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Prevalence and associated factors of mild cognitive impairment among middle-aged and older adults: Results of the first phase of Ardakan Cohort Study on Aging

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Abstract

Background and Aims: Data on mild cognitive impairment (MCI) in low- to middle-income countries are still being determined, despite the fact that most future older adults are expected to reside in these regions. This study aimed to investigate the prevalence and associated factors of MCI in Iran.

Methods: A cross-sectional study was conducted on 4938 community-dwelling subjects aged 50 years or above in the first wave of the Ardakan Cohort Study on Aging. MCI was evaluated using the Mini-Mental State Examination (MMSE) and the Abbreviated Mental Test Score (AMTS) in literate and illiterate individuals. The relationship between factors associated with the odds of MCI was assessed through logistic regression.

Results: The prevalence of MCI among all participants, the literates and illiterates, was 15.8%, 6.3%, and 36.4%, respectively. It was found that failure to accomplish any of the MMSE or AMTS items was significantly related to MCI ($p < 0.001$). Age ([odds ratio (OR): 1.05; $p < 0.001$ in the literates], [OR: 1.06; $p < 0.001$ in the illiterates]), sex (OR: 0.13; $p < 0.001$ in the illiterates), history of stroke ([OR: 2.86; $p = 0.006$ in the literates], [OR: 2.04; $p = 0.045$ in the illiterates]), and depression ([OR: 1.87; $p < 0.001$ in the literates], [OR: 1.41; $p = 0.008$ in the illiterates]) were significantly associated with MCI.

Conclusion: This study highlights the significant associations between age, education, depression, stroke, and MCI in Iranian participants. These findings emphasize the need for targeted interventions in low-literacy populations, mental health screening, and stroke prevention strategies to mitigate the burden of MCI and enhance cognitive health.

KEYWORDS

cognitive dysfunction, geriatrics, middle aged, prevalence

1 | INTRODUCTION

The global population is experiencing rapid aging due to increased life expectancy. The World Health Organization (WHO) estimates that by 2050, the population of people aged 60 years or above will increase from 1 billion in 2020 to 2.1 billion globally, while approximately two-thirds of this population will live in low- and middle-income countries (LMICs).[1] This demographic shift presents serious challenges for community health systems, as older adults are more susceptible to various health complications associated with aging.[1]

Of particular concern is the sharp rise in the incidence of dementia, with cases doubling with every 6.3 years increase in age among the elderly population.[2] The impact of dementia is immense, as it leads to cognitive decline beyond normal aging, causing disability, dependency, and substantial social and economic consequences for affected individuals, their families, caregivers, and society at large.[3] Given the absence of a cure for dementia, identifying modifiable risk factors for conditions associated with its development becomes crucial in devising strategies for prevention and delaying its onset.[4]

One important target for dementia prevention is mild cognitive impairment (MCI), which represents a state of cognitive decline that is more severe than normal aging predicted based on an individual's age and education but does not qualify for dementia. Several sets of criteria have been suggested. Despite their differences, they all contain a measurable deficit in at least one area of cognition in the absence of dementia and impairment in daily function.[5,6] There should be evidence, either by self-report or by an informant, of a change in cognitive abilities compared to the individual's previous level of functioning.

The prevalence of MCI varies broadly, ranging from 3% to 42% across different studies worldwide.[7–10] It has been proposed that older adults with MCI have a higher risk for progression to dementia.

According to previous studies, 27% to more than half of those with MCI progress to dementia over a 3- to 10-year follow-up period.[11–14] On the other hand, the progression rates from MCI to dementia range from 5% to 16% per year.[12,15]

Demographic and social factors, including age,[16] gender,[17] socioeconomic status, low educational attainment,[18] and comorbidities such as diabetes mellitus,[19] hypertension,[20] depression, and anxiety,[21] have been identified as risk factors for MCI. Nevertheless, considering the context of each study is crucial to comprehend the differences in results.

As dementia continues to rise rapidly in LMICs, these regions face serious strain on their social and economic systems.[3] By 2050, nearly two-thirds of people with dementia are expected to reside in LMICs.[2] Despite the relevance of studies conducted in LMICs, very few have investigated MCI, raising concerns about the generalizability of findings, given the varying contexts in terms of wealth, culture, and infrastructure to support aging populations.[9,22–24] Conflicting results have been reported in examining MCI in LMICs, with the WHO reporting an overall MCI prevalence of 15.3% in these contexts.

