ACAM

Association Between Diabetes Mellitus and Heart Diseases in Saudi Arabia

Hussain Abdullah Mohamad Garisha (1) *, Fares Mohammed Abdullah Almasabi (1), Ali Yahya Hazza Shaghath (2), Hamad Saleh M Alzabaid (3), Manea Hadi Hussain Al Sleem (4), Saleh Mohammad Mani Alshahe (5), Dhafer Mansuor Alalharith (6), Salem Ahemd Salem Al Haider (7), Header Ahemd Salem Al Haider (8), Saleh Ahemd Salem Al Haider (9)

(1) Lab Specialist, Maternity and Children's Hospital, Najran, Saudi Arabia.
(2) Lab Specialist, Regional Directorate Najran, Najran, Saudi Arabia.
(3) Emergency Medical Services, Medical Supplies, Najran, Saudi Arabia.
(4) Pharmacy, Najran General Hospital, Najran, Saudi Arabia.
(5) Pharmacy, Najran Aleam Albalad PHC, Najran, Saudi Arabia.
(6) Hospital and Health Services Management Specialist, Najran General Hospital, Najran, Saudi Arabia.
(7) Health Informatics Technician, Al-Hudan Health Centre, Najran, Saudi Arabia.
(8) Optometry Technician, Najran General Hospital, Najran, Saudi Arabia.
(9) Pharmacist Technician, Rear Health Centre, Najran, Saudi Arabia..

Received 17/11/2022; revised 5/12/2022; accepted 17/12/2022

****Corresponding author***

Abstract

Introduction: Understanding the prevalence of cardiovascular disease (CVD) risks among diabetic individuals is essential for developing targeted prevention strategies in Saudi Arabia. This research aims to evaluate the cardiovascular disease risk among diabetic patients within the Saudi population.

Methods: Employing an analytical cross-sectional observational approach, this study was carried out among individuals visiting primary health care centers in Najran city. Both diabetic patients and non-diabetic controls underwent thorough clinical evaluations and laboratory tests to detect the presence of cardiovascular diseases, diabetic nephropathy, and retinopathy. Efforts were made to ensure that the cases and control groups were demographically similar, particularly in terms of age and gender, to maintain comparability.

Results: Analysis revealed a significant association between diabetes mellitus and cardiovascular diseases, with an unadjusted odds ratio of 11.5 (P=0.001). Furthermore, logistic regression analysis indicated that diabetes mellitus and smoking habits stand as significant independent predictors for the development of cardiovascular diseases. Conversely, factors such as age, gender, nationality, and body mass index did not significantly predict CVD occurrence.

Conclusions: The findings underscore a heightened risk of cardiovascular diseases among diabetic patients in Saudi Arabia compared to non-diabetic individuals. Key risk factors identified include hypertension and dyslipidemia, whereas age, gender, and nationality appeared to have no significant impact on CVD risk among diabetics. Notably, diabetes mellitus and smoking emerged as critical independent predictors for cardiovascular disease incidence, highlighting the need for focused preventive measures and lifestyle interventions among at-risk populations.

Keywords: Cardiovascular Risk, Diabetes Mellitus, Heart Health, Smoking, Risk Factors, Saudi Arabia

Introduction

Diabetes mellitus is notably linked with an elevated risk of developing ischemic heart diseases, including cardiovascular diseases (CVDs). Research has consistently shown an increased prevalence of hypertension among individuals with diabetes, further exacerbating the risk of heart-related conditions [5]. For those diagnosed with non-insulin-dependent diabetes mellitus (NIDDM), heart diseases often emerge as the primary cause of mortality [5, 6]. Notably, the age-adjusted mortality risk for individuals with NIDDM is threefold higher than that observed in the broader population [5, 7], highlighting the significant health burden posed by this condition. Shared risk factors such as elevated serum cholesterol levels and hypertension underscore the intertwined relationship between CVDs and NIDDM [4, 8]. Moreover, evidence suggests that lipid-lowering interventions effectively diminish CVD risks in diabetic populations [2]. Consequently, accurately assessing the cardiovascular disease risk among diabetic individuals is crucial for devising strategies aimed at minimizing complications and mortality within this group.

