Received: September 28, 2026
Accepted: October 21, 2026
Published: November 27, 2026

Acad Med J 2026;6(3):145-157
UDC: 616.12:616.153.455]:331.4
616.12:616.153.916]:331.4
Original article

ASSOCIATION OF NIGHT SHIFT WORK AND PHYSICAL ACTIVITY AT THE WORKPLACE WITH HYPERGLYCEMIA AND DYSLIPIDEMIA IN WORKERS WITH SIGNIFICANT CORONARY ARTERY DISEASE

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Abstract

Introduction: Occupational hazards related to psychological or psychophisiological efforts at the workplace, as well as occupational hazards related to organization of work may impact occurrence and course of coronary artery disease (CAD).

Aim of the study. To assess the association between hyperglycemia and dyslipidemia with night shift work and physical activity at the workplace in workers with significant CAD.

Material and methods: A cross-sectional study including 110 workers (mean age 55.34±6.51 years) with significant CAD was performed at the Specialized hospital for prevention, treatment and rehabilitation of cardiovascular diseases "St. Stefan" in Ohrid. Methodology of the study included completion of a questionnaire on demographics, characteristics and organization of the work activities and history of disease, as well as measurements of blood sugar and lipid profile.

Results: A significant linear positive correlation was found between night shift work and hyperglycemia ($R_{(110)}$=0.461; p=0.00001), as well as dyslipidemia ($R_{(110)}$=0.200; p=0.0356). In addition, a significant linear negative correlation was registered between physical activity at the workplace (sedentary work → hard physical work) and hypeglycemia ($R_{(110)}$=(-0.217; p=0.0228), as well as dyslipidemia ($R_{(110)}$=(-0.314; p=0.0008).

Conclusion: Our findings indicated significant association between hyperglycemia and dyslipidemia with night shift work, as well as their significant negative correlation with hard physical work at the workplace.

Keywords: hyperlycemia, lipid profile, night shift work, physical activity at the workplace, significant coronary artery disease

Introduction

Coronary artery disease (CAD) is clinical syndrome caused by reduced or stopped blood flow through coronary arteries, usually due to atherosclerotic plaques and their complications. Clinical manifestations of CAD vary from asymptomatic ischemia and stable pectoral angina to acute coronary syndromes (non-stable angina pectoris and acute myocardial

infarction). Significant CAD is a form of the disease characterized by severe coronary artery stenosis, which commonly requires myocardial revascularization.

CAD is a multifactorial disorder and its risk factors are classified as non-modifiable and modifiable. Non-modifiable or endogenous risk factors of CAD are sex, age and genetic factors, whereas modifiable risk factors include arterial hypertension, dyslipidemia, diabetes mellitus and metabolic syndrome, obesity, smoking, dietary habits, physical inactivity, stress, etc. Findings of several studies indicated that occupational hazards may initiate or modulate atherogenesis. In addition, in recent decades, there has been an increasing interest in the role of occupational hazards related to psychological and psycho-physiological efforts, such as heavy physical work or sedentary work, as well as occupational hazards related to work organization, such as night shift work or overtime work[1-6].

Aim of the study

The aim of this study was to assess the association between hyperglycemia and dyslipidemia and night shift work and physical activity at the workplace in workers with significant CAD.

Material ad methods

Design of the study. A cross-sectional study was performed in the PHI Specialized Hospital for Prevention, Treatment and Rehabilitation of Cardiovascular Diseases “St. Stefan” -Ohrid, RN Macedonia, in the period January-May 2026. The association between hyperglycemia and dyslipidemia and night shift work and physical activity at the workplace in workers was assessed in all working active subjects with diagnosed significant CAD by coronary angiography in the mentioned period. This study was part of a larger investigation on the association between occupational hazards related to psychological and psychophysiological efforts and work organization and significant CAD.

Study population

The study included 110 participants, 96 males and 14 females, aged 29 to 66 years, i.e. all working active subjects that fulfilled inclusion criteria. They were divided in two groups by their working experience at the actual workplace: the group of workers with working experience 5 to 14 years, and the group of workers with working experience equal or more than 15 years. All participants were informed about the objectives of the study, and their written consent was obtained.

Inclusion criteria: working active subjects with significant CAD diagnosed by actual criteria of the European Society of Cardiology (ESC), working experience at the actual workplace equal or longer than 5 years, written consent and ability for collaboration in the study.

Exclusion criteria: workers with working experience at the actual workplace less than 5 years and retired workers, cardiovascular disorders (workers with non-significant CAD or with significant CAD previously treated with stenting or bypass intervention, previous myocardial infarction, heart valve disease, and cardiomyopathy), disorders of other organs and systems (malignancy, chronic respiratory or renal failure, acute infectious disease, systemic connective tissue disease, manifested mental disorder, and pregnancy), and uncompleted study protocol.

Study methodology

Study methodology included completion of a questionnaire on demographic and other characteristics of the participants and laboratory analyses of blood sugar and lipid profile.

