Mod Care J. 2025 April; 22(2): e159620 https://doi.org/10.5812/mcj-159620

Published Online: 2025 April 28 **Research Article**

Cognitive Disorders in Patients with Cardiac Angina Referred to Sayad Shirazi Hospital in 2024

Vahid Shahriari [1], Yasmin Ghelichi [2], Fateme Ghorbani [3,*], Maryam Zahedi Tabarestani [4,5,**]

[1] Assistant Professor of Psychiatry, Department of Psychiatry, Golestan Research Center of Psychiatry, School of Medicine, Golestan University of Medical Sciences, Gorgan, Iran
[2] Anesthesiologist, Bent Al-Hoda Hospital, North Khorasan University of Medical Sciences, Bojnord, Iran
[3] Medical Student, Golestan Research Center of Psychiatry, School of Medicine, Golestan University of Medical Sciences, Gorgan, Iran
[4] Assistant Professor, Department of Anesthesiology and Critical Care, 5azar Hospital, School of Medicine, Golestan University of Medical Sciences, Gorgan, Iran
[5] Department of Anesthesiology and Critical Care, Taleghani Children's Hospital, School of Medicine, Golestan University of Medical Sciences, Gorgan, Iran

[*] ***Corresponding Author:*** Medical Student, Golestan Research Center of Psychiatry, School of Medicine, Golestan University of Medical Sciences, Gorgan, Iran. Email: fatemeghorbani7@gmail.com
[**] ***Corresponding Author:*** Assistant Professor, Department of Anesthesiology and Critical Care, 5azar Hospital, School of Medicine, Golestan University of Medical Sciences, Gorgan, Iran. Email: maryamzahedi25@yahoo.com

Received: 13 January, 2025; **Revised:** 11 April, 2025; **Accepted:** 19 April, 2025

Abstract

Background: Cognitive disorder occurs when a person has difficulty remembering, learning new things, concentrating, or making decisions that affect their daily life. There is a relationship between cardiovascular-coronary diseases and the risk factors of these diseases with cognitive disorders.

Objectives: The present study was conducted with the aim of investigating cognitive disorder in patients with unstable cardiac angina compared to non-sufferers.

Methods: This case-control study was conducted on 45 patients with unstable cardiac angina and 45 non-sufferers referred to Sayad Shirazi Hospital in 2024. The tool for data collection was the Montreal cognitive assessment test (MoCA). Data were analyzed using SPSS version 23 software with the Chi-square test and Fisher's exact test. The risk and effective factors associated with developing the disease were measured using logistic regression and expressed as odds ratios (OR) with a 95% confidence interval (CI).

Results: Although the cognitive status of cardiac angina patients compared to non-sufferers was suggestive of mild cognitive disorders (MCI), the difference was not statistically significant (P = 0.31). The risk of cognitive disorder in people with cardiac angina was 1.71 times higher (OR = 1.71, P = 0.21, 95% CI: 0.74 - 3.94) than in those without cardiac angina. The risk of cognitive disorder in men with cardiac angina was 4.35 times higher (OR = 4.35, P = 0.21, 95% CI: 1.19 - 15.86) than in women, and in diabetics with cardiac angina, it was 5.78 times higher.

Conclusions: The risk of cognitive disorder is higher in people with cardiac angina. Also, men and diabetics with unstable angina are more susceptible to cognitive disorders.

Keywords: Cognitive Disorders, Cardiovascular Disease, Unstable Angina, Risk Factor

1. Background

Cardiac angina is the most common ischemic heart disease and occurs due to a temporary decrease in blood flow and oxygen supply to the heart (1). Angina arises from the narrowing and hardening of arteries, unstable plaques, decreased heart muscle pumping function, and coronary artery spasm (2). Symptoms include chest pain and discomfort, often radiating to the arms, neck, jaw, shoulder, or back (3). The intensity, duration, and type of

How to Cite: Shahriari V, Ghelichi Y, Ghorbani F, Zahedi Tabarestani M. Cognitive Disorders in Patients with Cardiac Angina Referred to Sayad Shirazi Hospital in 2024. Mod Care J. 2025; 22 (2): e159620. https://doi.org/10.5812/mcj-159620.

angina can vary (1). Consequently, cardiac angina accounts for a significant number of emergency room visits and repeated hospitalizations in cardiac intensive care units (1, 4).