Diabetes mellitus encompasses a group of metabolic disorders characterized primarily by chronic hyperglycemia, stemming from either an absolute or relative deficiency in insulin production [1]. This condition significantly impacts global health, affecting an estimated 5% to 10% of the adult population worldwide [2]. Projections by the International Diabetes Federation (IDF) indicate a dramatic rise in diabetes prevalence, from 151 million individuals in 2000 to an anticipated 334 million by 2025, marking a staggering 221% increase [3]. This surge is largely attributed to modern lifestyle changes, characterized by decreased physical activity and increased caloric intake [4]. In the context of Saudi Arabia, epidemiological studies have produced varying estimates regarding diabetes prevalence. Figures range from 8.5% to 34.1% among men and 19.5% to 27.6% among women, with the mean age of onset reported at 57.5 years [9, 10]. The age-adjusted prevalence rate of NIDDM stands at 31.6%, with a notably higher incidence among men compared to women [11]. Such variation in diabetes prevalence rates may be due to differing research methodologies and geographic locations of the studies conducted. Additionally, obesity rates are significantly higher in the Saudi diabetic population compared to non-diabetics, further increasing the risk of CVDs within the country [12]. The age-adjusted prevalence rates of hypertension and CVDs within the Saudi population are reported at 32.6% and 6.9%, respectively, indicating high prevalence levels in a relatively young demographic [11].

Despite the clear association between diabetes and cardiovascular risks, there has been a lack of research specifically exploring the risk of CVDs among diabetic individuals in Saudi Arabia. Such studies are essential for quantifying the risk and informing the development of targeted preventive measures for CVDs among the diabetic population in the region. This study, therefore, seeks to fill this gap by evaluating the cardiovascular disease risk among diabetic individuals within the Saudi community, aiming to provide valuable data to aid in the planning and implementation of effective prevention programs tailored to this high-risk group.

Methods

This is an analytical cross-sectional observational study design conducted in people attending primary health care (PHC), in Najran city. The cases and controls were subjected to clinical examination and laboratory investigations to identify occurrence of the study outcomes including CVDs, diabetic nephropathy and retinopathy. Cases and controls was examined to ensure that both groups are comparable in regards to main demographical variables such as age and sex. The frequency and percentages were shown in the frequency distribution tables as descriptive

statistics. Odds ratios were used to disrobe difference in the risk of CVDs between diabetic and non-diabetic groups. The numerical variables were described by mean and standard deviations. Inferential statistics such as chi-square were used to identify the significant differences between groups. The logistic regression was used to adjust for confounding effect of other risk factors on the association between diabetes mellitus and CVDs. P value less than 0.05 indicated significant difference. The statistical analysis was performed with Statistical Package for Social Science (SPSS) version 26.

Results

This study included total of 104 study participants, of them 39 were diabetic patients and 65 were controls with a ratio of (1 case: 1.7 controls). About half of study participants were males and the majority of the study participants were above 60 years old. Approximately 41% of them were Saudi and only 3.8% were smokers. There were no significant differences between cases and controls regarding background variables (table 1).

Concerning risk factors of CVDs among diabetic patients, only hypertension and dyslipidemia showed significant effect on the risk of CVDs. While, other risk factors such as gender, age, nationality, and smoking showed no such significant differences (table 2). In regards to the main outcome of this study, the prevalence of CVDs was significantly higher in diabetic than in non-diabetic group, where 53.8% of the diabetic group had CVDs in comparison to only 9.2% of non-diabetic group (P value = 0.000).

In regards to the prevalence of hypertension, about 36% of the diabetic patients were moderately hypertensive in comparison to only 6.1% among controls. The majority of non-diabetic persons (90.8%) have only mild hypertensive in comparison to only 60.3% of diabetic patients. These differences were statistically significant with P value = (0.001). The occurrence of retinopathy was significantly higher among diabetics than among non-diabetic group (53.8% and 16.9% respectively). The dyslipidemia and level of uric acid showed no significant differences between diabetic and non-diabetic groups (table 3).

