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Association between Prevalence of Diabetes Mellitus and Coronary Heart Disease with Shift Work in Adults - Shahedieh Cohort Study

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Abstract

Objective: The development, industrialization, the nature of work, technical and economic reasons, and increasing demand for services jobs have made shift work common. The aim of this study was investigation of association between Prevalence of Diabetes Mellitus and Coronary Heart Disease (CHD) including Angina and Heart Failure with Shift Work in Adults of Shahedieh cohort study in Yazd.

Materials and Methods: The data of this study were from the cross-sectional phase of the Shahedieh Cohort Study. The data of 9513 participants in the study were used to analyze the data. Data were analyzed using SPSS 22 software. Chi-square test was used to examine the relationship between independent and dependent variables and t-test was used to compare means. Binary logistic regression was also used for statistical modeling. Significance level less than 0.05 were considered.

Results: Our subjects' shift work prevalence was 6.7% (n= 633). The crude odds ratio of shift work was calculated for diabetes mellitus and CHD (OR= 0.38, CI: 0.28-0.51) and (OR= 0.52, CI: 0.36-0.72) respectively, which were statistically significant. But by adjusting age and sex, the odds ratio reached (OR= 0.75, CI: 0.55-1.01) and (OR= 0.86, CI: 0.57-1.28) respectively which was not statistically significant. By adjusting other confounders, the odds ratio reached (OR= 0.76, CI: 0.55-1.04) for diabetes and (OR= 0.84, CI: 0.55-1.28) for CHD.

Conclusion: No significant association was found between shift work with diabetes and CHD in our study. Age and gender were essential confounders in our study.

Keywords: Diabetes mellitus, Coronary heart disease, Shift work

QR Code:

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Introduction

The development, industrialization, the nature of work, technical and economic reasons and increasing demand for services jobs have made shift work common (1-3). Therefore, shift work is one of the common employment methods in companies, industries, and hospitals (4).

The definition of shift work is to work outside the regular daily work hours, i.e., between 7 am and 6 pm (5). During the day and night, it is necessary to have several working periods in addition to the daily standard to provide workers (6). Shift work includes night, morning, evening, rotating shifts and irregular (7,8).

Working in 22% of the population of industrialized countries is one of the types of shift work (9). 20-25% of workers in Europe and the United States and 15.2% of workers in South Korea are shift workers (10).

Shift work with a negative effect on the circadian rhythm can cause changes in the secretion of hormones in the body such as melatonin, cortisol, and leptin. Changes in these hormones also alter metabolism (decrease glucose tolerance and increase insulin resistance). Changes in circadian rhythms also increase the risk factors for cardiovascular disease (11,12).

41.3% of all deaths in Iran are due to cardiovascular diseases; It is predicted that this ratio by 2030 will increase to 44.8% (13). Diabetes mellitus (DM) is a major public health problem, and it has involved about 400 million people in the world. Which is growing faster in Asian countries than in English-speaking and high-income European countries (14).

The prevalence of metabolic syndrome in shift workers in the study of Ye et al. was reported to be 15.3%, which has five times more than the working day workers (10). Some studies have reported an association between shift work and metabolic syndrome (15) and some studies have found no association (16).

Due to the increasing number of cardiovascular diseases, diabetes and increasing jobs in different work shifts, this study was designed. The aim of this study was investigation of association between shift working and the prevalence of diabetes mellitus and conventional coronary heart disease in adults of Shahideh cohort in Yazd.

Materials and methods

Study design and participants

Shahedieh cohort study is part of the Persian cohort study in Yazd province in the Shahedieh region (17). This study was started in September 2016 to examine chronic diseases in 10,000 residents of this area. The age of participants in the Shahedieh cohort study is 35 years and older. Data were collected through questionnaires, clinical examinations, urine, blood, and Paraclinical tests.

Definition of variables

Shift Work: The following question was used in the cohort questionnaire for shift working. Have you had night work (at least 6 hours between 9 pm and 6 am) over the past year?

DM: History of diabetes diagnosed by a doctor at the beginning of the study

Coronary Heart Disease (CHD) including angina and heart failure

History of CHD diagnosed by a doctor at the beginning of the study.

Body mass index (BMI) was categorized into three categories according to the report of the World Health Organization (18). Normal: BMI< 25 kg/m2, Overweigh: 25 kg/m2≤BMI<30 kg/m2and obesity: BMI≥ 30 kg/m2.

Waist circumference (WC) was categorized into two categories according to the report of the World Health Organization (18). Normal WC was <88 centimeter for female and <102 centimeter for male.

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Smoking: The following question was used in the cohort questionnaire for smoking. Have you smoked at least 100 cigarettes in your lifetime?

