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Differences in physical function across dementia subtypes and cognitive decline: a cross-sectional study

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Abstract

Cognitive impairment significantly affects physical function in dementia patients, but variations across dementia types and levels of cognitive decline remain unclear. This retrospective cross-sectional study included 874 patients (80.75±8.00 years; 60.4% female) with different dementia types and cognitive impairment levels. Six physical function tests were administered: the De Morton Mobility Index (DEMMI), 6-minute walking test (6MTW), 10-meter walking test (10MWT), hand grip strength (HGS), 30-second chair stand (30sSTS), and the timed "Up & Go" test (TUG). Cognitive function was assessed using the Mini-Mental State Examination (MMSE). The Mild Cognitive Impairement (MCI) group outperformed Alzheimer's Dementia (AD) and Vascular Dementia (VaD) on DEMMI, 30sSTS and HGS (p <0.001, η^2=0.012 to 0.052). Differences in the 6MWT were significant in ANOVA but disappeared after adjusting for sex and age (p=0.066). Severe cognitive impairment was linked to significantly lower physical performance across all measures (p <0.001, η^2=0.037 to 0.064). Physical function profiles vary by dementia type and cognitive decline level, highlighting the need for targeted interventions to address specific physical challenges.

Key Words: physical function, cognitive impairment, dementia, geriatric psychiatry, older adults.

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Dementia is a rapidly increasing global burden, particularly among the aging population. According to the Global Burden of Disease[1] estimates, the number of people living with dementia is expected to triple by 2050 due to demographic shifts and an aging global population. Currently, dementia prevalence increases significantly with age, affecting 13.5% to 35.9% of people aged 80-84 and over 90, respectively.[2] Dementia is an acquired, chronic syndrome that impairs multiple higher cortical functions, including memory, thinking, orientation, comprehension, calculation, learning capacity, language, and judgment.[3] Beyond cognitive deficits, dementia also negatively impacts physical function.[4]

The connection between cognitive decline and physical function is evident in gait speed, often referred to as the "6th vital sign" due to its ability to predict outcomes such as fall risk, mortality, dependency in self-care, disability in Activities of Daily Living (ADLs), and cognitive decline over five years.[5] Individuals with slower gait speed are more likely to experience steeper cognitive decline and develop dementia.[6] For instance, compared to cognitively intact controls, gait speed reduction in people with cognitive impairment, mild dementia, and moderate dementia was 0.11 m/s, 0.20 m/s, and 0.41 m/s, respectively.[7] Furthermore, functional mobility assessed through the timed "Up & Go" test (TUG) in cognitively impaired older adults was found to be an independent risk factor for 12-month mortality.[8] Moreover, exercise capacity has been positively associated with memory performance in older adults with Mild Cognitive Impairment (MCI).[9] Sampaio *et al.*[10] found that cardiorespiratory endurance had the strongest relationship with cognition in older adults, followed by upper body strength, which explained 7.4% and 7.2% of the variance in cognitive function, respectively.

Muscle mass may also play a critical role in the development of dementia. Low appendicular lean mass has been linked to greater cognitive decline over three years in individuals aged 45 to 85 years.[11] Similarly, sarcopenia—loss of muscle mass and strength—is associated with an increased risk of developing dementia and lower cognitive function.[12] Evidence suggests that a 5-kg decrease in Handgrip Strength (HGS) is associated with a 16% increase in

the risk of developing all-cause dementia in men and a 14% increase in women.[13] In older adults, greater lower extremity strength has been associated with a 34% reduction in the risk of low cognitive function.[14]

