Original Research Article

Assessment of Obesity as a marker for Patients with Type II Diabetes in the Ashanti Region, Ghana

Abstract

Diabetes mellitus is a metabolic syndrome characterized by high blood glucose levels that is currently a worldwide health concern. The purpose of this study is to use anthropometric indicators to determine the prevalence of obesity and overweight among Type II Diabetic Patients. Over a 20-week period, this cross-sectional study was conducted on Type II Diabetic Patients who were identified through a simple randomized sampling from the Diabetics' Clinic. This study enlisted the participation of a hundred (100) Diabetic Patients. A standardized pre-tested questionnaire was used to collect demographic information from the participants. Anthropometry measurements such as height, weight, waist circumference, and hip circumference were all taken using standardized procedures, and the BMI, WHR, BAI, and WHtR were calculated. In this study, 36% of patients were between the ages of 55 and 64, with 31% of the participants being female. Obesity was prevalent in 46% of the study population according to the BMI classification, 45% according to the WHR classification, 40% according to the WHtR classification, and 32% according to the BAI classification. Using BMI values, 82.6% of females were obese, compared to 17.4% of males, and 58.5% of females were overweight, compared to 41.4% of males. Stretching, swimming, and bicycling were all associated with obesity in Type II Diabetic Patients indicating $X2(9) = 19.968$, P 0.018, $X2(9) = 15.674$, P 0.016, $X2(9) = 12.898$, P 0.045, respectively. There was an establishment of an increased prevalence of obesity and overweight among the cohort of Diabetic patients recruited for this study with the females indicating a higher prevalence than their male counterparts.

Keywords: Evaluation, Obesity, Diabetes, Patients, Ashanti Region

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INTRODUCTION

Diabetes mellitus is a metabolic syndrome characterized by high levels of glucose in the blood and is diagnosed with fasting glucose levels ≥ 7.0mmol/L and an oral glucose tolerance test of ≥. 11.1mmol/L. This condition may be insulin dependent as seen in Type I or non-insulin dependent in Type II Diabetes (Ana et al., 2021; Balaji et al., 2019). Accumulated evidence indicates various environmental factors as responsible for the onset of the disease, and the recent upsurge in diabetic population numbers has been attributed to the increasing lifestyle changes (Suryasa et al., 2021; Kaku et al., 2010). Modifiable lifestyle practices such as diet and physical activity are major factors that lead to the increase in the prevalence of Diabetes mellitus (Wong & Sabanayagam., 2020). The complications of diabetes mellitus are mostly deleterious and include cardiovascular diseases, cerebrovascular accidents, retinopathy, and renal insufficiency.

Diabetes mellitus is currently a global health concern (Khan *et al.*, 2020; Standl *et al.*, 2019). The past two decades have seen a significant increase in the incidence of diabetes mellitus worldwide. Approximately 100 million people were estimated to have Diabetes in the 1990s, which rose sharply to about 250 million by 2007, and is predicted to further increase to 350 million by 2030 (Bindiya, *et al.*, 2020). The well-known risk factor for Type II Diabetes is obesity (Jiang *et al.*, 2020; Amanat et al., 2020). It has further been established that the incidence of Diabetes increases by 2-3-fold in obese individuals (Mugharbel & Al-Mansouri, 2003). Obesity refers to the accumulation of excess fat that may be detrimental to an individual's health (Puhl *et al.*, 2009). This is primarily due to an imbalance between energy expenditure and energy intake. This build-up of excess fat is caused by reduced physical activity coupled with unhealthy eating patterns (Divella, *et al.*, 2021).

