yürük, Z. Ö. et al. Acceptability, reliability and validity of the Turkish version of the de Morton mobility index (DEMMI) in elderly patients with knee osteoarthritis. *Turk J. Geriatr* **17**, (2014).
 19. Zupanc, A., Vidmar, G., Novak, P. & Puh, U. Feasibility of de Morton mobility index for adult patients of all ages at low and basic functioning level: a study using the Slovenian translation. *Int. J. Rehabil Res.* **42**, 352–357 (2019).
 20. Gyombolai, Z. et al. Validation of the de Morton mobility index for measuring mobility related activities in Hungarian institutionalized older adults. *Sci. Rep.* **15**, 26840 (2025).
 21. Gerrard, P. The hierarchy of the activities of daily living in the Katz index in residents of skilled nursing facilities. *J. Geriatr. Phys. Ther.* **36**, 87–91 (2013).

22. Kotschy, R. & Bloom, D. E. A comparative perspective on long-term care systems. *Int. Soc. Secur. Rev.* **75**, 47–69 (2022).
23. Fierro-Marrero, J., Reina-Varona, Á., Paris-Aleman, A. & La Touche, R. Frailty in geriatrics: a critical review with content analysis of instruments, overlapping constructs, and challenges in diagnosis and prognostic precision. *J. Clin. Med.* **14**, 1808 (2025).
24. Tasioudi, L. et al. The impact of frailty and geriatric syndromes on the quality of life of older adults receiving home-based healthcare: a cross-sectional survey. *Healthcare* **11**, 82 (2022).
25. Zhang, S., Yin, Z. & Zhang, G. Long-term care models in geriatric nursing: a comparative analysis and recommendations for optimal care. *J. Innov. Med. Res.* **2**, 10–18 (2023).
26. Taylor, J., Hill, H. & Kay, K. An integrated practice approach to mobility care for older people. *Nurs. Stand.* **30**, 51–60 (2016).
27. Elsayed, S. M., Ali Ibrahim, A. M., Alkubati, S. A., Atta, M. H. R. & Monged, H. H. Critical care nurses' and physicians' knowledge, attitudes, and self-reported behaviors in mobilizing older adult patients: implications for optimizing geriatric care. *BMC Nurs.* **24**, 1173 (2025).
28. Folstein, M. F., Folstein, S. E. & McHugh, P. R. Mini-mental state. A practical method for grading the cognitive state of patients for the clinician. *J. Psychiatr Res.* **12**, 189–198 (1975).
29. Charlson, M. E., Pompei, P., Ales, K. L. & MacKenzie, C. R. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J. Chronic Dis.* **40**, 373–383 (1987).
30. Mahoney, F. I. & Barthel, D. W. Functional evaluation: the Barthel index. *Md. State Med. J.* **14**, 61–65 (1965).
31. Shirley Ryan AbilityLab. Rehabilitation Measures Database. (2024).
<https://www.sralab.org/rehabilitation-measures/barthel-index>
32. Wallace, M. & Shelkey, M. Hartford Institute for Geriatric Nursing. Katz index of independence in activities of daily living (ADL). *Urol. Nurs.* **27**, 93–94 (2007).
33. Dhamnetiya, D., Jha, R. P., Shalini, S. & Bhattacharyya, K. How to analyze the diagnostic performance of a new test? Explained with illustrations. *J. Lab. Physicians.* **14**, 090–098 (2022).
34. Shreffler, J. & Huecker, M. R. *Diagnostic Testing Accuracy: Sensitivity, Specificity, Predictive Values and Likelihood Ratios*. StatPearls Publishing, (2026). Available from:
<https://www.ncbi.nlm.nih.gov/books/NBK557491/>
35. Nahm, F. S. Receiver operating characteristic curve: overview and practical use for clinicians. *Korean J. Anesthesiol.* **75**, 25–36 (2022).
36. Xiaoli, L. & Floor effect in *The ECPH Encyclopedia of Psychology* 539–540 Springer Nature Singapore, (2024).
37. MedCalc Software Ltd. Comparison of AUC of independent ROC curves. (2025).
https://www.medcalc.org/en/calc/comparison_of_independentROCtest.php
38. Cologne, G. Institute for Quality and Efficiency in Health Care (IQWiG). In brief: sensitivity and specificity. (2025). <https://www.informedhealth.org>