The questionnaire consisted of three parts. The first part included 19 questions on demographics (sex and age, nationality, marital status, body height and weight, chronic disease

diagnosed by a physician, smoking status, and leisure-time physical activity). The second part included 15 items on actual and former workplaces of the participants and their working experience, organization of the working activities, and physical activity at their workplace. The World Health Organization Health and Work Performance Questionnaire (HPQ) and the Work Organization Assessment Questionnaire (WOAQ) were used as a model for this part of the questionnaire[7-9]. Night shift work was defined by the Labor Relation Law of North Macedonia as a work that began at 22:00 and ended at 06:00 the next day[10]. Additionally, there was an item for weekly number of the night shifts. Physical activity at the workplace was defined by the Rulebook on the manner of preparing a safety statement, its content, as well as the data on which the risk assessment should be based and it was classified in 4 categories: sedentary work, low physical work (movement without a load), moderate physical work (movement with a light load), and hard physical work[4]. The third part of the questionnaire included items related to the history of CAD (newly or previously diagnosed disease, current symptoms, presence of arterial hypertension, diabetes mellitus or/and dyslipidemia, and recommended treatment).

Laboratory analyses including measurements of blood sugar, total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and triglycerides were performed at the Biochemical Laboratory at the PHI Specialized Hospital for Prevention, Treatment and Rehabilitation of Cardiovascular Diseases "St. Stefan"-Ohrid on the Beckman Coulter Diagnostics AU480 Chemistry Analyzer (Beckman Coulter, Inc., Brea, CA, USA). Blood sugar was measured by standard spectrophotometric method Hexokinase (HK)/G6P-DH (referral values 3.80-5.80 mmol/L). Hyperglycemia was considered in the participants with measured values of blood sugar higher than its referral values, as well as in the participants treated with antidiabetics. Blood triglycerides level was measured with standard enzyme spectrophotometric test for triglycerides (referral values 0.80-1.70 mmol/L). Hypertriglyceridemia was considered in the participants with measured values of triglycerides higher than its referral values, as well as in the participants treated with adequate drugs. Total cholesterol level was measured with enzyme spectrophotometric method CHO-POD (cholesterol oxydase + peroxydase reaction) (referral values 3.60-5.20 mmol/L). Serum LDL and HDL levels were measured with direct enzyme spectrophotometric method. Referral values of HDL were 0.91-2.28 mmol/L, whereas referral values of LDL depended on cardiovascular risk of the study subject (values lower than 1.8 mmol/L in the participants with high cardiovascular risk). Dyslipidemia was defined as an abnormal amount of lipids in the blood, including high triglycerides level, high total cholesterol level, high LDL level, or low HDL level, or treatment with medications for abnormal lipid metabolism[11-14].

Statistical analysis

Statistical analyses were performed using the SPSS software package, version 26.0 for Windows. Categorical variables were presented as absolute and relative frequencies. Continuous variables were summarized using measures of central tendency (mean, median, minimum, and maximum values) and dispersion (standard deviation). Differences in proportions were assessed using the difference test. The Shapiro-Wilk W test was used to assess the normality of the data distribution. Differences between continuous variables with non-normal distributions were assessed using the Mann–Whitney U test. Associations between glucose levels and dyslipidemia and selected variables with non-normal distributions were evaluated using Spearman's rank-order correlation coefficient. Binary and multiple logistic regression analyses were performed to determine the predictive role of selected variables for elevated blood glucose levels and dyslipidemia, respectively. All statistical tests were two-sided, and a p-value <0.05 was considered statistically significant.

Results

The study sample consisted of 110 participants with significant CAD. From the total sample, 96 participants (87.27%) were male and 14(12.73%) were female, corresponding to a male-to-female ratio of 6.9:1 and a significantly higher proportion of males (p=0.00001). According to the duration of exposure to the defined occupational hazards, participants were divided into two groups: (a) exposure ≤14 years - 29 participants (26.36%); and (b) exposure >14 years - 81 participants (73.64%) (Table 1 and Figure 1).

The mean age of the participants was 55.34 ± 6.51 years, with a min/max age of 29–66 years. Overall, 25% of the participants were aged >60 years, while 50% were aged ≤56.5 years, with a median age of 56.5 years (IQR, 52-60). The mean age of male and female participants was 55.01±6.78 and 57.57±3.76 years, respectively, with no statistically significant difference in age between the sexes (p=0.2566) (Table 1 and Figure 1).

Table 1. General characteristics of the participants by sex

Parameters	Sex			p
	Male	Female	Total	
Gender				
N (%)	96(87.27%)	14(12.73%)	110(100%)	p=0.00001*
Age (years)				
Mean± SD	55.01±6.78	57.57±3.76	55.34±6.51	Z=-1.134; p=0.2566
Min/Max	29/66	49/64	29/66	
Median (IQR)	56(51.5-60)	57.5(56-60)	56.5(52-60)	

Difference test, Z=Mann-Whitney U Test: *significant for p<0.05

The distribution of the participants according to general characteristics of sex (male/female) and age (years) is presented in Table 1 and Figure 1.

