Association of Anthropometric parameters with Hypertension in Type 2 Diabetes Mellitus Patients

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Abstract

Background: T2DM is strongly associated with hypertension. The co-existence of hypertension and diabetes mellitus increases the risk of microvascular and macrovascular complications among type 2 diabetes mellitus. Increasing the prevalence of obesity is one of the modifiable risk factors among type2 diabetes mellitus that elevates the emerging prevalence of hypertension among diabetes mellitus.

Objective: This study aims to evaluate the association of Anthropometric parameters with hypertension in type 2 diabetes mellitus patients in southwest Ethiopia.

Methods: An institution-based cross-sectional study was conducted among type-2 diabetes mellitus in southwest Ethiopia from September 2020 to January 2021. A total of 318 Type-2 diabetes mellitus patients were selected by using convenient sampling. Data on socio-demographic parameters were collected by using a structured questionnaire and data on anthropometric were collected by well-trained nurses. Data was entered and analyzed using SPSS version 20 (IBM, USA). An odds ratio was used to test the association between obesity indicators with hypertension. P-value <0.05 was considered statistically significant.

Result: From the total 318 T2DM patients 165(51. 9%) are male and the remaining 153 (48.1%) are female. 192(60.4%) of the participant had hypertension. The prevalence of hypertension is higher among females 94(57%). The prevalence of hypertension was higher among overweight and obese males and females by using waist circumference and waist to hip ratio with the percentage of (58.1% versus 64.1%), (60.0% versus 65.3%) respectively for males and females but, an insignificant association was observed between hypertension with waist circumference and waist-hip ratio in both sex. While the very strong positive association was observed between hypertension and increasing body mass index with (percentage 68.8%, p-value =0.000, OR=26.2).

Conclusion: The coexistence of obesity and hypertension among Type 2 diabetes mellitus patients was higher and a statistically significant strong positive association was observed between BMI and hypertension among tyep2 diabetes mellitus patients. So, precise regulation of body weight and hypertension among type 2 diabetes mellitus patients were important to prevent micro-vesicular and macro-vesicular.

Keywords: Body mass index, Hypertension, Diabetes Mellitus

Introduction

According to the World Health Organization (WHO), 2017 report, Non-Communicable Diseases (NCDs) kill 40 million people(1). Among these, type 2 diabetes mellitus (T2DM) is a well-known disease in both developing and developed countries. Type-2 diabetes mellitus constitutes over 80-90% of all DM cases and is mostly diagnosed after the age of 40. In T2DM insulin is usually produced but not properly utilized by target tissue due to receptor-mediated insulin resistance (IR) in the cells. (2). In addition to being a chronic disease, it is becoming an important global public health problem that leads to disability, which adversely affects the individual's quality of life and(3). It also places considerable socioeconomic pressures on the individual and overwhelming costs to global health economies, estimated at US$825 billion per year (4).

A cluster of risk factors for type-2 diabetes mellitus, which occur together, is known as metabolic syndrome(5). Hypertension is the common risk factor associated with type 2 DM. Its prevalence in diabetic patients is almost double as compared to non-diabetics(6). The coexistence of hypertension and diabetes mellitus is a major contributor to the development and progression of microvascular and macrovascular complications in people with diabetes mellitus(7). It causes profound psychological and physical distress to both patients and care workers. This put a huge burden on the already fragile health-care systems(4)

One key element in the rapid progression of Type-2 diabetes mellitus is the increasing prevalence of obesity (8). reports showed that By 2025, diabetes mellitus related obesity would rise to an alarming number of 400 million (9). The global rising of obesity, physical inactivity, and energy-dense diets has resulted in an unprecedented increase in the number of patients with type-2 diabetes(4).

