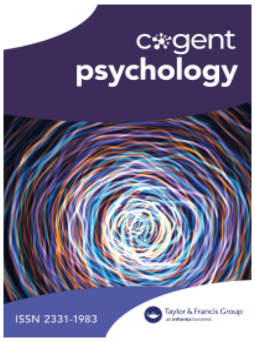

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Factors associated with mild cognitive impairment among Palestinian community-dwelling older adults: a cross-sectional study

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ABSTRACT

The main purpose of the current study was to determine the prevalence and risk factors associated with Mild Cognitive Impairment (MCI) among community-dwelling older adults in Palestine. A cross-sectional study was done among Palestinians > 60 years living in Hebron governorate. An interview-based questionnaire was used to obtain information related to socio-demographic characteristics and lifestyle habits, medical history, nutritional status, cognitive status, and physical fitness performance. A total of 358 older adults were included in the study. The prevalence of cognitive impairment for MCI was 37.3%. The analysis revealed that MCI was significantly associated with: being above 70 years old; lower education levels; living with family members, widow, unemployment, low physical activity level, history of hypercholesterolemia, heart disease, and COPD, lower mid upper arm circumference, lower calf circumference, higher waist-to-hip ratio, higher body fat percentage, lower skeletal muscle mass, higher, poor functional status and poor physical fitness ($p<0.05$). MCI was associated with reduced muscle mass, lower speed, and lower flexibility, according to the multivariate analysis. In conclusion around half of the study sample had mild cognitive impairment and was associated with modifiable and non-modifiable variables. Systematic screening is recommended to identify older adults with a high risk of developing MCI.

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SUBJECTS
Allied Health; Health Conditions; Social Work and Social Policy

IMPACT STATEMENT

This study highlights the high prevalence of Mild Cognitive Impairment (MCI) among older adults in Palestine and identifies key modifiable and non-modifiable risk factors. The findings emphasize the urgent need for systematic screening programs to detect MCI early and implement targeted interventions. By addressing lifestyle factors, physical fitness, and medical conditions, healthcare providers can reduce the risk of cognitive decline and improve the quality of life for aging populations. This research provides valuable insights for policymakers and public health professionals to develop comprehensive, culturally tailored strategies for promoting cognitive health and supporting older adults in Palestine.

Introduction

The age of the Palestinian population is moving towards the elderly. In mid-year 2021, the number of older adults over 60 years old was 282,679 (5% of the total population) (PCBS, 2021). Moreover, the life expectancy in the country increased by about 5–8 years over the last two decades [Palestinian Central Bureau of Statistics (PCBS, 2017). It increased from 67 years in 1992 to 71.3 years in 2012 for males, and from 67 years to 74.1 years for females, with the expectation to reach 77 years by 2050 (Saxena, 2008). The increase in life expectancy will result in rising the number of aged people in the Palestinian territory, even though their percentage is relatively low,

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it is expected to start increasing after the middle of the next decade (PCBS, 2021). With this increase in longevity, the risk of developing cognitive impairment is predicted to rise (Batum et al., 2015). Furthermore, the prevalence of dementia all over the world is predicted to triple during the next two decades (Norton et al., 2014).

Petersen and his colleagues defined MCI as amnestic impairment that was assumed to exemplify a precocious manifestation of Alzheimer's disease (AD) (Petersen et al., 1999). The definition was then widened to include other cognitive areas, with the anticipation that the initial pattern of impairment foresaw different diagnostic results (Winblad et al., 2004). The MCI diagnostic criteria include memory complaint by family, physician, or patient, normal activities of daily life, normal general intellectual function, objective deterioration in one area of cognitive function as evidenced by scores >1.5 SD, or abnormal memory function for age, Clinical dementia rating score of 0.5, and Not diagnosed with dementia (Petersen et al., 1997, 1999)

During the past 20 years, numerous epidemiological studies have been performed to determine the prevalence of MCI. A former systematic review stated that the prevalence of MCI ranges from 0.5% to 42% (Ward et al., 2012). Furthermore, many prior studies showed that MCI prevalence among older adults ranges from 6.5% to 39.1% in America, Bulgaria, Mexico, and Japan (Dimitrov et al., 2012; Juarez-Cedillo et al., 2012; Katz et al., 2012; Petersen et al., 2010; Wada-Isoe et al., 2012; Yaffe et al., 2011). In a former Saudi Arabian study, it was found that the prevalence of MCI among older adults was 38.6% (Alkhunizan et al., 2018). The fundamental difference in the prevalence of MCI is attributed to several reasons including; variations in demographic characteristics of studied populations, detection procedures, and application of MCI diagnostic criteria (Ding et al., 2015). Despite the availability of accurate screening tools for MCI in Arabic nations, an increase in the life span of Palestinians, and aging population, there are no available published research about the prevalence and risk factors of MCI among Palestinians.

Predictors or risk factors for MCI include age, gender, education level, marital status, race/ethnicity, health condition, and the presence of comorbidities (Alkhunizan et al., 2018). Xue et al. (2018) conducted a systematic review including 48 research, to evaluate the incidence and risk factors of MCI, and the results revealed that older age, female sex, and rural residence were related to a greater prevalence of MCI (Xue et al., 2018). Moreover, when compared to their contemporaries who had normal cognitive function, older persons with MCI displayed poor physical fitness. In community-based research, lower hand grip scores, a slower gait speed, and poor flexibility were all linked to MCI (Lee et al., 2016; Malaysia, 2017). A poor score on activities of daily living was a strong predictor of mild cognitive impairment as reported in a cohort study (Makino et al., 2020).

