DOI: 10.21088/potj.0974.5777.18125.7

Physiotherapy and Occupational Therapy Journal
Volume 18 Number 1, January - March 2025

ORIGINAL ARTICLE

Assessment of Cognitive Function by Using Montreal Cognitive Assessment Scale in Lower Limb Amputee Individual

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How to cite this article:

Swati G. Ade, Shyam D. Ganvir. Assessment of Cognitive Function by Using Montreal Cognitive Assessment Scale in Lower Limb Amputee Individual. Physio. and Occ. Therapy Jr. 2025; 18(1): 55-61.

ABSTRACT

Introduction: Diabetes and peripheral arterial disease affect many physiological systems and can lead to health problems or commodities. In particular, as individuals with diabetes age, they are at risk of developing diabetes-related cognitive dysfunction. Mild or moderate cognitive deficits have been detected, which may affect performance in everyday tasks. Individuals with diabetes are also 19 times more at risk of undergoing lower extremity amputations (LEA) than the general population.

Objectives: To assess cognitive function by using the Montreal Cognitive Assessment Scale in lower limb amputee individuals.

Methods: cognitive function assessment using the Montreal assessment scale in lower limb amputee individuals. This study was designed as a cross-sectional survey. Eligible participants were older than 50 years of age for lower limb amputation

Results: Questionnaires were distributed among 20 participants, and data were analyzed for 20 participants. Participants' Demographic details were recorded, and each participant was interviewed individually to complete the data collection. The demographic details of the participants of both groups are given below in Table 1. Participants in the analysis were more likely to be males (65%) and females (35%) with comorbidity diabetes mellitus and hypertension (45%-30%), respectively. They were also likely reported to have a level of education based on literacy and illiteracy (75%-25%) and working status (Employee 20% Unemployment 80%).

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➢ **Received:** 26-12-2024 ➢ **Revised:** 07-01-2025 ➢ **Accepted:** 14-02-2025

Conclusions: This study concluded the importance of assessing cognitive function in individuals with lower limb amputation, particularly those with comorbidity conditions like diabetes and hypertension. Cognitive impairments, especially in executive function, attention, and abstraction, can impact rehabilitation outcomes and quality of life.

KEYWORDS

• Cognitive function • Lower limb • Amputation • Quality of life

ABBREVIATIONS

MOCA: Montreal cognitive assessment
LEA: Lower Limb Amputation
DM: Diabetes mellitus
HTN: Hypertension
BMI: Body Mass Index
VCI: vascular cognitive impairment
PAD: Peripheral artery disease

INTRODUCTION

Diabetes and peripheral arterial disease affect many physiological systems and can lead to health problems or commodities. In particular, as individuals with diabetes age, they are at risk of developing diabetes-related cognitive dysfunction. Mild or moderate cognitive deficits have been detected, which may affect performance in everyday tasks. Individuals with diabetes are also 19 times more at risk of undergoing lower extremity amputations (LEA) than the general population[1]

Cognitive impairment from vascular disease impacts problem-solving, reasoning, and concentration. Multiple studies have concluded that cognitive impairment has implications for functional ability, mastery of the prosthesis, and rehabilitation following amputation.[2] Various cognitive domains should be assessed to accurately quantify the extent of cognitive impairment, including executive functioning, memory, attention, concentration, visuospatial abilities and processing speed. Assessing the level of impairment in these domains has implications for functional mobility, as the presence of cognitive impairment is a predictor of poorer walking ability in individuals with LEA.

The Montreal Cognitive Assessment (MoCA) is one measure of global cognition that rehabilitation teams can readily administer to evaluate cognitive functioning across various domains.[14] This tool is proven sensitive to abnormalities associated with vascular cognitive impairment, 15 making it appropriate for the LEA population.[2] The MoCA is a widely used screening tool that assesses an individual's cognitive ability by briefly evaluating 7 cognitive domains. The domains evaluated are visuospatial and executive function, naming, delayed recall, attention, language, abstraction and orientation; the test is out of 30 points. This measure was initially developed to aid in identifying mild cognitive impairment and is more sensitive to cognitive abnormalities than other brief assessments.[15–17] MoCA scores of 26 or above are considered normal. The Montreal Cognitive Assessment (MoCA) is a rapid screening test designed to assess cognitive ability. MoCA is a one-page, 30-point test administered in 10 minutes. Details on the specific MoCA items are as follows: Attention and concentration, executive functions, working memory, language, visuoconstructional skills, conceptual thinking, calculation and orientation. Twenty-one points and above are considered normal cognitive functions.[3]

METHOD STUDY DESIGN

This study was designed as a cross-sectional survey.

Participant

The institutional Ethics Committee granted ethical approval. Eligible participants were older than 50 years of age for lower limb

amputation, and all levels of lower limb amputation were included.

