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## Prevalence of Comorbidity of Diabetes and Cardiovascular Disease History in the Shahrekord Cohort Study

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### Abstract

**Background and Objective:** The prevalence and incidence of diabetes and cardiovascular diseases (CVD) have been increasing in the past few decades. Determining the prevalence of these diseases helps in the early diagnosis of people at risk, facilitates prevention efforts, and helps reduce the disease burden, mortality, and potential economic impacts on individuals, families, healthcare systems, and society. This study aims to determine the prevalence of comorbidity between diabetes and a history of CVD in the Shahrekord Cohort Study participants.

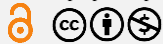
**Methods:** This descriptive comorbidity sub-study included 10,075 participants from the registration phase of the Shahrekord Cohort Study. Data were analyzed using SPSS version 26.

**Findings:** The overall prevalence of comorbidity between diabetes and a history of cardiovascular diseases (CVD) was 55.58 per 1,000 participants (95% CI: 51.11–60.05). The comorbidity was found to be highest among several subgroups, specifically: women, illiterate individuals, those who were widowed or divorced, retirees, and individuals with a family history of the disease in first-degree relatives, as well as urban residents.

**Conclusion:** Knowledge of the prevalence of diabetes, CVD, and comorbidity of these diseases and the associated risk factors in the community is essential for developing medical strategies to interrupt the progression from one disease to comorbidity. Early intervention in the treatment and control of diabetes or common risk factors may prevent the onset of CVD and vice versa.

**Keywords:** Prevalence, Comorbidity, Diabetes mellitus, Cardiovascular diseases, Cohort studies.

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## Introduction

Non-communicable diseases (NCDs) are the main causes of health threats worldwide, with seven out of ten deaths globally related to these conditions. The increase in life expectancy and the rapid growth of the aging population have led to a greater burden of NCDs (1, 2). Over the past decade, the number of deaths from non-communicable diseases and disability-adjusted life years (DALYs) have increased (3).

Cardiovascular diseases (CVD) are the main cause of death in the world. According to the report of the World Health Organization in 2019, 32% of all global deaths occurred due to CVD (4). In Iran, cardiovascular diseases are the leading cause of death. The mortality rate from CVD has been rising, accounting for 35% of all deaths in the country in 2016 (5, 6). Diabetes is the most common metabolic disease and a major cause of morbidity and mortality (7). The simultaneous existence of two or more chronic diseases in one person is known as comorbidity (8). According to global estimates, the average prevalence of comorbidity of NCDs in 2017 in 28 developing countries was reported as 7.8% (2, 9). Lifestyle factors such as obesity, inactivity, alcohol consumption are among the factors associated with comorbidity (10).

According to recent studies, approximately 75% of adults with diabetes have two or more comorbidities (11, 12). One of the main comorbidities of diabetes is cardiovascular disease, which is estimated to affect about one third (32.2%) of people with diabetes. Type 2 diabetes is an important risk factor for cardiovascular diseases, including stroke (13, 14).

The coexistence of diabetes and CVD, known as comorbidity, not only exacerbates the disease burden but also worsens prognosis, reduces quality of life, and increases healthcare utilization (1). Identifying the prevalence and distribution of this comorbidity across different sociodemographic groups is crucial for designing effective prevention, screening, and management strategies (5).

Primary manifestations of CVD in diabetes usually appear as peripheral arterial diseases and high blood pressure (16.2%) as well as heart failure and MI (14.7%). The risk of heart failure in patients with diabetes is 40% higher compared to non-diabetic people (15). The chance of death in patients with type 2 diabetes and CVD at the same time is 4.56 (3.34 - 5.81) compared to patients who had neither type 2 diabetes nor CVD (14). The results of the National Health and Nutrition Cohort Study (NHANES) showed that 26.3% of strokes were related to diabetes, with the risk of stroke in people with diabetes being twice as high, leading to a 50% increase in hemorrhagic strokes (16).

Understanding the course of diabetes, MI, stroke and the comorbidity of these diseases along with the related risk factors is necessary to develop medical strategies to stop the progression from one disease to multi-

ple diseases. Evidence shows that early intervention in the treatment and control of diabetes or common risk factors may prevent the onset of CVD (16). Identifying multiple NCD patterns is useful for several reasons including generating hypotheses about disease progression or pathways, enhancing prevention and management strategies, and improving prediction of health care utilization and adverse health outcomes (14).