According to the latest information from the International Diabetes Federation (IDF), 451 million adults worldwide have diabetes; this number is predicted to reach 693 million figures by 2045 (10). The overall prevalence of T2DM in Africa among 20–79 year-olds is 3.2% (2.1–6.7%) with the majority of people in the 40–79 age range (11). According to the IDF report of 2014, it was estimated that 4.9 million Ethiopians of the age group 20-79 lived with diabetes and more than 2.9 million suffered from impaired glucose tolerance(12). In Ethiopia, the prevalence of diabetes in adults has increased from 2.9% in 2015 to 3.8% in 2016 to 5.2% in 2017(13). Ethiopia is now facing a double burden problem because type-2 DM is currently increasing due to various factors such as aging, urbanization, and an increasing prevalence of obesity (14). There are many types of research done on the concomitant presence of hypertension and obesity among Type- 2 diabetes mellitus. But very little attention is paid to the Association of Obesity with Hypertension in Type 2 Diabetes Mellitus Patients. The present study is conducted in an attempt to fill this gap by determining the association of Anthropometric parameters with Hypertension among Type 2 Diabetes Mellitus Patients. It also useful for other researchers as reference material while conducting further studies on similar problems.

Materials and methods

Study design, period, and area: An institution-based, cross-sectional study was conducted at

southwest, SNNPR, Ethiopia, between September 2020 and March 2021.318 diabetes mellitus patients were included in the study. These patients had regular follow-up at least once per month. Also, patients used to visit the clinic when he/she needed care.

Eligibility Criteria: All T2DM patients age ≥30 years that were already registered and had follow-up for at least 6 months at the diabetes clinic were included in the study. While pregnant mothers, severely ill patients, those having difficulty standing or with physical deformity excluded from the study.

Sample size and study subjects: The sample size for the study was determined using the single population proportion formula. The formula estimates the minimum sample size required for determining a proportion in a source population as a function of the desired level of significance, the margin of error, and the expected level of the proportion. Specifications made during the computation were: (74.5%) expected prevalence of hypertension among DM patients (9), 95% confidence level, 5% margin of error, 10% compensation for possible non-response, and design effect.

$$n = \frac{(Z\,{}^{a}/_{2})2 * P * (1 - P)}{d2}$$

$$n = \frac{(1.96)2 * 0.75 * 0.25}{(0.05)2} = 289$$

By considering the nonrespondent rate we added 10%, the total sample size became 318.

The sample was selected by convenient sampling from type-2 DM patients who came for routine follow-up and willing to participate in the study during the study period. Data on demographics were collected by trained personnel through a face-to-face interview using a structured questionnaire. The World Health Organization (WHO) stepwise approach (three steps) for non-communicable disease surveillance was used to collect the data (15).

Data collections: Data was collected by well-trained nurses and a data collection form was designed to record all valuable information (sex, age, address, and educational status,). Physical measurements of height and weight needed to calculate body mass index (BMI), waist circumference, and blood pressure were taken as follows.

A portable weight and height scale were used to measure the weight of the participant wearing light clothes and height in an upright standing position on a flat surface. Body mass index (BMI) was defined as the ratio between weight (kg) and the square of the height (m) and used to categorize BMI-measured weight status: patients with BMI ≤ 18.5 is stated as underweight, patients with BMI 18.5–24.9 is considered as normal, however, patients with BMI 25.0– 29.9 is overweight and obese if BMI is ≥30 (16). Waist circumference (WC) was measured at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest, using a flexible plastic tape. WC values>94 and >80cm for men and women, respectively, were considered high according to the World Health Organization (WHO) recommendation (2). Blood pressure was taken by qualified personnel using an analog sphygmomanometer and stethoscope. Duplicate measurements were taken from the upper arm with the hand flexed at the elbow and the flexed elbow should be at the heart level after the patient had been sitting for more than 5 minutes and the averaged value was recorded. Hypertension is a persistent elevation of systolic blood pressure of

≥140 mm Hg and diastolic blood pressure of ≥90 mmHg (7).