Changes in physical fitness also affect functional capacity, particularly in performing ADLs among older adults.[10] ADL performance in people with dementia is associated with alterations in gait parameters, including velocity, step length, stride length, and gait quality.[15] Better ADL performance is linked to higher health-related quality of life in people with dementia.[16] Given the growing evidence, identifying physical function deficits in patients with cognitive decline and dementia is crucial for initiating appropriate treatment strategies that address or prevent these deficits. Most studies have focused on institutionalized[10,15-17] and community-dwelling older adults with dementia[7,11-14,18] with few conducted in clinical settings,[8] and none specifically in geriatric psychiatric settings. Additionally, different types of dementia exhibit varying cognitive,[19] behavioral,[20] and motor symptoms.[21] Motor impairments are more commonly observed in patients with non-Alzheimer's disease (non-AD) dementias.[18,22-24] Most studies have focused on gait disorders, consistently finding that patients with Lewy Body Dementia (LBD), Parkinson's Disease Dementia (PDD),[24] Frontotemporal Dementia (FTD)[22], and Vascular Dementia (VaD)[23] experience greater gait and balance impairments compared to those with Alzheimer's Dementia (AD). When multiple types of dementia are examined, research often categorizes them broadly as AD and non-AD.[23] Beyond gait, previous studies suggest that AD patients tend to have better lower limb muscle strength compared to those with VaD and LBD, whereas no significant differences in handgrip strength have been found among these groups.[18] Distinguishing physical function deficits is crucial for optimizing dementia care. However, the limited available data highlight the need for further research in this area.

To our knowledge, this is the first study conducted in a clinical geriatric psychiatry setting that investigates physical function differences among different types of dementia. The second aim of this study is to determine physical function differences according to the level of cognitive decline. Understanding these differences that are specific to the underlying pathophysiology of each dementia type can help tailor therapeutic interventions and management strategies, adding importantly to the quality of life. Without this distinction, current treatment approaches that constitute good post diagnostic support may be overly generalized, potentially overlooking critical physical function challenges unique to each dementia subtype.

Materials and Methods

Participants

The study included 874 patients, aged 52 to 99, diagnosed with MCI, AD, VaD, PDD or LBD, and FTD. Participants were required to meet the following inclusion criteria: i) a diagnosis of any type of dementia or MCI and ii) admission to the Gerontopsychiatric Unit at the University Psychiatric Clinic Ljubljana. Patients were not excluded based on the presence of comorbidities. Patient information, including age, Body Mass Index (BMI), Mini Mental State Examination (MMSE) score, and diagnosis, was obtained from the clinic's database. All data were anonymized to ensure compliance with data protection standards.

Study design and procedures

A retrospective cross-sectional quantitative study was conducted from October 2020 to August 2023. The data were collected as part of an standardized clinical pathway for assessing physical functions in individuals with dementia admitted to the Gerontopsychiatric ward. Therefore, no specific consent for data processing was obtained. All collected data were anonymized prior to processing. Ethical approval was granted by the Commission for Ethical Issues at the University Psychiatric Clinic Ljubljana (reference number KEV/2023-03). The study was performed in accordance with the Declaration of Helsinki and its subsequent amendments.

Diagnosis protocol

Participants were classified into dementia subtypes—MCI, AD, VaD, PDD/LBD, and FTD—based on comprehensive evaluations conducted by experienced psychiatrists and neurologists. These evaluations included clinical interviews, neurological examinations, cognitive assessments (primarily MMSE), and neuroimaging (MRI or PET-CT). Diagnoses followed the NIA-AA 2018 framework[25] for AD and internationally established guidelines for other dementia subtypes, in accordance with the 10th edition of the International Classification of Diseases (ICD-10).[3]

For the second analysis, however, we focused solely on differences in cognitive decline, regardless of the specific diagnosis. Cognitive function was assessed using the Slovenian version of the MMSE, which evaluates orientation, attention, memory, language, and visuospatial skills, with a maximum score of 30 points.[26] Based on MMSE scores, participants were categorized into three groups: mild cognitive impairment (20-30 points), moderate cognitive impairment (11-19 points), and severe cognitive impairment (≤10 points). Given this classification, we included MCI within the mild cognitive impairment group. This approach was justified, as some patients diagnosed with AD, VaD, or PDD/LBD scored higher on the MMSE than those with MCI. It is well established that MMSE scores do not always correlate precisely with the severity of cognitive decline, particularly in cases of mild impairment.[27]

Assessments

Eligible participants underwent a series of six physical function tests administered by trained physiotherapists: the De Morton Mobility Index (DEMMI), 6-minute walking test (6MTW), 10-meter walking test (10MWT), hand grip strength (HGS), 30-second chair stand (30sSTS), and the TUG. When administering the tests, adaptations were made as needed, such as simplifying instructions or providing practical demonstrations. In many cases, multiple verbal prompts were used to guide the patient through the entire testing process. Breaks were incorporated whenever nec-

essary to ensure patient comfort. Each test was administered only once, with no repetitions performed, to avoid causing unnecessary fatigue for the patients.