39. Challis, D. Dependency in older people recently admitted to care homes. *Age Ageing*. **29**, 255–260 (2000).
40. Portela, D., Almada, M., Midão, L. & Costa, E. Instrumental activities of daily living (iADL) limitations in Europe: an assessment of SHARE data. *Int. J. Environ. Res. Public. Health*. **17**, 7387 (2020).
41. Goto, R. & Haruta, J. The process of transprofessional collaboration: how caregivers integrated the perspectives of rehabilitation through working with a physical therapist. *Fam Med. Community Health*. **8**, e000378 (2020).
42. Kongkar, R. et al. The impact of interdisciplinary team-based care on the care and outcomes of chronically ill patients: a systematic review. *J. Multidiscip Healthc*. **18**, 445–457 (2025).
43. Amer, I. A. et al. The role of physiotherapy in mobility, nursing in daily care, and nutrition in cognitive and physical recovery. *J. Int. Crisis Risk Commun. Res*. **7**, 2055–2058 (2024).
44. Bourret, E. M., Bernick, L. G., Cott, C. A. & Kontos, P. C. The meaning of mobility for residents and staff in long-term care facilities. *J. Adv. Nurs*. **37**, 338–345 (2002).
45. Courtney, M. D. et al. A randomised controlled trial to prevent hospital readmissions and loss of functional ability in high risk older adults: a study protocol. *BMC Health Serv. Res*. **11**, 202 (2011).
46. Berger, B., Graeb, F., Baumann, M. & Wolke, R. Becoming bedridden and being bedridden: implications for nursing and care for older people in long-term care: a scoping review. *Int J. Older People Nurs* **20**, (2025).
47. Muslih, A. M. A. et al. Promoting mobility and independence: best practices in physiotherapy and nursing collaboration. *J. Namibian Stud*. **32**, 2326–2336 (2022).
48. Kuluski, K., Ho, J. W., Hans, P. K. & Nelson, M. L. Community care for people with complex care needs: bridging the gap between health and social care. *Int J. Integr. Care* **17**, (2017).
49. Ernstmeyer, K. & Christman, E. *Nursing Skills* (Chippewa Valley Technical College, 2024).
50. Kogan, A. C., Wilber, K. & Mosqueda, L. Person-centered care for older adults with chronic conditions and functional impairment: a systematic literature review. *J Am. Geriatr. Soc* **64**, (2016).