Iran, a rapidly aging LMIC, is projected to have 33% of its population aged over 60 by 2050, a substantial increase of 26% from 2011, surpassing the global estimate of 21% for the elderly population.[25] However, studies on MCI in Iran remain scarce, with only a few reporting figures of 37% and 45.3%.[26,27] Given its status as a resource-limited setting, focusing on preventive strategies, budgeting, and public health surveillance to reduce the burden of dementia in Iran becomes of paramount importance.

Hence, this study aimed to address the research gap by providing a comprehensive report on the prevalence of MCI in Iran, examining a larger sample, and investigating the factors associated with this condition.

2 | METHODS

2.1 | Study design and setting

An observational cross-sectional study was conducted on individuals participating in the first wave of the Ardakan Cohort Study on Aging (ACSA) in the City of Ardakan, center of Iran, in 2020. The ACSA is a subset of the Persian cohort "IRanian Longitudinal Study on Aging (IRLSA)."[28]

The health centers' middle-aged and older adults were initially considered a stratum, and based on the proportion of people aged 50 years and older in that center, the specific center's allocation of the total sample was determined. Individuals from each center were then randomly selected until the required number of samples from that center was reached.

2.2 | Participants and inclusion and exclusion criteria

The ACSA population included community-dwelling Iranians aged 50 years or above. Due to the necessity of cooperation, individuals with severe visual, hearing, verbal loss, dementia, or Alzheimer's were excluded.

2.3 | Data collection and definition of terms

Data on age, sex, marital status (single, married), educational status (illiterate, elementary school, middle school, high school, college), as well as self-rated comorbidities including type II diabetes, hypertension, history of stroke, and myocardial infarction (MI), were gathered with a face-to-face interview.

This study assessed MCI using the Mini-Mental State Examination (MMSE) and the Abbreviated Mental Test Score (AMTS) for the literate and illiterate groups. The MMSE is an 11-item test with a score ranging from 0 to 30, which assesses five areas of cognitive function: orientation, registration, attention and calculation, recall, and language.[29] Although MMSE is not a diagnostic tool for dementia, it has been widely used for cognitive impairment screening.[30–32] The AMTS is a concise, 10-item test with a 10-points scale that evaluates intact short- and long-term memory, attention, and orientation.[33] The validity and reliability of AMTS in the older Iranian population were evaluated by Foroughan et al.[34] Since MMSE requires basic writing and reading knowledge, AMTS was utilized for the illiterate group. MCI was defined as having a score of 20–24 in MMSE or 4–6 in AMTS.

Since the diagnosis of MCI cannot be made solely based on one screening test, such as the MMSE or AMTS, the results of the tests were confirmed by self-report or by an informant for participants with scores falling within the categories indicative of MCI regarding a discernible change in their cognitive abilities compared to their previous level of functioning. Furthermore, it is important to note that all individuals identified with MCI did not show any impairments in performing their activities of daily living, including both basic and instrumental activities.

Body mass index was calculated based on each participant's weight and height and categorized into three groups: obese (>30), overweight (25 < ≤30), and normal (≤25). An adult who has smoked at least 100 cigarettes in his or her lifetime but who had quit smoking at the time of the interview was considered a former smoker.[35] To detect anemia, the World Health Organization (WHO) definition of anemia as a hemoglobin less than 13 g/dL in adult men and less than 12 g/dL in women was implemented.[36] Depression was assessed using the Center for Epidemiologic Studies Depression Scale (CES-D10)[37] and was described as a score of 10 or more. Sharif Nia et al.[38] translated and validated the Persian version of this tool. Anxiety was described using the anxiety subscale of the Hospital Anxiety and Depression Scale (HADS)[39]; a score of 7 and below, 8–10, and 11 and above were considered negative, borderline, and positive, respectively. Montazeri et al. translated and evaluated the reliability and validity of the Iranian version.[40]

2.4 | Statistical analysis

Quantitative variables were represented as mean and standard deviation (SD), whereas categorical variables were expressed as frequency and percentage. The relationship between factors associated with MCI was assessed through logistic regression. Variables with $p < 0.2$ in the first step (univariable model) were entered into the final model, then with a backward stepwise approach, only statistically significant variables ($p < 0.05$) were kept. All data were analyzed using Stata V.15.1 software. The significance threshold was considered less than 0.05.