De Morton Mobility Index

The DEMMI is a standardized tool for assessing patient mobility, covering 15 items that evaluate aspects such as bed and chair mobility, static and dynamic balance, and ambulation. Eleven items are rated on a 2-point scale, while the remaining four are rated on a 3-point scale. The raw scores, ranging from 0 to 19, are converted to interval-level DEMMI scores from 0 to 100, with higher scores indicating greater independence in mobility.[28]

6-minute walking test

The 6 MTW measures functional exercise capacity.[29] Participants were asked to walk at a comfortable pace for six minutes along a flat, straight, 25-meter corridor. If required, patients were allowed to use walking aids such as canes or walkers. During the test, patients could stop or slow down as needed and were encouraged to resume walking as soon as possible. The total distance covered was recorded. A 6MWT distance of less than 450 meters reflects impaired functional status.[30]

Timed 10-meter walk test

Gait speed was assessed using the 10MWT. Patients walked a 14-meter corridor at their preferred speed, with the middle 10 meters used to measure time, excluding the first and last 2 meters designated for acceleration and deceleration phases. The test completion time was recorded using a stopwatch. A gait speed of 0.8 m/s is considered a predictor of poor clinical outcomes, while a threshold of 0.6 m/s is used to anticipate further functional decline in older adults who are already impaired.[31]

Hand grip strength

HGS was measured using the Saehan Hydraulic Hand Dynamometer, set to the second handle position. Standardized protocols were followed: participants were seated with feet flat on the floor, shoulders adducted in neutral rotation, elbows flexed at 90°, forearms in a neutral position, and wrists in 15°-30° of extension and 0°-15° of ulnar deviation.[32] Scores below 25.8 kilograms for men and 17.4 kilograms for women suggest reduced mobility among community-dwelling older adults.[33]

Sit to stand

Lower extremity strength was evaluated using the 30sSTS.[34] Participants were seated in a standard chair (height: 45 cm) with their arms crossed over their chest and instructed to stand up and sit down as many times as possible within 30 seconds, starting on the command "go." The diagnostic cut-off scores for sarcopenia are 15 for females and 17 for males.[35]

Timed up and go test

The TUG assesses overall mobility and balance.[36] Participants began in a seated position, stood up, walked 3 meters at their preferred pace, turned around, returned to the chair, and sat down. The time taken to complete the test was recorded in seconds using a stopwatch. Use of walking aids was permitted, if necessary. Older adults who take more than 12 seconds to complete the test are at risk of significant hospitalization associated functional decline.[37]

Statistical analysis

The data are presented as means±standard deviations. The threshold for statistical significance was set at $\alpha<0.05$, and all analyses were carried out in SPSS statistical software (version 25.0, IBM, USA). Group comparisons were conducted with a univariate Analysis Of Variance (ANOVA) with group as single fixed factor. Additionally, an Analysis Of Covariance (ANCOVA) was conducted to control for age and sex. Prior to ANOVA and ANCOVA, assumptions of normality and homogeneity of variance were evaluated using the Shapiro-Wilk test and Levene's test, respectively. The assumptions for ANCOVA, including linearity and homogeneity of regression slopes, were also assessed and confirmed. Visual inspections of histograms and scatterplots were performed to further verify data distribution and the absence of outliers.The correlations were interpreted as follows: negligible ($r <0.1$), weak ($r=0.1$-0.4), moderate ($r=0.4$-0.7), strong ($r=0.7$-0.9), and very strong ($r >0.9$).[38]

Results

Study population

Of the 874 patients included in the study, 346 (39.6%) were male and 528 (60.4%) were female with an average age of 80.75±8.00 years and an average Body Mass Index (BMI) of 25.80±4.94 (BMI data was missing for 82 patients, or 9.4%). Among the participants, 113 (12.9%) had MCI, 497 (56.9%) were diagnosed with AD, 219 (25.1%) had VaD, 37 (4.2%) presented with PDD or LBD, and 8 (0.9%) were diagnosed with FDT. The MMSE was administered to 692 (79.2%) of the patients, revealing an average score of 16.65±7.14 points. Additionally, the degree of cognitive decline was determined through clinical examination for another 105 patients (12.0%), while the remaining 77 patients (8.8%) were included based on their clinical diagnoses. All participants were included in the comparison based on the level of cognitive decline; however, the 8 participants diagnosed with FDT were excluded from the dementia subtype analysis due to the small sample size.