Cognitive disorder refers to conditions in which a person has difficulty remembering, learning new things, concentrating, or making decisions that affect daily life (5). Cognitive disorders range from mild to severe. Individuals with mild impairment may notice changes in cognitive function but can still perform daily activities independently, whereas severe impairment can result in the inability to understand meaning, speak, or write, ultimately leading to the loss of independent living (6). People with mild cognitive disorder (MCI) who complain of memory deficits are at a higher risk of developing dementia, particularly Alzheimer's disease, in the future (7). About one percent of individuals experience no cognitive impairment, a phenomenon referred to as "successful aging" (8). Mild cognitive disorder is classified into two subgroups: Amnestic (a-MCI) and non-amnestic (Non-MCI) (8). Non-amnestic MCI affects cognitive domains such as attention, language use, or spatial skills, without impacting memory (9, 10).

The results of some studies show that cognitive disorder interacts with cardiovascular diseases such as coronary artery disease, abnormal blood pressure, heart failure, and arrhythmia. Patients with coronary heart disease (CHD) may have a higher risk for vascular dementia due to the progression of atherosclerotic disease and the burden of vascular risk factors (11-15). Cardiovascular disease risk factors in middle age are associated with a higher risk of cognitive disorder later in life. Furthermore, treatments that reduce vascular risk may lower the risk of cognitive disorder (16). However, other studies have reported no statistically significant relationship between cardiovascular diseases, bleeding disorders, and cognitive disorders (17).

Given the conflicting results in previous research, the present study was conducted to investigate cognitive disorder in patients with cardiac angina compared to healthy individuals and to examine the relationship between demographic factors and cardiovascular risk factors with cognitive disorder in patients with cardiac angina referred to Sayad Shirazi Hospital in 2024.

2. Objectives

The aim of this study was to investigate cognitive disorder in patients with cardiac angina compared to healthy individuals and to evaluate the relationship between demographic factors and cardiovascular risk factors with cognitive disorder in these patients.

3. Methods

3.1. Study Design

The current study is a case-control study with an analytical approach. In this study, homogeneity was used to control for confounding factors. The variables of age, gender, education level, and employment status were homogeneous.

3.2. Participants

In this study, 45 patients who presented to Shahid Sayad Shirazi Hospital in Gorgan city in 2024 with the first complaint of cardiac angina (the group with unstable cardiac angina) and 45 individuals without cardiac angina (the group not suffering from unstable cardiac angina) were selected using an easy and accessible sampling method. Unstable angina in the patients was confirmed by a cardiologist.

The inclusion criteria for the group with unstable cardiac angina included patients aged 18 years and older, with stable vital signs, who were alert and oriented, had no dyspnea, and exhibited no symptoms resulting from the use of sedative drugs. The samples for the group not suffering from unstable cardiac angina were selected from among the companions of the patients, who were over 18 years old and had no history of cardiovascular diseases, psychiatric diseases, or any type of chronic disease, using a simple and careful selection method.

The exclusion criteria for both groups were a history of myocardial infarction, a history of stroke, serious psychiatric disorders, and a history of cognitive disorders.

The sample size was based on the study by Joosten et al. (18), where the mean and standard deviation of cognitive disorder scores between the two groups were reported as 64 ± 22 and 50 ± 18, respectively. Using the formula for determining the sample size in two independent groups, with a confidence level of 0.95, a statistical power of 90%, and considering a 5% drop-out rate, 45 participants were estimated for each group, resulting in a total of 90 samples.

$$n = \frac{\left(z_{1-\frac{\alpha}{2}} + z_{1-\beta}\right)^2 \left(s_1^2 + s_2^2\right)}{\left(\mu_1 - \mu_2\right)^2}$$

Sampling was conducted using an available method, and informed consent was obtained after checking the eligibility criteria. The data collection tools included a checklist of demographic information (age, gender, marital status, education level, and occupation) and the Montreal cognitive assessment test (MoCA).

3.3. Scales

3.3.1. Montreal Cognitive Test Questionnaire

The MoCA Test was established by Nasreddine et al. in 2005 as a short and simple screening tool to detect cognitive disorders. This test evaluates seven cognitive domains, including short-term memory (recall delay, 5 points), visuospatial skills (cube drawing, clock drawing, 4 points), executive functions (alternating trail making, verbal abstraction, 4 points), attention and concentration, working memory (digit span, serial subtraction, vigilance, 5 points), language (naming, sentence repetition, 5 points), abstract reasoning (2 points), and orientation to time and place (5 points). It has become an alternative to the traditional mini-mental state examination (MMSE) (19).