It has become a top public health goal to have a better understanding of mild cognitive impairment (MCI), including its origins, underlying pathophysiological processes, associated factors, and earliest feasible detection (Kasper et al., 2020). Recognizing the modifiable risk factors assists in adapting intervention strategies to reduce the occurrence of MCI or may slow down the progress of cognitive decline (Kasper et al., 2020). Furthermore, the prevalence of MCI, a transitional stage between normal cognitive aging and dementia (Lin et al., 2013), might provide useful information about older adults at a high risk of developing dementia (Ding et al., 2015). It was reported that 46% of those diagnosed with MCI would develop dementia within 3 years, compared to 3% of the general population of similar age (Tschanz et al., 2006). A systematic review included 19 longitudinal studies from 1991 to 2001 that examined mild cognitive impairment to dementia conversion. The conversion rate was 10%, however, research varied greatly (Bruscoli & Lovestone, 2004). There are documented factors that affect the rate of conversion from MCI to dementia such as Diabetes mellitus, metabolic syndrome, nutrient deficiency, depression, multiple comorbidities, and age. While a healthy diet, such as a Mediterranean diet, a higher educational level, decreases the rate (Bruscoli & Lovestone, 2004; Cooper et al., 2015).

There are several screening tools for evaluating cognitive status such as the Mini-Mental Status Examination (MMSE), Saint Louis University Mental Status (SLUMS) exam, and Montreal Cognitive Assessment (MoCA). The MMSE has been translated and validated in a variety of languages, and it assesses orientation, immediate memory, short-term memory, and language functioning. MMSE's advantages include its brevity and ease of administration, but its disadvantages include its narrow scope, inability to detect subtle memory losses, and interpretation complexity due to age, education, and cultural background. The SLUMS, which is also available in multiple languages, evaluates several categories—orientation, short-term memory, calculations, naming of animals, clock drawing test, and recognition of geometric figures. The advantages of the SLUMS include its brevity and sensitivity for mild cognitive impairment. While the disadvantages of SLUMS are the lack of research on its psychometric properties and its use with different populations (Slavych, 2019). The MOCA is widely used across the world in a variety of settings and shows good validity in multiple languages (Dautzenberg et al., 2020). MOCA targets several categories—visuospatial/executive functions, naming, memory, attention, language, abstraction, delayed recall, and orientation. The advantages of the MOCA include its ease of use and its sensitivity as a screening tool (Slavych, 2019). Its higher sensitivity could be attributed to its memory test, which has more words, fewer learning trials, and a longer time window before recall than other tests like the MMSE. Moreover, MOCA examines the executive functions, higher-level language abilities, and complex visuospatial processing by a greater number and harder tasks than other screening tools (Rahman & El Gaafary, 2009). However, MOCA takes a longer time to be administrated compared to the MMSE and SLUMS tests (Slavych, 2019).

The studies investigating the prevalence of MCI in the Arab world are scarce. There is no published literature about the prevalence of MCI and its associated risk factors among Palestinian older adults. Thus the purpose of this study is to estimate the prevalence of MCI among Palestinian older adults using a validated Arabic version of the MOCA test (Rahman & El Gaafary, 2009). It also aims to identify its potential risk factors (e.g. sociodemographic characteristics and lifestyle habits, medical history, nutritional status, functional status, and physical status).

Methods

Study design, settings, and population

A representative sample of older Palestinians from the Hebron Governorate in Palestine participated in this cross-sectional survey. Hebron Governorate is the largest governorate in the West Bank in both size and population. It lies in the southern region of Palestine. Seven cities and eighteen towns make up the Hebron Governorate (ARIJ, 2009). Hebron serves as a representative of the Palestinian community in the West Bank since the Palestinian community is homogenous in terms of ethnicity, religion, and culture.

Sample size calculation and sampling method

The sample size was determined using G power software with an alpha of 0.05 (two-sided) and 80% power, indicating that a minimum of 200 participants was needed to determine MCI prevalence. This calculation was done considering the MCI prevalence is 17.9, the expected difference is ±5%, as reported in a recent meta-analysis about the prevalence of MCI among community-dwelling older adults (Song et al., 2023). To determine the association between MCI and the study variables, the sample size was recalculated to determine the association between MCI and gender, using the MCI proportion from the previous study (Men 10.2% and Women: 18.9%) (Liu et al., 2022), considering 5% level of significance, (80%) power, giving a sample size of 365 participants. Considering the dropout or missing data the required sample size was 400 participants.

Hebron City and two other towns, Dura and Ash-Shuyukh, were chosen to represent the entire population of the Hebron Governorate. The participants were selected by the systematic random sampling method. The data collection team visited the selected areas and started from a random starting point (i.e. city center, village center, popular buildings) and moved to the right, selecting one household for every five households. The team introduced themselves to the selected houses and asked if one or more of the family members were older adults. In case the families have older adults, they were briefed about the study objectives and the required data; and then invited to join the study. Participants who verbally consented to join the study were asked to choose a date for the team to come to the house for data collection. The written consent form was taken from the participants on the day of data collection.

The inclusion criteria were participants aged 60 years old or above, and willing to participate and to provide all the required data. Whereas the exclusion criteria were the presence of an acute illness on the days of data collection, having severe hearing problems that prevented communication with the research team, having a medical situation that may limit their ability to perform the tests (e.g. participants with severe edema, cachexia, or ascites), being diagnosed with dementia according to the family caregivers, not submitting the consent form to participate in the study, and having missing primary data.

Ethical considerations

The research protocols were in accordance with the Declaration of Helsinki and reported in line with the STROBE checklist for reporting cross-sectional studies. The study protocol was approved by the Deanship of Scientific Research Ethical Committee at Palestine

Polytechnic University (reference number KA/41/2019). Informed written and verbal consent was collected from all participants prior to data collection.

Data collection and research tool

Data collection was done face-to-face through a team of six nutritionists who were trained to take anthropometric measurements and assess body composition, and do physical function tests. The team collected the data within six months starting from March 2021 to September 2021. Participants were verbally briefed about the purpose of the study, then, pretested-structured questionnaires were distributed to participants upon their signed consent to participate. Participants' sociodemographic characteristics and lifestyle habits, medical history, nutritional status, cognitive function, functional status, and physical fitness status were recorded.