Differences between types of dementia

Significant differences in physical performance measures were observed across cognitive impairment and dementia groups. For the dementia subgroups, DEMMI, 30sSTS, and HGS demonstrated statistically significant differences after adjustment for sex and age ($p <0.001$), with effect sizes ranging from small to moderate ($\eta 2=0.012$ to 0.052). Notably, MCI group showed higher performance than AD and VaD. Similarly, 6MWT showed a significant group effect in ANOVA ($F=6.24$; $p <0.001$, $\eta 2=0.022$), but not after ad-

justing for sex and age (p=0.066). Performance on 10MWT and TUG was not significantly different among groups. These results imply significant differences in performance and function across dementia subtypes, and suggest some outcome measures may be more sensitive to detect these differences (Tables 1 and 2).

Differences between levels of cognitive impairment

When comparing levels of cognitive impairment, individuals with severe cognitive impairment exhibited notably lower performance across all measures compared to those with mild and moderate impairment. DEMMI, 30sSTS, HGS, and TUG were significantly lower in the severe group (p <0.001), with effect sizes ranging from η^2=0.037 to 0.064. ANCOVA further confirmed these differences after adjustment for sex and age. In contrast to the first analysis, the 6MWT and 10MWT also showed significant differences both in ANOVA and ANCOVA (p <0.05). These results suggest that there is a progressive decline in physical performance associated with increasing severity of cognitive impairment, reflected in decline in all outcome measures in this study (Tables 3 and 4).

Table 1. *Descriptive statistics by dementia type and results of ANOVA.*

Variable	Mild cognitive impairment [M±SD]	Alzheimer's dementia [M±SD]	Vascular dementia [M±SD]	Parkinson's/ lewy body dementia [M±SD]	Analysis of variance (ANOVA) F	p	Eta2
DEMMI [points]	67.27±21.32	56.01±22.38	57.19±20.76	57.69±25.52	8.151	**<0.001***	0.022
30sSTS [stands]	6.12±4.66	4.00±4.19	3.94±4.30	5.29±5.50	8.505	**<0.001***	0.029
HGS [kg]	19.65±10.89	12.92±8.97	14.77±9.68	16.35±8.74	14.800	**<0.001***	0.052
6 MWT [m]	229.5±145.74	177.36±132.10	173.25±124.85	226.00±158.74	6.249	**<0.001***	0.022
10 MWT [s]	18.03±13.42	23.21 ±18.68	25.18±30.66	27.93±63.51	2.394	0.067	0.009
TUG [s]	22.61±8.59	28.53±22.34	29.84±23.52	30.85±38.06	2.562	0.054	0.010

DEMMI, de Morton mobility index; 30sSTS, 30 second sit to stand HGS, hand grip strength; 6MWT, 6 minute walking test; 10MWT, 10 meter walking test; TUG, timed up and go test; M, mean; SD, standard deviation.

Table 2. *Descriptive statistics by dementia type and results of ANCOVA.*

Variable	Mild cognitive impairment [M±SD]	Alzheimer's dementia [M±SD]	Vascular dementia [M±SD]	Parkinson's/ lewy body dementia [M±SD]	Adjusted for sex and age (ANCOVA) F	p	Eta2
DEMMI [points]	67.27±21.32	56.01±22.38	57.19±20.76	57.69±25.52	3.448	**0.016***	0.012
30sSTS [stands]	6.12±4.66	4.00±4.19	3.94±4.30	5.29±5.50	4.513	**0.004***	0.016
HGS [kg]	19.65±10.89	12.92±8.97	14.77±9.68	16.35±8.74	6.998	**<0.001***	0.025
6 MWT [m]	229.5±145.74	177.36±132.10	173.25±124.85	226.00±158.74	2.404	0.066	0.009
10 MWT [s]	18.03±13.42	23.21 ±18.68	25.18±30.66	27.93±63.51	1.884	0.138	0.007
TUG [s]	22.61±8.59	28.53±22.34	29.84±23.52	30.85±38.06	1.418	0.236	0.006

