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RESEARCH ARTICLE

TYPE 2 DIABETES MELLITUS IN ASSOCIATION WITH CARDIOVASCULAR DISEASE IN SAUDI ARABIA

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ABSTRACT

Background: Cardiovascular disease is increased in type 2 diabetes mellitus subjects due to a complex combination of various traditional and non-traditional risk factors. **Objectives:** To illustrate the association between Type II DM and cardiovascular comorbidities in Riyadh, Saudi Arabia. **Methods:** A cross-sectional study carried out among type II diabetic patients in Riyadh city during the period from 1 May to 31 August, 2019.Data was collected using a self-administered questionnaire after taking the acceptance from the administration to distribute the questioner to all eligible participants. The questionnaire was analyzed to evaluate prevalence of CVD among diabetic patients**. Results:** 290 (17.3%) of the respondents had Type II diabetes mellitus. As regards the association between Type II DM and cardiovascular comorbidities, according to our findings 31% of diabetic patients were hypertensive, 41.4% had hypercholesterolemia and 6.9% had atherosclerosis, 27.6% were obese and the association between these conditions and type II DM was significant (P<0.05). Conclusion: among the general population of Riyadh, KSA, there was significant association between type II DM and hypertensive, hypercholesterolemia atherosclerosis, and obesity (P<0.05).

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INTRODUCTION

Type 2 diabetes mellitus (DM) is a complex metabolic disease in which concomitant insulin resistance and beta-cell impairment lead to hyperglycemia, which is the hallmark of the disease (Stumvoll, 2005). The latest estimates by the international diabetes federation project that 592 million (1 in 10 persons) worldwide will have DM by 2035 (Aguiree, 2013). Studies have demonstrated that diabetic patients have a two- to fourfold propensity to develop coronary artery disease (CAD) and myocardial infarction (MI), establishing that type 2 DM is an independent risk factor for stroke and heart disease (Grundy, 1999; Kannel, 1979). A number of evidences exist, demonstrating that the interaction of type 2 DM and related cardiovascular risk underpin the progressive nature of the vascular damage, leading to atherosclerosis (Grundy, 2012).

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Diabetes is associated with both macrovascular and disease. Chronic hyperglycemia and insulin resistance play an important role in the initiation of vascular complications of diabetes and involve three mechanisms including increased formation of advanced glycation end products and activation of the receptor for advanced glycation end products AGE-RAGE axis, oxidative stress, and inflammation (Brownlee, 2005). A previous literature review to estimate the current prevalence of CVD among adults with T2DM by reviewing literature published within the last 10 years analyzed data from 57 articles with 4,549,481 persons having T2DM. Europe produced the most articles (46%), followed by the Western Pacific/China (21%), and North America (13%). Overall in 4,549,481 persons with T2DM, 52.0% were male, 47.0% were obese, aged 63.6 ± 6.9 years old, with T2DM duration of 10.4 ± 3.7 years. CVD affected 32.2% overall (53 studies, N = 4,289,140); 29.1% had atherosclerosis (4 studies, N = 1153), 21.2% had coronary heart disease (42 articles, N = 3,833,200), 14.9% heart failure (14 studies, N = 601,154), 14.6% angina (4 studies, N = 354,743), 10.0% myocardial

infarction (13 studies, N = 3,518,833) and 7.6% stroke (39 studies, N = 3,901,505). CVD was the cause of death in 9.9% of T2DM patients (representing 50.3% of all deaths) (Einarson, 2018).

Study objectives: To illustrate the association between Type II DM and cardiovascular comorbidities in Riyadh, Saudi Arabia.

METHODOLOGY

Study Design, population, period and sitting: A cross-sectional study carried out among type II diabetic patients among the general population in Riyadh city during the period from 1 May to 31 August, 2019.

Sampling:

We will calculate our sample size using standard online tools through the following formula $N=(Z\alpha)^2 \times ((p(1-p))/d^2)$

Where: n = estimated sample size., Zα at 5% level of significance = 1.96, d = level of precision and is estimated to be 0.05, p = prevalence unknown (assumed to be 50%). Hence, the minimum sample size = 284diabetic subjects. The inclusion criterion set out for the study was:

- All participants who were willing to participate
- Aged 18 or more.

While the exclusion criteria for participation included:

- Subjects that was not intend to participate in the study
- Aged less than 18 years.

Data collection: Data was collected using a self-administered online questionnaire after taking the acceptance from the administration to distribute the questioner to all eligible participants. The questionnaire was analyzed to evaluate prevalence of CVD among diabetic patients. The questionnaire was completed and returned to data collectors in the same session. This questionnaire will cover the socio demographic characteristics age (in years), marital state (married, single, divorced, widowed), education level, body weight and height. Another section included questions about the participant's personal experience with the disease. The remaining sections of the questionnaire assessed the risk factors, indications, and prevalence of CVD among diabetic patients.

Data management and statistical analysis: Data entry and statistical analyses was performed with (SPSS version 25). In all performed analysis, a significance difference equal to, or smaller than 0.05, was used to determine statistical significance. Descriptive statistics by simple table was presented as frequency and percent of categorical data, numerical data for continuous outcome was presented as mean and standard deviation. Chi square test was used to test the relation between Type II diabetes and the found cardiovascular diseases.