Data management and quality control: The data quality assessment was started with socio-demographic data collection, continued throughout anthropometric measurements, final data entry, and statistical analysis. Results were checked for completeness on daily basis by the immediate supervisor.

Data analysis and interpretation: Data entry was done by using Epi Data statistical software version 3.1 and then exported to SPSS software version 20(IBM, USA) for analysis. P-value of < 0.05 at 95% confidence level was considered statistically significant. The Association of hypertension with different demographic variables and obesity parameters was evaluated by calculating the odds ratio (OR). The finding was presented by the table.

Ethical approval

Informed consent was obtained from the study participants before administering the questionnaire and collecting anthropometric parameters.

Results

From the total 318 T2DM patients 165(51. 9%) are male and the remaining 153 (48.1%) are female. Of the total participants 181(56.9%) lived in urban the rest 153 (48.1%) lived in rural areas. While 192(60.4%) of the participant had hypertension. The mean ages of the participant were (53.44±10.041) with an age range between 30 and 81years. The mean and standard deviation of obesity indicators were described as follows in Table 1.

Table 1 Means and standard deviation of indicators of obesity in patients with Type 2 diabetes mellitus 2021

Indicator of obesity	Mean	Std. Deviation
waist circumference (WC)	**107.88cm**	**8.071cm**
hip circumference	**97.591cm**	**7.286cm**
waist to hip ratio(WHR)	**1.127**	**.4531**
Height	**168.154cm**	**6.978cm**
Weight	**79.41kg**	**8.491kg**
Body mass index(BMI)	**27.957** kg/m2	**2.549** kg/m2

cm: centimeters; kg: kilograms; m: meters; kg/m2: kilograms per meter square

The prevalence of hypertension is higher among females 94(57%), urban dweller 113(62.4%), older age 172 (59.7%), and literate 167(60.7%). But, the associations were statistically insignificant with (p-value = 0.197, 0.389, 0.459 and 0.747) for gender, address, age and educational status respectively. The prevalence of hypertension was higher among overweight and obese males and females by using waist circumference and waist to hip ratio with the percentage of (58.1% versus 64.1%), (60.0% versus 65.3%) respectively for males and females but, an insignificant association was observed between hypertension with waist circumference and waist-hip ratio in both sex. While very strong positive association were observed between hypertension and increasing body mass index with (percentage 68.8%, p-value =0.000, OR=26.2).table 2

Table 2 Association of age, sex, address, educational status and different parameters of obesity with hypertension in patients with type 2 diabetes mellitus (DM)

LIST OF VARIABLE		Blood pressure		P-value	odd ratio
		normotensive	hypertensive		
SEX	male	71(43.0 %)	94(57%)	0.197	1.346
	Female	55(39.9%)	98(64.4%)		
ADRESSS	Urban	68(37.6%)	113(62.4%)	.389	.820
	Rural	58(42.3%)	79(57.7%)		
AGE	Age <40	10(33.3%)	20(66.6%)	0.459	0.741
	age >= 40	116(40.3%)	172(59.7%)		
Educational status	Illiterate	18((41.9%)	25(58.1%0	0.747	1.11
	Literate	108(39.3%)	167(60.7%)		
hip circumference for male	Normal	4(80%)	1(20%)	0.09	5.55
	High	6741.9%)	93(58.1%)		
hip circumference for female	Normal	0	0(0%)		
	High	55(35.9%)	98(64.1%)		
waist to hip ratio for male	Normal	17(56.7%)	13(43.3%)	0.095	1.96
	High	54(40.0%)	81(60.0%)		
waist to hip ratio for female	Normal	3(100%)	0(0.0%	0.02	2.885
	High	52(34.7%)	98(65.3%)		
body mass index (BMI)	BMI<25	37(92.5%)	3(7.5%)	0.000	26.2
	BMI>=25	89(32.2%)	189(68.8%)		