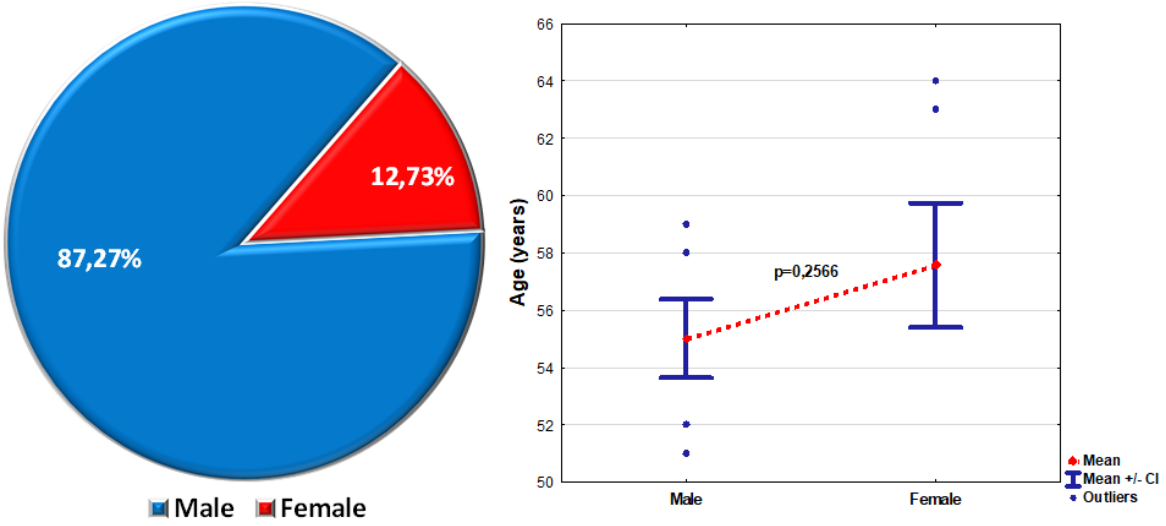

Fig. 1. Distribution of the participants by sex and age

The participants had a mean duration of employment of 22.34 ± 10.71 years, with 50% having ≥21.5 years of work experience. No statistically significant difference was observed between male and female participants with regard to duration of employment (p=0.9001). Similarly, no significant association was found between the two categories of duration of employment (≤14 *vs*. >14 years) and sex (p=0.3474) (Table 2).

Table 2. Selected parameters of occupational history according to sex

Parameters	Sex			p
	Male	Female	Total	
Duration of employment (years)				
Mean± SD	22..32±10..90	22..43±9..70	22..34±10..71	Z=-0.125; p=0.9001
Min/Max	5/42	10/36	5/42	
Median (IQR)	21..5(12-30)	22..5(15-30)	21..5 (12-30)	
Duration of employment (categories)				
≤ 14 years	27 (28..13%)	2 (14..29%)	29 (26..36%)	p=0.3474
>15 years	69 (71..88%)	12 (85..715)	81 (73..64%)	
Night-shift work				
No	35 (36..46%)	6 (42..86%)	41 (37..27%)	X^2=0.214; df=1; p=0.6437
Yes	61 (63..54%)	8 (57..14%)	69 (62..73%)	
Night shift work (times per week)				
Mean± SD	1..05±0..92	0..86±0..95	1..03±0..92	Z=0.673; p=0.5012
Min/Max	0/ 2	0/ 2	0/ 2	
Median (IQR)	1 (0-2)	0..5 (0-2)	1 (0-2)	
Physical activity				
None (sedentary work)	37 (38..54%)	6 (42..86%%)	43(39..09%)	
Movement without a load (low physical work)	37 (38..54%)	6 (42..86%)	43(39..09%)	yes/ no
Movement with a light load (moderate physical work)	13(13..54%)	2 (14..28%)	15(13..64%)	X^2=0.096; df=1; p=0.7572
Heavy physical work (hard physical work)	9(9..38%)	0(0%)	9(8..18%)	

X^2 = Pearson Chi-square test; Fisher exact test; Z=Mann-Whitney U Test: *significant for p<0.05

Night shift work was reported by 69(62.73%) of the participants including 61(63.54%) men and 8(57.14%) women, with no statistically significant association between sex and night shift work (p=0.6437). The mean number of night shifts per week was 1.03±0.92, with a minimum–maximum range of 0-2 shifts, and 50% of the participants reported one night shift per week. No statistically significant difference was observed between male and female participants in terms of the number of night shifts per week (Table 2).

No physical activity (sedentary work) was reported by 37(38.54%) male participants and 6 (42.86%) female participants, whereas hard physical work was reported by 9 (9.38%) men and none of the women. No statistically significant association was found between sex and the presence or absence of physical activity (p=0.7572) (Table 2 and Figure 3).

