The Prevalence of Obesity and the Associated Risk Factors among Type II Diabetic Patients Attending Al-Aziziyah Al-Sharqiah Primary Health Care Center in Makkah Al-Mukarramah, 2018

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Abstract **Background:** Obesity among type 2 diabetic patients has proven to have adverse effects in management and control of diabetes and a considerable proportion of type 2 diabetic patients have been reported to be obese in different settings, which increase the risk of microvascular complications among them. **Objectives:** To estimate the prevalence of and define determinants of obesity among type 2 diabetic patients. **Subjects and Method:** A cross-sectional study was conducted at Al-Aziziyah Al-shargiah primary health care center, Makkah among a random sample of type 2 diabetic patients registered in the chronic disease clinic. Self-administrated validated questionnaire was used for data collection. It composed of two sections; socio-demographic and personal characteristics of the participants as well as factors associated with obesity. Additionally, the body mass index (BMI) was calculated by an expert nurse. **Results**: Overall, 160 patients were enrolled for the study with a response rate of 91.4%. Their age ranged between 38 and 85 years with mean±SD of 51.5±9.2 years. Most of them (72.5%) were females and majority were Saudis (90%). Aalmost two-thirds of the respondents (63.8%) were obese. Results of multivariate logistic regression analysis revealed that compared to single persons, divorced were at 9-folds risk for obesity (AOR=9.0; 95% CI=1.19-106.0, p=0.017). Participants who didn`t stop aerobic exercise for two consecutive days or more per week were at lower risk for obesity compared to those did that always (AOR=0.05; 95% CI=0.001-0.74, p=0.029). Type 2 diabetic patients who treated with insulin were at higher significant risk for obesity compared to those treated with tables only (AOR=8.11; 95% CI=1.01-65.24, p=0.019). **Conclusion**: Obesity is highly prevalent among type 2 diabetic patients. Some modifiable risk factors were identified. Multidisciplinary effort is warranted to reduce obesity among type 2 diabetic patients.

Keywords: *obesity, type 2 diabetes mellitus, risk factors, Saudi Arabia*

Cite This Article: Amani Onayzan Alsaeedi, "The Prevalence of Obesity and the Associated Risk Factors among Type II Diabetic Patients Attending Al-Aziziyah Al-Sharqiah Primary Health Care Center in Makkah Al-Mukarramah, 2018." *American Journal of Medical Sciences and Medicine*, vol. 7, no. 3 (2019): 80-88. doi: 10.12691/ajmsm-7-3-6.

1. Introduction

1.1. Background

Type 2 diabetes (non-insulin dependent diabetes or adult-onset diabetes) accounts for at least 90% of all cases of diabetes [1]. It is characterized by insulin resistance and relative insulin deficiency, either or both of which may be present at the time diabetes is diagnosed [1]. The diagnosis of type 2 diabetes can occur at any age [1].

Globally, 1 out of 11 adults have diabetes (415 million), also there are 5 million die from diabetes every year [2]. Kingdom of Saudi Arabia (KSA) is now classified by the International Diabetes Federation to be among the top 10 countries globally with the highest prevalence of diabetes in 2015 (17.6%) [2].

Numerous literature have documented that obesity is an important modifiable risk factor for type 2 diabetes [3,4,5,6]. Furthermore, it has been linked to many adverse health consequences including hypertension, hyperglycaemia, dyslipidaemia, cardio-vascular diseases, osteoarthritis, gallbladder diseases, respiratory tract diseases and psychiatric disorders [7,8,9]. According to the World Health Organization Global Report on Diabetes (2016), obesity as well as physical inactivity are responsible for increasing prevalence of diabetes [10]. Obesity is strongly linked to insulin resistance, which, when associated with relative insulin deficiency, leads to the development of type 2diabetes mellitus [11].

The prevalence of obesity has increased dramatically throughout the last 3 decades with adverse consequences

to public health [13]. Obesity is defined by a 30 or higher body mass index (BMI) [14]. Obesity and type 2 diabetes have been traditionally considered among diseases of affluence [15]. In the context, on global basis, the Kingdom of Saudi Arabia (KSA) had one of the highest prevalence of both obesity/overweight and type 2 diabetes [16].