Discussions

This study demonstrated the prevalence of hypertension was (60.4%) which was similar to the study conducted in Debre Tabor General Hospital, Northwest Ethiopia, the prevalence of hypertension was 59.5%(17) and slightly lower than the cross-sectional study which was conducted at Hiwot-Fana Specialized University Hospital and Jugal Hospital, eastern Ethiopia, on a total of 416 study participants demonstrated that the prevalence of hypertension was (62.7%) among diabetes patients (18). While another finding which was conducted in Diabetic Patients in Jimma University Medical Center showed that the prevalence of hypertension among diabetic patients was (37.4%)(19). This was very low relative to our finding. This difference may occur due to differences in sample size, age of patients, feeding habits, environmental factors, and living standards of the community.

In this study, the prevalence of hypertension among males and females were (57%) and (64.4%) respectively. This finding demonstrated a higher prevalence of hypertension among females relative to males. In agreement with this finding cross-sectional study which was conducted at the University of Gondar Hospital among type 2 diabetes mellitus revealed that elevated blood pressure was (39%) and (60.2%) among males and females respectively(20). But the blood pressure among males were (57%) versus (39%). in our finding the blood pressure were higher among male in relative to the finding of the University of Gondar Hospital. This difference may happen due to differences in sampling method, age, and socio-economic status of the study participants.

In our study, the finding demonstrated that the prevalence of hypertension was higher among urban residents and better educated. In agreement with this finding, a cross-sectional, population-based study in Malawi demonstrated that hypertension was highly prevalent in urban residents and better educated than in rural and least educated participants(21). This difference among urban and rural may occur as a result of a difference in lifestyles, use of energy dense diet, and physical inactivity.

This study reveals that the prevalence of overweight and obesity by using BMI among Type 2 diabetes mellitus patients was (68.8%). In agreement with this finding a cross-sectional which was conducted in Debre Tabor General Hospital, Northwest Ethiopia showed that the prevalence of overweight and obesity was (75.7%) (17). But the prevalence of overweight and obesity was lower in our finding this may be a difference in sample size, age of the participant, location of the study area, and community living styles.

In our study, the prevalence of hypertension among overweight and obese (body mass index >= 25) were (68.8%). In a cross-sectional study which was conducted in Nishtar Hospital 83.1% of the patients who had a high BMI (≥ 27) were found to be hypertensive(9). In our study, the lower prevalence of hypertension was observed relative to the finding in Nishtar Hospital. This variation may occur as a result of differences in sample size, socio-demographic characteristics, age of study participants, and nutritional habits of the study participant.

This study revealed that central obesity hadn't a statistically significant association with hypertension but a very strong positive association was observed between hypertension and increasing body mass index with a percentage of (68.8%),(p-value =0.000). In contrast to this finding, the cross-sectional study which was conducted in Bangladesh showed that both general and central obesity were found to be significantly associated with hypertension among diabetes mellitus patients(22).

This difference may occur due to variation in community life style, feeding habit, community standard physical inactivity and sampling method.

Conclusion and recommendation: The coexistence of obesity and hypertension among Type 2 diabetes mellitus patients was higher and a statistically significant strong positive association was observed between BMI and hypertension among tyep2 diabetes mellitus patients. So, precise regulation of body weight and hypertension among type 2 diabetes mellitus patients were important to prevent micro-vesicular and macro-vesicular.

Limitation of the study

Since the study was cross-sectional, it cannot show the cause-effect relationship and it used a small sample size.

Abbreviations

BMI: Body mass index; DM: Diabetes mellitus; SNNPR: South nation nationality people region; SPSS: Statistical Package for Social Sciences; T2DM: Type-2 diabetes mellitus; WC: Waist circumference; WHO: World Health Organization; WHR: Waist Hip Ratio.

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Authors' contributions

I hereby declare that this research entitled "Association of anthropometric parameters with Hypertension in Type 2 Diabetes Mellitus Patients in Southwest Ethiopia." is my original work.

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