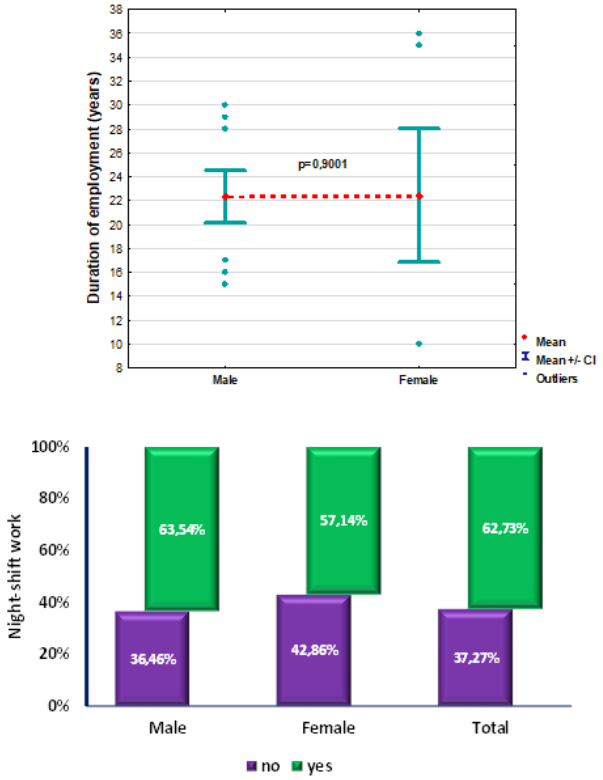

Fig. 2. Distribution of duration of employment and night-shift work according to sex

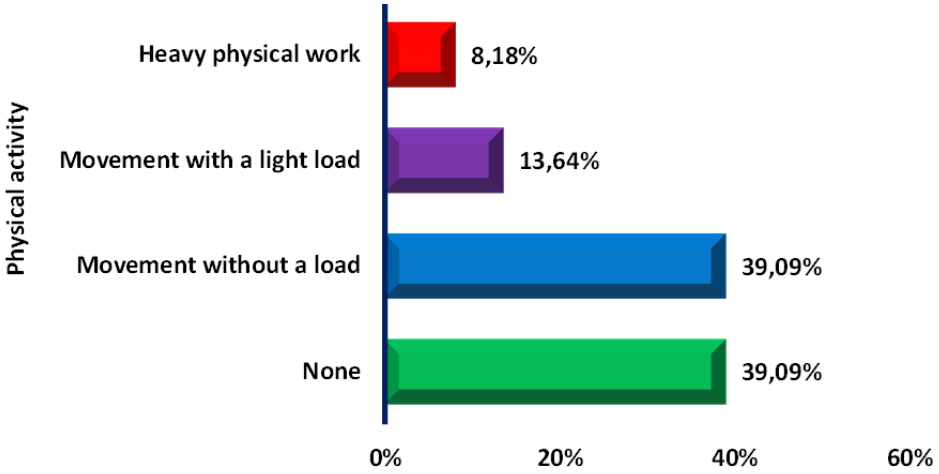

Fig. 3. Distribution of the participants by physical activity at the workplace

A statistically significant, weak positive correlation was observed between: (a) duration of employment (years) and hyperglycemia ($R_{(110)}$=0.269; p=0.0044); and (b) duration of employment (years) and dyslipidemia ($R_{(110)}$=0.219; p=0.0217). Longer duration of employment was significantly associated with higher occurrence of hyperglycemia and dyslipidemia (Table 3 and Figure 4).

A statistically significant positive moderate correlation was observed between night shift work (no/yes) and hyperglycemia ($R_{(110)}$=0.461; p=0.00001), whereas a statistically significant weak positive correlation was observed between night shift work (no/yes) and

dyslipidemia ($R_{(110)}$=0.200; p=0.0356). Night shift work was significantly associated with higher occurrence of both hyperglycemia and dyslipidemia (Table 3 and Figure 4).

A statistically significant moderate positive correlation was observed between the number of night shifts per week and hyperglycemia ($R_{(110)}$=0.420; p=0.00001), whereas a statistically significant weak positive correlation was observed between the number of night shifts per week and dyslipidemia ($R_{(110)}$=0.216; p=0.0231). A higher number of night shifts per week was significantly associated with a higher occurrence of both hyperglycemia and dyslipidemia (Table 3 and Figure 4).

A statistically significant weak negative correlation was observed between the level of physical activity (none → hard physical work) and hyperglycemia ($R_{(110)}$=-0.217; p=0.0228), whereas a statistically significant moderate negative correlation was observed between the level of physical activity (none → hard physical work) and dyslipidemia ($R_{(110)}$=-0.314; p= 0.0008). A higher level of physical activity was significantly associated with lower occurrence of both hyperglycemia and dyslipidemia (Table 3 and Figure 4).

Table 3. Correlations of selected parameters with hyperglycemia and dyslipidemia

Parameters	Spearman Rang Order correaltion - R	
	Hyperglycemia (absent/present)	Dyslipidemia (absent/present)
Sex (male/female)	$R_{(110)}$=(-0.038; p=0.6804	$R_{(110)}$=0.035; p=0.7143
Age (years)	$R_{(110)}$=0.074; p=0.4391	$R_{(110)}$=0.008; p=0.9319
Duration of employment (years)	$R_{(110)}$=0.269; p=0.0044*	$R_{(110)}$=0.219; p=0.0217*
Night shift work (no/yes)	$R_{(110)}$=0.461; p=0.00001*	$R_{(110)}$=0.200; p=0.0356*
Number of night shifts per week	$R_{(110)}$=0.420; p=0.00001*	$R_{(110)}$=0.216; p=0.0231*
Physical activity (none → hard physical work)	$R_{(110)}$=(-0.217; p=0.0228*	$R_{(110)}$=(-0.314; p=0.0008*