DEMMI, de Morton mobility index; 30sSTS, 30 second sit to stand; HGS, hand grip strength; 6MWT, 6 minute walking test; 10MWT, 10 meter walking test; TUG, timed up and go test; M, mean; SD, standard deviation.

Table 3. *Descriptive statistics by levels of cognitive decline and results of ANOVA.*

Variable	Mild cognitive impairment [M±SD]	Moderate cognitive impairment [M±SD]	Severe cognitive impariment [M±SD]	Analysis of variance (ANOVA)		
				F	p	Eta2
DEMMI [points]	63.87±23.06	60.48±20.06	51.16±22.25	19.988	**<0.001***	0.046
30sSTS [stands]	5.82±4.77	4.62±4.35	2.91±3.69	22.624	**<0.001***	0.052
HGS [kg]	17.97±10.16	14.81±9.30	11.27±8.78	23.33	**<0.001***	0.056
6 MWT [m]	219.60±149.92	192.07±130.88	160.75±121.35	9.263	**<0.001***	0.022
10 MWT [s]	19.02±16.35	22.35±24.01	27.57±31.02	5.486	**0.004***	0.014
TUG [s]	21.52±18.91	27.69±21.97	33.38±25.95	11.722	**<0.001***	0.030

DEMMI, de Morton mobility index; 30sSTS, 30 second sit to stand; HGS, hand grip strength; 6MWT, 6 minute walking test; 10MWT, 10 meter walking test; TUG, timed up and go test; M, mean; SD, standard deviation.

Table 4. *Descriptive statistics by levels of cognitive decline and results of ANCOVA.*

Variable	Mild cognitive impairment [M±SD]	Moderate cognitive impairment [M±SD]	Severe cognitive impariment [M±SD]	Adjusted for sex and age (ANCOVA)		
				F	p	Eta2
DEMMI [points]	63.87±23.06	60.48±20.06	51.16±22.25	16.077	**<0.001***	0.037
30sSTS [stands]	5.82±4.77	4.62±4.35	2.91±3.69	18.894	**<0.001***	0.016
HGS [kg]	17.97±10.16	14.81±9.30	11.27±8.78	26.618	**<0.001***	0.064
6 MWT [m]	219.60±149.92	192.07±130.88	160.75±121.35	2.404	**0.003***	0.014
10 MWT [s]	19.02±16.35	22.35±24.01	27.57±31.02	4.548	**0.011***	0.012
TUG [s]	21.52±18.91	27.69±21.97	33.38±25.95	9.098	**<0.001***	0.024

DEMMI, de Morton mobility index; 30sSTS, 30 second sit to stand; HGS, hand grip strength; 6MWT, 6 minute walking test; 10MWT, 10 meter walking test; TUG, timed up and go test; M, mean; SD, standard deviation.

Discussion

The aim of this study was to examine physical function differences among patients with MCI, AD, VaD, and PPD or LBD in a clinical geriatric psychiatry setting. Additionally, we investigated physical function differences across varying levels of cognitive impairment, including mild, moderate, and severe cognitive impairment. As physical function is a multi-faceted concept it was assessed using a comprehensive battery of six physical tests: DEMMI, 30sSTS, HGS, 6MWT, 10MWT, and TUG, which collectively measure six primary domains of physical function: general mobility, lower extremity strength, upper extremity strength, cardiorespiratory endurance, gait speed, and functional mobility. Our findings reveal distinct physical function patterns among the different types and severities of dementia. Specifically, patients with AD and VaD showed greater physical function deficits compared to those with MCI, particularly in the domains of general mobility, cardiorespiratory endurance, and upper and lower extremity strength. Conversely, no significant physical function differences were found in patients with PDD or LBD compared to the other dementia types. As hypothesized, when comparing severity of cognitive impairment, it showed a clear trend of reduced physical function as cognitive impairment progressed, affecting all six domains.