This 30-point test can be completed in approximately 10 minutes. Individuals who score 26 or above are considered cognitively normal, while scores below 26 suggest MCIs (20). In the study by Duro et al., the reliability of the MoCA test was confirmed with a Cronbach's alpha of 92% and a test-retest reliability of 83% (21). In Iran, Amsaki et al. confirmed the reliability of this test with a Cronbach's alpha of 0.77 and a validity of 0.79 (22).

3.4. Data Collection

After obtaining permission from the Ethics Committee of Golestan University of Medical Sciences, the researcher (student) visited Shahid Sayyad Shirazi Hospital in Gorgan and examined all patients who had been hospitalized with complaints of angina pectoris. All patients who had angina pectoris, met the inclusion criteria, and provided written consent were included in the study. The companions of the patients who met the inclusion criteria were selected as the control group. In selecting the patients, attention was given to ensuring that they had stable vital signs, were oriented, had no dyspnea, and that their symptoms were not due to the use of sedative drugs.

3.5. Data Analysis

After data collection, the data were analyzed using SPSS software version 23. Mean and standard deviation were used to describe quantitative variables, and a frequency distribution table was used for qualitative variables. Qualitative variables were compared using the chi-square test and Fisher's exact test. The risk and effective factors associated with contracting the disease were assessed using logistic regression, with results expressed as odds ratios (OR) and 95% confidence intervals (CI).

3.6. Ethical Considerations

This study was conducted after receiving the code of ethics (IR.GOUMS.REC.1402.011) from the Ethics Committee of Golestan University of Medical Sciences. Before completing the questionnaire, informed consent was obtained from the patients, and upon their agreement, the questionnaire was completed. Throughout the study and afterward, patient information was kept confidential, and no names were mentioned at any stage. The procedures outlined in the research plan did not pose any side effects for the patients.

4. Results

The present study was conducted on 90 participants, divided into two groups: Those with unstable cardiac angina and those without unstable cardiac angina, with 45 samples in each group. The comparison of demographic indicators between the two groups is presented in Table 1. The two groups were homogeneous in terms of gender frequency (P = 0.07), age group (P = 0.22), marital status (P = 0.117), education level (P = 0.208), and employment status (P = 0.065). However, the frequency of diabetes (P = 0.006) and hypertension (P = 0.037) was significantly higher in the group with unstable cardiac angina compared to the group without unstable cardiac angina (Table 1).

The rate of cognitive disorders among all participants in the current study was 48.89% (44 individuals). The mean score of the total cognitive status according to the Montreal cognitive assessment in the group with unstable cardiac angina was 24.93 ± 2.75, compared to 25.47 ± 2.43 in the group without unstable cardiac angina, with a score range of 19 - 30. Therefore,

Table 1. Comparison of Demographic and Clinical Indicators Between Two Groups with Unstable Cardiac Angina and Without Unstable Cardiac Angina [a]

Variables	Without Unstable Cardiac Angina	With Unstable Cardiac Angina	P-Value
Gender			0.070
Male	26 (57.8)	34 (75.6)	
Female	19 (42.2)	11 (24.4)	
Age (y)			0.220
> 40	2 (4.4)	6 (13.3)	
40 - 49	22 (48.9)	15 (33.3)	
50 - 59	14 (31.1)	19 (42.2)	
≤ 60	7 (15.6)	5 (11.1)	
Marital status			0.117
Single	0	4 (8.9)	
Married	45 (100)	41 (91.1)	
Education			0.208
High school	15 (33.3)	23 (51.1)	
Diploma	21 (46.7)	14 (31.1)	
University	9 (20.0)	8 (17.8)	
Employment status			0.065
Employee	17 (37.8)	21 (46.7)	
Unemployed	28 (62.6)	24 (53.3)	
Diabetes	8 (17.8)	21 (46.7)	0.006
High blood pressure	5 (11.1)	14 (31.1)	0.037

[a] Values are expressed as No. (%).

there was no significant difference in cognitive status between the two groups (P = 0.31). Based on the obtained scores, both groups exhibited an abnormal cognitive state, suggesting MCIs. The frequency of impaired cognitive status was 55.6% in the group with unstable angina and 42.2% in the group without unstable angina. The OR of cognitive disorders in individuals with unstable cardiac angina was 1.71 times that of individuals without unstable cardiac angina (OR = 1.71, P = 0.21, 95% CI: 0.74 - 3.94) (Table 2).