The increasing rate of obesity is explained by a combination of environmental and behavioural factors, rather than the biological factors. Additionally, the amount of energy spent has also decreased over the years, which also promotes obesity [17]. An epidemic of obesity and type 2 diabetes mellitus prevail in the Arabic world, including KSA. This is attributed to genetic factors, among others [18].

Loss of weight among type 2 diabetic patients has proven to have beneficial effects in management and control of diabetes [19]. Additionally, it reduces the cardiovascular risks among type 2 diabetics [20]. Despite of that, considerable proportion of type 2 diabetic patients have been reported to be obese in different settings [21,22,23,24], which increase the risk of cardiovascular and microvascular complications among diabetics [25].

Lifestyle intervention methods are tried to be effective Randomized controlled trials have shown that intensive life style modification; particularly weight control could prevent or at lead to delay the occurrence of diabetes [26].

1.2. Aim of the Study

To estimate the magnitude and determinants of obesity among type 2 diabetic patients.

1.3. Objectives

The objectives of this study are:
i. To estimate the prevalence of obesity among type II diabetic patients attending Al-Aziziyah Al-Sharqiah primary health care center in Makkah Al-Mukarramah, 2018.
ii. To determine the risk factors that contributes to obesity among type II diabetic patients attending Al-AziziyahAl-Sharqiah primary health care center in Makkah Al-Mukarramah, 2018.

1.4. Research Significance

Both of obesity and type 2 diabetes are prevalent public health problems in Saudi Arabia. They are closely related to each other and have modifiable risk factors. Identifying of these risk factors would help in reducing the burden of both problems.

1.5. Rationale

1. With the changes in major lifestyles, the prevalence of obesity is increasing; therefore, this issue implicated to complicate the diabetes outcome.
2. The researcher has a special interest in obesity and its related complication, particularly in type II diabetic patients
3. Up to the researcher's knowledge, no published studies were conducted in Holy Capital of Makkah defined the risk factors for developing obesity among type 2 diabetic patients.

2. Literature Review

Relatively few studies have been cited through literature review in the issue of estimating the prevalence and determinants of obesity among type 2 diabetic patients. Some of them were conducted in the Kingdom of Saudi Arabia. However, no study was cited from Makkah. The following is summary of the most relevant findings of these studies.

2.1. Studies carried out in Saudi Arabia

In Aseer region, Al-shahrani and Al-khaldi (2013) estimated the prevalence of obesity among 14,252 diabetic patients attended PHC centers. The prevalence of obesity among diabetic patients was 46%. About half of the diabetics had poor diabetic control, with significant association with obesity [27].

In Al-Khobar region, AlMugharbel et al. (2003) reviewed 382 files of type 2 diabetic patients in PHC centers to estimate the prevalence of obesity among Type 2 diabetic patients. Their results revealed that 39.9% were obese and 6.3% had morbid obesity [22].

In Jeddah (2013), Bakhotmah identified the risk factors for developing obesity among 723 Saudi diabetic patients attending PHC centers. The prevalence of obesity was 38.3% among them, 15.9% had severe obesity. Prevalence of severe obesity was more significantly reported among female than male diabetic patients. The housewives were at higher risk for obesity; particularly non-smokers [28].

2.2. Studies Conducted in the Arab World

In Yemen, Al-sharafi and Gunaid (2014) estimated the prevalence of obesity in patients 25 years old/above with type 2 diabetes mellitus. The prevalence of obesity among male patients (BMI $\geq$ 30 kg/m^2) was 11% whereas it was 32% among female patients [23].

Abuyassin and Laher (2015) published a review regarding the association between obesity and type 2 diabetes in the Arab world and concluded that the Arab world have an epidemic of obesity and type 2 diabetes mellitus. They reported that replication studies have identified several genetic variants in Arab people with obesity linked diabetes [18].

Alzaman and Ali (2016) reported in their comprehensive review that over the last two decades, obesity was a risk factors for increasing incidence of type 2 diabetes mellitus among Arabs. They explained that to the fact that obesity is strongly associated with insulin resistance, which, if associated with insulin deficiency, leads to overt type 2 diabetes mellitus [11].

