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Sudanese diabetics with hypertension are at high risk for cardiovascular disease

Abstract

Objectives: To measure blood glucose, lipid profile levels, and blood pressure in diabetic hypertensive patients in order to identify the association between the parameters measured and an increased risk of cardiovascular risk in the Sudanese diabetic hypertensive patients.

Material and methods: During the months of April 2012 and March 2013, a case-control study was employed in Gezira State, Sudan. The study enrolled 200 patient who met the participation criteria, with respondents divided into diabetic hypertensive and non-diabetic categories to estimate fasting blood glucose levels (FBG), Glycosylated hemoglobin (HbA_{1C}) and lipid profile which include; total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C) and triglycerides (TG). The random access auto-analyzer bio system, A15 was used to test samples for various biochemical parameters. Individual information, as well as anthropometric and biochemical measurements were collected on a questionnaire. After each participant gave verbal consent, venous blood samples were drawn after an overnight fast. The statistical evaluation was achieved with the aid of a statistical package for social sciences (SPSS version 16, Chicago, IL, USA).

Result: The WC and BMI both increased significantly by (p=<0.0001), according to the analysis of variance (ANOVA). FBG and HbA_{1C} levels were significantly elevated by (p=<0.0001). The increase in systolic blood pressure (SBP) was significant by (p=<0.0001). The mean HDL-C level was at high risk (49.73) with a significant increase by (p=0.009). The mean LDL-C concentration was above the optimum level (109.03) with a non-significant increase (p=0.697).

Conclusion: WC, BMI, DBP, FBG, and HDL-C all increased significantly. Diabetic-hypertensive participants were at a high risk of develops dyslipidemia and cardiovascular disease.

Keywords: Diabetic hypertensive, lipid profile, cardiovascular disease, Sudan

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Abbreviations: DM, diabetes mellitus; T2DM, type2 diabetes mellitus; HTN, hypertension; CVD, cardiovascular disease; FBG, fasting plasma glucose; HbA1C, glycosylated hemoglobin; TC, total cholesterol; TG, triglyceride; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; SBP, systolic blood pressure; DBP, diastolic blood pressure; WC, waist circumferance; BMI, body mass index; WHO, World health organization; p, probability; mg, milligram; M, meter; mmHg, millimeter of mercury

Introduction

Diabetes mellitus (DM) is one of the most prevalent chronic diseases caused by inadequate of insulin production or use.[1] The most popular form of diabetes, type 2 diabetes mellitus (T2DM), is related to obesity[2] which is consider as risk factor for the development of insulin resistance, hypertension (HTN) and cardiovascular diseases[3] and later on increased risk of developing kidney disease.[4] According to the World Health Organization (WHO), DM affects 387 million people globally and is expected to rise to 592 million adults in less than 25 years,[5,6] rendering it the world's seventh leading cause of death by 2030.[7] The lowest prevalence of DM was found in low-income countries, while the highest prevalence was found in upper-middle-income countries for both sexes.[8] Though 80% of diabetic death was in low- and middle-income countries.[7] Among all WHO's regions, the African Region is expected to have the largest proportional increase 90.5% in the number of adult with diabetics by 2030,[7] it affected 14 million individuals in 2011 and this is expected to rise to about 28 million by 2030.[9] DM will cause five million deaths per year[5] in people under the age of 60.[10] Sudan is a member of the WHO's East Mediterranean region and was classified as a lower middle income country by the World Bank Income Groups in 2013[11] and it has a medium prevalence of T2DM among populations.[12]

An epidemic of T2DM is underway in both developed and developing countries,[13] increased as a consequence of childhood obesity and more generally as one's age reached 40years.[14] Although T2DM can be prevented by engaging in thirty minutes of moderate-intensity physical exercise on most days and eating a healthy diet, inadequate access to health care and appropriate drugs, along with a lack of knowledge about diabetes, can result in complications such as blindness, amputation, cardiovascular disease (CVD), and kidney failure.[8] The risk of DM complications increases with age, DM duration, insulin use, ischemic heart disease, and elevated serum creatinine.[15]

Hypertension is described as a persistent increase in resting arterial blood pressure (BP) of more than 140 mm Hg systolic (SBP) and/or 90 mm Hg diastolic (DBP).[16] Age, weight, smoking habits, physical activity and a family history of (CVD) are risk factors for HTN.[17]