Iran is currently undergoing a demographic transition from a predominantly young population to an aging one. According to World Health Organization estimates, by 2050, Iran—a developing country—will have a significantly higher proportion of elderly citizens. Additionally, the growth of the urban population and lifestyle changes have escalated the risk of non-communicable diseases (17). This combination of demographic shifts and lifestyle factors has led to a substantial rise in non-communicable and multiple chronic diseases in Iran (18).

Iran, like many developing countries undergoing rapid urbanization and lifestyle changes, faces an increasing burden of NCDs (3). The PERSIAN Cohort, including the Shahrekord site, provides a valuable opportunity to investigate chronic disease patterns in diverse Iranian populations. However, evidence regarding the prevalence of comorbidity between diabetes and CVD in this population remains limited.

Since no previous study has examined the comorbidity of diabetes and cardiovascular disease history in the province, and accurate data on its prevalence are lacking, this study aims to determine and quantify the prevalence of this comorbidity. Using cohort study data—collected through participant self-reports, interviewer assessments, and diagnostic tests—we seek to identify and measure the coexistence of diabetes and cardiovascular disease history in the population.

## Methods

### Statistical population, sampling, and sample size:

As a sub-study of the Shahrekord cohort study, this research incorporated the baseline data collected during the enrollment phase. The research plan of the Shahrekord cohort study includes the study of health and non-communicable diseases of Chaharmahal and Bakhtiari province and the Persian Shahrekord cohort study. This study is a 20-year prospective epidemiological study, which was approved by the University Research Council in December 2014 and was implemented with the notification of the Iranian Ministry of Health, Treatment and Medical Education (19). This study is a population-based cohort, drawing an initial sample of at least 10,075 individuals. As one of the national Persian Cohort centers located in the southwest of Iran, its primary aim is to investigate the general health status, chronic and non-communicable

diseases, and associated risk factors in the adult population aged 35 to 70. The total sample size includes 7,034 people from Shahrekord city and 3,041 people from the rural areas of Ardal city, both located within Chaharmahal and Bakhtiari province.

Shahrekord cohort data was collected using a standard questionnaire to obtain general, physical condition, health, socio-economic, and occupational history from all participants. Objective data included the measurement of weight, height, and abdominal circumference (for BMI calculation) and blood pressure. Laboratory tests for the cohort program measured blood cholesterol and fasting blood sugar. Additionally, trained interviewers recorded specific data on physical activity and reviewed medical records for information on drugs and treatments related to cardiovascular diseases and diabetes (19).

Using data from the cohort enrollment phase, we estimated the prevalence of diabetes and history of cardiovascular diseases in people regardless of comorbidity.

**Data analysis:**

Descriptive statistics were used to summarize the demographic characteristics of the study participants, and the results are presented as frequencies, means, and standard deviations.

**Results**

The participants in the first phase of the Shahrekord Persian Cohort Study ranged from 35 to 70 years of

age, with a recorded mean ± SD age of 49.60±9.36 years. The cohort exhibited a gender distribution of 53.2% women and 46.8% men. Urban residency accounted for 69.8% of the study population, while 30.2% were rural residents. Regarding ethnic composition, the Bakhtiari group represented the largest segment at 48.4%. Table 1 summarizes these baseline demographic characteristics.

The overall prevalence of diabetes was 11.4%, and the self-reported history of cardiovascular diseases (CVD) was 29.9%. The prevalence of specific conditions within the study population included high blood pressure at 26.4%, a history of cardiac disease at 5.6%, a history of Myocardial Infarction (MI) at 1.3%, and a history of stroke at 0.9%. These prevalence rates are visually presented in the accompanying Figure 1.

The findings of this study show that the highest prevalence rate of comorbidity of diabetes with a history of cardiovascular diseases was 55.58 per 1,000 individuals (95% CI: 51.11–60.05). Conversely, the lowest prevalence rate reported was for the comorbidity of diabetes with a history of stroke, at 2.46 per 1,000 individuals (95% CI: 1.49–3.43) within the Shahrekord cohort study population. Figure 2 provides further details regarding the prevalence of these specific comorbidities.

Table 1: Demographic characteristics of the population.