Figures

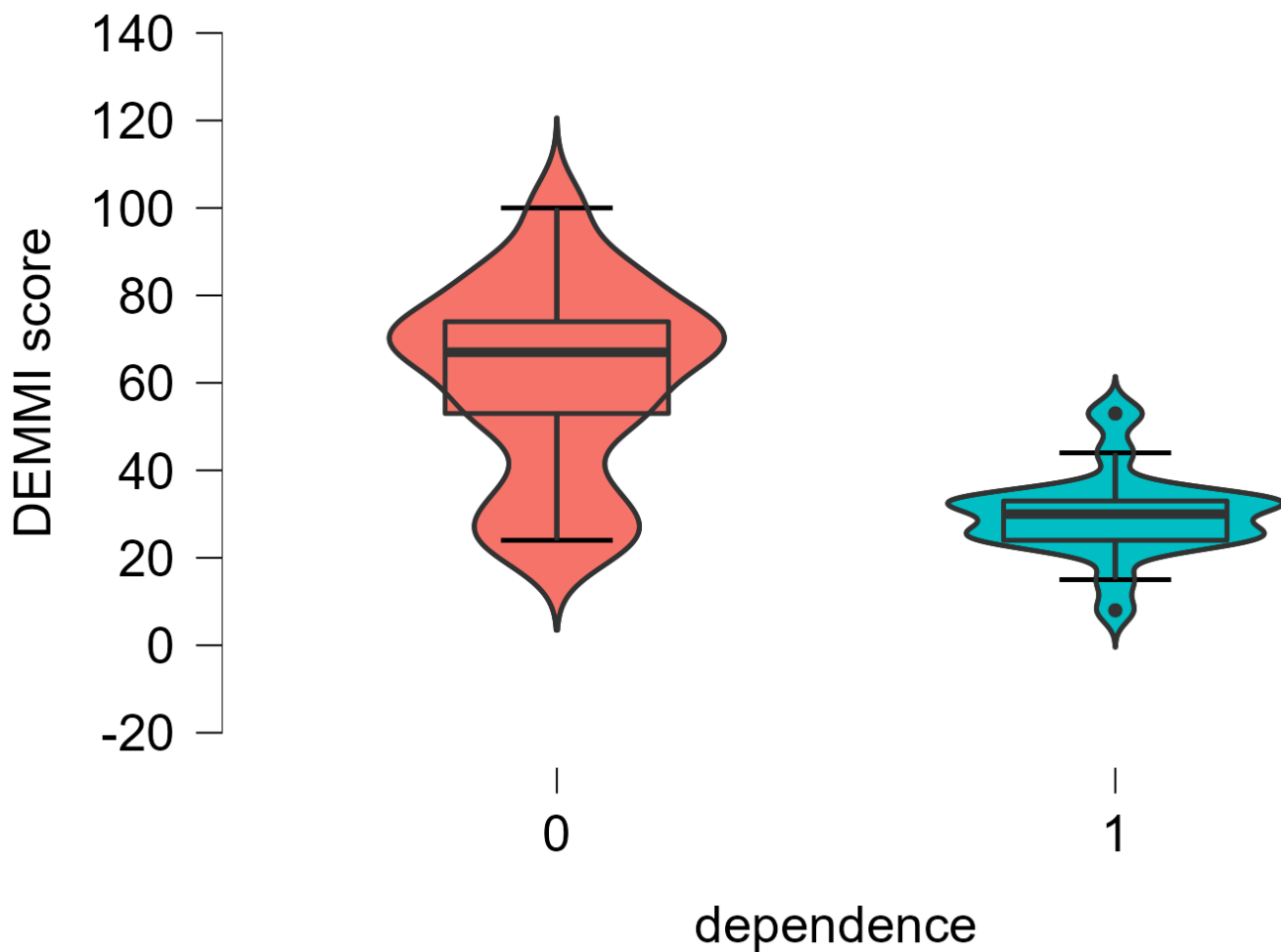


Figure 1

Distribution of DEMMI scores in independent (0; Katz Index ≥ 5) and dependent (1; Katz Index < 5) older adults. Violin plots represent the distribution of scores based on kernel density estimation, with embedded box plots indicating the median and interquartile range (Q1–Q3). The wider spread of scores in the dependent group reflects the ability of the DEMMI to capture variability across lower levels of mobility, including individuals with substantial functional limitations.