2.3. International Studies

Daousi et al. (2006) determined the prevalence of obesity among patients with type 2 diabetes mellitus in the United Kingdom, and assessed the impact of obesity

on glycaemic control and cardiovascular risk factors in patients with type 2 diabetes and concluded more than half of type 2 diabetic patients (52%) were obese, and 8.1% had morbid obesity. Obese patients with type 2 diabetes were younger, had worse glycaemic control, higher blood pressure, and poorer lipid profiles, compared with not obese patients [21].

In Tanzania (2017), Damian et al carried out a study aimed to estimate the prevalence of overweight/obesity among patients with type 2 diabetes attended diabetes clinics. The prevalence of overweight and obesity among them were 44.9% and 40.1%, respectively. Almost one-third of them (33.7%) were overweight or obese after type 2 diabetes diagnosis. Female diabetic patients were at higher significant risk compared to males to overweight/obesity (OR=5.1) [29].

Abdullah et al (2010) carried out a meta-analysis study to estimate the overall relative risk (RR) of having type 2 diabetes for overweight and obese populations compared to those with normal subjects. They included 18 prospective cohort studies and concluded that the overall RR of diabetes for obese persons compared to those with normal weight was 7.19 (95% CI: 5.74, 9.00) and for overweight was 2.99 (95% CI: 2.42, 3.72). However, variation between studies was observed concerning the sample size, method of assessment of body mass index (BMI) and technique used to diagnose type 2 diabetes. After controlling for the confounding effect of age, family history of type 2 diabetes, and physical activity, the RR was 7.28 (95% CI: 6.47, 8.28) for obesity and 2.92 (95% CI: 2.57, 3.32) for overweight [30].

3. Methodology

3.1. Study Design

Cross-sectional design was adopted in the present study.

3.2. Study Area and Population

All type 2 Diabetic patients who registered in chronic disease clinic in Al-Aziziyah Al-shargiah primary health care center, Makkah at the time of study conduction.

3.3. Inclusion Criteria

• All type II diabetic patients.
• Both males and females.
• All nationalities.

3.4. Sample Size

Sample size was calculator by Raosoft Online sample size calculator [31]. It was 159 patients, based on assumption that during the last 3 weeks, the total number of diabetic patients who visited the chronic disease clinic at Al-Aziziyah Al-Sharqiah PHCC was 270 patients, prevalence was considered as 50%, confidence level was 95%, margin of error was 5%. By adding 10% for defaulter and non-respondent, 175 patients were invited to participate in the study.

3.5. Sampling Technique

Systematic sampling technique was used. Approximately 20 patients visit the PHC center daily. Ten patients were selected daily by choosing every other patient. Thus, nearly 16 working days were needed to collect the sample.

3.6. Data Collection Tool

Self-administrated questionnaire was used for data collection. It was adopted from a previous Saudi study. [5] Some modifications were done and the new format was validated by three consultants (family medicine, Endocrinology and community medicine). The final draft of the questionnaire consists of two sections:
- First section: Includes socio-demographic and personal characteristics of the participants.
- Second section: Includes associated factors with obesity in type II diabetic patients (smoking, physical exercise, diet habit. Additionally, the body mass index (BMI) was calculated by an expert nurse.

3.7. Data Collection Technique

• During the study period (14th January to 1st February), the researcher was available at the involved primary healthcare centers five days in the week to clarify any issue.
• The researcher distributed the questionnaire in the waiting area by themself to the selected patients.
• The questionnaires were collected at the same time.

3.8. Study Variables

Dependent variable: Obesity in type 2 diabetic patients. It was defined as body mass index>30 Kg/m^2 [32].

Independent variables: Age, gender, nationality, marital status, educational level, income level, marital status, smoking, physical exercise, dietary habits, duration of diabetes, type of treatment, complications and history of co-morbid chronic diseases.

3.9. Data Entry and Analysis

Data were entered and analyzed using the Statistical Package for Social Sciences (SPSS version 25). Categorical variables were presented as frequency and percentage whereas continuous variables were presented as mean and standard deviation (±SD).

Results were presented as adjusted odds ratio (AOR) and its 95% confidence interval (CI). Statistical significance was determined at $p<0.05$ for all comparisons.