	Variable	Number	Percentage
Gender	Male	4553	46.8
	Female	5180	53.2
Residence	Urban	6810	69.8
	Rural	2923	30.2
Ethnicity	Bakhtiari	4714	48.4
	Fars	3967	40.8
	Turk	647	6.6
	Other	405	4.2
Level of Education	Illiterate	2519	25.9
	Under Diploma	2561	26.4
	Diploma	1634	16.8
	Associate degree and Bachelor’s degree	1836	18.9
	Master’s degree and PHD	422	4.3
	Single	157	1.6

Marital status	Married	9137	93.9
	Widowed OR Divorced	439	4.5
Employment	No	4600	47.5
	Yes	674	7
	Retired	730	7.6
Socio-economic status Soc	Housewife	3670	37.9
	First quarter	2436	25.3
	Second quarter	2394	24.7
	Third quarter	2577	26.6
	Fourth quarter	2266	23.4

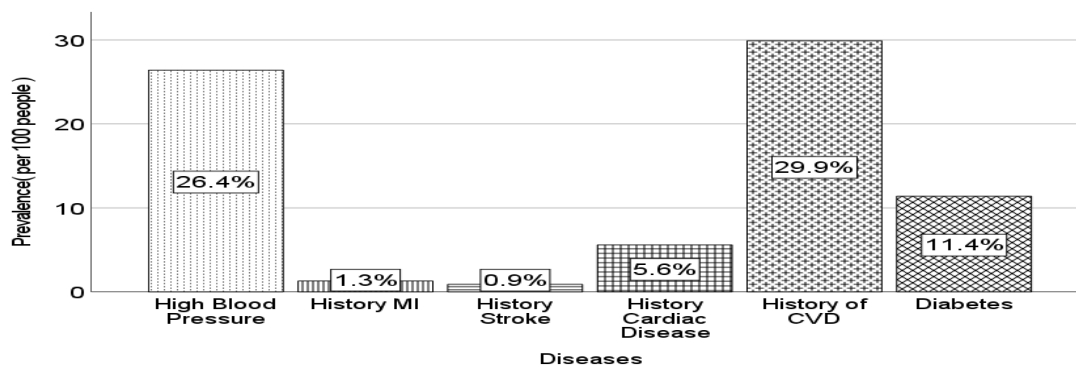


Figure 1: Prevalence percentage of diabetes and history of cardiovascular diseases

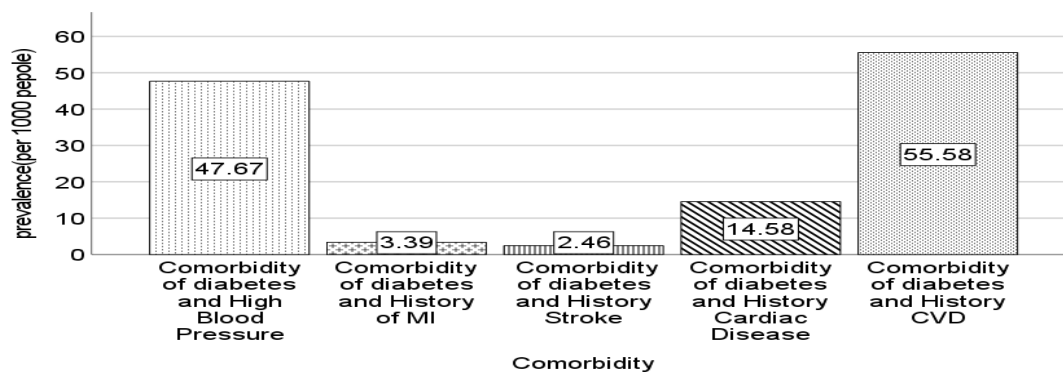


Figure 2: Prevalence of comorbidity of diabetes with a history of cardiovascular diseases

## Discussion

The present study aims to determine the prevalence of comorbidity of diabetes and history of cardiovascular diseases (high blood pressure, history of cardiac disease, MI, and stroke). Bivariate logistic regression was used to determine the related factors in Shahrekord cohort study population. Independent variables were entered into a regression model to investigate their relationship with diabetes, a history of cardiovascular diseases (CVD), and the comorbidity of these conditions. The overall prevalence of diabetes was 11.4% and the history of CVD was 29.9%. Within the CVD group, the prevalence rates for specific conditions were: high blood pressure (26.4%), cardiac disease history (5.6%), MI history (1.3%), and stroke (0.9%). In a comparable cross-sectional analytic investigation, Shakeri et al. (2019) examined factors associated with diabetes and hypertension among individuals aged 35–65 in Mashhad. Their findings reported a prevalence of high blood pressure in 24.2% of the population and diabetes in 7% (20).