Demographics and lifestyle habits

Questions regarding demographic data, including age, gender, marital status, area of living, living status, and years of education were asked of each participant. Data about lifestyle habits (e.g. smoking, and physical activity level) were elicited from the participants. Physical activity level was measured by utilizing International Physical Activity Questionnaire (IPAQ) (Helou et al., 2018).

Medical history

In this section, health status was determined by dichotomized questions (yes/no) about the presence of diseases (hypertension, hypercholesterolemia, diabetes, stroke, heart disease, and chronic obstructive pulmonary disease "COPD").

Nutritional status

Nutritional status was assessed using anthropometric indices (e.g. weight, height, waist circumference, hip circumference, calf circumference, and Mid Upper Arm Circumference "MUAC"), and body composition data (e.g. body fat percentage, muscle mass, and basal described by Nieman and Lee (2019). Body mass index was calculated as (body in kilogram divided by height squared in meters (kg/m^2), thereafter classified according to WHO cut-off points (WHO, 2021).

The body composition was analyzed using a portable machine named InBody 120. The data collection team has requested that the participants to take off their socks and their shoes, and to put any metallic accessories (e.g. rings, watches, and bracelets) on the table. Then, the participants were asked to step on the machine with their bare feet and catch the hand device with their hands. Body fat percentage and basal metabolic rate were extracted from the machine output (InBody, 2024).

Cognitive function

The presence of mild cognitive impairment was assessed using a validated Arabic version of the Montreal Cognitive Assessment – basic (Rahman & El Gaafary, 2009). The Montreal cognitive assessment – basic assesses the following cognitive domains (language, orientation, executive function, simple mathematical calculations, memory, conceptual thinking, visual perception, attention, and concentration). The questionnaire was scored on 30 points. After score calculation, one point was added for illiterate participants and those with less than 4 years of education. Scores ≥ 26 are considered normal, scores < 26 indicate mild cognitive impairment (Rahman & El Gaafary, 2009); whereas less than 17 is considered the cutoff point for suspected dementia (Alkhunizan et al., 2018).

Functional status

Function status assessment was determined by using (ADL) and instrumental activities of daily living (IADL). The ADL was assessed using the Katz index scale (Hartigan, 2007); and the IADL was assessed using the Lawton scale (Lawton & Brody, 1969). Physical fitness was performed using senior fitness tests.

Physical status

Senior fitness tests were used to assess participants' physical fitness; handgrip for upper body strength, which is a valid predictive measure for age-related disorders (Bohannon, 2008); 30 s chair stand test as a reliable and valid indicator for lower body strength (Jones et al., 1999); back scratch test for upper body flexibility, set and reach for lower body flexibility; 8-ft time up and go as a valid test for balance, 2 min step test to assess cardiovascular fitness and endurance, and gait speed for pace assessment (Merellano-Navarro et al., 2017).

Statistical analysis

SPSS version 26.0 was used for analyzing the data. Continuous variables were assessed for normality of distribution graphically and via the Shapiro-Wilk Test. Descriptive analysis including the means and the standard deviations were used to analyze the continuous data, and the categorical data were described in percentages and frequencies. Mann-Whitney test was used to investigate the relationship between continuous variables and cognitive function. The prevalence of MCI was assessed by the proportion of participants scoring less than 26 on the MOCA, while the prevalence of dementia was determined by the proportion of people scoring fewer than 17. The gender and age-specific prevalence of MCI were also determined by calculating the percentage of individuals with MCI in each category. On the other hand, the Chi-Square test was used for analyzing the association between MCI and categorical data. A significant level was set at $p < 0.05$. Binary logistic regression was employed for analysing the possible risk factors related to MCI. The dependent variable was the MoCA score with binary options. The logistic model was adjusted for age, gender, activities of daily living, and instrumental activity of daily living scores. A significant level was set at $p < 0.05$.

Results

Participants' recruitment

Participants were recruited from Hebron Governorate, Palestine. A total of 401 participants were invited to join the study, met the inclusion criteria, and verbally consented to join the study. Only 358 participants were included in the final analysis: 240 (67.0%) females and 118 (33.0%) males. The rest of the participants were excluded mainly due to their inability to either perform senior fitness tests or to stand on the body composition analyzer as shown in Figure 1.

Participants' sociodemographic characteristics and lifestyle habits

The mean age of participants was 71.0 ± 6.2 years, ranging from 60 to 98 years old. Nearly half of the participants were living in Hebron city by 55.9%, living with their family members by 54.7%, and were widows by 54.5%. Moreover, the data depicts that the vast majority of participants were not working (84.4%). Our analysis also reveals that the mean years of participants' education was 8.1 ± 5.1 years, ranging from 0 to 20 years. The analysis of the IPAQ survey reveals that only 8.4% of participants ($n = 30$) showed a high level of physical activity, 14.5% of them ($n = 52$) showed a moderate level of physical activity and a relatively high percentage of them 77.1% ($n = 276$) showed a low level of physical activity. Moreover, the findings show that most of the participants (82.1%) stated that they were non-smokers. The sociodemographic and lifestyle characteristics of the subjects are described in Supplementary File 1.

Participants' medical history

Nearly half of the participants had hypertension by 49.4% and had diabetes mellitus by 42.2%. Whereas chronic obstructive pulmonary disease and cancer were the least common among our participants by 7.8%, and 3.6. More details about the participants' medical history are presented in Supplementary File 1.