3.10. Pilot Study/Pretesting

A pilot study was conducted on 16 patients, representing approximately 10% of the sample size. It was done in another PHCC rather than those involved in the study to test the clarity of the questions and feasibility of the methodology. No modifications were made according to the pilot results.

3.11. Ethical Considerations

Research committee approval ,Written permission from the joint program of family medicine in Makkah Al-Mukarramah, Written permission from concerned authority in Ministry of Health (MOH) PHCC in Makkah Al-Mukarramah, Individual verbal consent from all participants before data collection, Acknowledgments of all supervisors, advisors, helpers, facilitators and participants. All collected data were kept confidential.

3.12. Relevance & Expectations

This study provides information about the prevalence of obesity among type II diabetic patients. Also, a possibility of relevant risk factors may contribute to obesity in the diabetic patient. This could help policy makers to set strategies to combat obesity among type 2 diabetic patients.

4. Results

4.1. Response Rate

The study included 160 patients, out of invited 175 (Response rate = 91.4%).

Table 1. Socio-demographic characteristics of the participants (n=160)

Variables	N	%
Sex		
Male	44	27.5
Female	116	72.5
Nationality		
Saudi	144	90.0
Non-Saudi	16	10.0
Age (years)		
<50	67	41.8
50-60	62	38.8
>60	31	19.4
Range	38-85	
Mean±SD	51.5±9.2	
Marital status		
Single	10	6.3
Married	121	75.5
Divorced	7	4.4
Widowed	22	13.8
Occupation		
Housewife	73	45.6
Government employee	41	25.6
Non-government employee	6	3.8
Self-employed	4	2.5
Retired	32	20.0
Unemployed	4	2.5
Income (SR/month)		
<5,000	59	36.8
5,000–10,000	80	50.0
10,001–20,000	19	11.9
>20,000	2	1.3
Educational level		
Illiterate	24	15.0
Read and write	14	8.8
Primary school	22	13.8
Intermediate school	14	8.8
Secondary school	39	24.3
College/University	43	26.8
Postgraduate degree	4	2.5

- Socio-demographic characteristics:

Table (1) shows the socio-demographic details of the respondents. Most of them (72.5%) were females and married (75.5%). Majority were Saudis (90%). Their age ranged between 38 and 85 years with mean±SD of 51.5±9.2 years. Less than half of them (45.6%) were house wives whereas 25.6% were government employees. Exact half of them had income ranged between 5000 and 10000 SR/month. More than a quarter of them (26.8%) were university graduated whereas 15% were illiterates.

Table 2. Habitual factors associated with obesity among type II diabetic patients

	Frequency	Percentage
Physical activities or exercises		
No	93	58.1
Yes	67	41.9
Type of physical activities or exercises (n=67)		
Walking	14	20.9
Running	21	31.3
Both	32	47.8
Do you stop aerobic exercise for two consecutive days or more per week?		
Always	103	64.4
Sometimes	41	25.6
No	16	10.0
Eating a portion of fruit		
Never	14	8.8
Daily	65	40.6
Weekly	75	46.9
Monthly	6	3.8
Eating a portion of vegetables		
Never	10	6.3
Daily	110	68.8
Weekly	40	25.0
Do you have breakfast daily?		
Always	116	72.5
Sometimes	36	22.5
No	8	5.0
Do you drink soft drink daily? e.g. Pepsi		
Always	22	13.8
Sometimes	33	20.6
No	105	65.6

- **Habitual factors associated with obesity**

More than half of the participants (58.1%) did not practice physical activities or exercises. Among those practiced, both walking and running were mentioned by 47.8% as types of physical activities. About two-thirds of patients (64.4%) stopped aerobic exercise for two consecutive days or more per week. Only 40.6% of them reported eating a portion of fruit daily whereas 8.8% never eat fruits. However, more than two-thirds of them (68.8%) reported eating a portion of vegetable daily whereas 6.3% never eat vegetables. Most of them (72.5%) reported taking breakfast daily and 5% never take breakfast. Almost two-thirds of them (65.6%) never consume soft drinks whereas 13.8% consume them daily.