It is indicated that the prevalence of adult obesity in the U.S.A. has exceeded 30 percent, 20 percent, and 4 – 70% in European countries and Polynesian populations respectively (Lara *et al.*, 2006). Over 300 million people in the world are affected by obesity (De Fronzo, 2004), and is thus considered an epidemic by the World Health Organization (WHO). According to a study by Biritwum *et al.* (2005), the prevalence of obesity in Ghana was (5.5%) and higher in females (7.4%) as compared to males (2.8%) (Lartey *et al.*, 2020). Though data from literature from other parts of the globe indicates that, Type II Diabetes is on the ascendency, available data in Ghanaian populations are scanty to draw a conclusive relationship between the body mass indices, and Type II Diabetes. This study seeks to determine the prevalence of obesity among Type II Diabetic patients using anthropometric indicators.

Materials and Methods

A descriptive cross-sectional method was employed in this study involving a total of hundred (100) Type-II Diabetic Patients recruited from a Diabetic Clinic. This cohort of patients was identified and sampled with a simple randomized sampling method over a period of 20 weeks.

Study Design

Demographic Measurements and Physical Activities

A standardized questionnaire (study tool) was designed and updated after pre-testing with 15 Type II Diabetics to ascertain the suitability of the contents, clarity, sequence, and flow of the questionnaire. The Study tool captured Demographic variables such as age, gender, marital status, religion, occupation, locality, level of education, average individual income, family type, and Diet. Physical activities such as stretching, walking, swimming, cycling, jogging, and other exercises specified by the participants were measured with the aid of the same study tool.

Anthropometry

Anthropometry measurements such as height, weight, waist circumference, and hip circumference, were all carried out following standardized procedures by experienced personnel. The height in centimeters was measured using a regular calibrated portable stadiometer (Hopkins Road Rod®, USA) to the nearest centimeter, and the weight in kilograms of the patient was

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measured using a digital weighing scale to the nearest kilogram. Participants were made to stand without their sandals, bags, or anything of significant weight on the weighing scale. The equipment was calibrated by standard weight prior to taking of participants' weight. The body mass index (BMI) of each participant was calculated as the weight (kg) over the height squared (m^2) and categorized using the current World Health Organization (WHO, 2002) definitions of which BMI of <18.5kg/m^2, 18.5-24.9kg/m^2, 25-29.9kg/m^2 and >30kg/m^2 were used to define underweight, normal weight, overweight, and obese cases respectively. WHR was defined for both males and females with WHR<0.90, 0.90–0.991, and >1.0 as normal weight, overweight, and obese respectively for males and <0.80, 0.80-0.8,4 and >0.85 defined as normal weight, overweight and obese respectively for females. The hip circumference was measured at the maximum circumference around the hips and the waist circumference was obtained at the level of the umbilicus with the participant in the supine position using a flexible measuring tape. The waist-to-hip ratio (WHR) was calculated and recorded to the nearest 2 decimal places. The body adiposity index (BAI) was calculated as; BAI= Hip circumference/Height (m) in which hip circumference was measured in centimeters.

Ethical Approval

The study received ethical approval from the Institute of Research and Innovative Development (IRID) (IRID/EC2013/HS0016) of Kumasi Technical University, Ghana.

Statistical method

Statistical analysis was carried out using SPSS version 20, after entering the initial data in a Microsoft Excel sheet. Outputs were indicated as in percentage frequency table reports showing the prevalence of overweight and obesity. The chi-square test was used to test for association between obesity, lifestyle, and Type II Diabetes with a P-value less or equivalent to 0.05 considered statistically significant.

Results

Demographic features of obesity among Type II Diabetic Patients

With the total of one hundred (100) Type II Diabetic Patients recruited for this study, the mean age in years was 51.9±21.74 with that of female participants indicating 49.6±21.95 and 54.6±22.35 for males. Most of the participants (36%) were between the ages of 55 and 64 years with 86.1% of them being females as against 13.9% males. More females (74%) were married compared to the male participants (26%), 69% of the general population had completed their basic education. The urban dwellers were 53 compared to 28 and 19 who lived in the rural and pre-urban settings respectively. Most of the participants were Christians (92%) and Akans (78%). Out of the one hundred participants, 29% were unemployed as observed in Table 1.

