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Research Article

Gender as a Risk Factor for Cardiovascular Disease in type 2 Diabetes-Sudan

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Abstract

OBJECTIVES: Researchers intended to see if there was a link between gender and an increased risk of dyslipidemia and cardiovascular disease (CVD) in Sudanese people with type 2 diabetes mellitus (T2DM) by measuring fasting plasma glucose (FPG), glycated hemoglobin (HbA1C) and lipid profiles as well as blood pressure.

MATERIALS AND METHOD: During the period of April 2012 and March 2013, a case-control study was conducted in Central Sudan. The study involved 300 people who met the inclusion criteria, who were divided equally into diabetes, diabetic hypertension, and non-diabetic non hypertensive (NDNH) groups to estimate FPG, HbA1C, and lipid profile levels (TC, HDL-C, LDL-C, and TG). A15, a random access auto-analyzer bio system, was used to analyze the samples. A questionnaire was completed, which included personal information, anthropometric and biochemical measurements. After each respondent gave verbal consent, venous blood was drawn after an overnight fast. The statistical analysis was done with the help of a statistical software for social sciences (SPSS version 16, Chicago, IL, USA).

RESULT: In the women's group, statistically significant differences in anthropometric measurements (WC =0.017, BMI =0.004, SBP <0.0001, DBP=0.029) and biochemical measurements (FPG <0.0001, HbA1C =0.007, HDL-C=0.027) were discovered when the means were compared. When the mean HDL-C values of diabetic and diabetic hypertensive women were compared, there was a significant rise of 0.029. Men, on the other hand, had statistically significant disparities in anthropometric parameters, with WC=0.001, BMI <0.0001, and SBP <0.0001. FPG showed a significant increase of <0.0001, whereas HbA1C mean in diabetes and diabetic hypertensive patients showed poor management with no significant increase (0.615). HDL-C had a modestly high mean (0.089), while DBP had a non-significant increase (0.172).

CONCLUSION: Diabetic and diabetic hypertensive women were at increased risk of dyslipidemia and CVD.

Key-words: Type 2 diabetes mellitus; cardiovascular disease; dyslipidemia; Sudan

Introduction

DM is a group of metabolic disorders with multiple etiologies that are characterized by chronic hyperglycemia caused by defects in insulin secretion, insulin action, or both, as well as disturbances in carbohydrate, fat, and protein metabolism, resulting in long-term organ damage, dysfunction, and failure. Thirst, polyuria, blurred vision, and weight loss are all symptoms of diabetes mellitus. Ketoacidosis or a non-ketotic hyperosmolar condition might occur in the most severe cases, resulting in stupor and coma (Alberti and Zimmet, 1998). The global prevalence of DM was estimated to be 8.8% among adults aged 20-79 years, (Zinman, 2015); 7.0% for male, 8.1% for female and 7.5% for both sex (Islam, *et al.*, 2014). T2DM will overtake obesity as the major cause of disease burden in men and the second greatest cause in women by 2023. (Goss, 2008).

Hyperglycemia, which induced by high FPG or high postprandial plasma glucose (PPG), has major immediate consequences, including endocrine emergencies, and is one of the complications of diabetes mellitus along with diabetic ketoacidosis (DKA) and hyperosmolar

hyperglycemic state (HHS) (Umpierrez G and Korytkowski M, 2016). Furthermore, chronic hyperglycemia is a significant risk factor for the development of microvascular complications, such as retinopathy, nephropathy, and neuropathy, which are caused by damage to small vessels within the microcirculation of the kidney, retina, and neurons.