HTN is a progressive CV syndrome with functional and structural cardiac and vascular abnormalities that affect the heart, kidneys, brain, vasculature, and other organs, resulting in premature morbidity and death.[18]

In diabetic patients, high blood pressure is a risk factor for heart disease and it rises with the incidence of nephropathy,[19] the existence of both nephropathy and HTN has a significant impact on heart damage in diabetics.[20] Only one-third of diabetic patients achieve the recommended target blood pressure value of less than 130/80mm Hg.[21] HTN affects about one billion people worldwide, with two-thirds of them living in developed countries. In 2025, 56 billion adults will have HTN, with annual deaths above 8 million and 3.2 million HTN complications.[22]

Glucose intolerance, T2DM, atherogenic dyslipidemia, CVD, elevated blood pressure HTN and central obesity is all representative of the metabolic syndrome. Dyslipidemia is a lipid metabolism disease that causes changes in circulating lipids and lipoprotein levels in the blood.[23] This is reflected in increased TG and LDL-C, as well as a decrease in HDL-C levels.[24]

Such abnormalities occur in the same individual and result in several of the risk factors that frequently coexist.[25] The involvement of three or more of the metabolic abnormalities mentioned below meets the criterion for metabolic syndrome: abdominal obesity or waist circumference (WC)>102cm in men and WC>88cm in women, hypertriglyceridemia, TG ≥150mg/dL, low HDL-C levels <40mg/dL in men and <50mg/dL in women, raised blood pressure (SBP≥130mmHg, DBP≥85mmHg), and raised FBG≥110mg/dL.[26] The normal cholesterol content of lipoprotein is 60-70% of LDL-C, 20-30% of HDL-C and 10-15% of VLDL of the total serum cholesterol.[24]

Material and methods

Study design, subject, and area: Participants were drawn from rural and urban areas in and around Wad Madani for a case-control study. The study ranged from April 2012 to March 2013. A total of 200 individuals of both males and females were enrolled in this study. One hundred diabetic hypertensive participants and 100 apparently healthy participants were participated as part of a non-diabetic or (control) group.

Inclusion criteria: The study participants ranged in age from 24 to 65 and were healthy. A total of 100 people were diagnosed as diabetic hypertensive and were administered hypoglycemic, antihypertensive, and other medications. The remaining 100 respondents were categorized as non-diabetic and seemed to be in good health.

Ethical approval: The study was permitted by the State Ministry of Health's Ethics Committee.

Study method: Verbal approval was obtained. Both patients and non-diabetic participants provided bio data and anthropometric measurements; (weight was measured in kilogram (kg) and heights in meter (m) and then the body mass index (BMI) was calculated applying 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 examined for various biochemical parameters.

Statistical analysis: The statistical analysis was implemented using a statistical package for social sciences (SPSS version 16, Chicago, IL, USA). To compare differences in the means of continuous variables between the studies groups, analysis of variance were used (ANOVA). The frequency of the relationship between two numerical variables was measured using Chi-Squire test. P-values of 0.05 or less ($p<0.05$) were deemed meaningful.

Results

Table 1 shows the characteristics and distribution of study group participants based on study variables. There were 100 diabetic hypertensive (50%) and 100 non-diabetic participants in the study (non- diabetic). Females made up 148 % of the study participants (74.0%), while males made up 52 (26.0%). 123(61.5%) have moderate physical activity. When the study was taken, 88% of diabetic hypertensive patients had elevated blood pressure, while only 12% had normal blood pressure. One hundred forty-three patients (71.5%) and 135(67.5%) had a family history of hypertension and diabetes mellitus respectively. 87(43.5%) use Antihypertensive +Hypoglycemic drug and only 2(1.0%) use dietary restriction for regulating blood glucose and pressure, and 43(43%) use additional drugs like dietary supplements and sulpho- salicylic acid. "($p\leq0.0001$), ($p\geq0.0001$).

Table 1 Characteristic and distribution of participants in study groups according to study variable

Variables		Frequency	Percent %	Total
Group	Diabetic hypertensive	100	50	200
	non-diabetic	100	50	
Gender	Male	52	26	200
	Female	148	74	
	Low	54	27	200
Physical activity	Moderate	123	61.5	
	High	23	11.5	
HTN	Normal (SBP\ DBP= less than 120\80)	12	12	
	Pre-hypertension (SBP\ DBP=120 -139\ 80-89)	51	51	
	Stage1 HT (SBP\DBP=140-159\DBP 90 -99)	24	24	100
	Stage 2 HT (SBP\DBP= 60\100 and above)	13	13	
Family History of HTN	Yes	143	71.5	200
	No	57	28.5	

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Table Continued...