There were a total of 44 individuals with cognitive disorders, 25 from the group with unstable angina and 19 from the group without unstable angina. The risk of cognitive disorder in men with unstable angina was 4.35 times higher (OR = 4.35, P = 0.21, 95% CI: 1.19 - 15.86) than in women. The risk of cognitive disorder in diabetics with unstable angina was 5.78 times higher. The risk of cognitive disorder did not have a statistically significant relationship with age (P = 0.271), education level (P = 0.244), employment status (P = 0.112), or blood pressure (P = 0.142) among samples with unstable angina (Table 2).

5. Discussion

This study was conducted with the aim of determining cognitive disorders in patients with unstable cardiac angina compared to a group without unstable cardiac angina. In the present study, although cognitive disorders were more frequent among patients with cardiac angina compared to those without, the difference was not statistically significant, and having cardiac angina was not identified as a risk factor for cognitive disorders. Additionally, the variables of gender, age, marital status, occupation, diabetes, and hypertension were not found to influence the cognitive status of the subjects studied. However, individuals with lower education levels (middle school education) were more likely to suffer from cognitive disorders compared to those with a university education.

The findings of the present study showed that the likelihood of cognitive disorder in men with unstable cardiac angina was four times higher than in women with the same condition. Furthermore, patients with unstable cardiac angina who also had diabetes had nearly six times higher odds of developing cognitive disorders compared to non-diabetic patients with unstable cardiac angina.

The relationship between disease and cognitive disorders has been explored in various studies. In the

Table 2. Determining the Effect of Demographic and Clinical Variables on Cognitive Disorders in People with Unstable Angina [a]

Variables	Cognitive Disorders		Test Result		
	Without Unstable Cardiac Angina (N = 19)	With Unstable Cardiac Angina (N = 25)	OR	%95 CI	P-Value
Gender [b]			354.4	19.1 - 86.15	023.0
Male	8 (42.1)	19 (76)			
Female	11 (57.9)	6 (24)			
Ages [b]			97.1	59.0 - 66.6	271.0
> 50	10 (52.6)	9 (36)			
50 ≤ [c]	9 (47.4)	16 (64)			
Education [b]			49.0	14.0 - 63.1	244.0
Cycle [c]	8 (42.1)	15 (60)			
Diploma and above	11 (57.9)	10 (40)			
Employment status [b]			85.2	79.0 - 31.10	112.0
Employed	10 (52.6)	19 (76)			
Unemployed [c]	9 (47.4)	6 (24)			
Diabetes [b, c]			78.5	34.1 - 92.24	011.0
Yes	3 (15.8)	13 (52)			
No [c]	16 (84.2)	12 (48)			
Blood pressure [b, c]			00.3	68.0 - 17.13	142.0
Yes	3 (15.8)	9 (36)			
No [c]	16 (84.2)	16 (64)			

[a] Values are expressed as No. (%).
[b] Logistic regression.
[c] Reference.

study by Covello et al., it was shown that suffering from cardiovascular disease, including coronary artery disease, cardiac angina, heart failure, myocardial infarction, or other heart conditions, does not lead to an increased cognitive decline compared to the healthy population (23). Our study findings were consistent with these results.

In contrast, the study by Xie et al. showed that the occurrence of CHD was associated with long-term cognitive decline, a finding not observed in our study (6). The difference may be attributed to the study designs and populations: Our study was cross-sectional, while Xie et al. conducted a longitudinal study assessing cognitive function at diagnosis and again 1 to 12 years later. Furthermore, our patient group only included individuals with cardiac angina, whereas Xie et al.'s study population included patients with both myocardial infarction and angina. Based on the comparison, it can be argued that while cognitive function may not differ at the time of the cardiac event, it may decline over time (6).

In the study by Stewart et al., it was found that MCIs in patients with stable CHD did not differ based on the type of medication used; however, increasing age, lack of education, diabetes, and hypertension were associated with a higher risk of cognitive disorders (24). Our study also found that lower education levels and diabetes were associated with cognitive impairment, consistent with Stewart's findings, although no significant association was observed between age, hypertension, and cognitive status in our population.