2.5 | Ethical considerations

This investigation has been authorized by the Ethical Committee of the University of Social Welfare and Rehabilitation Sciences (record number IR.USWR.REC.1394.490). Informed consent was received from all participants.

3 | RESULTS

A total of 4938 participants were enrolled, including 3380 (68.45%) literate and 1558 (31.55%) illiterate. The overall prevalence of MCI was 15.8%. The prevalence of MCI in the literates and illiterates was 6.3% and 36.4%, respectively.

The mean age was 62.2 (SD: 7.8) years, with a female predominance of 51.99%. Most individuals were married (90.97%), and the most reported level of education was elementary school (30.93%). 42.17% of participants were obese, and 13.59% expressed themselves as current smokers. Hypertension (50.10%), followed by diabetes (32.47%), were the most frequent comorbidities. 17.23% of the participants were affected by depression and 11.79% by anxiety. The baseline characteristics are shown in Table 1.

The distribution of impairment in each item of MMSE and AMTS is represented in Table 2.

According to the MMSE subscale, in the fields of time and place orientation, the most failed tasks to accomplish among the literates were telling the day of the month (*N*: 291 (5.89%)) and naming the room the individual was in (*N*: 279 (5.65%)). Among all MMSE items, the most failed task to accomplish was in the construction area (*N*: 1264 (25.59%)). Based on the AMTS subscale, the year of the Iran–Iraq war (*N*: 1158 (23.45%)), date of birth (*N*: 763 (15.45%)), and current year (*N*: 758 (15.35%)) were the most failed tasks among the illiterates. Failure to accomplish any of the MMSE or AMTS items was significantly associated with MCI ($p < 0.001$).

Table 3 demonstrates the logistic regression results of factors associated with the MCI in the literates. In the univariable analysis, age, marital status, educational level, stroke, hypertension, depression, and anxiety were associated with MCI. Afterward, a multivariable regression model showed that age had a statistically significant association with MCI, as each single-year increase in age increased the risk of MCI by 5% (odds ratio [OR]: 1.05, $p < 0.001$). People with a middle school education had 55%, those with a high school education had 83%, and those with a college education had 88% decreased odds of developing MCI in comparison with elementary school education ($p < 0.001$). The odds of MCI was significantly higher in those with a stroke history (OR: 2.86, $p = 0.006$). Individuals with depression had 87% increased odds of MCI ($p < 0.001$).

Table 4 indicates the logistic regression results of factors associated with MCI in the illiterates. In the multivariable analysis, there was a statistically significant association between age and MCI (OR: 1.06, $p < 0.001$). The odds of developing MCI in females were 87% higher ($p < 0.001$). There was a statistically significant association between a stroke history and MCI (OR: 2.04, $p = 0.045$). The odds of MCI in people with depression increased by 41% ($p = 0.008$).

TABLE 1 Characteristics of under study population in total, Illiterates, and literates.