Besides that, macrovascular complications, such as CVD, are caused by damage to large vessels (Orasanu G and Plutzky J, 2009). Macrovascular disease affects 40% of newly diagnosed T2DM patients (Laakso, 2001), and it is responsible for 80% of all premature illness and death due to an elevated risk of CVD (Turner and Holman, 1996). When compared to people without diabetes, T2DM is responsible for a 2 to 4 fold increase in vascular problems (Assmann and Schulte, 1988). According to Islam et al. (2014), 50% of T2DM patients die from cardiovascular complications, while high blood pressure is responsible for 75% of specific cardiovascular issues (Bild and Teutsch, 1987; Sowers, et al., 2001). Diabetics with CVD have a 3-fold greater mortality rate than the overall population (Sowers, et al., 2001). CVD is one of the metabolic syndrome, which is defined as a group of metabolic diseases that includes glucose intolerance, T2DM, atherogenic dyslipidemia, high blood pressure, Hypertension (HTN), and central obesity (Expert Panel on Detection and Treatment of High Blood Cholesterol in, 2001). These abnormalities occur in the same individual and cause a multiple set of risk factors that commonly appear to interact (Sattar, et al., 2003).

The presence of three or more of the following metabolic disorders meets the criteria for the metabolic syndrome: abdominal obesity (WC >102 cm in men and >88 cm in women), hypertriglyceridemia (TG >150 mg/dL), low HDL-C levels (HDL-C < 40 mg/dL in males and 50 <mg/dL in women), blood pressure (SBP >130 mmHg, DBP >85 mmHg), and FPG >110 mg/dL are all risk factors for CVD (Matthews, et al., 1985). As a result, T2DM patients exhibit metabolic abnormalities in lipoprotein quality and quantity, which are linked to an elevated risk of cardiovascular problems and chronic heart disease (Assmann and Schulte, 1988).

MATERIAL AND METHODS:

STUDY SUBJECT, DESIGN AND AREA:

300 persons of both genders participated in a cross-sectional case-control study. There were 222 female participants and 78 male participants in this study. A total of 200 patients with type 2 diabetes were found, with the diabetic and diabetic hypertensive groups being split equally. Non-diabetic, non-hypertensive volunteers made up the remaining group (NDNH). The participants came from both rural and urban locations in the Wad Madani city district, and they were treated at the Abu A'gla health center. The research lasted from April 2012 through March 2013.

INCLUSION AND EXCLUSION CRITERIA:

Participants who did not have a current infection or diabetic problems were included in the trial. NDNH persons who agreed to participate were enrolled in the study. If a subject did not match any of the inclusion criteria, they were removed from the study.

ETHICAL APPROVAL:

The Ethics Committee of the Ministry of Health granted ethical permission for the study.

STUDY PROCEDURE:

After informed consent, all patients and NDNH participants provide their personal data and anthropometric measurements, (weight was measured in kilograms (kg) and heights in meters (m), and the body mass index (BMI) was calculated using the formula: BMI = (weight in kg)/(height in m)2 (Ng M, 2014). Using the A15, a random access auto-analyzer bio system, plasma samples were evaluated for various biochemical parameters.

STATISTICAL ANALYSIS:

The statistical analysis was done with the help of a statistical software for social sciences (SPSS version 16, Chicago, IL, USA). The mean and standard error of the mean were used to express all of the numerical data. The proportion of distribution of study participants was calculated using the Chi-square test. Analysis of variance was used to compare differences in the means of continuous variables between the research groups (ANOVA). To compare differences between the study groups, multiple comparisons (post hoc tests such as Tukey HSD, Gabriel test, and Games Howell) were performed. P-values of 0.05 or less ($p<0.05$) were considered significant.

RESULTS:

The participants in this study were separated into three groups: diabetes, diabetic hypertensive, and NDNH as a control group. Men made up 78 participants (26 percent) of the general study sample, while women made up 222 participants (74 percent). The participants age ranged from 22 to 65 years old. The group with the highest mean weight, WC, BMI, SBP, and DBP (80.28kg, 104.14cm, 31.65kg/m2, 128.10mmHg, and 81.40mmHg, respectively) was the diabetic hypertensive group (Table1).