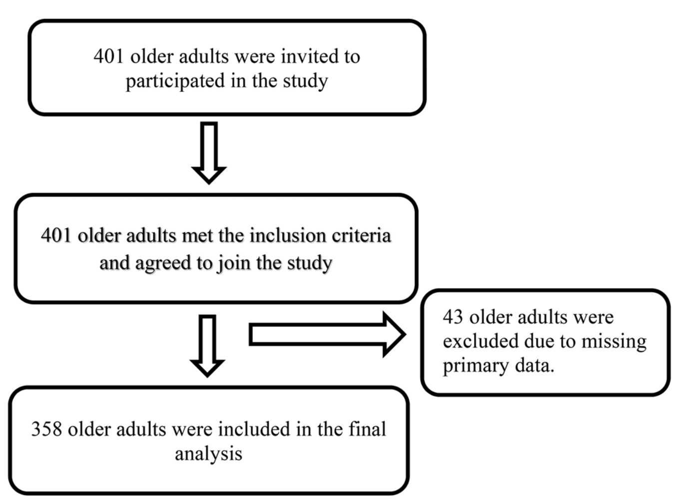


Figure 1. Participant's recruitment steps.

Participants' nutritional, functional, and physical fitness profile

Our findings reveal that males had a higher mean of waist-to-hip ratio (1.00 ± 0.5) and body fat percentage (36.3 ± 9.8) as compared to females. Besides that, women showed a higher mean of IADL (6.0 ± 2.1) as compared to men (5.4 ± 1.9). In regard to physical fitness, the women showed a lower level of physical fitness in the following tests; 2 min step test, and hand grip test as compared to men. The results show that 9.2% of the participants had normal weight, 27.7% were overweight, and more than half of our participants were obese 62.6%. The descriptive data about participants' nutritional, functional, and physical fitness are presented in Supplementary File 1.

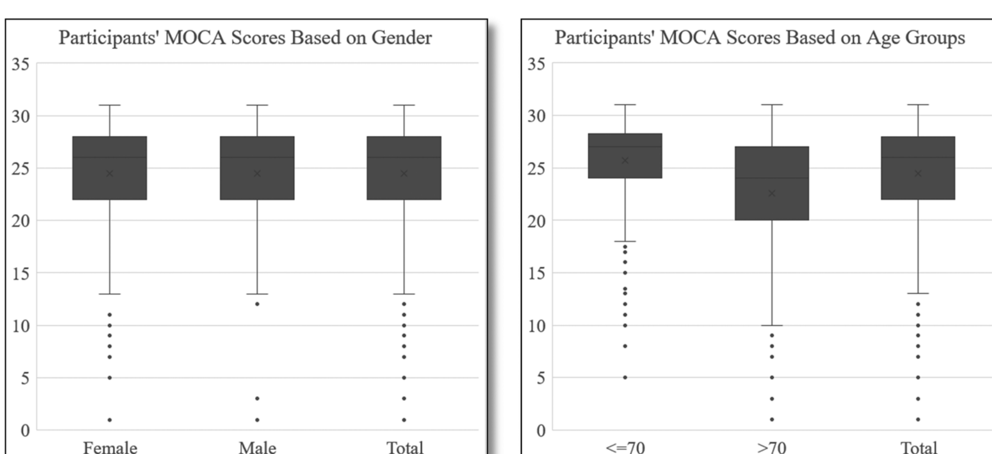
MCI Prevalence and associated factors

The prevalence of cognitive impairment for MCI was 37.3% (95% CI: 0.32–0.42), and 8.9% (95% CI: 0.06–0.12) for suspected dementia. The association between gender and cognitive function was not significant as shown in Table 1. Mean of MOCA score was 26.0 ± 6.0, with no significant difference in mean scores between men (26.0 ± 6.0) and women (26.0 ± 5.8). The participants with MCI had a mean age of 72.5 ± 6.9, while those with normal cognitive function had a mean age of 69.4 ± 4.5, $p < 0.001$. The age-specific MOCA score was lower among those aged 80 years and above as compared to those between the ages of 60 and 79 years old. Those between the ages 90 and 99 years old (18.0 ± 13.0) had the lowest MOCA score as compared to those

Table 1. Prevalence of mild cognitive impairment and suspected dementia by age and gender.

Parameter	Normal *n* (%)	MCI *n* (%)	Suspected dementia *n* (%)	*P* value
Total	192 (53.8)	133 (37.3)	32 (8.9)	
Gender				
Men	62 (52.5)	45 (38.1)	11 (9.3)	0.945[1]
Women	130 (54.2)	89 (37.1)	21 (8.8)	
Age category/years				
60–69	115 (60.2)	68 (35.6)	8 (4.2)	NA[1]
70–79	65 (53.3)	39 (32)	18 (14.8)	
80–89	12 (30)	24 (60)	4 (10)	
90–99	0 (0)	3 (60)	2 (40)	
MOCA score, Mean ± SD				
	Total (Mean ± SD)	Men (Mean ± SD)	Women (Mean ± SD)	
MOCA	23.7 ± 5.2	23.8 ± 4.8	23.7 ± 5.3[2]	
Age category				
60–69	24.8 ± 4.3*[2]	24.5 ± 4.2*[2]	24.8 ± 4.4*[2]	
70–79	23.1 ± 5.9	24.2 ± 4.7	22.4 ± 6.5	
80–89	21.5 ± 5.3	21.8 ± 5.7	21.3 ± 5.1	
90–99	17.8 ± 3.7	17.3 ± 4.8	18.5 ± 2.1	

*Significant at $p < 0.05$. [1]using Chi-Square test, NA: Not Applicable. [2]using Kruskal-Wallis Test.
Abbreviation: MOCA: Montreal Cognitive Assessment (MOCA); SD: standard deviation; MCI: Mild Cognitive Impairment.



(a) (b)

Figure 2. MOCA score is based on gender (a) and age groups (b).

Table 2. Sociodemographic characteristics and lifestyle habits according to cognitive function.