Variables		Frequency	Percent %	Total
Family History of DM	Yes	135	67.5	200
	No	65	32.5	
Medication for DM & HTN	Hypoglycemic Drug only	9	9	100
	Dietary Control	2	2	
	Antihypertensive +Hypoglycemic Drug	87	87	
	Anti-Hypertensive Drug only	2	2	
Additional Drugs	Yes	43	43	100
	No	57	57	
Dietary Restriction	Yes	41	20.5	200
	No	159	79.5	

DM, diabetes mellitus; HTN, hypertension

Analysis of variance showed that the WC and BMI mean was (31.65) and (104.14) and they increased significantly all by ($p \geq 0.0001$) pointed to that the participants were obese and had visceral obesity. The mean concentrations of FBG was (164.63) and HbA_{1C} was (7.42) with highly significant by ($p \geq 0.0001$) for both indicating high FBG with good HbA_{1C}. SBP mean was (128.10) with highly significant by ($p \geq 0.0001$) indicating elevated blood pressure. DBP mean was (81.40) with non-significant increase by (p=0.782) because the mean of DPB of non-diabetic group was higher (82.00) than the diabetic hypertensive group. Regarding lipid profile, analysis of variance showed that; TC had non-significant increase in their mean concentrations (189.78) by (p=0.220). HDL-C mean showed high risk (49.73) with significant increased by (p=0.009). LDL-C mean showed above optimal concentration level (109.03) with non-significant increased by (0.697). TG mean concentration was (161.57) with significant non- increased by (p=0.137).

Discussion

Diabetic hypertensive participants were found to be older compared with non-diabetic group with strong statistical significance (Table 2). The incidence of HTN in T2DM patients rises by 40% to 60% between the ages of 45 and75, indicating that HTN in diabetic patients rises with age. This conclusion is consistent with that of others.[27] Participants with diabetes and hypertension had significantly higher WC, BMI, modest physical activity, and low HDL-C concentrations. These findings were in line with those of Danquah, et al.,[28] and Ljungman, et al.,[29] who discovered that T2DM is a socioeconomic illness that mostly affects obese people and is linked to an elevated risk of HTN and hyperlipidemia in both sexes in the context of high blood pressure, BMI and family history of HTN. Diabetic hypertensive individuals showed high FBG, suggesting that the study participants had uncontrolled plasma glucose and marked rise in HbA_{1C}, suggesting that diabetic participants were unable to meet the HbA1c target, putting them at a high risk of developing diabetes complications. Table 1 shows that 135(67.5%) of study participants had a family history of diabetes, whereas 143(71.5%) had a family history of HTN, indicating that DM and HTN are hereditary disorders. These findings were similar to those of Lillioja, et al.,[30]; Mannino, et al.,[17]

Dietary management, in addition to regular exercise, is the initial intervention in diabetes therapy, however in our current study food restriction had no statistical significance in the current trial due to a lack of attention to dietary plans by both the diabetes care center and the patients, but Lettieri-Barbato et al.,[31] showed that dietary restriction is effective in reducing adipose mass and central or visceral adiposity by diminished the biomarkers of inflammation, and increase insulin resistance.

Table 2 Analysis of variance (ANOVA)

Variable	Group	Mean	Std. Deviation	Std. Error	Minimum	Maximum	P-Value
Age (years)	Diabetic Hypertensive	56.17	7.213	0.721	40	65	<0.0001
	non-diabetic	46.74	7.77	0.78	24	65	
Weight (kg)	Diabetic Hypertensive	80.28	14.19	1.42	51	120	<0.0001
	non-diabetic	72.51	13.76	1.38	40	110	
Height (m)	Diabetic Hypertensive	1.6	0.079	0.008	1.46	1.82	0.017
	non-diabetic	1.63	0.1	0.01	1.4	1.9	
WC (cm)	Diabetic Hypertensive	104.14	10.95	1.1	80	130	<0.0001
	non-diabetic	98.15	10.73	1.073	69	127	
BMI (kg/m^2)	Diabetic Hypertensive	31.65	5.81	0.59	20.2	46.62	<0.0001
	non-diabetic	27.54	5.48	0.55	17.31	42.86	