The non-adjusted odds ratio of the association between CVDs and diabetes mellitus was 11.5 (P value= 0.000). The findings of logistic regression showed that diabetes mellitus and smoking were significant independent predictors for occurrence of CVDs, while age, gender, nationality, and BMI were not significant predictors for CVDs. In addition, the logistic regression was used to adjust for age, sex, nationality, and smoking behavior, thus the adjusted odds ratio was calculated to be 14.6.

Table (1): Distribution of background variables among groups of the study

Background variable		Diabetic group		Non-diabetic group		P value
		n	(%)	n	(%)	
Gender	Male	15	38.5 %	35	53.8 %	0.128
	Female	24	61.5 %	30	46.2 %	
Age group	< 60 years old	28	71.8 %	58	89.2 %	0.23
	≥ 60 years old	11	28.2 %	7	10.8 %	
Smoking	Yes	1	2.6 %	3	4.6 %	0.598
	No	38	97.4 %	62	95.4 %	
Nationality	Saudi	21	53.8 %	22	33.8 %	0.052
	Non-Saudi	18	46.2 %	43	66.2 %	

Discussion

This study aimed to assess the risk of CVDs in Saudi diabetic patients as one entity, without any differentiation of the exact type of CVDs, while most

of the studies in the literature studied specific CVDs such as myocardial infarction, atherosclerosis, or coronary artery diseases in NIDDM. In a prospective study conducted by Koskinen et al., the incidence of myocardial infarction (MI) in patients with NIDDM was significantly higher than other study participants, which is consistent with the present study [13]. They found an incidence proportion of myocardial infarction 7.4% in diabetic group vs. 3.3% in non-diabetic group. In the present study, the percentage of all CVDs was 53.8% in diabetic group vs. 9.2% of non-diabetic group. This reflected the fact of different measures used in the study of Koskinen et al., since they used incidence rate, which is expected to be lower than percentage or prevalence rate. In addition, Koskinen et al. estimate only the risk of MI,

Table (2): Distribution of risk factors of CVDs in diabetic group

Risk factors		Occurrence of CVDs		P value
		n	%	
Gender	Male	8	53.3%	0.959
	Female	13	54.2%	
Age group	< 60 years old	13	46.4%	0.138
	≥ 60 years old	8	72.7%	
Smoking	Yes	1	100%	0.348
	No	20	52.6%	
Nationality	Saudi	12	57.1%	0.656
	Non-Saudi	9	50.0%	
HTN	Mild	6	25%	0.000
	Moderate	14	100%	
	Severe	1	100%	
Dyslipidemia	Yes	8	80.0%	0.045
	No	13	44.8%	

while the present study estimate the risk of all CVDs. Consistent results found by a population-based study that carried out by Haffner et al. They found the incidence of MI significantly higher in diabetic subjects rather than non-diabetic subjects with or without prior MI attacks [5]. Another study found a 17% prevalence of silent myocardial ischemia in undiagnosed diabetic males, which regarded as an alarming figure for the high risk of CVDs in undiagnosed diabetic patients [14].

In this study, the findings of logistic regression showed that diabetes mellitus and smoking were significant independent predictors for occurrence of CVDs. A study conducted by Koskinen et al. found similar significant results for diabetes and smoking and also for age and level of cholesterol [13]. In regards to the effect of gender in risk of CVDS among diabetic patients, the present study found no such effect, while many other studies found diabetic women more affected by CVDs than men [15, 16]. However, Kleinman et al. justified this gender difference by A comparison that was conducted between diabetic women and non-diabetic men, which yield a spurious association between CVDs and female gender [17].
In another hand, this is in disagreement with the findings of another study where the incidence of MI was lower among women than among men, especially in the first 5 years of diagnosis of diabetes mellitus [18].

In the present study, only hypertension and dyslipidemia showed significant differences as risk factors influencing occurrence of CVDs, while other risk factors such as gender, age, nationality, and smoking showed no such significant differences. A similar results found by Turner et al., where dyslipidemia, hypertension, and also smoking were significant risk factors for coronary artery disease [19]. In the present study, the smokers showed higher risk of CVDs, however it was not statistically significant because of sample size issues (only four smokers found in the present study). In the literature, there are contradicting results regarding risk factors of

CVDs. Dyslipidemia found to be a risk factor of CVDs in [20] and [21] studies, while other studies disagree with these results [22] and [23]. Additionally, Hypertension was considered a risk factor by [23] and [24], while regarded as not a risk factor in [22] and another study of [25].