Previous longitudinal evidence suggests a steeper decline in mobility in individuals with both AD and non-AD com-

pared to those who remained cognitively healthy.[4] In addition, functional impairment, as measured through informant reports of ADLs, is more severe in people with dementia than in those with MCI.[39] Our study demonstrates notable differences in general mobility between patients with AD and VaD compared to those with MCI, using the DEMMI which assesses bed and chair mobility, ambulation, and static and dynamic balance,[28] which are critical components for performing ADLs. People with mild AD often require assistance with ADLs, while those with MCI generally do not, despite some difficulties in performing these tasks[40] However, when comparing patients with AD to those with VaD, greater limitations in ADL performance have been observed in patients with VaD.[41] In our study, we did not find significant differences in general mobility between dementias, which could be attributed to varying levels of cognitive impairment as measured by MMSE scores.

Improvements in cardiorespiratory fitness have been shown to positively impact brain structure and function, such as increases in hippocampal volume and white matter integrity,[42] and midlife fitness is associated with a lower risk of dementia later in life.[43] Our results suggest that patients with less severe cognitive impairment exhibited better cardiorespiratory endurance than those with moderate or severe cognitive impairment, underscoring the close relationship between cardiorespiratory endurance and cognitive function observed in prior studies.[9,10] However, no significant differences in cardiorespiratory endurance were observed across different types of dementia, suggesting that the relationship may be more closely tied to the severity of cognitive impairment rather than the type of dementia. This lack of variation between dementia types could be attributed to a predominantly sedentary lifestyle prior to hospitalization. In fact, previous studies have shown that older adults typically spend an average of 7.7 to 9.0 hours per day engaged in sedentary activities.[44] Therefore, our findings highlight the potential value of cardiorespiratory exercise as a modifiable factor in maintaining cognitive health, in particular for the patients with higher levels of cognitive decline.

The prevalence of sarcopenia among patients with dementia is as high as 65%[45] and is associated with the severity of cognitive impairment[12] indicating that muscle mass and muscle strength play a significant role in cognitive impairment. Our study found that patients with MCI had significantly greater upper and lower extremity strength than those with AD or VaD. When comparing across levels of cognitive impairment, we observed that greater muscle strength was consistently found in those with milder impairment, suggesting that muscle strength may be an important indicator of physical function in relation to cognitive health. This aligns with findings from a large cohort study indicating that lower extremity strength is associated with better global cognitive performance among community-dwelling older women.[46] Additionally, the authors established that the «five-times sit-to-stand» test can serve as a screening tool for cognitive decline, where completing the test in under 15 seconds made the presence of moderate cognitive impairment unlikely. Similarly, previous studies have emphasized the significance of HGS as a valuable screening tool, as it may serve as an early, non-cognitive marker of cognitive decline or dementia.[47] A combination of low HGS and a slow walking pace has been found to correlate with the highest risk of developing dementia, even when adjusting for several potential confounders such as physical activity, dietary patterns, hypertension, depression, diabetes, and a family history of dementia.[48] Our findings contribute to this growing body of evidence by highlighting the importance of assessing muscle strength in dementia care. Our results also emphasize the need for individually-tailored strength-based interventions that address the unique physical challenges associated with each dementia subtype.

Regarding gait speed, previous research has found that gait speed and increased gait variability are strongly associated with lower Montreal Cognitive Assessment test scores in both single-task and dual-task conditions, indicating a significant relationship between gait and cognitive function in older adults.[49] Furthermore, slower gait speed is linked to a steeper cognitive decline over time.[6] Similarly, poorer performance on the TUG has been shown to increase the risk of developing dementia by 1.34-fold.[50] In our study, we observed that patients with severe cognitive impairment took longer to complete both the 10MWT and the TUG compared to those with mild cognitive impairment. However, when comparing patients with moderate and severe cognitive impairment, differences were only found for the TUG, not the 10MWT. This discrepancy can likely be attributed to the complexity of the TUG, which involves multiple components such as standing, walking, and turning, proved to be a more complex task compared to a straightforward 10MWT. Supporting this, a functional magnetic resonance imaging study demonstrated that prefrontal brain activation correlated with TUG performance, but not with simple walking.[51] When evaluating performance on the 10MWT and TUG among different types of dementia, we did not observe significant differences. Previous studies suggest that patients with non-amnestic MCI and non-AD experience greater gait decline than patients with amnestic MCI and AD.[52] This inconsistency between our results and previous studies may be due to differences in the study sample, specific dementia subtypes and variations in disease progression among participants. Moreover, the sensitivity of these tests can be influenced by cognitive impairment and the adjustments made during their administration, such as offering practical demonstrations and providing multiple verbal prompts to guide the patient throughout the testing process.[53]