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Variable	Group	Mean	Std. Deviation	Std. Error	Minimum	Maximum	P-Value
SBP (mmHg)	Diabetic Hypertensive	128.1	14.33	1.43	100	180	<0.0001
	non-diabetic	114.3	13.2	1.32	80	170	
DBP (mmHg)	Diabetic Hypertensive	81.4	9.32	0.93	60	110	0.782
	non-diabetic	82	19.54	1.954	30	130	
FBG (mg/dL)	Diabetic Hypertensive	164.63	66.51	6.65	57	380	<0.0001
	non-diabetic	89.77	24.01	2.401	46	242	
HbA1C (%)	Diabetic Hypertensive	7.42	2.08	0.21	3.4	12.8	<0.0001
	non-diabetic	5.34	0.76	0.08	3.45	6.98	
TC (mg/dL)	Diabetic Hypertensive	189.78	44.08	4.41	82	361	0.22
	non-diabetic	197.51	44.85	4.49	75	312	
LDL-C(mg/dL)	Diabetic Hypertensive	109.03	29.47	2.95	40	202	0.697
	non-diabetic	107.36	31.02	3.1	32	184	
HDL-C (mg/dL)	Diabetic Hypertensive	49.73	14.2	1.42	20	88	0.009
	non-diabetic	55.51	16.89	1.69	25	97	
TG	Diabetic Hypertensive	161.57	73.67	7.37	60	508	0.137
(mg/dL)	non-diabetic	145.72	76.27	7.63	46	376	

WC, waist circumferance; BMI, body mass index; M, meter; cm, centimeter; SBP, systolic blood pressure; DBP, diastolic blood pressure; mmHg, millimeter of mercury; FBG, fasting plasma glucose; HbA_{1C}, glycosylated hemoglobin; TC, total cholesterol; TG, triglyceride; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol; mg, milligram; p, probability

The lipid profile showed a significant decrease in the mean concentration of HDL-C, according to Table 2 analysis of variance. The mean concentrations of TG and LDL-C both increased slightly. These findings matched those of Muna,[32] who found that T2DM patients show metabolic abnormalities in both lipoprotein quality and quantity. The success of HTN medicine in the treatment of HTN, heart failure, and other cardiovascular disorders may be explained by the non-significant change in lipid profile concentrations. Our findings matched those of Otamere, et al.,[33] who found that participants under care had no change in lipid profile concentrations, indicating that the low level of HDL-C in this study, despite the use of anti-hypertensive drugs, suggests a high risk of improving dyslipidemia and macro-vascular disease.

Recommendations

Effective diabetes treatment in Sudan demands effective diabetic care centers, properly educated staff, and strict adherence to therapy and diet; as a consequence, it is recommended to engage in personnel training, model care center creation, and patient education.

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Conflicts of interest

The authors declare no conflict of interest.

References

1. Evans J, Newton R, Ruta D, et al. Socio–economic status, obesity and prevalence of Type 1 and Type 2 diabetes mellitus. *Diabet Med* 2000;17(6):478–480.
2. Jung S, Park H, Kim K, et al. Effect of weight loss on some serum cytokines in human obesity:increase in IL–10 after weight loss. *J Nutr Biochem.* 2008;19(6):371–375.
3. Calle E, Thun M, Petrelli J, et al. Body–mass index and mortality in a prospective cohort of U.S. adults. *N Engl J Med.* 1999;341(15):1097–1105.
4. Ritz E. Nephropathy in type 2 diabetes. *J Intern Med.* 1999;245(2):111–126.
5. Zinman B. The International diabetes Federation World diabetes congress 2015. *Eur Endocrinol.* 2015;11(2):66.
6. Mathers C, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. *PLoS Med.* 2006;3(11):442.
7. Whiting D, Guariguata L, Weil C, et al. IDF diabetes atlas:global estimates of the prevalence of diabetes for 2011 and 2030. *Diabetes Res Clin Pract.* 2011;94 (3):311–321.
8. Islam S, Purnat T, Phuong N, et al. Non–communicable diseases (NCDs) in developing countries:a symposium report. *Global Health.* 2014;10:81.
9. L'Heveder R, Nolan T. International Diabetes Federation. *Diabetes Res Clin Pract.* 2013;101(3):349–351.
10. Bloomgarden Z. Questioning glucose measurements used in the International diabetes Federation (IDF) Atlas. *J Diabetes.* 2016;8 (6):746–747.
11. Boutayeb A, Boutayeb W, Maamri A, et al. The rise of diabetes prevalence in the Arab region. *Open J Epidemiology.* 2012;2:55–60.