Table 1: **Demographic features of obesity among Type II Diabetic Patients**

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Variables (n = 100)	% Frequency Total	Males	Females
Age			
Average age	51.9±21.74	49.6±21.95	54.6±22.35
< 35	6 (6.0)	6 (100.0)	0 (-)
35-44	7 (7.0)	4 (57.1)	3 (42.9)
45-54	18 (18.0)	3 (16.7)	15 (83.3)
55-64	36 (36.0)	5 (13.9)	31 (86.1)
65-74	19 (19.0)	6 (31.6)	13 (68.4)
75+	14 (14.0)	7 (50.0)	7 (5.0)
Marital status			
Single	20 (20.0)	9 (45.0)	11 (55.0)
Married	50 (50.0)	13 (26.0)	37 (74.0)
Divorced	15 (15.0)	9 (60.0)	6 (40.0)
Widowed	15 (15.0)	0 (-)	15 (100.0)
Education			
None	19 (19.0)	3 (15.8)	16 (84.2)
Basic	69 (69.0)	25 (36.2)	44 (63.8)
Secondary	9 (9.0)	3 (33.3)	6 (66.7)
Tertiary	3 (3.0)	0 (-)	3 (100.0)
Residence			
Urban	53 (53.0)	15 (28.3)	38 (71.7)
Per-Urban	19 (19.0)	6 (31.6)	13 (68.4)
Rural	28 (28.0)	10 (35.7)	18 (64.3)
Religion			
Christian	92 (92.0)	26 (28.3)	66 (71.7)
Muslim	6 (6.0)	3 (50.0)	3 (50.0)
Other	2 (2.0)	2 (100.0)	0 (-)
Ethnic group			
Akan	78 (78.0)	21 (26.9)	57 (73.1)
Ewe	9 (9.0)	3 (33.3)	6 (66.7)
Mole-Dagbaani	4 (4.0)	4 (100.0)	0 (-)
Grussi	3 (3.0)	0 (-)	3 (100.0)
Hausa	6 (6.0)	3 (50.0)	3 (50.0)
Occupation			
Clerk	6 (6.0)	0 (-)	6 (100.0)
Agric/Fisheries	21 (21.0)	9 (42.9)	12 (57.1)
Craft & related works	25 (25.0)	7 (20.0)	28 (80.0)
Plant & Machine Op.	3 (3.0)	0 (-)	3 (100.0)
Retired	3 (3.0)	3 (100.0)	0 (-)
Service/Sale	3 (3.0)	0 (-)	0 (-)
Unemployed	29 (29.0)	12 (41.4)	17 (58.6)

Classification of Obesity among Type II Diabetic Patients

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This study classified the participants according to the levels of obesity, establishing that, 71.7 % of the participants between the ages of 30-34 years were in the category of Class I obesity while 21.7 % between the ages of 35-39 years and 6.5% between the ages of 40 years and above were categorized as Class II and Class III of obesities, respectively.