Variable		Normal cognitive function ($n=191$)	MCI ($n=133$)	p-value
Education [years; mean ± SD]		8.8 ± 4.6	7.5 ± 5.4	0.002*
Place of residence	Dura [n (%)]	20 (10.5)	55 (41.4)	0.000*
	Ash-Shuyukh [n (%)]	21 (11.0)	32 (24.1)	
	Hebron [n (%)]	150 (78.5)	46 (34.6)	
Living status	Alone [n (%)]	24 (12.6)	18 (11.7)	0.000*
	Spouse only [n (%)]	84 (44.0)	34 (22.1)	
	Family members [n (%)]	83 (43.5)	102 (66.2)	
Marital status	Single [n (%)]	7 (3.7)	3 (2.3)	0.000*
	Married [n (%)]	117 (61.3)	31 (23.3)	
	Widow [n (%)]	67 (35.1)	99 (74.4)	
Employment status	Employed [n (%)]	42 (22.0)	13 (9.8)	0.003*
	Not employed [n (%)]	150 (78.0)	120 (90.2)	
Smoking status	Smoker [n (%)]	23 (12.0)	22 (16.5)	0.442
	Non-smoker [n (%)]	159 (82.7)	106 (79.9)	
	Former smoker [n (%)]	10 (5.2)	5 (3.5)	
Physical activity level	Low [n (%)]	133 (69.6)	103 (87.0)	0.011*
	Moderate [n (%)]	37 (19.4)	11 (7.8)	
	High [n (%)]	21 (11.0)	8 (5.2)	

Data are presented as n (%) or mean ± SD; *$p<0.05$.
Pearson Chi-Square test was employed for categorical variables and Mann-Whitney test for continuous variables. SD: standard deviation.
The analysis also reveals that older adults who had hypercholesterolemia, heart disease, or chronic obstructive pulmonary disease were significantly more likely to have MCI ($p<0.05$; Table 4).

between the ages 60 and 69 years old (26.0 ± 4.0), $p<0.05$. In addition, the gender-specific prevalence of MOCA score showed significantly lowest MOCA score in the oldest group (90–99 years old) as compared to the younger age group for both older men (16.0± (NA) and women (19.5± (NA), $p<0.05$. MOCA score was significantly lowest in the suspected dementia group (13.0 ± 6.8), followed by the MCI (23.0 ± 4.5) group, $p<0.001$. Gender-specific analysis for MOCA score also revealed the lowest MOCA scores in the group of suspected dementia. The mean differences in MOCA scores between the cognitive function categories were significant for each gender. For clear distribution of the data the MOCA scores according to gender and age are presented in Figure 2.

A significantly higher prevalence of MCI was associated with lower education levels, living in Dura, living with their family members, being a widow, being unemployed, and having a low physical activity level ($p<0.05$; Table 2). According to multiple comparisons of the significant variables;

The results of nutritional, functional, and physical status profiles based on cognitive function are presented in Table 3. It is very clear that older adults with MCI had significantly lower mid-upper arm circumference, higher body fat percentage, and lower skeletal muscle mass in comparison to older adults with normal cognitive function ($p<0.05$). The analysis also shows that older females with MCI had significantly lower mid-upper arm circumference and lower skeletal muscle mass (in comparison to older females with normal cognitive function ($p<0.05$). Moreover, it was found that older men with MCI had significantly lower skeletal muscle mass in comparison to older men with normal cognitive function ($p<0.05$). The analysis also reveals that there was no significant association between cognitive function and BMI categories.

In terms of functional status, it was found that the mean scores of IADL and ADL were significantly lower in participants with MCI than their counterparts ($p<0.05$). Furthermore, IADL scores were significantly lower among older women with MCI as compared to older women with normal cognitive function ($p<0.05$).

With respect to older adults' physical fitness status profile, participants with MCI had significantly lower physical performance in the following tests; back scratch test, gait speed, rapid pace, and 8-ft time up and go, as compared to their counterparts ($p<0.05$; Table 4). It is noticed that participants with MCI were more likely to have less upper body flexibility as indicated by the higher mean score of the back scratch test, slower pace as indicated by the higher mean score of both gait speed and rapid pace, and lower balance as indicated by the lower mean score of 8-ft timed up and go test as compared to participants with normal cognitive function.

The regression analysis in Table 5 shows that a 1 unit increase in skeletal muscle mass was associated with decreased risk of being in the MCI group (OR:0.956, 95%CI:0.924;0.988; $p=0.008$). An increase in the usual gait speed score was associated with 1.102 increased odds of being in the MCI group (OR: 1.102; 95%CI: 1.013; 1.200; $p=0.024$). Besides that, a

Table 3. Nutritional, functional, and physical status according to cognitive function and gender.