*significant for p<0.05

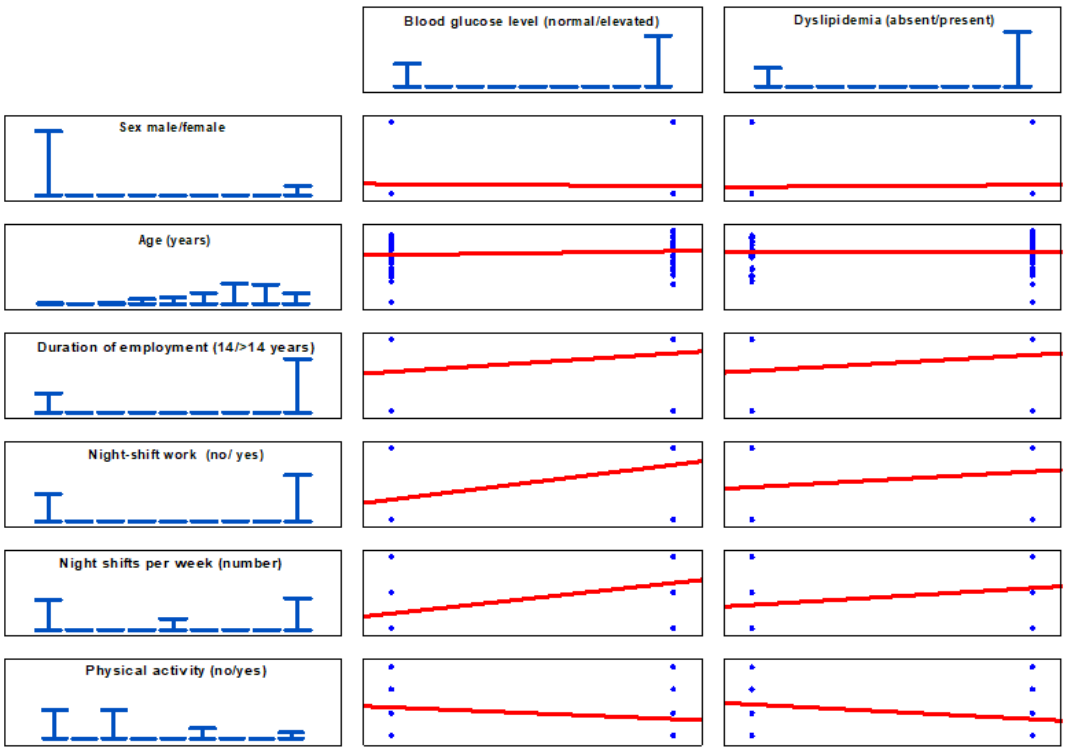

Fig. 4. Correlations of selected parameters with hyperglycemia and dyslipidemia (Spearman Rang Order correaltion – R)

No statistically significant associations were found between sex or age and hyperglycemia (absent/present) or dyslipidemia (absent/present) (Table 3 and Figure 4).

A statistically significant positive association with hyperglycemia was found for duration of employment >14 years, night shift work, and the number of night shifts per week. Participants with >14 years of employment had 3.496-fold higher odds of hyperglycemia [OR =3.496; 95% CI: 1.434-8.526; p=0.006]. Night shift work was associated with 8.329-fold higher odds [OR=8.329; 95% CI: 3.340-20.775; p=0.0001], while each additional night shift per week was associated with 3.098-fold higher odds of hyperglycemia [OR=3.098; 95% CI: 1.820-5.275; p=0.0001]. In contrast, hard physical work, compared with no physical activity, was negatively associated with hyperglycemia [OR=0.172; 95% CI: 0.037-0.807; p=0.026], corresponding to 82.8% lower odds of elevated blood glucose levels (Table 4).

Table 4. Binary logistic regression analysis of the predictive role of selected factors for hyperglycemia

Parameters	Blood glucose level			
	p	OR	95% CI	
			lower	upper
Binary logistic regression				
Sex (ref. male/female)	0.678	0.779	0.240	2.527
Age (years)	0.146	1.047	0.984	1.113
Duration of employment (ref. ≤14/>14 years)	0.006*	3.496	1.434	8.526
Night shift work (ref. no/yes)	0.0001*	8.329	3.340	20.775
Number of night shifts per week	0.0001*	3.098	1.820	5.275
Physical activity (ref. none)				
Movement without load	0.610	1.299	0.476	3.546
Movement with a light load	0.054	0.301	0.088	1.023
Hard physical work	0.026*	0.172	0.037	0.807
Multiple logistic regression				
Duration of employment (ref. ≤14/>14 years)	0.248	0.526	0.177	1.565
Night shift work (ref. no/yes)	0.180	2.760	0.625	12.176
Number of night shifts per week	0.179	1.768	0.771	4.056
Hard physical work	0.159	0.268	0.043	1.676

Dependent variable: Blood glucose level (normal/ elevated), OR: Odds ratio, CI: Confidece Interval, *significant for p<0.05

A statistically significant positive association with dyslipidemia was found for duration of employment >14 years, night shift work, and the number of night shifts per week. Participants with >14 years of employment had 2.868-fold higher odds of dyslipidemia [OR= 2.868; 95% CI: 1.144-7.191; p=0.025]. Night shift work was associated with 2.485-fold higher odds [OR=2.485; 95% CI: 1.035-5.970; p=0.042], while each additional night shift per week was associated with 1.773-fold higher odds of dyslipidemia [OR=1.773; 95% CI: 1.083-2.901; p=0.023]. In contrast, movement with a light load and hard physical work, compared with no physical activity, were negatively associated with dyslipidemia. Movement with a light load was associated with 88.5% lower odds of dyslipidemia [OR=0.115; 95% CI: 0.029-0.459; p= 0.002], whereas hard physical work was associated with 83.6% lower odds [OR=0.164; 95% CI: 0.033-0.824; p=0.028] of dyslipidemia (Table 5).