Variable	Diabetic (n=100)	Diabetic-hypertensive (n=100)	NDNH (n=100)
Gender (men/ women)	26 /74	21/79	31 /69
Age (years)	49.67±0.71	56.17±0.72	46.74±0.78
Weight (kg)	79.95±1.69	80.28±1.42	72.51±1.38
WC (cm)	98.69±1.15	104.14±1.10	98.15±1.07
BMI (Kg/m2)	30.36±0.58	31.65±0.59	27.54±0.55
SBP (mmHg)	118.60±0.80	128.10±1.43	114.30±1.32
DBP(mmHg)	76.70±0.71	81.40±0.93	82.00±1.95
Duration of DM (years)	4.75±0.41	7.18±0.62	-
Duration of HTN (years)	-	5.78±0.57	-

WC=waist circumference; BMI=body mass index, Cm=centimeter, Kg=kilogram, m= meter, SBP= Systolic Blood Pressure; DBP= Diastolic Blood Pressure; mmHg= millimeter of mercury, DM=Diabetes mellitus, HTN= Hypertension

Table 1: The general characteristics of anthropometric and biochemical measurements of the study groups

Variable	Subgroup			
	Diabetic (n=74)	Diabetic-hypertensive (n=79)	NDNH (n=69)	p-value
Age (years)	48.92±0.79	55.44±0.81	46.48±0.86	<0.0001
WC (cm)	99.03±1.33	103.99±1.19	100.65±1.26	0.017
BMI (Kg/m2)	30.78±0.62	32.22±0.65	29.09±0.68	0.004
SBP (mmHg)	118.65±0.90	126.46±1.45	114.64±1.63	<0.0001
DBP (mmHg)	77.03±0.83	81.14±1.10	82.90±2.48	0.029
Duration of DM (years)	5.08±0.51	6.37±0.68	-	0.137
Duration of HTN (years)	-	6.01±0.68	-	-
FPG (mg/dL)	215.34±10.97	165.81±7.42	87.57±2.13	<0.0001
HbA_{1C} (%)	8.38±0.31	7.3506±0.22	-	0.007
TC (mg/dL)	197.42±4.95	192.32±4.69	200.33±5.86	0.535
LDL-C (mg/dL)	105.45±3.51	111.05±3.36	107.62±4.10	0.537
HDL-C (mg/dL)	52.68±1.85	51.13±1.58	57.97±2.12	0.027
TG (mg/dL)	173.62±10.35	162.96±8.58	149.19±9.44	0.203

WC=waist circumference; BMI=body mass index, Cm=centimeter, Kg=kilogram, m= meter, SBP= Systolic Blood Pressure, DBP= Diastolic Blood Pressure; mmHg= millimeter of mercury, DM=Diabetes mellitus, HTN= Hypertension FPG=fasting plasma glucose, HbA_{1C}=Glycosylated Hemoglobin, TC=total cholesterol, LDL-C=low density lipoprotein cholesterol, HDL-C=high density lipoprotein cholesterol, TG=tri-glycerides, mg=milligram; dL=deciliter.

Table 2: Comparison of mean of anthropometric and biochemical parameter in the women groups (n=222)

In the men's group, mean comparisons indicated statistically significant differences in anthropometric parameters (age, WC and BMI), and biochemical measurement FPG as well as marginal significance difference in HDL-C in addition to SBP and DBP in men's group (Table 3).