Ethical considerations: Our study didn't involve any invasive techniques or tissue/fluid sample collection. There were no incentives or rewards provided and there was no risk imposed on the participants. All questionnaires were submitted anonymously. Participation was voluntary and acceptance in the participation in the study with a returned and completed questionnaire was taken as consent.

RESULTS

Table (1) shows the socio-demographic characteristics and BMI groups of the participants. 83.3% were male, 43.5% aged between 25 –35 years, 69.0% had university degree of education, and 65.5% were married. As regards the BMI, 35.7% were overweight and 32.7% obese. 290 (17.3%) of the respondents had Type II diabetes mellitus. Table (2) illustrates the association between Type II DM and cardiovascular comorbidities, according to our findings 31% of diabetic patients were hypertensive, 41.4% had hypercholesterolemia and 6.9% had atherosclerosis, 27.6% were obese and the association between these conditions and type II DM was significant (P<0.05). Also, 6.9% had valvular heart diseases, no cases has pericarditis or anemia.

Type 2 diabetes mellitus (DM) is a complex metabolic disease in which concomitant insulin resistance and beta-cell impairment lead to hyperglycemia, which is the hallmark of the disease (Stumvoll, 2005). The latest estimates by the international diabetes federation project that 592 million (1 in 10 persons) worldwide will have DM by 2035 (Aguiree et al., 2013). Studies have demonstrated that diabetic patients have a two- to fourfold propensity to develop coronary artery disease (CAD) and myocardial infarction (MI), establishing that type 2 DM is an independent risk factor for stroke and heart disease (Grundy, 1999; Kannel, 1979). A number of evidences exist, demonstrating that the interaction of type 2 DM and related cardiovascular risk underpin the progressive nature of the vascular damage, leading to atherosclerosis (Grundy, 2012). Diabetes is associated with both macrovascular and disease. Chronic hyperglycemia and insulin resistance play an important role in the initiation of vascular complications of diabetes and involve three mechanisms including increased formation of advanced glycation end products and activation of the receptor for advanced glycation end products AGE-RAGE axis, oxidative stress, and inflammation (Brownlee, 2005).

A previous literature review to estimate the current prevalence of CVD among adults with T2DM by reviewing literature published within the last 10 years analyzed data from 57 articles with 4,549,481 persons having T2DM. Europe produced the most articles (46%), followed by the Western Pacific/China (21%), and North America (13%). Overall in 4,549,481 persons with T2DM, 52.0% were male, 47.0% were obese, aged 63.6 ± 6.9 years old, with T2DM duration of 10.4 ± 3.7 years. CVD affected 32.2% overall (53 studies, N = 4,289,140); 29.1% had atherosclerosis (4 studies, N = 1153), 21.2% had coronary heart disease (42 articles, N = 3,833,200), 14.9% heart failure (14 studies, N = 601,154), 14.6% angina (4 studies, N = 354,743), 10.0% myocardial infarction (13 studies, N = 3,518,833) and 7.6% stroke (39 studies, N = 3,901,505). CVD was the cause of death in 9.9% of T2DM patients (representing 50.3% of all deaths) (Einarson, 2007).

DISCUSSION

The incidence of diabetes mellitus (DM) is increasing substantially worldwide.

Table 1. Socio-demographic characteristics of the participants and BMI groups(n=1680)

Variables	Frequency (N=1680)	Percent
Sex		
•Male	1400	83.3
•Female	280	16.7
Age groups		
•< =24	291	17.3
•25 -	729	43.5
•35 -	531	31.5
•50 +	129	7.7
Educational level		
•Primary or illiterate	50	3.0
•Preparatory or Secondary	301	17.9
•University degree	1162	69.0
•Master or PhD	168	10.1
Marital status		
•Single	498	29.8
•Married	1102	65.5
•Divorced	70	4.2
•Widowed	1	.6
Body Mass Index		
•Underweight	6	3.6
•Normal	47	28.0
•Overweight	598	35.7
•Obese	552	32.7
Type II Diabetes		
•Yes	290	17.3
•No	1390	82.7