Table 5. Binary logistic regression analysis of the predictive role of selected factors for dyslipidemia

Parameters	Dyslipidemia			
	p	OR	95% CI	
			lower	upper
Binary logistic regression				
Sex (ref. male/female)	0.712	1.291	.333	5.008
Age (years)	0.935	1.003	.939	1.071
Duration of employment (ref. ≤14/>14 years)	0.025*	2.868	1.144	7.191
Night shift work (ref. no/yes)	0.042*	2.485	1.035	5.970
Number of night shifts per week	0.023*	1.773	1.083	2.901
Physical activity (ref. none)				
Movement without load	0.104	0.383	0.120	1.217
Movement with a light load	0.002*	0.115	0.029	0.457
Hard physical work	0.028*	0.164	0.033	0.824
Multiple logistic regression				
Duration of employment (ref. ≤14/>14 years)	0.189	0.497	0.175	1.410
Night shift work (ref. no/yes)	0.816	0.830	0.173	3.989
Number of night shifts per week	0.323	1.523	0.662	3.507
Movement with a light load	0.017*	0.169	0.040	0.724
Hard physical work	0.075	0.214	0.039	1.170

Dependent variable: dyslipidemia absent/ present), OR: Odds ratio, CI: Confidece Interval, *significant for $p<0.05$

Multiple logistic regression analysis did not confirm any of the predictors identified as significant in the binary logistic regression analysis as independent predictors of hyperglycemia or dyslipidemia. The only variable identified as an independent significant predictor was movement with a light load, which was associated with 83.1% lower odds of dyslipidemia [OR =0.169; 95% CI: 0.040-0.724; p=0.017] (Tables 3 and 4).

Discussion

According to data of the National Institute for Occupational Safety and Health (NIOSH), 10-20% of the total cardiovascular mortality in working population in the US in the last decade was due to exposure to occupational hazards. Findings from several studies on cardiovascular effects of occupational hazards indicated that occupational hazards occurring during the working processes, i.e. occupational physical, chemical, biological, and psychosocial hazards, could act as initiators or modulators of atherogenesis and pathogenesis of CAD[15-22]. On the other hand, there is still insufficient evidence about the influence of occupational hazards related to psychological or psychophisiological efforts at the workplace, as well as occupational hazards related to organization of work, in the occurrence and course of CAD. The aim of the present study was to assess the association between hyperglycemia and dyslipidemia, as modifiable risk factors for CAD, and night shift work and physical activity at the workplace in a cross-sectional analysis among workers with newly diagnosed significant CAD. The study included 110 workers, 96 males and 14 females, with mean age of 55.34± 6.51 years, and mean working experience at the actual workplace of 22.34±10.71 years.

Night shift work is an integral part of working activities in many jobs and workplaces. According to data from the US, about 20% of total working population is employed as permanent or rotating night shift workers. Findings from several studies showed higher cardiovascular morbidity and mortality in night shift workers than in daily workers. According to the recent knowledge, the relationship between CAD and night shift work may be based on

desynchronization of the circadian rhythm and biological clock, behavioral changes (sleep disturbances, poor diet, smoking, reduced physical activity, etc.), and imbalanced autonomic regulation of the cardiovascular system[23-26]. Findings from the present study indicated statistically significant association of hyperglycemia and dyslipidemia with night shift work. In addition, significant positive correlation was found between length of the work in night shifts and a weekly number of the night shifts. Similar findings were found in several other studies in this field. In the study which included 700 underground miners working in rotating night shifts, Strzemecka and Skrodzuik found abnormal levels of total cholesterol LDL and HDL significantly related to the length of the work in night shifts. In a meta-analysis that included 187,063 workers from different occupations, Dutheil *et al.,* registered a significantly higher risk of dyslipidemia among permanent night shift workers than among rotating night shift workers [27,28].