Variables, *n* (%)	Total	Illiterates	Literates
Age, mean (SD)	62.2 (7.8)	66.5 (7.9)	60.2 (6.7)
Sex			
Male	2382 (48.01)	469 (29.65)	1913 (56.61)
Female	2579 (51.99)	1113 (70.35)	1466 (43.39)
Marital status			
Single	448 (9.03)	288 (18.20)	160 (4.74)
Married	4513 (90.97)	1294 (81.8)	3219 (95.26)
Educational status			
Illiterate	1614 (31.14)	1614 (100.00)	0 (0.00)
Elementary school	1603 (30.93)	0 (0.00)	1603 (44.91)
Middle school	753 (14.53)	0 (0.00)	753 (21.10)
High school	621 (11.98)	0 (0.00)	621 (17.40)
College	592 (11.42)	0 (0.00)	592 (16.59)
BMI			
Under 25 (normal)	1038 (21.02)	276 (17.57)	762 (22.62)
25–30 (overweight)	1818 (36.81)	510 (32.46)	1308 (38.84)
More than 30 (obese)	2083 (42.17)	785 (49.97)	1298 (38.54)
Smoking history			
Never smoked	3739 (75.60)	1325 (83.97)	2414 (71.67)
Former smoker	535 (10.82)	139 (8.81)	396 (11.76)
Current smoker	672 (13.59)	114 (7.22)	558 (16.57)
Diabetes			
No	3271 (67.53)	930 (60.27)	2341 (70.92)
Yes	1573 (32.47)	613 (39.73)	960 (29.08)
Hypertension			
No	2435 (49.90)	572 (36.78)	1863 (56.03)
Yes	2445 (50.10)	983 (63.22)	1462 (43.97)
Anemia			
No	4500 (94.38)	1403 (92.85)	3097 (95.09)
Yes	268 (5.62)	108 (7.15)	160 (4.91)
History of stroke			
No	4777 (98.05)	1506 (97.29)	3271 (98.41)
Yes	95 (1.95)	42 (2.71)	53 (1.59)
History of MI			
No	4630 (95.50)	1464 (94.76)	3166 (95.85)
Yes	218 (4.50)	81 (5.24)	137 (4.15)
Depression			
No	4084 (82.77)	1198 (76.16)	2886 (85.87)
Yes	850 (17.23)	375 (23.84)	475 (14.13)

TABLE 1 (Continued)

Variables, *n* (%)	Total	Illiterates	Literates
Anxiety			
No	3686 (74.27)	1081 (68.29)	2605 (77.07)
Borderline	692 (13.94)	260 (16.42)	432 (12.78)
Yes	585 (11.79)	242 (15.29)	343 (10.15)

Note: Data are presented as number (%) and mean ± SD.
Abbreviations: BMI, body mass index; MI, myocardial infarction.

4 | DISCUSSION

The findings showed that the prevalence of MCI was 15.8% in over-50-year-old Iranian participants. Age and low educational attainment were linked to the development of MCI. People with depression or a history of stroke were at higher risk of MCI, and females were more predisposed.

In LMICs, two cross-sectional studies from China reported MCI prevalence of 15.5% and 20.1%.[41,42] Another cross-sectional study by Das et al.[43] in India reported a prevalence of 14.9%. In high-income countries, five studies from Europe reported a prevalence of 7.8%, 11.1%, 16.1%, 19.3%, and 20.0%, respectively.[44–48] In the United States, four major population-based studies reported a prevalence of 14.8%, 16.6%, 22%, and 24.7%.[6,49–51] The variability might be due to the difference in the population studied, sample size, age distribution, and the definitions.

According to our findings, age was associated with an increased risk of MCI. This finding was similar to the results from the Italian Longitudinal Study on Aging (ILSA)'s first and second surveys, with a 3.5-year follow-up.[52] Furthermore, the Swedish Kungsholmen Project reported a substantial increase in cognitive impairment after age 79 after correcting the estimates for attrition due to demise during follow-up.[53] Tervo et al.,[54] in a population-based study of 806 eligible participants aged 60–76 with a 3-year follow-up, found that those with higher ages were more likely to convert to MCI (OR: 1.08). Also, the Leipzig Longitudinal Study of the Aged, a population-based German study of the epidemiology of dementia and MCI, showed that every additional year of age yielded an hazard ratio of 1.06 for MCI.[55] Since MCI represents a predementia stage and the incidence of dementia itself also clearly increases with age, an increase in the incidence of MCI with age might be expected. This phenomenon may be explained through the changes occurring alongside aging, including general atrophy, especially in the hippocampus, amyloid-β deposition, inflammation, and the frailty of neurons in memory-related regions.[56]

In our findings, higher educational status was associated with a decreased risk of MCI. Similarly, Tervo et al.[54] indicated that participants with a high level of education were less likely to progress to MCI. Another population-based study of 2963 cases aged 65–84 proposed that participants with more than 3 years of education had a significantly lower risk of MCI.[52] It is assumed that low levels of education may increase susceptibility to cognitive deterioration via a lack of cognitive reserve.[57]