In a 20-year cohort study focusing on the prevalence of multiple diabetes, heart disease and stroke in middle-aged women, Mishra et al. (2018) reported a high disease burden, with 56.6% prevalence for diabetes and 50.9% for cardiovascular disease. The comorbidity of these two conditions was found to be 12.3% (18). In a 2018 study focusing on individuals over 60 years of age in the Sahlan area of Tabriz, Moghaddas et al. found that 44.42% of the elderly had hypertension and 20.81% had diabetes (21).

The overall prevalence of comorbidity involving diabetes and a history of cardiovascular disease (CVD) in the Shahrekord Cohort Study population was reported at 55.55 per 1,000 studied individuals. Within this comorbidity, the rates (per 1,000) included diabetes co-occurring with hypertension (47.67), a history of cardiac disease (14.57), a history of MI (3.39), and stroke (2.46). For comparison, a similar study by Shakeri et al. (2019), using a bivariate logistic regression model to determine factors associated with diabetes and hypertension for 35–65 aged people in Mashhad, found that 7.3% of the people studied had both diabetes and hypertension (20). Similarly, Ntiyani et al. (2021) conducted a study on the prevalence of and factors associated with hypertension, diabetes, stroke and heart attack multimorbidity in Botswana. Their study reported a 3.5% prevalence rate for the comorbidity of hypertension, diabetes, stroke, and heart attack within their sample population (11).

A 2019 study by Quinones et al. examined multimorbidity in middle-aged and older adults, reporting that the combination of diabetes, arthritis, high blood pressure, and heart disease had a prevalence of 10% (22). For comparison, an earlier longitudinal

study by Mishra et al. (2016) found a 16.8% prevalence for the multimorbidity involving diabetes, a history of cardiovascular disease, and stroke among mid-aged women (17). Considering that data on the prevalence of non-communicable diseases in the Shahrekord Cohort Study is based on self-reporting, the lower-than-expected prevalence of diabetes and CVD comorbidity in the present study may be due to potential underreporting. This underreporting could be attributed to participants' lack of knowledge about their conditions or their inaccurate self-reporting, particularly concerning the history of MI and stroke.

## Conclusion

The present study revealed a relatively high prevalence of comorbidity between diabetes and cardiovascular diseases (CVD), with a rate of 55.58 per 1,000 individuals in the studied population. The comorbidity was particularly pronounced among women, individuals with low educational attainment, widowed or divorced persons, retirees, those with a positive family history of chronic diseases, and urban residents. These findings underscore the urgent need for targeted prevention and control strategies tailored to high-risk groups. Early detection, improved access to routine screening, and community-based interventions aimed at lifestyle modification could play a crucial role in reducing the burden of this dual morbidity. Strengthening public health policies focused on education, equitable healthcare services, and timely management may help curb the growing prevalence and associated complications of these non-communicable diseases.

## Footnotes

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**Authors' Contribution:** Study concept and design: Mousavi, Masoumeh Sadat and Parzhin Khazdoozi. Acquisition of data: Shaghayegh Rastgoo and Nahid Jahangiri. Interpretation of data: Moluk Hadi Alijanvand. Drafting of the manuscript: Mousavi, Masoumeh Sadat. Critical revision of the manuscript for important intellectual content: Mousavi, Masoumeh Sadat and Parzhin Khazdoozi. Statistical analysis: Moluk Hadi Alijanvand. Administrative, technical, and material support: Mousavi, Masoumeh Sadat. Study supervision: Mousavi, Masoumeh Sadat.

**Conflict of Interests Statement:** The authors declare that they have no conflict of interests. This includes no funding or research support beyond the stated sources, no employment or personal/financial interests, no stocks or shares in companies, no consultation fees, no patents, and no relevant personal or professional relations with organizations or individuals (e.g., family relationships). Furthermore, the authors hold no unpaid membership in any relevant government or non-governmental organization, and none of the authors serve as an editorial board member or a reviewer of this journal.

**Ethical Approval:** The study was reviewed and approved by the Ethics Committee in Research of Shahrekord University of Medical Sciences (Ethics Code: IR.SKUMS.REC.1401.113). All participants provided informed consent to participate in the Shahrekord Cohort Study. All individual data collected remain strictly confidential and coded.

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