Findings from a number of studies indicated that regular physical activity is associated with many health benefits, such as healthier body composition, higher cardiorespiratory fitness, lower levels of insulin resistance markers, and lower risk of cardiovascular morbidity and mortality, but majority of these studies investigated effects of physical activity only in the leisure time. In addition, findings from several studies conducted in the last two decades indicated a higher risk of cardiovascular morbidity in workers with hard muscular work at their workplaces. The experts in this field considered that causes of this phenomenon, referred to as health paradox of physical activity, could be long periods of intense muscular work (8-hour working time) with short periods of rest and recovery, higher heart frequency during the work activities, hypertensive effect due to static work and isometric muscle contractions, etc.[29,30]. On the other hand, there is consistent evidence that sedentary behavior, including sedentary work, increases the risk of atherosclerosis and cardiovascular morbidity due to obesity of central type, insulin resistance with hyperglycemia and dyslipidemia, decreased fibrinolytic capacity of the blood, endothelial dysfunction, etc.[31,32]. The results of this study indicated an inverse relation of hard physical activity at the workplace and sedentary work regarding hyperglycemia and dyslipidemia, i.e. statistically significant negative correlation of hyperglycemia and dyslipidemia with increase of the level of physical activity at the workplace. Findings of the present study should be interpreted in the context of its limitations. The relatively small number of participants in the study could have implication on the results obtained and their interpretation. In addition, heterogeneity of the participants regarding their concrete workplaces characterized by presence of different occupational hazards could also have implication on the results obtained and their interpretation. On the other hand, this is the first study in our country investigating the association between certain modifiable risk factors of CAD and occupational hazards related to psychological or psychophisiological efforts at the workplace and occupational hazards related to work organization. These findings may improve the still limited knowledge in this field.

Conclusion

In conclusion, in this cross-sectional study aimed at assessing the association of hyperglycemia and physical activity at the workplace with hyperglycemia and dyslipidemia in workers with significant CAD, we found their significant association with night shift work and their significant negative correlation with the level of physical activity at the workplace. The results obtained indicated the need for workplace intervention regarding the mentioned occupational hazards in order to protect cardiovascular health of exposed workers.

Conflict of interest statement. None declared.

References

1. Vrints C, Andreotti F, Koskinas KC, Rossello X, Adamo M, Ainslie J, *et al*. 2024 ESC Guidelines for the management of chronic coronary syndromes. *Eur Heart J* 2024; 45(36): 3415-3537. doi: 10.1093/eurheartj/ehae177.
2. Nakano S, Kohsaka S, Chikamori T, Fukushima K, Kobayashi Y, Kozuma K, *et al*. JCS 2022 Guideline Focused Update on Diagnosis and Treatment in Patients With Stable Coronary Artery Disease. *Circ J* 2022; 86(5): 882-915. doi: 10.1253/circj.CJ-21-1041.
3. Cury RC, Leipsic J, Abbara S, et al. CAD-RADS™ 2.0 - 2022 Coronary Artery Disease - Reporting and Data System.: An expert consensus document of the Society of Cardiovascular Computed Tomography (SCCT), the American College of Cardiology (ACC), the American College of Radiology (ACR) and the North America Society of Cardiovascular Imaging (NASCI). *J Am Coll Radiol* 2022; 19(11): 1185-1212.
4. [Rulebook on the manner of preparing a safety statement, its content, as well as the data on which the risk assessment should be based, in Macedonian]. Official Gazette of the RM, No. 2/09.
5. Australian Government. Australian Safety and Compensation Council (ASCC). Work-related cardiovascular disease in Australia, 2006. Available from: *https://www.abs.gov.au/* (Accessed 05.09.2026).
6. National Institute for Occupational Safety and Health (NIOSH). About Work-related Heart Disease. Available from: *https://www.cdc.gov.niosh/heartdisease/* (Accessed 07.09.2026).
7. Kessler RC, Barber C, Beck A, Berglund P, Cleary PD, McKenas D, *et al*. The World Health Organization Health and Work Performance Questionnaire (HPQ). *J Occup Environ Med* 2003; 45(2): 156-174. doi: 10.1097/01.jom.0000052967.43131.51.
8. Calitz C, Pratt C, Pronk NP, Fulton JE, Jinnett K, Thorndike AN, *et al*. Cardiovascular Health Research in the Workplace: A Workshop Report. *J Am Heart Assoc* 2021; 10(17): e019016. doi: 10.1161/JAHA.120.019016.
9. Karimi L, Oakman J. The Work Organization Assessment Questionnaire: validation for use with community nurses and paramedics. *Int J Evid Based Healthc* 2020; 18:000-000.
10. [Labor Relation Law of North Macedonia, in Macedonian]. Official Gazette of the RM, No. 2/09.74/15.
11. Dyslipidaemia. Available from: *https://www.who.int/news-room/fact-sheets/detail/dyslipidaemia* (Accessed 12.09.2026).
12. Mosca S, Araújo G, Costa V, Correia J, Bandeira A, Martins E, *et al*. Dyslipidemia Diagnosis and Treatment: Risk Stratification in Children and Adolescents. *J Nutr Metab* 2022; 2022: 4782344. doi: 10.1155/2022/4782344.
13. Marx N, Federici M, Schütt K, Müller-Wieland D, Ajjan RA, Antunes MJ, *et al*. 2023 ESC Guidelines for the management of cardiovascular disease in patients with diabetes. *Eur Heart J* 2023; 44(39): 4043-4140. doi: 10.1093/eurheartj/ehad192. Erratum in: *Eur Heart J 2023* Dec; 44(48): 5060. doi: 10.1093/eurheartj/ehad774.
14. Boffa MB, Stranges S, Klar N, Moriarty PM, Watts GF, Koschinsky ML. Lipoprotein(a) and secondary prevention of atherothrombotic events: A critical appraisal. *J Clin Lipidol* 2018; 12(6): 1358-1366. doi: 10.1016/j.jacl.2018.08.012.
15. Shrivastav A, Swetanshu, Singh P. The Impact of Environmental Toxins on Cardiovascular Diseases. *Curr Probl Cardiol* 2024; 49(1 Pt C): 102120. doi: 10.1016/j.cpcardiol.2023.102120.
16. Du W, Tian Z, Lv B, Wang P, Wang H, Ding S, *et al*. Association of carbon monoxide poisoning with cardiovascular disease risk: A systematic review and meta-analysis. *Heliyon* 2024; 10(14): e34062. doi: 10.1016/j.heliyon.2024.e34062.