Our study implied that people with a history of stroke were at a two or threefold higher risk of MCI. It has been assumed that subclinical cerebral microbleeds caused by vascular and amyloid pathologic mechanisms have a critical role.[58] The results of the Sydney Stroke Study, performed on patients aged 50–85, 3–6 months after a stroke incidence, showed that stroke volume and premorbid function were significant determinants of cognitive impairment in stroke patients.[59]

Based on our investigation, depressive symptoms were associated with up to a twofold increase in risk for MCI in people with depression, depending on whether they are illiterate or literate. Depression and MCI are complex conditions with multiple causes, and they often coexist or share common risk factors. Some researchers propose that the chronic inflammation and vascular changes associated with depression may contribute to cognitive decline. A prospective cohort study, conducted on adults aged 60 or older, with 3 and 6 years of follow-ups, proposed that those with persistent depressive symptoms had almost a threefold higher risk for cognitive impairment.[60] This association might be explained through the synergism effect of the apolipoprotein E genotype with depression, which could accelerate the process of cognitive decline.[61]

Anxiety, compared to depression, has been studied less. In our study, there was a nonsignificant relation between anxiety and MCI, similar to a Canadian longitudinal study.[62] Contrary to these findings, Rozzini et al. stated that executive functions and anxiety were linked independently. Therefore, they might be a marker of incipient cognitive decline in cases with MCI. They hypothesized that the relation between anxiety and executive functions might be due to precise pathologic mechanisms at the caudate nucleus.[63]

The association between gender and MCI has remained unsettled. Our findings suggested that among the illiterates, females had a higher risk for MCI. Similarly, a higher prevalence of MCI in women was observed in ILSA[46] and the French Personnes Agées QUID.[15] A Chinese cross-sectional study on 46,011 adults aged 60 or older presented the female sex as a risk

TABLE 2 Distribution of impairment in each item of MMSE and AMTS in study population.

Item	Negative for cognitive impairment number (%)	MCI number (%)
MMSE subscales		
MMSE orientation		
Time orientation		
Year	23 (0.72)	42 (18.83)
Season	4 (0.13)	18 (8.07)
Month	32 (1.01)	38 (17.04)
Day of month	200 (6.29)	91 (40.81)
Day of week	25 (0.79)	25 (11.21)
Place orientation		
Country	0 (0.00)	1 (0.45)
City	0 (0.00)	1 (0.45)
Neighborhood	0 (0.00)	2 (0.90)
Location (site)	16 (0.50)	22 (9.87)
Room	210 (6.60)	69 (30.94)
MMSE construction	1085 (34.10)	179 (80.27)
MMSE language		
Command 0, 1, 2#	1 (0.03), 1 (0.03), 0(0)	5 (2.24), 0(0), 3 (1.35)
Repetition	4 (0.13)	7 (3.14)
Naming 0, 1$	1 (0.03), 0(0)	2 (0.90), 0(0)
Writing	64 (2.01)	50 (22.42)
Reading	42 (1.32)	41 (18.39)
MMSE memory		
Immediate recall 0, 1, 2#	0(0), 2 (0.06), 5 (0.16)	0(0), 3 (0.09), 8 (0.23)
Delayed recall 0, 1, 2#	118 (3.71), 627 (19.70), 1373 (43.15)	57 (25.56), 79 (35.43), 68 (30.49)
MMSE attention*	4.55 ± 0.71	1.97 ± 1.38
AMTS subscales		
Age in years	20 (2.02)	135 (23.18)
Time to the nearest hour	28 (2.83)	171 (30.16)
Address for recall at the end of test	308 (31.08)	386 (68.08)
Current year	240 (24.22)	518 (91.36)
Name of a place	4 (0.40)	47 (8.29)
Recognition of two persons (doctor, nurse, etc.)	14 (1.41)	45 (7.94)
Date of birth	244 (24.62)	519 (91.53)
The year of Iran–Iraq war	598 (60.34)	560 (98.77)
Name of current leader of the country	7 (0.71)	75 (13.23)
Count backwards from 20 to 1	87 (8.78)	367 (64.73)

Note: In all subscales, the maximum score is 1, except for $ and #, with a maximum of 2 and 3 points, respectively. Data are presented as frequency and percent for impairment in each subscale except for *, which is presented as the mean ± SD of the total score.

Abbreviations: AMTS, Abbreviated Mental Test Score; MCI, mild cognitive impairment; MMSE, Mini-Mental State Examination.