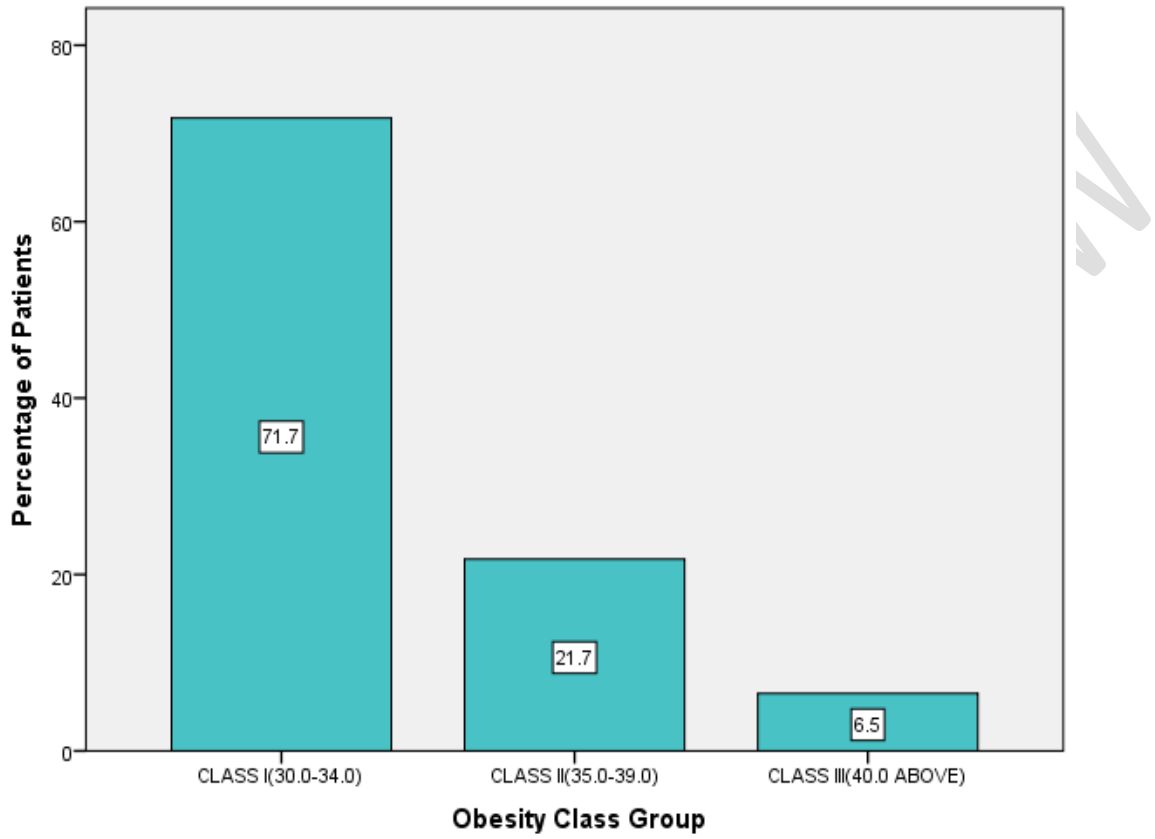

Figure 1: Obesity Classification and Distribution among Type II Diabetic Patients

Prevalence of Obesity among Type II Diabetic Patients According to Gender

There was a significantly higher incidence of overweight and obesity among females compared to their male participants. The prevalence of obesity in females compared to males was 82.6% as against 17.4% in males for BMI, 68.6% as against 31.4% in males for WHR, 67.5% as against 32.5% in males for WHtR, and 69.2% as against 30.8% in males for BAI. The incidence of overweight in terms of BMI, WHR, WHtR, and BAI was also higher in the female participants compared to the males as shown in Table 2.

Table 2: Prevalence of Obesity among the Type II Diabetic Patients by Gender

	% Frequency		
Anthropometrics	**Total**	**Male**	**Female**
Body Mass Index (BMI)			

Underweight	7 (7.0)	3 (42.9)	4 (57.1)
Normal	6 (6.0)	3 (50.0)	3 (50.0)
Overweight	41 (41.0)	17 (41.4)	24 (58.5)
Obese	46 (46.0)	8 (17.4)	38 (82.6)
Waist to Hip (WHR)			
Underweight	2 (2.0)	2 (100.0)	0 (-)
Normal	18 (18.0)	5 (27.8)	13 (72.2)
Overweight	45 (45.0)	13 (28.9)	32 (71.1)
Obese	35 (35.0)	11 (31.4)	24 (68.6)
Waist to Height Ratio (WHtR)	10 (10.0)	3 (30.0)	7 (70.0)
Underweight	22 (22.0)	7 (31.8)	15 (68.2)
Normal	28 (28.0)	8 (28.6)	20 (71.4)
Overweight	40 (40.0)	13 (32.5)	27 (67.5)
Obese			
Body Adiposity Index (BAI)			
Underweight	1 (1.0)	1 (100.0)	0 (-)
Normal	28 (28.0)	9 (32.1)	19 (67.9)
Overweight	32 (32.0)	9 (28.1)	23 71.9)
Obese	39 (39.0)	12 (30.8)	27 (69.2)

ANOVA Table of Anthropometric Measurements of Obesity among Type II Diabetic Patients.