Variable	Sub-group			
	Diabetic (n=26)	Diabetic-hypertensive (n=21)	NDNH (n=27)	p-value
Age (years)	51.81±1.51	58.90±1.46	47.32±1.64	<0.0001
WC (cm)	97.73±2.33	104.71 ± 2.71	92.58 ±1.64	0.001
BMI (Kg/m2)	29.19±1.37	29.53±1.32	24.08±0.53	<0.0001
SBP (mmHg)	118.46±1.73	134.29±3.88	113.55±2.25	<0.0001
DBP (mmHg)	75.77±1.38	82.38±1.68	80.00±3.08	0.172
Duration of DM (years)	3.82±0.57	10.24±1.38	-	<0.0001
Duration of HTN (years)	-	6.67±1.09	-	-
FPG (mg/dL)	215.31±22.45	160.19±15.29	94.68±6.10	<0.0001
HbA_{1C} (%)	8.12±0.67	7.67±0.55	-	0.615
TC (mg/dL)	188.31±7.09	180.24±11.38	191.23±6.25	0.626
LDL-C (mg/dL)	100.46±4.50	101.43±5.93	106.77±4.17	0.575
HDL-C (mg/dL)	54.15±3.25	44.48±3.00	50.03±2.48	0.089
TG (mg/dL)	169.81±15.33	150.70±13.55	141.23±13.71	0.340

WC=waist circumference; BMI=body mass index, Cm=centimeter, Kg=kilogram, m= meter, SBP= Systolic Blood Pressure, DBP= Diastolic Blood Pressure; mmHg= millimeter of mercury, DM=Diabetes mellitus, HTN= Hypertension FPG=fasting plasma glucose, HbA_{1C}=Glycosylated Hemoglobin, TC=total cholesterol, LDL-C=low density lipoprotein cholesterol, HDL-C=high density lipoprotein cholesterol, TG=tri-glycerides, mg=milligram; dL=deciliter.

Table 3: Comparison of mean of anthropometric and biochemical parameter in the men groups(n=78):

In the women's group, Post Hoc test revealed a significant difference in WC between the diabetes and diabetic hypertensive groups (p=0.017). The NDNH group varied considerably from the diabetic hypertensive group in terms of mean BMI (p=0.003). FPG was significantly different between the diabetic hypertensive and the NDNH groups (p=0.001), as well as between the diabetic and the NDNH groups (p<0.0001). The diabetic-hypertensive and NDNH groups had substantially different mean HDL-C (p=0.029) (Table 4).

Group	**Diabetic (n=74)**			**Diabetic hypertensive (n=79)**			**Diabetic hypertensive (n=79)**		
Compared with	**NDNH (n=69)**			**NDNH (n=69)**			**diabetic (n=74)**		
Variable	**Mean Diff**	**SE**	**p-value**	**Mean Diff**	**SE**	**p-value**	**Mean Diff**	**SE**	**p-value**
WC (cm)†	-1.63	1.83	0.650	3.34	1.74	0.137	4.96	1.79	0.017
BMI (Kg/m^2)†	1.69	0.92	0.165	3.13	0.94	0.003	1.44	0.90	0.249

FPG (mg/dl)§	127.77	11.18	<0.0001	78.24	7.720	<0.0001	-49.53	13.24	0.001
TC (mg/dl)†	-2.91	7.41	0.971	-8.02	7.29	0.614	5.10-	7.16	0.856
LDL-C (mg/dl)†	-2.18	5.25	0.967	3.43	5.16	0.880	5.60	5.07	0.610
HDL-C (mg/dl)†	-5.30	2.82	0.149	-6.84	2.65	0.029	-1.55	2.44	0.801
TG (mg/dl)‡	24.43	13.65	0.208	13.77	13.31	0.659	-10.66	13.16	0.803

WC=waist circumference; BMI=body mass index, Cm=centimeter, Kg=kilogram, m= meter, FPG=fasting plasma glucose, TC=total cholesterol, LDL-C=low density lipoprotein cholesterol, HDL-C=high density lipoprotein cholesterol, TG=tri-glycerides, mg=milligram; dL=deciliter, †= Tukey HSD; ‡=Gabriel test; §=Games Howell

Table 4: Post hoc analysis in the women group

In the men's group, Post Hoc test revealed a significant difference in mean BMI between the NDNH group and each of the diabetic (p=0.004) and diabetic hypertensive (p=0.002) groups, beside significant difference in WC between diabetic and NDNH group (0.001) . FPG was significantly different between the NDNH group and each of the diabetic hypertensive (p<0.0001) and diabetic (p=0.001) groups (Table 5).