History of co-morbid chronic diseases

The commonest reported co-morbid chronic disease was hypertension (43.8%), followed by arthritis/other rheumatic diseases (27.5%) and dyslipidemia (26.9%). (Table 3)

Table 3. History of co-morbid chronic diseases among the participants

	Frequency	Percentage
Asthma	11	6.9
Hypertension	70	43.8
Dyslipidemia	43	26.9
lung diseases	0	0.0
Heart diseases	16	10.0
Arthritis or other rheumatic diseases	44	27.5

4.2. Prevalence of Obesity

From Figure 1, it is obvious that almost two-thirds of the participated type 2 diabetic patients (63.8%) were obese.

4.3. Factors Associated with Obesity among Type 2 Diabetic Patients

4.3.1. Socio-demographic Factors

All divorced participants compared to 40% of singles were obese, p=0.035. All self-employed and 78.1% of house wives compared to none of unemployed and 43.8% of retired participants were obese, p<0.001.

4.3.2. Habitual Factors

Most of persons who sleep on the average <8 hours/day (74.3%) compared to 55.6% of those who sleep on the averages ≥8 hours/day were obese. This difference was statistically significant, p=0.014. Most of participants who did not practice physical activity (72%) compared to 52.2% of those who reported practicing physical activity were obese. This difference was statistically significant, p=0.010. Most of those practicing running (81%) compared to 31.3% of those who practice both running and walking were obese, p=0.002. Most of individuals who stop aerobic exercise for two consecutive days or more per week (72.8%) compared to 37.5% of those who never did that were obese, p=0.004. Most of the participants (85.7%) who never eat fruits compared to 53.8% of those eat fruits daily were obese, p=0.009.

4.3.3. Medical Factors

All patients treated with insulin only compared to 57.6% of those treated with tables only were obese, p=0.002. Type of diabetic complication was associated with obesity as all patients with neuropathy and cardiovascular complications compared to 53.8% of those with eye complications and none of those with renal complications were obese, p=0.003.

4.4. Multivariate Logistic Regression Analysis

Results of multivariate logistic regression analysis revealed that compared to single persons, divorced were at 9-folds risk for obesity (AOR=9.0; 95% CI=1.19-106.0, p=0.017). Considering house wives as a reference category, governmental employees, retired and unemployed participants were at lower significant risk for obesity (AOR=0.36; 95% CI=0.16-0.82, p=0.014; AOR=0.22; 95% CI=0.09-0.53, p=0.001 and AOR=0.22; 95% CI=0.14-0.34, p=0.004, respectively). Participants who didn`t stop aerobic exercise for two consecutive days or more per week were at lower risk for obesity compared to those did that always (AOR=0.05; 95% CI=0.001-0.74, p=0.029). Type 2 diabetic patients who treated with insulin were at higher significant risk for obesity compared to those treated with tables only (AOR=8.11; 95% CI=1.01-65.24, p=0.019). Duration of sleep/day, physical exercise, type of physical exercise, eating fruits and complications of diabetes were not significantly associated with obesity after controlling for confounding effect.
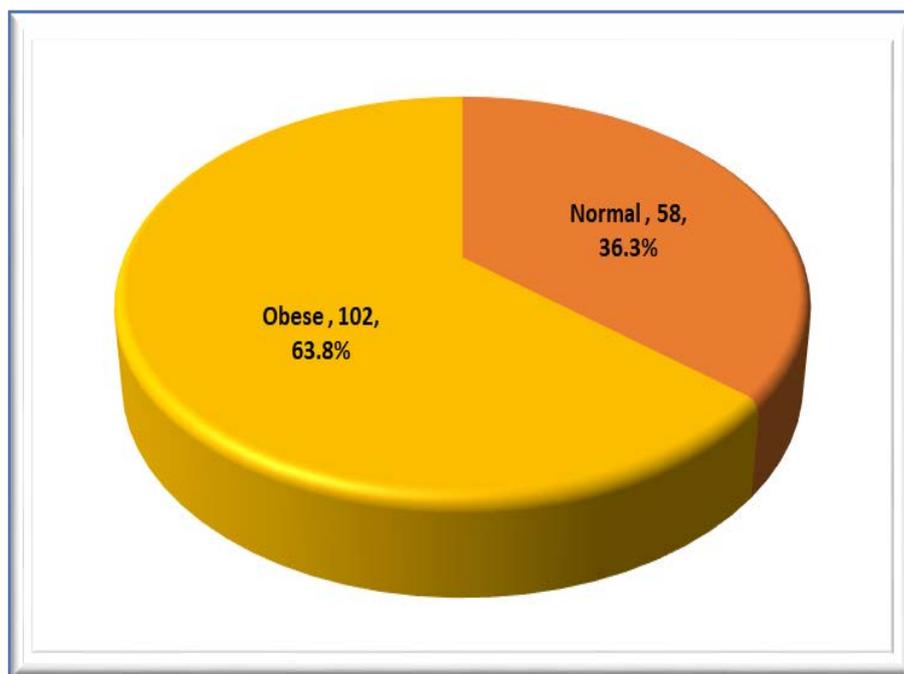
Figure 1. Prevalence of obesity among the participants