Statistical Analysis

Data were analyzed using SPSS 22 software. Data were described with frequency, percentage, mean and standard deviation. The data of 9513 participants in the study were used to analyze the data. Chi-square test was used to examine the relationship between independent and dependent variables and independent samples t-test was used to compare means. Binary logistic regression was also used for statistical modeling. Fasting blood sugar (FBS), Triglyceride (TG), Cholesterol, High-density lipoprotein (HDL), Low-density lipoproteins (LDL): These parameters were continuous quantitatively analyzed. Significance level less than 0.05 were considered.

Ethical considerations

This study has been approved by the ethics committee of Yazd Shahid Sadoughi University of Medical Sciences with ethics code IR.SSU.SPH.REC.1400.008.

Results

The results of our study include participants aged 30-71. Nine thousand five hundred thirteen people participated in our research. The Mean (± SD) age of participants in our study was 47.69 (± 9.62) years. Half of the participants were male (N= 4760). 31% of these people had elementary education. Our subjects' shift work prevalence was 6.7% (n= 633) (Table 1).

Our study showed a significant relationship between age ($P< 0.0001$), sex ($P< 0.0001$), education ($P< 0.0001$), diabetes ($P< 0.0001$), Cardio ischemic disease ($P= 0.001$), BMI ($P< 0.0001$), waist circumference ($P< 0.0001$) and smoking with shift work (Table 2).

There was a significant difference in the mean of FBS ($P< 0.0001$), and cholesterol ($P= 0.03$) between shift workers and non-shift workers (Table 3).

The crude odds ratio of shift work were calculated for DM and CHD (OR= 0.38, CI: 0.28-0.51) and (OR= 0.52, CI: 0.36-0.72) respectively, which were statistically significant. But by adjusting age and sex, the odds ratio reached (OR= 0.75, CI: 0.55-1.01) and (OR= 0.86, CI: 0.57-1.28) respectively which was not statistically significant. By adjusting other confounders, the odds ratio reached (OR= 0.76, CI: 0.55-1.04) for diabetes and (OR= 0.84, CI: 0.55-1.28) for CHD. That were not statistically significant (Table 4 and 5).

Discussion

The results of our study showed that the crude odds ratio of DM and CHD for shift work in is protective, which was also statistically significant. But this relationship became non-significant with the adjusting of confounder factors, especially age and gender.

The results of hui ye et al. showed that the odds ratio of metabolic syndrome in shift workers compared to day laborers is more than six times (10). The difference in the results obtained in this study with our study could be that the study population is industry workers in this study. Still, our study population is people.

A prospective study was conducted by Najimi Vazni et al. 2012-2016 on the workers of Isfahan Steel Factory. This study showed that the odds ratio of metabolic syndrome in regular shifts and weekly shifts to daily shifts were 1.93 and 1.26, respectively. These results were insignificant in regular work shifts and not significant in weekly work shifts (19). This study has been done like the study of hui ye et al. in industry. This study was designed to compare the incidence of the disease in the shift worker and day worker groups. So in terms of design, it was different from our study.The results of a study conducted by Vetter et al. showed that night worker have a higher chance of developing diabetes than day workers (20).

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Table 1. Demographic characteristics and prevalence of shift work in the subjects

Variables	Category	Frequency	Percent
Age	30-40	2763	29.0
	41-50	3150	33.1
	51-60	2461	25.9
	>61	1139	12.0
Sex	Male	4760	50.0
	Female	4753	50.0
Education	Illiterate	1570	16.5
	Elementary	2991	31.4
	Middle school	1588	16.7
	High school	1895	19.9
	Diploma and higher	1469	15.4
Shift Work	No	8880	93.3
	Yes	633	6.7

Table 2 .Relationship between the studied factors and shift work

Variables		shift Work		*P*-value
		No	Yes	
Age	30-40	2471 (89.4)	292 (10.6)	< 0.0001
	41-50	2919 (92.7)	231 (7.3)	
	51-60	2368 (96.2)	93 (3.8)	
	>61	1122 (98.5)	17 (1.5)	
Sex	Male	4141 (87)	619 (13)	< 0.0001
	Female	4739 (99.7)	14 (0.3)	
Education	Illiterate	1546 (98.5)	24 (1.5)	< 0.0001
	Elementary	2847 (95.2)	144 (4.8)	
	Middle school	1428 (89.9)	160 (10.1)	
	High school	1690 (89.2)	205 (10.8)	
	Above diploma	1369 (93.2)	100 (6.8)	
DM	No	7206 (92.5)	581 (7.5)	< 0.0001
	Yes	1671 (97)	52 (3)	
CHD	No	8137 (93)	604 (7)	0.001
	Yes	740 (96.2)	29 (3.8)	
BMI	<25	2048 (91.2)	198 (8.8)	< 0.0001
	25-29.9	3733 (92.8)	290 (7.2)	
	≥30	3056 (95.6)	139 (4.4)	
WC	Normal	4135 (89.3)	494 (10.7)	< 0.0001
	Ab-Normal	4701 (97.2)	133 (2.8)	
Family history of conventional coronary heart disease	No	3385 (92.9)	257 (7.1)	0.18
	Yes	5414 (93.6)	368 (6.4)	
Smoking	No	7039 (95.5)	333 (4.5)	< 0.0001
	Yes	1838 (86)	299 (14)	