Group	Diabetic(n=26)			Diabetic hypertensive(n=21)			Diabetic hypertensive(n=21)		
Compared with	**NDNH (n=27)**			**NDNH (n=27)**			**Diabetic (n=26)**		
Variable	**Mean Diff**	**SE**	**p-value**	**Mean Diff**	**SE**	**p-value**	**Mean Diff**	**SE**	**p-value**
WC (cm)†	5.15	2.93	0.227	12.13	3.11	0.001	6.98	3.23	0.098
BMI (Kg/m^2)†	5.11	1.47	0.004	5.45	1.42	0.002	0.34	1.91	0.983
FPG (mg/dl)§	120.63	23.26	<0.0001	65.51	16.46	0.001	-55.11	27.16	0.118
TC (mg/dl)†	-2.92	10.79	0.990	-10.99	11.46	0.711	-8.07	11.89	0.873
LDL-C(mg/dl)†	-6.31	6.45	0.697	-5.35	6.86	0.820	0.97	7.12	0.999
HDL-C (mg/dl)†	4.12	3.93	0.650	-5.56	4.18	0.460	-9.68	4.33	0.083
TG (mg/dl)‡	28.57	19.48	0.376	9.47	20.99	0.958	-19.11	21.63	0.759

WC=waist circumference; BMI=body mass index, Cm=centimeter, Kg=kilogram, m= meter, FPG=fasting plasma glucose, TC=total cholesterol, LDL-C=low density lipoprotein cholesterol, HDL-C=high density lipoprotein cholesterol, TG=tri-glycerides, mg=milligram; dL=deciliter, †= Tukey HSD; ‡=Gabriel test; §=Games Howell

Table 5: Post hoc analysis in the men group

DISCUSSION:

Women with T2DM, as well as diabetic hypertensive women, were found to be at increased risk for developing dyslipidemia and CVD in a recent study. According to previous study, women are more likely than males to develop diabetes complications indicating that DM is sex-related (Sowers,1998; Aso, et al.,2000). Colin, et al., 2010 reported that diabetics were at an increased risk of dyslipidemia, metabolic syndrome, hypertension, hyperglycemia, and lipid problems as they grew older, with higher WC, BMI, and had a family history of HTN in both sexes (Ljungman, et al., 1996), which contradicted our current findings.

Between diabetic hypertensive and NDNH patients, women's HDL-C concentrations were significantly lower in this study. The small variation in the concentration of other lipid profiles was not significant. Men's lipid profiles showed no significant variations across groups, with the exception of HDL-C, which exhibited a marginally significant drop when compared to women; this discrepancy could be related to the research population's varied lifestyles and social habits. These findings contradicted those of (Shahid, et al., 2005), who ensure that male diabetic patients have a higher risk of problems than female diabetic patients. Our findings contradicted those of (Oyewole, et al., 2008; Onmwuliri and Puppet, 2004), who found that sex has no manner on the lipid profile pattern in response to DM. A case-control study conducted in Sudan for lipid profile disorder determinations found that nearly half of 250 diabetic patients male had some lipid profile disorder, with lower mean HDL-C concentration in males than women compared to the NDNH group, indicating that sex is a risk factor for the development of dyslipidemia and CVD, which is consistent with this recent study (Elnasri and Ahmed, 2008).

CONCLUSION:

Diabetic and diabetic hypertensive women were at increased risk of dyslipidemia and CVD.

RECOMMENDATIONS:

Dietary restriction and regular exercise are recommended for diabetic patients to reduce their weight, BMI, and WC.

HbA1C and lipid profile must be evaluated on a frequent basis to avoid aggressive DM effects.

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CONFLICT OF INTEREST: None.

ABBREVIATIONS: T2DM=Type2 diabetes mellitus; DM=Diabetes mellitus; HTN= Hypertension, CV= Cardiovascular disease; HbA_{1C}=Glycosylated Hemoglobin.

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