Variables		Total			Males			Females		
		Normal cognitive function ($n = 191$)	MCI ($n = 133$)	p-value	Normal cognitive function ($n = 62$)	MCI ($n = 45$)	p-value	Normal cognitive function ($n = 129$)	MCI ($n = 88$)	p-value
MOCA score		27 ± 1.7	21 ± 2.3	0.000*	27.4 ± 1.7	21.4 ± 2.4	0.000*	27.4 ± 1.7	21.4 ± 2.4	0.000*
Nutritional status	MUAC [cm; mean ± SD]	32.6 ± 5.4	30.9 ± 4.8	0.005*	32.9 ± 4.6	31.0 ± 4.5	0.059	32.4 ± 5.8	30.8 ± 5.0	0.035*
	CC [cm; mean ± SD]	37.2 ± 6.2	36.4 ± 5.0	0.112	37.5 ± 4.8	35.6 ± 5.4	0.060	37.0 ± 6.8	36.9 ± 4.7	0.224
	WHR [mean ± SD]	0.93 ± 0.1	0.94 ± 0.5	0.211	0.97 ± 0.1	0.96 ± 0.8	0.956	0.91 ± 0.1	0.93 ± 0.1	0.123
	Body fat percentage [%; mean ± SD]	33.8 ± 8.7	35.9 ± 10.4	0.036*	35.4 ± 9.3	37.9 ± 10.4	0.307	33.0 ± 8.4	34.9 ± 10.4	0.063
	SMM [kg; mean ± SD]	39.7 ± 13.5	32.4 ± 11.3	0.000*	42.3 ± 15.0	30.1 ± 8.9	0.000*	38.4 ± 12.6	33.3 ± 12.3	0.000*
	BMR [k-calories, mean ± SD]	1595 ± 980.9	1562.5 ± 215.0	0.668	1584.2 ± 222.9	1722.7 ± 1615.9	0.123	1553.6 ± 211.2	1531.2 ± 282.9	0.315
BMI categories	Underweight [n (%)]	0 (0.0)	1 (100.0)	0.481	0 (0.0)	1 (100)	NA	0 (0.0)	0 (0.0)	0.283
	Normal weight [n (%)]	15 (57.7)	11 (42.3)		5 (41.7)	10 (58.3)		10 (71.4)	4 (28.6)	
	Overweight [n (%)]	60 (64.5)	33 (35.5)		21 (36.4)	12 (63.6)		39 (65)	21 (35)	
	Obesity [n (%)]	116 (57.1)	88 (42.9)		36 (59)	25 (41)		80 (56.3)	63 (43.8)	
Functional status	ADL [mean ± SD]	5.7 ± 0.9	5.6 ± 1.0	0.249	5.8 ± 0.6	5.8 ± 0.5	0.463	5.6 ± 1.0	5.5 ± 1.2	0.120
	IADL [mean ± SD]	6.2 ± 1.6	5.6 ± 2.3	0.009*	5.7 ± 1.2	5.3 ± 2.3	0.147	6.5 ± 1.7	5.8 ± 2.3	0.013*
Physical fitness	2-min step test [steps, mean ± SD]	66.5 ± 31.9	71.7 ± 38.0	0.060	74.2 ± 28.7	79.9 ± 38.4	0.263	62.9 ± 7	68.9 ± 37.5	0.051
	BST [cm, mean ± SD]	16.8 ± 10.2	24.3 ± 12.8	0.000*	18.8 ± 9.9	25.5 ± 11.9	0.001*	15.9 ± 10.2	23.1 ± 13.2	0.000*
	CSR [cm, mean ± SD]	2.0 ± 8.5	.5 ± 12.5	0.068	3.6 ± 8.5	0.7 ± 10.7	0.131	1.2 ± 8.5	0.7 ± 13.4	0.269
	CST [times, mean ± SD]	11.8 ± 4.2	11.1 ± 6.8	0.567	12.2 ± 4.0	10.6 ± 7.0	0.151	11.6 ± 4.3	11.1 ± 10.1	0.115
	Gait speed [second, mean ± SD]	10.1 ± 4.6	15.5 ± 9.8	0.000*	10.6 ± 5.7	16.6 ± 6.5	0.000*	9.8 ± 4.0	15.6 ± 11.1	0.000*
	Hand grip [kg, mean ± SD]	25.4 ± 11.6	24.2 ± 62.7	0.08	30.4 ± 11.8	35.2 ± 103.9	0.576	23.1 ± 10.7	20.5 ± 14.5	0.155
	RP [second, mean ± SD]	6.9 ± 4.3	11.4 ± 8.9	0.000*	7.5 ± 5.7	12.4 ± 6.0	0.000*	6.6 ± 3.5	10.9 ± 10.2	0.000*
	TUG [second, mean ± SD]	12.9 ± 3.9	15.9 ± 7.6	0.000*	12.7 ± 4.0	14.9 ± 5.3	0.021*	12.9 ± 3.9	15.5 ± 8.6	0.000*

Data are presented as n (%) or mean ± SD; *$p < 0.05$.
Pearson Chi-Square test is employed for categorical variables and Mann-Whitney test for continuous variables.
Abbreviation: SD: standard deviation, MUAC: mid upper arm circumference, CC: calf circumference, WHR: waist-to-hip ratio, SMM: skeletal muscle mass; BMR: basal metabolic rate, MOCA: Montreal cognitive assessment, ADL: activity of daily living, IADL: instrumental activity of daily living, 2 min.st: 2 minutes step test, BST: back scratch test, CSR: chair set and reach test, CST: chair stand test, RP: rapid pace, TUG: 8-ft timed up and go.

lower rapid gait speed score was associated with lower odds of being in the MCI group (OR: 0.835; 95%CI: 0.715; 0.976, $p = 0.023$). Similarly, older adults with higher scores on the back scratch test had a higher risk of being in the MCI group (OR: 1.037; 95%CI: 1.008; 1.066; $p = 0.011$). Older adults with heart disease were reported to have higher odds of suffering from MCI as compared to those with normal cognition (OR: 2.271; 95%CI: 1.084; 4.758, $p = 0.03$) (Table 3).

Discussion

At present cognitive impairment is considered a prime public health problem in the developing world especially in the Arab world because of its increased incidence rate, its great socioeconomic burden, and its effect on quality of life (Yaffe et al., 2011). In this regard, the current study was done to estimate the prevalence of MCI among a sample of Palestinian older adults and its association with other factors (e.g. sociodemographic characteristics and lifestyle habits, health status, anthropometric measurements, functional status, and physical fitness status), which are essential for developing preventative strategies.

Table 4. Medical history according to cognitive function.

Variable		Normal cognitive function ($n = 191$) N	(%)	MCI ($n = 133$) n	(%)	p-value
Hypertension	No	98	51.3	64	48.1	0.400
	Yes	93	48.7	69	51.9	
Hypercholesterolemia	No	130	68.1	79	59.4	0.04*
	Yes	61	31.9	54	49.6	
Diabetes mellitus	No	118	61.8	71	53.4	0.064
	Yes	73	38.2	62	46.6	
Heart disease	No	164	85.9	95	71.4	0.001*
	Yes	27	14.1	38	28.6	
Strokes	No	164	85.9	121	91	0.113
	Yes	27	14.1	12	9	
COPD	No	183	95.8	118	88.7	0.015*
	Yes	8	4.2	15	11.3	
Cancer	No	180	94.2	132	99.2	NA
	Yes	11	5.8	1	0.8	

*Significant $p < 0.05$ using Pearson Chi-Square test, NA: not applicable.