Table 2. Association between Type II DM and cardiovascular comorbidities

Variables		Type II Diabetes Mellitus		Total (N=1680)	P-value
		Yes (n=290)	No (n=1390)		
Age group	<24	0	290	290	0.001
		0.0%	20.9%	17.3%	
	25-	101	629	730	
		34.5%	45.3%	43.5%	
	35-	119	411	530	
		41.4%	29.5%	31.5%	
	50+	70	60	130	
		24.1%	4.3%	7.7%	
Hypertension	•Yes	90	50	140	0.000
		31.0%	3.6%	8.3%	
	•No	200	1340	1540	
		69.0%	96.4%	91.7%	
Hypercholesterolemia	•Yes	120	260	380	0.010*
		41.4%	18.7%	22.6%	
	•No	170	1130	1300	
		58.6%	81.3%	77.4%	
Atherosclerosis	•Yes	20	0	20	0.029*
		6.9%	0.0%	1.2%	
	•No	270	1390	1660	
		93.1%	100.0%	98.8%	
Cardiomyopathy	•Yes	0	10	10	0.827*
		0.0%	0.7%	0.6%	
	•No	290	1380	1670	
		100.0%	99.3%	99.4%	
Valvular diseases	•Yes	20	30	50	0.206
		6.9%	2.2%	3.0%	
	•No	270	1360	1630	
		93.1%	97.8%	97.0%	
Pericarditis	•Yes	0	0	0	N/A
		0%	0%	0%	
	•No	290	1390	1680	
		17.3%	82.7%	100.0%	
Anemia	•Yes	0	200	200	0.017*
		0.0%	14.4%	11.9%	
	•No	290	1190	1480	
		100.0%	85.6%	88.1%	
Obesity	•Yes	80	110	190	0.006*
		27.6%	7.9%	11.3%	
	•No	210	1280	1490	
		72.4%	92.1%	88.7%	
Age group	<24	0	290	290	0.001
		0.0%	20.9%	17.3%	
	25-	101	629	730	
		34.5%	45.3%	43.5%	
	35-	119	411	530	
		41.4%	29.5%	31.5%	
	50+	70	60	130	
		24.1%	4.3%	7.7%	

NA = Not Applicable

Over the past three decades, the global burden of DM has swelled from 30 million in 1985 to 382 million in 2014, with current trends indicating that these rates will only continue to rise (Matheus, 2013). A close link exists between DM and cardiovascular disease (CVD). Cardiovascular disease (CVD) represents a leading health problem worldwide CVD is the most prevalent cause of mortality and morbidity in diabetic populations. CVD death rates in the United States are 1.7 times higher among adults (> 18 years) with DM than those without diagnosed DM, largely due to an increased risk of stroke and myocardial infarction (MI) (Centers for Disease Control and Prevention, 2014). Prospective studies have demonstrated that diabetic patients have a two- to fourfold propensity to develop coronary artery disease (CAD), establishing that type 2 DM is an independent risk factor for stroke and heart disease (Kannel, 1979).

Although the most common forms of type 2 DM and the vast majority of CVD are polygenic, Mendelian forms have also been described for both conditions, in which a single gene mutation can trigger the disease (Grundy, 1999). Currently, a number of evidences exists, demonstrating that the interaction of type 2 DM and related cardiovascular risk underpin the progressive nature of the vascular damage, leading to atherosclerosis, while it is also proved that lifestyle modifications, such as physical activity and weight loss, counteract CVD risk factors in pre-diabetic individuals (Grundy , 2012). Cardiovascular disease is increased in type 2 diabetes mellitus subjects due to a complex combination of various traditional and non-traditional risk factors that have an important role to play in the beginning and the evolution of atherosclerosis over its long natural history from endothelial function to clinical events (International Diabetes Federation 2011). As regardsthe association between Type II DM and cardiovascular comorbidities, according to our findings 31% of diabetic patients were hypertensive, 41.4% had hypercholesterolemia and 6.9% had atherosclerosis, 27.6% were obese and the association between these conditions and type II DM was significant (P<0.05). Also, 6.9% had valvular heart diseases, no cases has pericarditis or anemia. Concerning the age group, 41.4% of diabetic patients aged 35-50 years and 34.5% aged 25-35 years (P<0.05).

In previous studies (International Diabetes Federation 2011; King, 1995; Qin, 2012), it was reported that the prevalence of diabetes washigher in patients aged 45–64 years and in those who had afamily history of DM (International Diabetes Federation 2011; King, 1995; Qin, 2012). Contrary to our finding, theauthors (International Diabetes Federation 2011; Qin, 2012) reported that diabetes was predominant inwomen. However, our results are consistent with those ofother authors who also reported diabetes to be more frequentin men (Azimi-Nezhad, 2008; Logue, 2011; Lipscombe, 2007; Choi, 2009; Logue, 2011). Findings of previous studies (Tang, 2003; Bay, 2007), including a study conducted on Saudi patients(22), also showed a direct relationship between BMI anddiabetes. The increasing incidence of DM in the Saudipopulation has been linked to obesity, which is a consequence of major sociocultural and lifestyle changes. Previous study found anincreasedprevalence of hypertensionindiabetic persons is similar to those reported in other studies (Bakhotmah, 2013; Abdella, 1998; James, 2014). It has been shown that although both hypertension and diabetes occur independently, they are known to exacerbate each other (James, 2014).

Saudi study reported that; cases were more likely than controls to be men (5X<0.0001), less educated (5X<0.0001), natives of eastern Saudi Arabia (5X<0.0001), retired (5X<0.0001), lower-salaried (5X<0.0001), or married or divorced (5X<0.0001). By univariate analysis cases were likely to be current smokers (*P*< 0.0001), hypertensive (5X< 0.0001), or overweight/obese (5X<0.0001) (26).

Conclusion

Among the general population of Riyadh, KSA, there was significant association between type II DM and hypertensive, hypercholesterolemia atherosclerosis, and obesity (P<0.05).

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