TABLE 3 Logistic regression of factors associated with odds of MCI in literates.

Covariates (reference level)	Univariable (α < 0.2)			Multivariable (α < 0.05)		
	OR	*p* Value	95% CI	OR	*p* Value	95% CI
Age	1.05	<0.001	1.03–1.06	1.05	**<0.001**	1.03–1.07
Sex (female)						
Male	0.85	0.250	0.64–1.11	-	-	-
Marital status (single)						
Married	0.57	0.040	0.34–0.97	-	-	-
Educational status (Elementary)						
Middle school	0.48	<0.001	0.34–0.69	0.45	**<0.001**	0.31–0.65
High school	0.18	<0.001	0.10–0.32	0.17	**<0.001**	0.09–0.30
College	0.11	<0.001	0.05–0.23	0.12	**<0.001**	0.06–0.24
BMI (under 25)						
25–30	1.17	0.398	0.80–1.70	-	-	-
More than 30	1.20	0.336	0.82–1.74	-	-	-
Smoking history (never smoked)						
Former smoker	1.23	0.296	0.82–1.84	-	-	-
Current smoker	0.98	0.931	0.67–1.43	-	-	-
Diabetes (no)						
Yes	1.23	0.153	0.92–1.65	-	-	-
Hypertension (no)						
Yes	1.59	0.001	1.21–2.10	-	-	-
Anemia (no)						
Yes	1.08	0.806	0.57–2.02	-	-	-
History of stroke (no)						
Yes	3.31	0.001	1.64–6.68	2.86	**0.006**	1.35–6.03
History of MI (no)						
Yes	1.64	0.088	0.92–2.90	-	-	-
Depression (no)						
Yes	1.97	<0.001	1.42–2.74	1.87	**<0.001**	1.33–2.62
Anxiety (no)						
Borderline	1.19	0.376	0.80–1.78	-	-	-
Yes	1.64	0.013	1.11–2.44	-	-	-

Note: Bold numbers indicate statistical significance ($p < 0.05$).

Abbreviations: BMI, body mass index; CI, confidence interval; MCI, mild cognitive impairment; MI, myocardial infarction; OR, odds ratio.

factor for MCI.[41] This might be related to estrogen reduction after menopause since estrogen has roles in the cholinergic[64] and glutamate systems[65] regarding learning and memory. In contrast, The Mayo Clinic Study of Aging reported a higher prevalence of MCI among men. According to one hypothesis, men undergo cognitive decline at an earlier age but more gradually. On the other hand, women alter from normal cognition straight to dementia at a later age but more abruptly.[10] Considerable attention must be directed toward the cultural context prevailing in each community. This study was conducted in Ardakan, Iran, with a deeply traditional background. Within this society, men are compelled to engage in social interactions and seek livelihood opportunities outside their homes, even if they lack literacy skills. Conversely, women in traditional societies predominantly assume domestic roles, exhibiting lower employment rates. Consequently, illiterate women encounter barriers to enhancing their cognitive capabilities

TABLE 4 Logistic regression of factors associated with odds of MCI in illiterates.

Covariates (reference level)	Univariable (α < 0.2)			Multivariable (α < 0.05)		
	OR	*p* Value	95% CI	OR	*p* Value	95% CI
Age	1.03	<0.001	1.02–1.05	1.06	**<0.001**	1.04–1.08
Sex (female)						
Male	0.18	<0.001	0.13–0.24	0.13	**<0.001**	0.10–0.19
Marital status (single)						
Married	0.47	<0.001	0.36–0.61	-	-	-
BMI (under 25)						
25 to 30	1.02	0.860	0.75–1.40	-	-	-
More than 30	1.32	0.059	0.98–1.77	-	-	-
Smoking history (never smoked)						
Former smoker	0.19	<0.001	0.11–0.33	-	-	-
Current smoker	0.17	<0.001	0.09–0.31	-	-	-
Diabetes (no)						
Yes	1.34	0.006	1.08–1.66	-	-	-
Hypertension (no)						
Yes	1.24	0.053	0.99–1.54	-	-	-
Anemia (no)						
Yes	0.82	0.366	0.54–1.25	-	-	-
History of stroke (no)						
Yes	1.70	0.093	0.91–3.17	2.04	**0.045**	1.01–4.11
History of MI (no)						
Yes	0.74	0.242	0.45–1.21	-	-	-
Depression (no)						
Yes	1.82	<0.001	1.44–2.32	1.41	**0.008**	1.09–1.83
Anxiety (no)						
Borderline	1.45	0.008	1.10–1.92	-	-	-
Yes	1.57	0.002	1.18–2.09	-	-	-

Note: Bold numbers indicate statistical significance ($p < 0.05$).