12. Elbagir M, Eltom M, Elmahadi E, et al. A high prevalence of diabetes mellitus and impaired glucose tolerance in the Danagla community in northern Sudan. *Diabet Med.* 1998;15(2):164–169.

13. Kronenberg HM, Melmed S, Polonsky KS, et al. Williams textbook of endocrinology. 11th edn. Saunders; 2008:1329–1563.

14. Colin D, Gareth W, David A, et al. Disorders of glucose homeostasis. Oxford Textbook of Medicine. 5th edn. New York: Oxford; 2003.

15. Nichols G, Hillier T, Erbey J, et al. Congestive heart failure in type 2 diabetes:prevalence, incidence, and risk factors. *Diabetes Care.* 2001;24(9):1614–1619.

16. Anderssen S, Holme I, Urdal P, et al. Diet and exercise intervention have favourable effects on blood pressure in mild hypertensives:the Oslo Diet and Exercise Study (ODES (*Blood Press.* 1995;4(6):343–349.

17. Mannino D, Caraballo R, Benowitz N, et al. Predictors of cotinine levels in US children:data from the Third National Health and Nutrition Examination Survey. *Chest.* 2001;120(3):718–724.

18. Giles T, Berk B, Black H, et al. Expanding the definition and classification of hypertension. *J Clin Hypertens (Greenwich).* 2005;7(9):505–512.

19. Tarnow L, Rossing P, Gall M, et al. Prevalence of arterial hypertension in diabetic patients before and after the JNC–V. *Diabetes Care.* 1994;17(11):1247–1251.

20. Van Hoeven K, Factor S. A comparison of the pathological spectrum of hypertensive, diabetic, and hypertensive–diabetic heart disease. *Circulation.* 1990;82(3):848–855.

21. Leenen F, Dumais J, McInnis N, et al. Results of the Ontario survey on the prevalence and control of hypertension. *CMAJ.* 2008;178(11):1441–1449.

22. Atlas D. Hypertenion *International Diabetes Federation.* 2nd edition. 2003.

23. Giuliano I, Caramelli B. Dis–lipidemiasnainfância e adolescência. *Pediatria.* 2008;29:275–285.

24. Expert Panel on Detection and Treatment of High Blood Cholesterol in Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III)(2001). *JAMA* 285 (19):2486–2497.

25. Sattar N, Wannamethee G, Sarwar N, et al. Metabolic syndrome with and without C–reactive protein as a predictor of coronary heart disease and diabetes in the West of Scotland Coronary Prevention Study. *Circulation.* 2003;108(4):414–419.

26. Matthews D, Hosker J, Rudenski A, et al. Homeostasis model assessment:insulin resistance and beta–cell function from fasting plasma glucose and insulin concentrations in man. *Diabetologia.* 1985;28(7):412–419.

27. Harris M, Cowie C, Stern M, et al. Diabetes in America. Washington, DC: National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases. 2nd edn. *National Institute of Diabetes and Digestive and Kidney Diseases;* 1995.

28. Danquah I, Bedu–Addo G, Terpe K, et al. Diabetes mellitus type 2 in urban Ghana:characteristics and associated factors. *BMC Public Health.* 2012.

29. Ljungman S, Wikstrand J, Hartford M, et al. Urinary albumin excretion––a predictor of risk of cardiovascular disease. A prospective 10–year follow–up of middle–aged nondiabetic normal and hypertensive men. *Am J Hypertens.* 1996;9(8):770–778.

30. Lillioja S, Mott D, Spraul M, et al. Insulin resistance and insulin secretory dysfunction as precursors of non–insulin–dependent diabetes mellitus. Prospective studies of Pima Indians. *N Engl J Med.* 1993;329(27):1988–1992.

31. Lettieri–Barbato D, Giovannetti E, Aquilano K. Effects of dietary restriction on adipose mass and biomarkers of healthy aging in human. *Aging (Albany NY).* 2016;8(12):3341–3355.

32. Muna W. Cardiovascular disorders in Africa. *World Health Stat Q.* 1993;46(2):125–133.

33. Otamere H, Aloamaka C, Okokhere P, et al. Lipid Profile in Diabetes Mellitus; What Impact Has Age and Duration. *British Journal of Pharmacology and Toxicology.* 2011;2(3):135–137.

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