Table 4. Socio-demographic factors associated with obesity among type II Diabetes patients

		BMI				Chi-square	
		Normal N=58		Obese N=102		X^2	P-value
		N	%	N	%		
Sex	Male (n=44)	18	14.9	26	59.1	0.570	0.450
	Female (n=116)	40	34.5	76	65.5		
Nationality	Saudi (n=144)	50	34.7	94	65.3	1.454	0.228
	Non-Saudi (n=16)	8	50.0	8	50.0		
Age (years)	<50 (n=67)	24	35.8	43	64.2	1.498	0.473
	50-60 (n=62)	20	32.3	42	67.7		
	>60 (n=31)	14	45.2	17	54.8		
Marital status	Single (n=10)	6	60.0	4	40.0	8.622	0.035
	Married (n=121)	44	36.4	77	63.6		
	Divorced (n=7)	0	0.0	7	100		
	Widowed (n=22)	8	36.4	14	63.6		
Occupation	House wife (N=73)	16	21.9	57	78.1	25.048	<0.001
	Government employee (N=41)	18	43.9	23	56.1		
	Non-government employee (n=6)	2	33.3	4	66.7		
	Self-employed (n=4)	0	0.0	4	100		
	Retired(n=32)	18	56.3	14	43.8		
	Unemployed (n=4)	4	100	0	0.0		
Income level (SR/month)	< 5000 (n=59)	18	30.5	41	69.5	5.586	0.134
	5000 – 10000 (n=80)	32	40.0	48	60.0		
	>10,000 – 20,000 (n=19)	6	31.6	13	68.4		
	> 20,000 (n=2)	2	100	0	0.0		
Educational level	Illiterate (n=24)	8	33.3	16	66.7	10.407	0.109
	Read and write (n=14)	2	14.3	12	85.7		
	Primary school (n=22)	6	27.3	16	72.7		
	Intermediate school (n=14)	6	42.9	8	57.1		
	Secondary school (n=39)	16	41.0	23	59.0		
	College/University (n=43)	20	46.5	23	53.5		
	Postgraduate degree (n=4)	0	0.0	4	100		

Table 5. Habitual factors associated with obesity among type II Diabetes patients