In the study by Hajduk et al., the prevalence of cognitive disorders in heart attack patients was reported to be 17%, with increasing age identified as a related factor (25). Our findings differed, as 55.6% of patients with cardiac angina had cognitive disorders, and diabetes and male gender were identified as associated factors rather than age.

Similarly, in the study by Cannon et al., the prevalence of cognitive disorders in heart failure patients was 43%, and the odds ratio for cognitive disorder was 1.67 (26). Our study showed a comparable odds ratio (1.71) for cognitive disorders among patients

with cardiac angina, although the prevalence was higher in our population.

In another study, Salzwedel et al. found that the prevalence of cognitive disorders in coronary artery disease patients undergoing cardiac rehabilitation was 36.7% (27). Again, the prevalence in our study was higher.

The study by Yaffe et al. demonstrated that cardiovascular risk factors such as increased systolic and diastolic blood pressure and elevated fasting blood sugar were associated with cognitive decline in midlife adults (15). Consistent with Yaffe's findings, our study indicated that diabetes (associated with elevated blood sugar) was related to an increased risk of cognitive disorder in patients with cardiac angina, although no significant association was found with blood pressure.

Finally, in the study by Roberts et al., CHD (including heart attack, angina, and angiography-confirmed coronary artery narrowing) was associated with non-amnestic cognitive decline, but not amnestic cognitive decline (28). Our findings were inconsistent with those of Roberts et al. Several factors could explain this discrepancy: Our study focused only on patients with cardiac angina and did not include other CHD patients; the type of cognitive disorder (amnestic vs. non-amnestic) was not investigated; and the study population primarily consisted of patients aged 50 – 60 years, whereas Roberts et al. included a broader age range (28).

5.1. Conclusions

The findings of the present study showed that having unstable cardiac angina is not related to cognitive disorders in patients. Additionally, a low level of education is associated with a 3.68-fold increase in the likelihood of cognitive disorders. In the present study, male gender and the simultaneous presence of diabetes were also associated with an increased odds of cognitive disorders in patients with unstable cardiac angina.

5.2. Limitations

One of the limitations of this study was the requirement for sufficient literacy among the subjects, which restricted the number of eligible samples. Additionally, a lack of cooperation from patients in answering the questionnaire posed another limitation. To overcome these challenges, the student researcher made multiple visits to the patients to collect data and complete the study forms.

Acknowledgements

The authors would like to express their gratitude to the vice president of research and technology of Golestan University of Medical Sciences, the support unit for development and clinical research of 5 Azargorgan, the officials and nurses of Shahid Sayad Shirazi Hospital and all the participants in the study.

Footnotes

Authors' Contribution: V. Sh., M. Z. T., and F. Gh. participated in the conception and design of the study. Y. Gh. and F. Gh. carried out the literature search. F. Gh. participated in the acquisition of the data. V. Sh and M. Z. T. carried out the statistical analysis. V. Sh. and Y. Gh. participated in the interpretation of the results and drafting of the manuscript. V. Sh. and M. Z. T. participated in the final approval of the version to be submitted. All the authors read and approved the final manuscript.

Conflict of Interests Statement: There is no conflict of sources in sending or publishing this article by the authors.

Data Availability: The data generated in this study are included in this paper in the form of tables.

Ethical Approval: This research is the result of the doctoral thesis of the Golestan University of Medical Sciences with the code of ethics number IR.GOUMS.REC.1402.011 .

Funding/Support: This study had no funding sources or support.

Informed Consent: Informed consent was obtained from the patient, ensuring that he fully understood the purpose and implications of this report. Clear information was provided regarding the use of his data and the measures taken to protect his privacy.

References

1. Mehta S, Kleiman N. Stable Angina. In: Timmis AD, Nathan AW, editors. *Essential Cardiology*. Hoboken, New Jersey: Blackwell Scientific Publications; 2013. p. 419-38. https://doi.org/10.1007/978-1-4614-6705-2_24.
2. Rousan TA, Mathew ST, Thadani U. Drug Therapy for Stable Angina Pectoris. *Drugs*. 2017;**77**(3):265-84. [PubMed ID: 28120185]. https://doi.org/10.1007/s40265-017-0691-7.
3. Valgimigli M, Biscaglia S. Stable angina pectoris. *Curr Atheroscler Rep*. 2014;**16**(7):422. [PubMed ID: 24838374]. https://doi.org/10.1007/s11883-

014-0422-4.