The analysis of variance on the anthropometric measurement of obesity indicates that BMI and BAI were statistically significant risk factors in the occurrence of type II diabetes with $F(3,96) = 3.995$, $p = 0.01$) and $F(3,96) = 3.615$, $p = 0.016$) respectively. However, WHR and WHtR were statistically not significant and hence do not increase the risk of type two diabetes in this study.

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Table 3: ANOVA Table of Anthropometric Measurements of Obesity among Type II Diabetic Patients

Anthropometric Measurements		Sum of Squares	df	Mean Square	F	P-value
Body Mass Index	Between Groups	7.959	3	2.653	3.995	0.010
	Within Groups	63.751	96	0.664		
	Total	71.710	99			
Waist To Hip Ratio	Between Groups	0. 591	3	0.197	0.322	0.809
	Within Groups	58.719	96	0.612		
	Total	59.310	99			
Waist To Height Ratio	Between Groups	2.155	3	0.718	0.691	0.560
	Within Groups	99.805	96	1.040		
	Total	101.960	99			
Body Adiposity Index	Between Groups	7.124	3	2.375	3.615	0.016
	Within Groups	63.066	96	0.657		
	Total	70.190	99			

H_0: Type II Diabetes Mellitus is not associated with an increased risk of obesity.
H_1: Type II Diabetes Mellitus associated with increased risk of obesity.

Results outputs as per the association of Type II Diabetes and Obesity in this study (Table 4) report a statistically significant association between Type II Diabetes with an increased risk of obesity with a *p-value* of 0.015. In effect, there is an increased risk of a Type II Diabetes Patient becoming obese.

Table 4: Association between Type II Diabetes and Obesity

	Value	df	P-value
Pearson Chi-square	12.382	4	0.015

Chi-square Test between an Obese Type II Diabetic Patients and Lifestyle

Stretching, walking, swimming, bicycling and jogging were the common lifestyle practices among the study participants. The chi-square test done on these lifestyle practices showed that stretching, swimming, and bicycling were statistically significant, both with ($p< 0.05$) in the management of type II diabetes. Walking and jogging were statistically not significant in the

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management of obesity in type II diabetes with (p = 0.438) and (p = 0.100) respectively according to our study.

Table 5: Chi-square Test between an Obese Type II Diabetic Patients and Lifestyle

LIFESTYLE	Value	df	*P-value*
Stretching	19.968	9	0.018
Walking	8.994	9	0.438
Swimming	15.674	6	0.016
Bicycling	12.898	6	0.045
Jogging	14.673	9	0.100

Discussion

The prevalence of obesity and overweight in type II diabetes keeps increasing globally. Over one billion cases of adult obesity and overweight are reported annually (O'Neill & O'Driscoll., 2015). This study assessed the prevalence of obesity among type II diabetic patients in a diabetes care center.

This study has found most of the female participants to be older than the male participants. This observation is similar to a study by Ogbera et al. (2016) which investigated the prevalence and risk factors for type II diabetes among older adults in Nigeria and found that the prevalence of type II diabetes was higher in older women compared to older men. The study also found that older women with type II diabetes were more likely to have comorbidities such as hypertension and obesity compared to older men with type II diabetes. Bahendeka et al. (2015) also found that older women with type II diabetes had worse glycemic control compared to older men with type II diabetes. They also found that older women with type II diabetes were more likely to experience diabetes-related complications such as neuropathy, retinopathy, and cardiovascular disease compared to older men with type II diabetes.