		Normal		Obese		Chi-square	
		N	%	N	%	X^2	P-value
Smoking	Smoker (n=22)	8	36.4	14	63.6	5.553	0.062
	Ex-smoker (N=6)	0	0.0	6	100		
	Non-smoker (N=132)	50	37.9	82	62.1		
Average number of sleep hours per day	<8 (n=70)	18	25.7	52	74.3	5.977	0.014
	>=8 (n=90)	40	44.4	50	55.6		
Average number of hours of watching TV per day	No	6	25.0	18	75.0	2.763	0.251
	1-3hs.	38	35.8	68	64.2		
	3-5hs.	14	46.7	16	53.3		
physical activities or exercises	No (n=93)	26	28.0	67	72.0	6.589	0.010
	Yes (n=67)	32	47.8	35	52.2		
Type of physical activities or exercises (n=67)	Walking (n=14)	6	42.9	8	57.1	12.725	0.002
	Running (n=21)	4	19.0	17	81.0		
	Both (n=32)	22	68.8	10	31.3		
Do you stop aerobic exercise for two consecutive days or more per week?	Always (n=103)	28	27.2	75	72.8	11.039	0.004
	Sometimes (n=41)	20	48.8	21	51.2		
	No (n=16)	10	62.5	6	37.5		
Eating a portion of fruit	Never (n=14)	2	14.3	12	85.7	11.539	0.009
	Daily (n=65)	30	46.2	35	53.8		
	Weekly (n=75)	26	34.7	49	65.3		
	Monthly (n=6)	0	0.0	6	100		
Eating a portion of vegetables	Never (n=10)	6	60.0	4	40.0	3.158	0.206
	Daily (n=110)	36	32.7	74	67.3		
	Weekly (n=40)	16	40.0	24	60.0		
Do you have breakfast daily?	Always (n=116)	46	39.7	70	60.3	2.203	0.332
	Sometimes (n=36)	10	27.8	26	72.2		
	No (n=8)	2	25.0	6	75.0		
Do you drink soft drink daily? e.g. Pepsi	Always (n=22)	8	36.4	14	63.6	0.000	1.000
	Sometimes (n=33)	12	36.4	21	63.6		
	No (n=105)	38	36.2	67	63.8		

Table 6. Medical factors associated with obesity among type II Diabetes patients

Associated factors		Normal N=58		Obese N=102		Chi-square	
		N	%	N	%	X^2	P-value
Duration of diabetes in years	<1 (n=12)	4	33.3	8	66.7	0.372	0.946
	1-5 (n=61)	22	36.1	39	63.9		
	6-10 (n=36)	12	33.3	24	66.7		
	>10 (n=51)	20	39.2	31	60.8		
Type of treatment for diabetes	Tablets (n=99)	42	42.4	57	57.6	12.682	**0.002***
	Tablets and insulin (n=49)	16	32.7	33	67.3		
	Insulin (n=12)	0	0.0	12	100		
History of diabetic complications	Yes (n=48)	16	33.3	32	66.7	0.254	0.614
	No (n=112)	42	37.5	70	62.5		
Type of diabetic complication, (n=48)	Diabetic foot (n=8) foot	2	25.0	6	75.0	16.218	**0.003***
	Eye complications on (n=26)	12	46.2	14	53.8		
	Renal complications (n=2)	2	100	0	0.0		
	Cardiovascular complications (n=8)	0	0.0	8	100		
	Neuropathy (n=4)	0	0.0	4	100		
Co-morbid chronic diseases	Asthma (n=11)	2	18.2	9	81.8	0.168*	
	Hypertension (n=70)	22	31.4	48	68.6	1.260	0.263
	Dyslipidemia (n=43)	16	37.2	27	62.8	0.023	0.878
	Heart diseases (n=16)	4	25.0	12	75.0	0.242*	
	Arthritis/rheumatic diseases (n=44)	12	27.3	32	72.7	2.177	0.146

* Fischer Exact test.

Table 7. Predictors of obesity among type 2 diabetic patients: Results of multivariate logistic regression analysis

	AOR	95% CI	p-value
Marital status			
Single (n=10)[a]	1.0	---	---
Married (n=121)	2.63	0.70-9.81	0.139
Divorced (n=7)	9.00	1.19-106.0	0.017
Widowed (n=22)	2.62	0.57-12.18	0.212
Occupation			
House wife (n=73)	1.0	---	---
Government employee (n=41)	0.36	0.16-0.82	0.014
Non-government employee (=6)	0.56	0.09-3.35	0.522
Self-employed (n=4)	0.78	0.69-1.88	0.293
Retired(n=32)	0.22	0.09-0.53	0.001
Unemployed (n=4)	0.22	0.14-0.34	0.004
Stopping aerobic exercise for two consecutive days or more per week			
Always (n=103)	1.0	---	---
Sometimes (n=41)	0.13	0.02-1.13	0.065
No (n=16)	0.05	0.001-0.74	0.029
Type of treatment for diabetes			
Tables (n=99)	1.0	---	---
Tablets and insulin (n=49)	1.52	0.74-3.12	0.252
Insulin (n=12)	8.11	1.01-65.24	0.019

[a] Reference category, AOR: Adjusted odds ratio, CI: Confidence interval.