Chi-square test
DM: Diabetes mellitus, CHD: Coronary Heart Disease including Angina and Heart Failure,
BMI: Body mass index, WC: waist circumference

Table 3. Comparison of mean blood factors in shift workers and non-shift workers

Variables	Shift Working		*P*-value
	No (mean ± SD)	Yes(mean ± SD)	
FBS	108 (± 42)	101 (± 37)	< 0.0001
TG	166 (± 133)	173 (± 98)	0.08
Cholesterol	189 (± 41)	185 (± 38)	0.03
HDL	52 (± 12)	49 (± 10)	< 0.0001
LDL	104 (± 37)	102 (± 29)	0.21

Independent samples t-test
FBS: Fasting blood sugar, TG: Triglyceride, HDL: High-density lipoprotein,
LDL: Low-density lipoproteins.

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Table 4. The crude and adjusted Odds Ratio of shift work for diabetes

Variables	OR crude	OR adjusted1	OR adjusted2
Shift work	0.38 (0.28-0.51)	0.75 (0.55-1.01)	0.76 (0.55-1.04)

Binary logistic regression
1.Adjusted by age and sex
2.Adjusted by age, sex, body mass index, waist circumference, conventional coronary heart disease, hypertension, family history of conventional coronary heart disease, education, smoking, physical activity

Table 5. The crude and adjusted odds ratio of shift work for CHD

Variables	OR crude	OR adjusted1	OR adjusted2
Shift work	0.52 (0.36-0.77)	0.86 (0.57-1.28)	0.84 (0.55-1.28)

Binary logistic regression
1.Adjusted by age and sex
2.Adjusted by age, sex, BMI, WC, CHD, hypertension, family history of CHD, education, smoking, physical activity

However, by investigating the obtained confidence interval, in this study, despite determining the high sample size and selecting the at-risk population, we find that the lower limit of the confidence interval is still a very small distance from one. And it might not be significant.

To justify the contradictions between the results of our study and the studies of others, the following can be stated. First, our study was done on population, but other studies have been done on specific people, such as industrial workers and factories. Second, the number of shift workers in our study was low. Third, the healthy worker effect; occupational health examinations tend to select healthier and younger individuals for shift work, which could obviate the true association between shift work and chronic diseases like diabetes and CHD.

The results of our study showed that no significant association was found between shift work with diabetes and Conventional coronary heart in our research. Age and gender were essential confounders in our study.

One of the reasons that a significant relationship between shift work and diabetes and cardiovascular diseases was not seen in our study could be that a small number of shift workers who were in this population may have participated in light work. And because the study was not, particularly on shift workers, the variables of some confounding factors were not collected in this study.

One of the strengths of our study was the high sample size of the research and the detailed and laboratory information. But one of the limitations of our study was that the number of shift workers was small. It is suggested that a survey be conducted to investigate systemic disease in shift workers and compare them with day workers in the future.

Another limitation of our study is the cross-sectional design. And cross-sectional studies cannot fully examine cause-and-effect relationships. Based on this, it is suggested to conduct a cohort study on industrial workers. Or a case-control study including two shift work groups and workers without shift work in the industry should be done.

Conclusions

Although shift work paradoxically appeared to have a protective effect on diabetes and CHD in the crude analysis of the study, this relationship was not statistically significant after adjusting for confounding variables, especially age and gender. The findings of this cross-sectional study on the general adult population of Yazd show that after eliminating the effect of age and gender, there is no independent association between shift work and diabetes and coronary heart disease. It seems that the younger and healthier shift work population compared to the general population is the main reason for the lack of a positive association in this study. Longitudinal (cohort) studies with more detailed follow-up and in homogeneous industrial populations are

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recommended to clarify the causal relationship.

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Conflict of Interest

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Author contributions

M.A , SM.A: Conceptualization, Methodology, Formal analysis, Writing and original draft.

A.D: Supervision, Writing , review & editing.

All authors critically revised the manuscript, agree to be fully accountable for the integrity and accuracy of the study, and read and approved the final manuscript.

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