The findings of this study showed that MCI was a prevalent concern among elderly individuals living in Hebron city and was common among them by 43.0%. In comparison with other countries, this percentage is higher than what is reported in a recent study in Saudi Arabia, where the prevalence of MCI was 31.6% (Algameel et al., 2021). A study in Thailand found that the incidence of MCI was 71.4% (Griffiths et al., 2020). Furthermore, a systematic review in 2018 revealed that MCI prevalence in China was 14.71% (Xue et al., 2018). According to a former systematic review in 2015, it was predicted that the global prevalence of MCI in different geographical regions was 5.0–36.7% (Sachdev et al., 2015). The variations in MCI prevalence may be due to multiple factors including differences in the definition and screening for MCI, different diagnostic approaches, and screening tools. Sachdev et al. (2015) found that when standardized criteria and screening tools were applied to harmonized data, a significant reduction in the amount of heterogeneity in MCI prevalence between countries was seen (Sachdev et al., 2015). In addition, the variation of the sample characteristics among the different studies could lead to variations in the prevalence of MCI such as age, level of education, sampling frame, and implemented assessment procedures.

This study also found that the prevalence of suspected dementia was 8.9% and these individuals had the lowest MOCA score, 13.0 ± 6.8 as compared to the MCI and normal group. Significant gender differences were observed in the MOCA score, with older men having suspected dementia scoring lower as compared to the women. This prevalence is lower as compared to other Asian countries such as China

Table 5. Factors associated with poor cognitive function among older adults.

Parameters	Estimate	Standard error	Odd ratio	95% CI	p-value
Skeletal muscle mass	−0.045	0.017	0.956	0.924; 0.988	0.008*
Hypertension	−0.137	0.314	0.191	0.471; 1.613	0.662
Hypercholesterolemia	0.159	0.335	1.172	0.608; 2.260	0.635
Heart disease	0.820	0.377	2.271	1.084; 4.758	0.030*
COPD	−0.395	0.581	0.674	0.216; 2.103	0.497
Usual gait speed	0.097	0.043	1.102	1.013; 1.200	0.024*
Rapid gait speed	−0.180	0.079	0.835	0.715; 0.976	0.023*
Waist hip ratio	−0.552	1.405	0.576	−0.037; 9.044	0.694
Time up and go test	−0.058	0.046	0.943	0.862; 1.032	0.202
Back scratch test	0.036	0.014	1.037	1.008; 1.066	0.011*
Hand grip strength	0.001	0.004	1.001	0.993; 1.010	0.777

Significant at $p < 0.05$ Model adjusted for age, education years, gender, BMI, IADL, and ADL. Dependent variable: (0: Normal cognition and 1: mild cognition impairment). Abbreviation: IADL: Instrumental Activities of Daily Living; ADL: Activities of Daily Living; BMI: Body Mass Index; 95% CI: 95% Confidence Interval.

*Significant at $p < 0.05$ using binary logistic regression test, Model adjusted.

which reported a suspected dementia prevalence of 26.8% among 773 community-dwelling adults from both the urban primary care clinics in Wuhan, China with risk factors female and higher age groups (Zongqin et al., 2022). Moreover, data from the Personality and Total Health Through Life (PATH) Project demonstrated that older women had greater memory impairment as compared to men due to a higher prevalence of midlife hypertension among older women in the study (Anstey et al., 2021).

According to the study findings, MCI status was connected with multiple sociodemographic characteristics; age, marital status, educational level, living and employment status. The current study found that the prevalence of MCI was significantly higher with advanced age. This finding is in parallel with (Algameel et al., 2021) study conducted in Saudi Arabia which concluded that the prevalence of cognitive impairment was significantly greater with increased age. Moreover, Sigurdsson and his colleagues revealed that with older age, the physiological function gradually drop, and the brain tissue starts to dwindle (Sigurdsson et al., 2012).

The findings of this study denoted that there was a statistically significant relationship between marital status and the prevalence of MCI among the study sample, and the unmarried elders (either single or widowed) had a greater risk of MCI in comparison to those who were married. This result is similar to that found in Algameel et al. (2021), and Zhuo et al. (2012), studies on the statistically significant association between marital status and MCI. This finding may be related to the fact that unmarried elders do not tend to participate in social activity and have usually a low chance of communicating (Algameel et al., 2021).

This study also found that the prevalence of MCI was significantly higher in elderly with low levels of education compared to their counterparts, with a statistically significant difference between the prevalence of MCI and the mean of education years. This finding comes in concordance with former studies (Algameel et al., 2021; Griffiths et al., 2020)] which confirmed that illiteracy was significantly related to a higher risk of developing MCI. This may be attributed to that education was considered an excellent dynamic system that might help ameliorate cognitive performance and cognitive stimulation, and memory according to Algameel et al. (2021).

Moreover, it was found that the elderly who were living with their family member had a higher risk of developing MCI than the elderly who were living either alone or with their spouse only, with a statistically significant correlation between living status and the risk of developing MCI. Additional studies would appear to be warranted to understand the relationship between living status and the prevalence of MCI.

The current study results showed a significant association between employment status and the prevalence of MCI which is consistent with a former study results (Min et al., 2015). The unemployed older adults had a higher risk of developing MCI in comparison to those who were employed. This could be interpreted that an unemployed individual usually have no enough money which would be related to food insecurity, inaccessibility to health care services, social inactivity, and less interpersonal communication, all of which can affect the cognitive function among the elderly (Algameel et al., 2021). However, (Razali et al., 2012) reported that there was no significant difference in the prevalence rates of MCI between employed older adults and unemployed older adults.