This study also found the prevalence of overweight and obesity to be significantly high among females compared to the male participants regardless of the anthropometric measurement used. These results are in accord with earlier studies by Tziomalos et al. (2018) which investigated the prevalence of overweight and obesity among adults in Greece and found the prevalence of overweight and obesity to be higher among females (39.5% and 31.5%, respectively) than among males (39.1% and 26.4%, respectively). This high prevalence in females can be attributed to less physical activities at ages above 35 years and the use of contraceptives which among other things induces hormonal changes. One study by Dinger et al. (2007) analyzed data from 10 randomized controlled trials and found that women who used hormonal contraceptives gained an average of 2-3 kg of weight over a 12-month period compared to non-users. Another study by Berenson et al. (2009) reported that the use of depot medroxyprogesterone acetate (DMPA), a commonly

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used hormonal contraceptive, was associated with significant increases in BMI and BF% over a two-year period. Women in Ghana tend to engage in occupations that are somewhat inactive (tabletop trading) compared to males. In Ghana, the perception of overweight and obesity as a sign of beauty and good health may be the reason for the growing epidemic of obesity in females according to Obirikorang *et al.* (2016).

Majority of the participant enrolled in this study were urban dwellers as against that of the rural participants. Several studies have reported that the prevalence of overweight and obesity is higher among urban dwellers compared to rural populations (Goryakin et al., 2015; Zoungas et al., 2014; Pradeepa et al., 2017). Amoah (2003) reported the highest overweight and obesity prevalence among the Akan and Ga tribes and low prevalence among Ewes.

This study has found stretching, swimming, bicycling, and jogging as the physical activities that were engaged by the participant. The chi-square test (table 5) revealed that, stretching, swimming and bicycling were significantly associated to obesity in Type-II diabetic patients ($X^2(9) = 19.968$, $P < 0.018$, $X^2(9) = 15.674$, $P < 0.016$, $X^2(9) = 12.898$, $P < 0.045$) for stretching, swimming and bicycling respectively. This implies that these lifestyles can effectively reduce or improve the incidences of obesity in Type-II diabetes. A similar study conducted among a youth group in Accra has shown that close to 4 out of 5 persons were found to be physically inactive, with the rate higher in females than males (El-Kebbi *et al.*, 2021). A study by Otieno et al. (2018) which investigated the association between physical activity and glycemic control among type II diabetes patients in Kenya found that patients who engaged in regular physical activity had better glycemic control than those who did not engage in physical activity.

This study has shown a significant difference in gender with regard to the prevalence of obesity and overweight. There was a higher prevalence of overweight and obesity in the female participant than in the males. As many as 82.6% of females were obese compared to 17.4% of males and 58.5% of females were overweight as compared to 41.4% of the males using the BMI values. Overweight and obesity were also more prevalent in females than males using the measured values of WHR, WHtR, and BAI as determinants. The general increase in the prevalence of overweight and obesity using BMI, and BAI was statistically significant (*P*-0.010, p-0.016) compared to WHR, WHtR (p-0.809, *P*-0.560).

A previous study conducted by Obirikorang *et al.*, (2015) established that using WHR followed by WHtR yielded the highest prevalence of obesity compared to BMI, this was contrary to the findings of this study which found BMI and BAI as better determinants of obesity and overweight. Another study report that both WC and BMI have similar diagnostic accuracy for obesity and overweight (Silveira, *et al.*, 2020) which agree with the findings of this study.

Conclusion

There is an increasing prevalence of obesity and overweight among Type II diabetic patients in the population of Kumasi as shown by this study with a higher prevalence among females than males. This may contribute greatly to the burden and poor outcomes of Type II Diabetes patients.

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Differences in BAI and BMI values for overweight and obesity were found to be statistically significant. Given the negative impact of obesity, overweight and Type II diabetes on national economies it is essential to stress patient education, healthy lifestyle intervention, public health awareness, and appropriate control measures to improve healthy eating habits and promote weight loss. Diabetic centres should be provided across the entire country to ensure adequate facilities to enhance the reduction of diabetes among the population. Further research should be conducted in other parts of the country to help establish the national prevalence of obesity and overweight among Type II diabetic patients.

Data availability

All data generated or analyzed during this study can be requested from the corresponding author.

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