17. Pan Z, Gong T, Liang P. Heavy Metal Exposure and Cardiovascular Disease. *Circ Res* 2024; 134(9): 1160-1178. doi: 10.1161/CIRCRESAHA.123.323617.
18. Münzel T, Molitor M, Kuntic M, Hahad O, Röösli M, Engelmann N, *et al*. Transportation Noise Pollution and Cardiovascular Health. *Circ Res* 2024; 134(9): 1113-1135. doi: 10.1161/CIRCRESAHA.123.323584.
19. Singh N, Areal AT, Breitner S, Zhang S, Agewall S, Schikowski T, *et al*. Heat and Cardiovascular Mortality: An Epidemiological Perspective. *Circ Res* 2024; 134(9): 1098-1112. doi: 10.1161/CIRCRESAHA.123.323615.
20. De Vita A, Belmusto A, Di Perna F, Tremamunno S, De Matteis G, Franceschi F, *et al*. The Impact of Climate Change and Extreme Weather Conditions on Cardiovascular Health and Acute Cardiovascular Diseases. *J Clin Med* 2024; 13(3): 759. doi: 10.3390/jcm13030759.
21. Krajnak K. Health effects associated with occupational exposure to hand-arm or whole body vibration. *J Toxicol Environ Health B Crit Rev* 2018; 21(5): 320-334. doi: 10.1080/10937404.2018.1557576.
22. Corliss J. Stress at work takes a toll on the heart. Available from: *https://www.health.harvard.edu/* (Accessed 08.09.2026).
23. Erdem JS, Das MK, De Ryck E, Skare Ø, Lie JS, Bugge M, *et al*. Night shift work and indicators of cardiovascular risk: A systematic review and meta-analysis. *Environ Res* 2025; 276: 121503. doi: 10.1016/j.envres.2025.121503.
24. Vestergaard JM, Dalbøge A, Bonde JPE, Garde AH, Hansen J, Hansen ÅM, *et al*. Night shift work characteristics and risk of incident coronary heart disease among health care workers: national cohort study. *Int J Epidemiol* 2023; 52(6): 1853-1861. doi: 10.1093/ije/dyad126.
25. Makar A, Al-Hemoud A, Khraishah H, Berry J, Alahmad B. A Review of the Links Between Work and Heart Disease in the 21st Century. *Methodist Debakey Cardiovasc J* 2024; 20(5): 71-80. doi: 10.14797/mdcvj.1478.
26. Chien JW, Chen CY, Lin SH, Lin SW, Lin YH. Cardiac Autonomic Modulation during on-Call Duty under Working Hours Restriction. *Int J Environ Res Public Health* 2020; 17(3): 1118. doi: 10.3390/ijerph17031118.
27. Strzemecka J, Skrodzuik J. The influence of shift work on the occurrence of hypertension, ischemic heart disease and dyslipidemia from the perspective of mine shift workers. *Health Prob Civil* 2019; 13(3): 187-192. doi: https://doi.org/ 10.5114/hpc.2019.84665.
28. Dutheil F, Baker JS, Mermillod M, et al. Shift work, and particularly permanent night shifts, promote dyslipidaemia: A systematic review and meta-analysis. Available from: *https://www.sciencedirect.com/science/article/pii/S0021915020304597* (Accessed 14.09.2026).
29. Holtermann A, Hansen JV, Burr H, Søgaard K, Sjøgaard G. The health paradox of occupational and leisure-time physical activity. *Br J Sports Med* 2012; 46(4): 291-295. doi: 10.1136/bjsm.2010.079582.
30. Holtermann A, Krause N, van der Beek AJ, Straker L. The physical activity paradox: six reasons why occupational physical activity (OPA) does not confer the cardiovascular health benefits that leisure time physical activity does. *Br J Sports Med* 2018; 52(3): 149-150. doi: 10.1136/bjsports-2017-097965.
31. Saeidifard F, Medina-Inojosa JR, West CP, Olson TP, Somers VK, Bonikowske AR, *et al*. The association of resistance training with mortality: A systematic review and meta-analysis. *Eur J Prev Cardiol* 2019; 26(15): 1647-1665. doi: 10.1177/2047487319850718.
32. Reed JL, Zaman D, Betancourt MT, Robitaille C, Majoni M, Blanchard C, *et al*. Physical Activity, Sedentary Behaviour, and Cardiovascular Disease Risk Factors in

Canadians Living With and Without Cardiovascular Disease. *Can J Cardiol* 2025; 41(3): 507-518. doi: 10.1016/j.cjca.2024.12.029.