Abbreviations: BMI, body mass index; CI, confidence interval; MCI, mild cognitive impairment; MI, myocardial infarction; OR, odds ratio.

through means such as home-based education, rendering them unable to acquire crucial mental stimulation. Furthermore, the study's findings revealed no significant disparity in the MCI between the sexes among the literates. It is posited that literacy and educational attainment may serve as protective factors against estrogen decline and postmenopausal women's susceptibility to MCI. Nonetheless, these hypotheses necessitate prospective investigations involving diverse social contexts.

The relationship between diabetes, hypertension, MI, and anemia with MCI is complex, and the evidence is inconsistent. We found no significant associations in this regard. Similarly, one study showed that midlife-diagnosed coronary heart diseases did not increase the risk of dementia, and only late-life heart diseases increased the chance of cognitive impairment.[66] Also, Ganguli et al.[67] found that among all coronary heart diseases, only heart failure is a risk factor for MCI. Tervo et al.[54] declared that neither diabetes nor hypertension significantly affected MCI. Several potential mechanisms, including hippocampal atrophy through elevated blood glucose,[68] amyloid-β accumulation and disruption in its brain clearance due to the hyperinsulinemia state,[69] and building of advanced glycation end products,[70] have been proposed. Hypertension could lead to vascular damage and cerebral small vessel disease, affecting blood flow to the brain via possible mechanisms such as increasing the risk of subcortical white matter lesions, blood–brain barrier dysfunction, and formation of free oxygen radicals.[71,72] Anemia may also induce cognitive decline, oxidative stress, and inflammatory responses due to a reduction in the oxygen-carrying capacity of the blood leading to brain hypoperfusion.[73]

4.1 | Limitations

There were limitations to this study. First, since the current investigation is cross-sectional, the impact of variables may only be evident after a prolonged follow-up period. Second, cognitive decline is an extensive concept involving many factors, although, in this study, a limited number of them were included.

5 | CONCLUSION

The findings of this study shed light on the prevalence and associated factors of MCI among Iranians.

The prevalence of MCI among illiterates emphasizes the urgent need for targeted interventions in low-literacy populations. Educational attainment appears to play a crucial role in cognitive health. The significant association between depression and MCI highlights the importance of mental health screening and intervention strategies in older adults. Moreover, the study indicates that a history of stroke is significantly related to the development of MCI. This underscores the importance of effective stroke prevention strategies, which could potentially have a preventive effect on cognitive impairment.

By identifying these modifiable risk factors, healthcare professionals and policymakers can develop targeted interventions and preventive measures to mitigate the burden of MCI. Promoting mental health services and integrating educational initiatives into public health programs may enhance cognitive health.

AUTHOR CONTRIBUTIONS

Ahmad Delbari: Conceptualization; data curation; investigation; project administration; validation. **Fatemeh-Sadat Tabatabaei**: Conceptualization; formal analysis; investigation; visualization; writing—original draft. **Hoomaan Ghasemi**: Investigation; writing—original draft; writing—review & editing. **Amirali Azimi**: Investigation; visualization; writing—review & editing. **Mohammad Bidkhori**: Formal analysis; software; writing—review & editing. **Mohammad Saatchi**: Formal analysis; methodology; software. **Mahshid Foroughan**: Validation; writing—original draft; writing—review & editing. **Elham Hooshmand**: Data curation; funding acquisition; project administration; resources; supervision; writing—review & editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data set and the analysis for this work are available from the authors at a reasonable request. Dr. Elham Hooshmand has full access to all of the data in this study and takes complete responsibility for the integrity of the data and the accuracy of the data analysis.

TRANSPARENCY STATEMENT

The lead author Elham Hooshmand affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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