MCI was significantly more prevalent among older adults engaging in low physical activity. This was also reported in China by Wang et al. (2015). They found that cognitively normal older adults had more exercise habits than older adults with MCI.

The results showed a significant association between MCI and comorbidities such as heart disease, high cholesterol, and chronic obstructive pulmonary disease. This study reported a positive relationship between hypercholesterolemia and MCI with a statistically significant difference. This positive result may possibly be due to the high production of β-amyloid or the presence of the apolipoprotein E type 4 allele as reported by Luchsinger et al. (2001). Alkhunizan et al. (2018) also reported that high cholesterol levels were among the risk factors for cognitive decline. Moreover, a recent systematic review has suggested that the use of cholesterol-lowering drugs (e.g. statins) may reduce the risk of cognitive impairment (e.g. MCI and Alzheimer's diseases) and dementia.

Another important point is that decreased cerebral blood flow as a result of heart disease regardless of its type could worsen the vascular homeostasis of the brain, and aggrandize any cognitive issues resulting from the accumulation of Aβ and tau proteins (Justin et al., 2013). The current study reported that older individuals with heart disease history were more likely to have MCI than older individuals who did not have a history of heart disease; with a statistically significant relationship between heart disease and MCI prevalence. This result goes in line with former studies that found that ischemic heart disease and atherosclerotic cardiovascular diseases were positively associated with cognitive decline (Laughlin et al., 2011). It is necessary, however, to understand the relationship between each type of heart disease and cognitive decline.

Notably, we also observed that MCI was significantly more prevalent among older adults with COPD compared to their counterparts (older adults without COPD). The current study finding comes in agreement with a recent study that concluded that the prevalence of MCI was (54%) among COPD patients (Yohannes et al., 2021). Hypercapnia, hypoxemia, depression, immobilization, smoking, and comorbidities were probable proposed reasons for cognitive decline (Ozyemisci-Taskiran et al., 2015). However, Incalzi et al. (2002) reported that non-hypoxemic COPD did not increase subclinical cognitive dysfunction among the elderly (Incalzi et al., 2002).

Moreover, the current study demonstrated that older adults with MCI performed significantly poorer than cognitively intact older adults on both instrumental ADL and ADL. This result was found by other researchers who showed that individuals with either questionable dementia or MCI had clinically significant functional impairments (Jefferson et al., 2008; Tabert et al., 2002).

It is well documented that activities of daily living (ADL) and instrumental activities of daily living (IADL) were two ways to express daily functioning. In order to maintain independence in daily life, high scores in ADL and IADL are essential. According to the literature, patients with minor cognitive disorders had trouble with a variety of physical functions, including motor skills, balance, and risk of falls. Moreover, IADL alterations were linked to reduced sensory functions. In light of this, daily functioning was found to be a crucial clinical and diagnostic indicator of moderate cognitive impairment (MCI) (Bruderer-Hofstetter et al., 2022). It is crucial to keep in mind that MCI and poor IADL and ADL share similar risk factors, such as age, lifestyle, and comorbidities, which may support the association.

Meanwhile, the results showed that MCI was linked to a lack of physical fitness as measured by muscle strength, flexibility, and agility. The univariate analysis demonstrated that older adults with MCI had significantly lower levels of physical fitness, lower upper body flexibility, lower body strength, upper body strength, gait, and agility/dynamic balance, compared to those without MCI. Similarly, the multivariate analysis showed MCI was significantly associated with low muscle mass, lower flexibility, and slower gait speed. This trend is supported by other cross-sectional studies reporting a significant relationship between poor cognitive function and poor physical fitness among the elderly (Auyeung et al., 2008; Fitzpatrick et al., 2007; Lee et al., 2016) showed that the prevalence of MCI was significantly higher among Korean older adults who had poor physical fitness (including upper body flexibility, and balance) compared to their counterparts. Fitzpatrick et al. (2007) found that slow walking was significantly associated with cognitive impairment in healthy older adults. Besides that, prospective studies found a relationship between poor physical fitness performance (gait, balance, lower body strength, and upper body strength/grip strength) and cognitive decline (Wang et al., 2006).

It is noteworthy to highlight the limitations of the current study. Firstly; the major limitation of the current study resides in its cross-sectional research design by which it was not possible to derive a cause-effect relationship between certain variables and MCI. Secondly, the data collected were self-reported. This might lead to misreporting, and recall bias because of the nature of the study and the older age of the participants. Future studies should focus on clarifying the causal relationship, and assess nutritional and social status for a better understanding of MCI among older adults. Nonetheless, our study is the first of its kind to explore the prevalence of MCI among elderly individuals in Palestine and its associated factors.

The results of this study are important for future intervention programs. They have underscored the necessity of identifying the modifiable risk factors that can be incorporated into intervention programs to promote healthy aging. In addition, they have stressed the importance of educating the elderly and increasing their engagement in life to prevent cognitive decline. As the prevalence of MCI was significant, early screening and intervention recommendations for older persons with MCI may be advantageous and needed. The elderly should be educated on the significance of exercise to maintain healthy muscle function in order to enhance their cognitive performance by boosting their level of fitness.

Conclusion

To conclude, around half of the studied sample had MCI using a validated Arabic version of MoCA. The presence of MCI was significantly associated with advanced age, being unmarried, low education level, living with family members, being unemployed, and low physical activity. According to our data, there was a relationship between MCI prevalence and certain comorbidities such as high cholesterol levels, heart disease, and COPD. Functional status was also among the factors that had a significant relationship with the increased risk of MCI among our sample. Additionally, the study has reported an inverse relationship between physical fitness and MCI prevalence. These findings are preliminary and require further investigation. Future research could repeat this study in different settings, such as long-term care facilities and other Palestinian cities.

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Data availability statement

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

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