Terms of duration of sleep/day, physical exercise, type of physical exercise, eating fruits and complications of diabetes were removed from the final logistic regression model (not significant).

5. Discussion

The magnitude of the problem of obesity and its influence on patients with type 2 with diabetes has not attracted enough attention, and relatively few obese diabetic patients are offered the option of weight management as an integral part of their management [21].

The present study was done to estimate the prevalence of and define determinants of obesity among type 2 diabetic patients in Makkah, Saudi Arabia.

In the current study, almost two-thirds of the type 2 diabetic patients (63.8%) were obese. This figure is higher than those reported in other similar studies carried out either locally or internationally. In Aseer region [27]. In Al-Khobar region [22]. In Jeddah [28]. In Yemen [23]. In Tanzania [29]. In the United Kingdom [21]. The high prevalence of obesity among type 2 diabetic patients is explained by the fact that obesity is strongly associated with insulin resistance, which, if associated with insulin deficiency, leads to overt type 2 diabetes mellitus [11].

This higher prevalence of obesity among type 2 diabetic patients in the present study over most of other similar studies necessitates greater efforts from responsible authorities to investigate the problem and find possible solutions.

In the present study, there was no significant difference between male and female type 2 diabetic patients regarding prevalence of obesity. In another study carried out in Jeddah [28], prevalence of obesity was higher in female than male patients. Also in Yemen, the prevalence of obesity among male patients was 11% whereas it was 32% among female patients [23]. In Tanzania, female diabetic patients were at almost 5-folds higher risk of overweight/obesity compared to male patients [29].

Marital status was a significant predictor for obesity among type 2 diabetic patients in the current study as divorced patients were at higher risk for obesity compared to singles. This could be explained by the fact that divorce patients were more prone to depression [33] and consequently depressed persons were more likely to develop obesity and vice versa [34].

Regarding job status, housewives were at higher risk for obesity compared to others in this study. The same has been observed in another Saudi study carried out in Jeddah [28]. This could be attributed to their relatively less movement and being at home most of the time.

Lack of physical activity was associated with higher rate of obesity in this study as participants who didn`t stop aerobic exercise for two consecutive days or more per week were at lower risk for obesity compared to those did that always. This is confirmed in many other studies [35,36,37,38].

In this study, poor dietary habit manifested by never eating fruits was associated with obesity in bivariate analysis. However, after controlling for confounders in multivariate analysis, this effect disappeared. In another Saudi study, obesity was associated with physical inactivity and unhealthy dietary habits [38]. Lifestyle intervention approaches including physical activity and dietary habits have proven to be effective in controlled trials in reducing burden of both obesity and type 2 diabetes [26].

The current study revealed that type 2 diabetic patients who treated with insulin were at higher significant risk for obesity compared to those treated with tables. Insulin therapy is usually given to type 2 diabetic patients with poor glycemic control. In a study carried out in Aseer region, poor diabetic control significantly association with obesity [27].

6. Strengths and Limitations

Up to our knowledge, this study is unique of its king in Makkah Al-Mukarramah city as it explored the magnitude and possible determinants of obesity among type 2 diabetic patients. Furthermore, we utilized WHO cut-off value for fefining obesity [32]. However, it has some limitations that should be mentioned. First, it was carried out in one healthcare facility, which could affect the generalizability of results. Second, its cross-sectional design has inherited disadvantage in ascertaining the temporal relationship between exposure and outcome.

7. Conclusion

Obesity is highly prevalent among type 2 diabetic patients. Divorced, house wives, patients who stopped aerobic exercise for two consecutive days or more per week as well as those treated with insulin were more likely to be obese.

8. Recommendations

From the results of the study, the following are recommended:
1. Screening for obesity among type 2 diabetic patients is needed
2. Early and effective management of obesity with sustained weight loss and re-obesity prevention is highly recommended through organized programs including health education and lifestyle modifications.
3. Encouraging physical activity and healthy food intake early in life is important to minimize the burden of the problems of obesity and type 2 diabetes.
4. Further study is needed to assess the outcome of type 2 diabetes in presence of obesity

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