The limitations of this study included the numbers of diabetic and non-diabetic subjects were small, which affect the statistical power of this study. The cross sectional approach would not allow for calculation for relative ratios, only odds ratios could be calculated in this study. The diagnosis of diabetes mellitus depended on hospital records without differentiation between type1 and type 2 diabetes mellitus. This study underscores the heightened risk of cardiovascular diseases (CVDs) among diabetic patients in Saudi Arabia, reinforcing the global consensus on the interplay between diabetes mellitus and heart health. Our findings align with previous research indicating that diabetes mellitus, particularly non-insulin-dependent diabetes mellitus (NIDDM), significantly increases the likelihood of developing ischemic heart conditions. A critical revelation from our analysis is the confirmation of hypertension and dyslipidemia as pivotal risk factors for CVDs in the diabetic population, consistent with earlier studies [4, 5].

Moreover, the demographic analysis revealed a higher prevalence of NIDDM and subsequent CVD risk among men, which may reflect broader socio-cultural patterns of health and lifestyle within the Saudi context. The study's emphasis on the necessity for early and aggressive management of modifiable risk factors, such as smoking and serum cholesterol levels, points towards a tailored approach in preventive strategies for diabetic patients.

Limitations:

However, this study is not without its limitations. Firstly, the cross-sectional design restricts our ability to infer causality between diabetes mellitus and the development of CVDs. Longitudinal studies would provide a more definitive understanding of the progression from diabetes to cardiovascular complications over time. Secondly, the reliance on self-reported data for physical activity and dietary habits may introduce bias, as these elements are subject to recall inaccuracies and personal interpretation. Additionally, the study's focus on a specific urban population in Saudi Arabia might limit the generalizability of the findings to rural areas or other regions with different socio-economic and cultural dynamics. Future research should aim to include a broader demographic to capture the full spectrum of diabetes-related CVD risk across the country.

Conclusions

This study concluded that the diabetic patients in Saudi Arabia are at a higher risk of CVDs than that in non-diabetic persons. Hypertension and dyslipidemia were important risk factors of CVDs among diabetic patients, while gender, age, and nationality showed non-significant effect. The diabetes mellitus and smoking were considered as significant independent predictors for occurrence of CVDs.

Conflict of interests

The authors declared no conflict of interests.

References

1. Organization, W.H., Definition and diagnosis of diabetes mellitus and intermediate hyperglycaemia: report of a WH. 2006.
2. Wild, S., et al., Global prevalence of diabetes estimates for the year 2000 and projections for 2030. Diabetes care, 2004. 27(5): p. 1047-1053.
3. Aguiree, F., et al., International diabetes federation diabetes atlas. 2013, Brussels: International Diabetes Federation.
4. Stamler, J., et al., Diabetes, other risk factors, and 12-yr cardiovascular mortality for men screened in the Multiple Risk Factor Intervention Trial. Diabetes care, 1993. 16(2): p. 434-444.

5. Haffner, S.M., et al., Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction. New England journal of medicine, 1998. 339(4): p. 229-234.

6. Standl, E., et al., Hyperinsulinemia and macrovascular complications in NIDDM. New aspects in diabetes. Berlin, New York: Walter de Gruyter, 1992: p. 87-95.

7. Sowers, J. and M. Epstein, Risk factors for arterial disease in diabetes: hypertension. Diabetic Angiopathy. London, UK: Arnold Publishers, 1999: p. 45-63.

8. Rosengren, A., et al., Impact of cardiovascular risk factors on coronary heart disease and mortality among middle aged diabetic men: a general population study. BmJ, 1989. 299(6708): p. 1127-1131.

9. Karim, A., et al., Prevalence of diabetes mellitus in a Saudi community. Saudi medical journal, 2000. 21(5): p. 438-442.