Procedure

This is a cross-sectional study that was carried out on Amputees for one month. The participants were decided using purposive sampling. After obtaining permission from the Institutional Ethical Committee, written and informed consent was obtained from lower amputees. The individuals were divided according to the types of amputation, and their samples were collected.[1]

OUTCOME MEASURES

The Montreal Cognitive Assessment (MoCA): The MoCA is a widely used screening tool that assesses an individual's cognitive ability by briefly evaluating 7 cognitive domains. The domains evaluated are visuospatial and executive function, naming, delayed recall, attention, language, abstraction and orientation; the test is out of 30 points. This measure was initially developed to aid in identifying mild cognitive impairment and is more sensitive to cognitive abnormalities than other brief assessments.[15–17] MoCA scores of 26 or above are considered normal. The Montreal Cognitive Assessment (MoCA) is one such tool that may be utilized, as it was designed to detect mild impairment on the cognitive impairment spectrum and captures seven cognitive domains. This sensitivity to the cognitive abnormalities associated with mild vascular cognitive impairment makes the MoCA a good screening tool for the diabetic population.

RESULTS

Questionnaires were distributed among 20 participants, and data were analyzed for 20 participants. Participants' Demographic details were recorded, and each participant was interviewed individually to complete the data collection. The demographic details of the participants of both groups are given below in Table 1. Participants in the analysis were more likely to be males (65%) and females (35%) with comorbidity diabetes mellitus and hypertension (45%-30%), respectively. They were also likely reported to have a level of education based on literacy and illiteracy (75%-25%) and working status (Employee 20%-Unemployment 80%). (Table 1)

Table 1: Demographic details of the studied lower limb amputees (n=30)

Characteristics of patients	n	%
Age	20	64.27 ± 13.23
Comorbidity		
DM	09	45%
HTN	06	30%
BMI	20	26.32 ± 6.74
Education		
Literate	15	75%
Iliterate	05	25%
Place of residence		
Urban	08	40%
Rural	12	60%
Gender		
Male (n%)	13	65%
Female (n%)	07	35%
Working status		
Employee	04	20%
unemployment	16	80%

Features related to amputation of patients with lower limb amputation are summarized in Table 2. Complete data from n=20 patients that met inclusion criteria was abstracted.

Table 2: Features-related amputation of a patient with lower limb amputation (n=20)

Surgical features	n	%
Reason for amputation		
Diabetic foot	09	45%
Gangrene	02	10%
Accident	08	40%
Infection	01	5%
Number of amputation		
One	19	95%
Two or more	01	5%
Side of amputation		
Right	13	65%
Left	7	35%

Surgical features	n	%
Prosthesis use		
Using	20	100%
Not use	0	0%
Level of amputation		
Below knee amputation	12	60%
Above knee amputation	05	25%
Syme's amputation	03	15%
Duration of amputation		
6 months	5	25%
6-12 months	3	15%
	2	10%
12-24 months	5	25%
24-36 months	5	25%

The MOCA average score of all domains was mentioned (Table 3). The average MoCA score for the sample was 24.3 (± 4.83), with scores ranging from 0 to 30

MOCA Sub-dimensions	Min-Max	Mean±SD
Visuospatial/executive	02-05	3.8 +1.36
Naming	02-03	2.25+0.43
Attention	02-06	4.35+1.93
Language	02-03	2.8+0.40
Abstraction	00-02	0.85+0.491
Delayed Recall	04-05	4.95+0.22
Orientation	04-06	5.3+0.90
Total	18-30	24.3+4.83

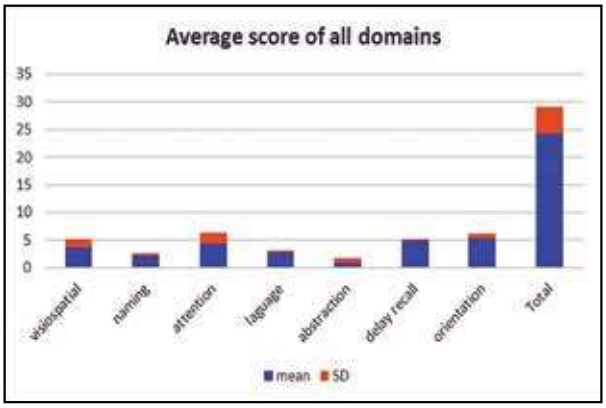

Fig. 1: Average score of all domains

DISCUSSION

The results of this study provide insights into the cognitive function of individuals with lower limb amputation, particularly those with comorbidity conditions such as diabetes and hypertension. The Montreal Cognitive Assessment (MoCA) has helped identify this population's extent of cognitive impairment across seven cognitive domains. In this section, we will discuss the potential implications of the findings, as well as how cognitive deficits might influence rehabilitation and quality of life in lower limb amputees.[6] The average MoCA score of 24.3 (±4.83) for the participants in this study suggests that mild cognitive impairment is prevalent among individuals with lower limb amputation. According to the MoCA scoring system, a score of 26 or above is typically considered normal, which means that the average score of the sample in this study falls below the standard threshold, indicating mild cognitive dysfunction. However, the variation in individual scores (ranging from 18 to 30) suggests that cognitive impairment can vary widely among amputees, and some individuals may experience more significant cognitive challenges than others. Several factors may contribute to this observed cognitive impairment.[7]