4. Pajak A, Jankowski P, Kotseva K, Heidrich J, de Smedt D, De Bacquer D, et al. Depression, anxiety, and risk factor control in patients after hospitalization for coronary heart disease: the EUROASPIRE III Study. *Eur J Prev Cardiol*. 2013;**20**(2):331-40. [PubMed ID: 22396247]. https://doi.org/10.1177/2047487312441724.
5. Boland R, Verdiun M, Ruiz P. *Kaplan & Sadock's synopsis of psychiatry*. Philadelphia, Pennsylvania: Lippincott Williams & Wilkins; 2021.
6. Xie W, Zheng F, Yan L, Zhong B. Cognitive Decline Before and After Incident Coronary Events. *J Am Coll Cardiol*. 2019;**73**(24):3041-50. [PubMed ID: 31221251]. https://doi.org/10.1016/j.jacc.2019.04.019.
7. Gauthier S, Reisberg B, Zaudig M, Petersen RC, Ritchie K, Broich K, et al. Mild cognitive impairment. *Lancet*. 2006;**367**(9518):1262-70. [PubMed ID: 16631882]. https://doi.org/10.1016/S0140-6736(06)68542-5.
8. Petersen RC, Roberts RO, Knopman DS, Boeve BF, Geda YE, Ivnik RJ, et al. Mild cognitive impairment: ten years later. *Arch Neurol*. 2009;**66**(12):1447-55. [PubMed ID: 20008648]. [PubMed Central ID: PMC3081688]. https://doi.org/10.1001/archneurol.2009.266.
9. Molano J, Boeve B, Ferman T, Smith G, Parisi J, Dickson D, et al. Mild cognitive impairment associated with limbic and neocortical Lewy body disease: a clinicopathological study. *Brain*. 2010;**133**(Pt 2):540-56. [PubMed ID: 19889717]. [PubMed Central ID: PMC2822633]. https://doi.org/10.1093/brain/awp280.
10. Petersen RC. Clinical practice. Mild cognitive impairment. *N Engl J Med*. 2011;**364**(23):2227-34. [PubMed ID: 21651394]. https://doi.org/10.1056/NEJMcp0910237.
11. Newman MF, Grocott HP, Mathew JP, White WD, Landolfo K, Reves JG, et al. Report of the substudy assessing the impact of neurocognitive function on quality of life 5 years after cardiac surgery. *Stroke*. 2001;**32**(12):2874-81. [PubMed ID: 11739990]. https://doi.org/10.1161/hs1201.099803.
12. Gharacholou SM, Reid KJ, Arnold SV, Spertus J, Rich MW, Pellikka PA, et al. Cognitive impairment and outcomes in older adult survivors of acute myocardial infarction: findings from the translational research investigating underlying disparities in acute myocardial infarction patients' health status registry. *Am Heart J*. 2011;**162**(5):860-869 e1. [PubMed ID: 22093202]. [PubMed Central ID: PMC3410733]. https://doi.org/10.1016/j.ahj.2011.08.005.
13. Zuo W, Wu J. The interaction and pathogenesis between cognitive impairment and common cardiovascular diseases in the elderly. *Ther Adv Chronic Dis*. 2022;**13**:20406223211063000. [PubMed ID: 35126964]. [PubMed Central ID: PMC8814974]. https://doi.org/10.1177/20406223211063020.
14. Gorelick PB, Furie KL, Iadecola C, Smith EE, Waddy SP, Lloyd-Jones DM, et al. Defining Optimal Brain Health in Adults: A Presidential Advisory From the American Heart Association/American Stroke Association. *Stroke*. 2017;**48**(10). https://doi.org/10.1161/str.0000000000000148.
15. Yaffe K, Vittinghoff E, Pletcher MJ, Hoang TD, Launer LJ, Whitmer R, et al. Early adult to midlife cardiovascular risk factors and cognitive function. *Circulation*. 2014;**129**(15):1560-7. [PubMed ID: 24687777]. [PubMed Central ID: PMC4700881]. https://doi.org/10.1161/CIRCULATIONAHA.113.004798.
16. Ganguli M, Fu B, Snitz BE, Hughes TF, Chang CC. Mild cognitive impairment: incidence and vascular risk factors in a population-based cohort. *Neurology*. 2013;**80**(23):2112-20. [PubMed ID: 23658380]. [PubMed Central ID: PMC3716350]. https://doi.org/10.1212/WNL.0b013e318295d776.