Overall, our study's strengths include the use of multiple quantitative physical function measures in a large sample of patients with varying types of dementias and severities of cognitive impairment. However, several limitations must be noted. First, the study's cross-sectional design limits the ability to infer causal relationships or track physical function changes over time. Second, the retrospective nature of data collection resulted in some missing information, such as BMI and MMSE scores. Moreover, potential confounding variables, such as medication use, comorbidities, and lifestyle factors, were not controlled for, which may have influenced the results and limited the robustness of the conclusions. Another limitation lies in the generalizability of the findings, as the study focused on individuals admitted to

a single hospital, which may not fully represent the broader population of patients with dementia. However, the clinic is the largest in the country, covering ¼ of its geographic territory. Lastly, while some observed group differences were statistically significant, the small effect sizes highlight that the clinical relevance of these differences might be minimal. Future studies addressing these limitations, such as using longitudinal designs, larger and more diverse populations, and controlling for confounding variables, are necessary to validate and expand upon these findings.

Conclusions

In conclusion, this study highlights significant differences in physical function among patients with various types and stages of dementia, emphasizing the complex relationship between cognitive function and physical performance. The findings reveal that individuals with AD and VaD face greater physical function deficits compared to those with mild cognitive impairment, underscoring the importance of incorporating physical function evaluations into comprehensive dementia care. Future research should focus on longitudinal studies to track changes in physical function over time and identify specific interventions that can help mitigate physical decline in dementia patients. Furthermore, investigating the effectiveness of targeted exercise programs tailored to the diverse needs of dementia patients holds promise for improving functional outcomes. From a practical perspective, incorporating routine physical function assessments into dementia care plans is crucial to addressing both cognitive and physical aspects of the condition. Developing and implementing rehabilitation programs customized to the specific needs of patients with different types of dementia represents a vital step forward. Such programs, including targeted exercise interventions that address the unique physical challenges of AD, VaD, or other dementia types, have the potential to enhance functional outcomes, slow physical decline, and improve overall quality of life. Additionally, these efforts may reduce the risk of complications related to immobility. Achieving these goals will require interdisciplinary collaboration among geriatricians, physiotherapists, and occupational therapists to create personalized care strategies that prioritize both cognitive and physical well-being in the holistic management of dementia.

List of abbreviations

ADLs, activities of daily living
HGS, handgirp strength
MMSE, Mini Mental State Examination
MCI, mild cognitive impairment
AD, Alzheimer's disease
VaD, Vascular Dementia
PDD, Dementia in Parkinson's disease
LBD, Lewy Body Dementia
FTD, Fronto-temporal dementia
non-AD, non Alzheimer's demenita
DEMMI, De Morton Mobility Index
6MTW, 6-minute walking test
10MWT, 10-meter walking test
30sSTS, 30-second chair stand
TUG, timed up and go test

Contributions

The authors confirm contribution to the paper as follows: study conception and design: KB, ZK, PRP; data collection: KB; analysis and interpretation of results: KB and ZK; draft manuscript preparation: KB, ZK, PRP. All authors reviewed the results and approved the final version of the manuscript.

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Conflict of interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ethical approval

Ethical approval was granted by the Commission for Ethical Issues at the University Psychiatric Clinic Ljubljana (reference number KEV/2023-03). The study was performed in accordance with the Declaration of Helsinki and its subsequent amendments.

Data availabilty

All collected data are included in the manuscript. Raw data is available upon reasonable request to the corresponding author.

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