Diabetes and Cognitive Dysfunction: Diabetes has long been associated with an increased risk of cognitive impairment, particularly vascular cognitive impairment (VCI). In this study, 45% of participants had diabetes, and the cognitive impairments observed are likely partly due to this comorbidity. Previous studies have shown that individuals with diabetes, especially those with poor glycemic control, are at greater risk for developing cognitive deficits that affect memory, attention, and executive function, all of which are essential for successful rehabilitation post-amputation. Peripheral arterial disease (PAD), which is common in individuals with diabetes, can also contribute to cognitive decline. Since amputation is frequently the result of complications arising from diabetes and PAD, it is not surprising that individuals with LEA show evidence of cognitive dysfunction. Hypertension is another common comorbidity among the study participants (30%), and it is well-established that hypertension, particularly when poorly controlled, can lead to damage to both the brain's vasculature and the

cognitive system. Hypertension has been linked to cognitive impairment, especially in older adults, through mechanisms such as cerebrovascular damage, reduced cerebral blood flow, and neurodegenerative changes. [8] Therefore, the combined effects of diabetes and hypertension may contribute synergistic allies to the observed cognitive deficits in this cohort. At the same time, the current study did not specifically assess psychological factors; the emotional burden of amputation could exacerbate existing cognitive challenges, further complicating rehabilitation and prosthetic training.[9]

Fig. 1: Assessing MOCA Scale

Fig. 2: Assessing MOCA Scale

The MoCA evaluates several cognitive domains, and the results from this study suggest that cognitive impairments in lower limb amputees are not uniform across all domains. Delayed Recall: Participants scored relatively high in the delayed recall subdomain (mean = 4.95 ± 0.22), indicating that their recall ability after a brief delay was relatively preserved. The orientation subdomain also had a high average score (mean = 5.3 ± 0.90). This subdomain tests awareness of time and place, an essential aspect of daily functioning. The relatively good performance in this domain may suggest that, for most participants, basic orientation was not significantly impaired, which may reflect that these impairments often appear in more severe stages of cognitive decline. Visuospatial and Executive Function: Participants had a slightly lower average score for visuospatial and executive functions (mean = 3.8 ± 1.36), which suggests mild impairment in these areas. Attention: subdomain had a mean score of 4.35 (± 1.93), suggesting that attention, which is crucial for tasks such as walking and interacting with the environment, may be moderately impaired in some participants. Reduced attention can affect prosthesis training, impair gait analysis, and hinder motor learning, all of which are important for the rehabilitation of amputees. Naming and Language abilities were also mildly impaired, with average scores of 2.25 (± 0.43) and 2.8 (± 0.40), respectively. Impairments in this domain may interfere with communication and social interactions during rehabilitation. Abstraction: subdomain showed the lowest scores (mean = 0.85 ± 0.49), consistent with findings from other studies on cognitive impairment in diabetes. Impaired abstract thinking can impact problem-solving, decision-making, and planning skills essential for managing rehabilitation and adapting to life after amputation[10] The findings of this study underscore the importance of considering cognitive function during the rehabilitation of lower-limb amputees. Cognitive impairments particularly in executive function, attention, and abstraction may interfere with rehabilitation and prosthesis training.[11]

Clinical implication:

Multidisciplinary Approach: Given the multifaceted nature of rehabilitation, a multidisciplinary approach that includes both physical and cognitive rehabilitation is essential. Cognitive screening using tools like the MoCA can help identify individuals who may benefit from cognitive training, psychological support, or additional interventions tailored to address cognitive deficits. Occupational therapy and neuropsychological support can be integrated into rehabilitation plans to maximize functional recovery.

Limitations

This study has several limitations. First, the sample size of 20 participants is relatively small, which limits the generalization of the findings. Additionally, the cross-sectional design does not allow for assessing how cognitive function changes over time or in response to rehabilitation.

Future scope

Future studies with larger sample sizes, longitudinal designs, and more detailed cognitive assessments could provide more substantial insights into the relationship between cognitive function and rehabilitation outcomes in lower limb amputees.

CONCLUSION

This study concluded the importance of assessing cognitive function in individuals with lower limb amputation, particularly those with comorbidity conditions like diabetes and hypertension. Cognitive impairments, especially in executive function, attention, and abstraction, can impact rehabilitation outcomes and quality of life. Screening for cognitive deficits using tools like the MoCA can help identify individuals who may benefit from additional support, and tailored rehabilitation strategies may improve functional recovery and psycho-social well-being.

Ethical Approval: Approved

Conflicts of interest: There are no conflicts of interest.

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