17. El Zoghbi M, Boulos C, Amal AH, Saleh N, Awada S, Rachidi S, et al. Association between cognitive function and nutritional status in elderly: A cross-sectional study in three institutions of Beirut—Lebanon. *Geriatric Mental Health Care*. 2013;**1**(4):73-81. https://doi.org/10.1016/j.gmhc.2013.04.007.
18. Joosten H, van Eersel ME, Gansevoort RT, Bilo HJ, Slaets JP, Izaks GJ. Cardiovascular risk profile and cognitive function in young, middle-aged, and elderly subjects. *Stroke*. 2013;**44**(6):1543-9. [PubMed ID: 23640826]. https://doi.org/10.1161/STROKEAHA.111.000496.
19. Nasreddine ZS, Phillips NA, Bedirian V, Charbonneau S, Whitehead V, Collin I, et al. The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. *J Am Geriatr Soc*. 2005;**53**(4):695-9. [PubMed ID: 15817019]. https://doi.org/10.1111/j.1532-5415.2005.53221.x.
20. Athilingam P. *Validation of an instrument to measure cognitive function in patients with heart failure [Dissertation]*. Rochester, USA: University of Rochester School of Nursing; 2008.
21. Duro D, Simoes MR, Ponciano E, Santana I. Validation studies of the Portuguese experimental version of the Montreal Cognitive Assessment (MoCA): confirmatory factor analysis. *J Neurol*. 2010;**257**(5):728-34. [PubMed ID: 19937448]. https://doi.org/10.1007/s00415-009-5399-5.
22. Amsaki G, Maulvi H, Chitsaz A, Mohdabattahi M, Asgari K. [Introducing and examining the psychometric properties of the Montreal Cognitive Assessment Scale in patients with Parkinson's disease]. *J Isfahan Med Sch*. 2014;**29**(158). FA.
23. Covello AL, Horwitz LI, Singhal S, Blaum CS, Li Y, Dodson JA. Cardiovascular disease and cumulative incidence of cognitive impairment in the Health and Retirement Study. *BMC Geriatr*. 2021;**21**(1):274. [PubMed ID: 33902466]. [PubMed Central ID: PMC8074515]. https://doi.org/10.1186/s12877-021-02191-0.
24. Stewart RAH, Held C, Krug-Gourley S, Waterworth D, Stebbins A, Chiswell K, et al. Cardiovascular and Lifestyle Risk Factors and Cognitive Function in Patients With Stable Coronary Heart Disease. *J Am Heart Assoc*. 2019;**8**(7). e010641. [PubMed ID: 30897999]. [PubMed Central ID: PMC6509727]. https://doi.org/10.1161/JAHA.118.010641.
25. Hajduk A, Saczynski J, Tsang S, Geda M, Dodson J, Ouellet G, et al. Cognitive Impairment and Six-Month Outcomes among Older Adults with Myocardial Infarction: The Silver-Ami Study. *Innovation in Aging*. 2018;**2**(suppl_1):772. https://doi.org/10.1093/geroni/igy023.2857.
26. Cannon JA, Moffitt P, Perez-Moreno AC, Walters MR, Broomfield NM, McMurray JJV, et al. Cognitive Impairment and Heart Failure: Systematic Review and Meta-Analysis. *J Card Fail*. 2017;**23**(6):464-75. [PubMed ID: 28433667]. https://doi.org/10.1016/j.cardfail.2017.04.007.
27. Salzwedel A, Heidler MD, Haubold K, Schikora M, Reibis R, Wegscheider K, et al. Prevalence of mild cognitive impairment in employable patients after acute coronary event in cardiac rehabilitation. *Vasc Health Risk Manag*. 2017;**13**:55-60. [PubMed ID: 28260915]. [PubMed Central ID: PMC5328136]. https://doi.org/10.2147/VHRM.S121086.
28. Roberts RO, Knopman DS, Geda YE, Cha RH, Roger VL, Petersen RC. Coronary heart disease is associated with non-amnestic mild cognitive impairment. *Neurobiol Aging*. 2010;**31**(11):1894-902. [PubMed ID: 19091445]. [PubMed Central ID: PMC2888961]. https://doi.org/10.1016/j.neurobiolaging.2008.10.018.