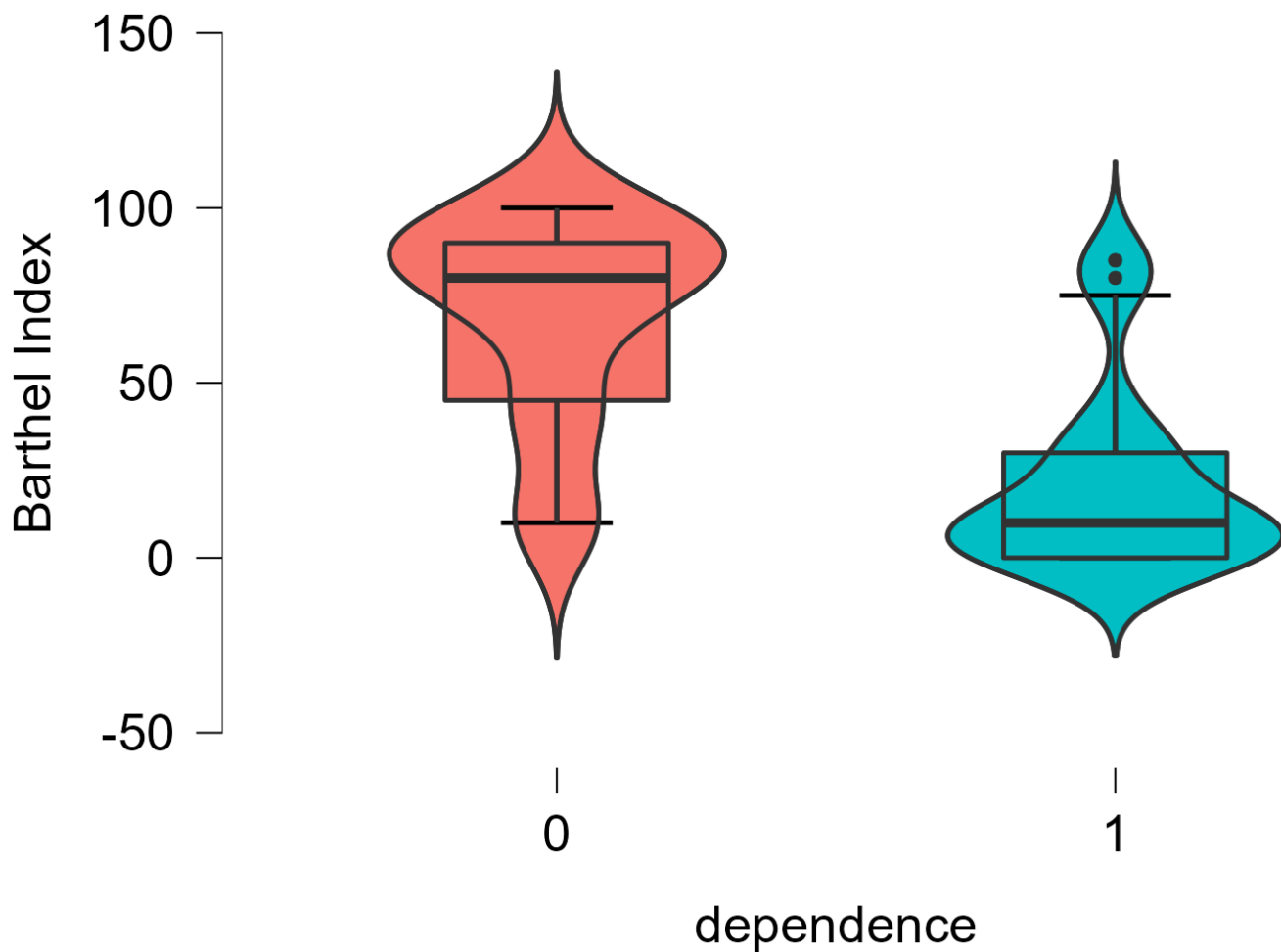


Figure 2

Distribution of Barthel Index scores in independent (0; Katz Index ≥ 5) and dependent (1; Katz Index < 5) older adults. Violin plots represent the distribution of scores based on kernel density estimation, with embedded box plots indicating the median and interquartile range (Q1–Q3). The clustering of scores at the lower end in the dependent group is consistent with the observed floor effect.

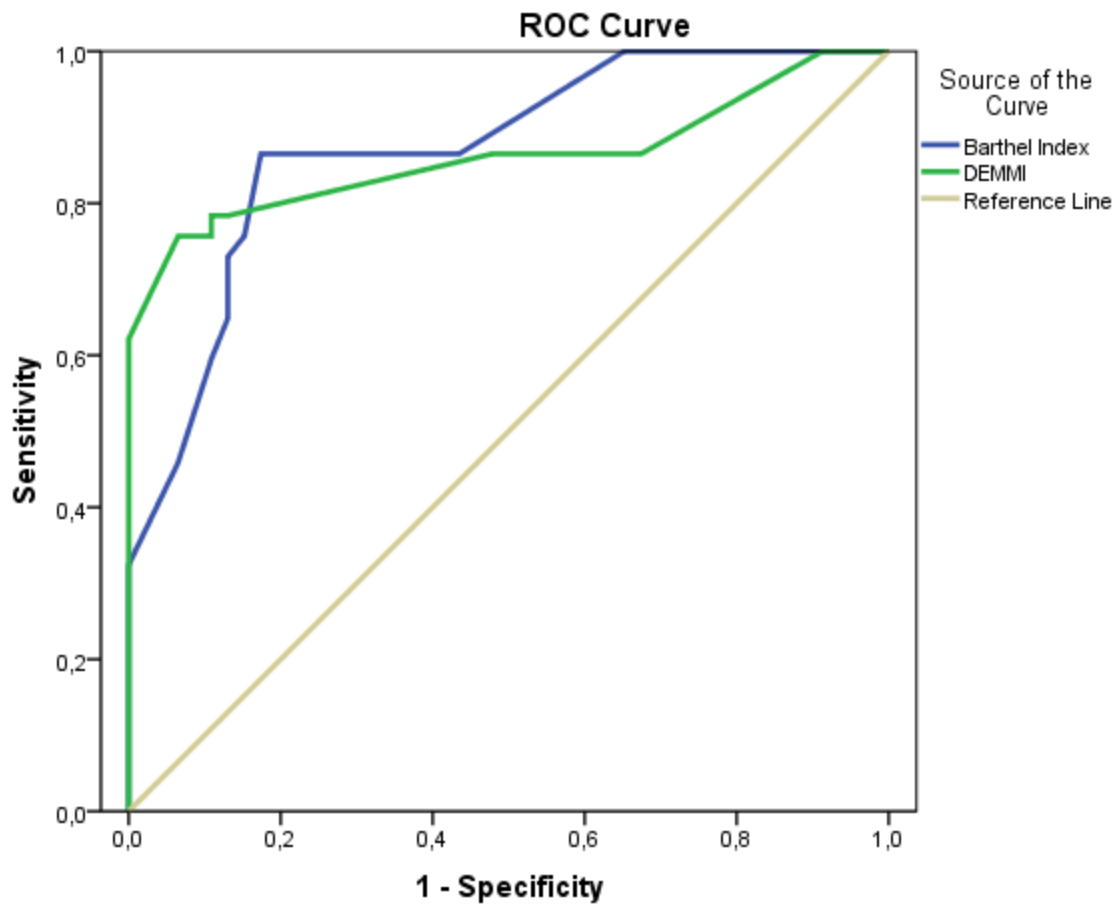


Figure 3

Receiver operating characteristics (ROC) curves of the DEMMI and Barthel Index for discriminating between independent (Katz Index ≥ 5) and dependent (Katz Index < 5) older adults.