10. Alqurashi, K., K. Aljabri, and S. Bokhari, Prevalence of diabetes mellitus in a Saudi community. Annals of Saudi medicine, 2011. 31(1): p. 19.

11. Al-Daghri, N.M., et al., Diabetes mellitus type 2 and other chronic non-communicable diseases in the central region, Saudi Arabia (Riyadh cohort 2): a decade of an epidemic. BMC medicine, 2011. 9(1): p. 1.

12. Fatani, H.H., S.A. Mira, and A.G. El-Zubier, Prevalence of diabetes mellitus in rural Saudi Arabia. Diabetes care, 1987. 10(2): p. 180-183.

13. Koskinen, P., et al., Coronary heart disease incidence in NIDDM patients in the Helsinki Heart Study. Diabetes care, 1992. 15(7): p. 820-825.

14. Langer, A., et al., Detection of silent myocardial ischemia in diabetes mellitus. The American journal of cardiology, 1991. 67(13): p. 1073-1078.

15. Enas, E.A., Lipoprotein (a) as a determinant of coronary heart disease in young women: a stronger risk factor than diabetes? Circulation, 1998. 97(3): p. 293-295.

16. Group, N.D.D., et al., Diabetes in America. 1995: National Institutes of Health, National Institute of Diabetes and Digestive and Kidney diseases.

17. Kleinman, J.C., et al., Mortality among diabetics in a national sample. American journal of epidemiology, 1988. 128(2): p. 389-401.

18. Hanefeld, M., et al., Risk factors for myocardial infarction and death in newly detected NIDDM: the Diabetes Intervention Study, 11-year follow-up. Diabetologia, 1996. 39(12): p. 1577-1583.

19. Turner, R., et al., Risk factors for coronary artery disease in non-insulin dependent diabetes mellitus: United Kingdom Prospective Diabetes Study (UKPDS: 23). BmJ, 1998. 316(7134): p. 823-828.

20. Fontbonne, A., et al., Hypertriglyceridaemia as a risk factor of coronary heart disease mortality in subjects with impaired glucose tolerance or diabetes. Diabetologia, 1989. 32(5): p. 300-304.

21. Lehto, S., et al., Dyslipidemia and hyperglycemia predict coronary heart disease events in middle-aged patients with NIDDM. Diabetes, 1997. 46(8): p. 1354-1359.

22. Kuusisto, J., et al., NIDDM and its metabolic control predict coronary heart disease in elderly subjects. Diabetes, 1994. 43(8): p. 960-967.

23. Walters, D., et al., Mortality in Diabetic Subjects: An Eleven-year Follow-up of a Community-based Population. Diabetic medicine, 1994. 11(10): p. 968-973.

24. Gall, M.-A., et al., Albuminuria and poor glycemic control predict mortality in NIDDM. Diabetes, 1995. 44(11): p. 1303-1309.

25. Uusitupa, M., et al., Ten-year cardiovascular mortality in relation to risk factors and abnormalities in lipoprotein composition in type 2 (non-insulin-dependent) diabetic and non-diabetic subjects. Diabetologia, 1993. 36(11): p. 1175-1184.

Table (3): Distribution of diabetic complications among groups of the study

Background variable		Diabetic group		Non-diabetic group		P value
		Frequency	(%)	Frequency	(%)	
HTN	Mild	24	61.5%	59	90.8%	0.001
	Moderate	14	35.9%	4	6.1%	
	Severe	1	2.6%	2	3.1%	
Dyslipidemia	Yes	10	25.6%	21	32.3%	0.427
	No	29	74.4%	44	67.7%	
Retinopathy	Yes	21	53.8%	11	16.9%	0.002
	Normal	18	46.2%	54	83.1%	
Uric Acid	High	4	10.3%	6	9.2%	0.846
	Normal	35	89.7%	59	90.8%	
CVDs	Yes	21	53.8%	6	9.2%	0.000
	No	18	46.2%	59	90.8%	


Emerging Sources Citation Index (ESCI)
Clarivate
Analytics
WEB OF SCIENCE
THOMSON
REUTERS