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Research Article

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Glycemic control of Obese Patients with Type 2 Diabetes Mellitus

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Abstract

Background and Objective: *The incidence of type 2 diabetes mellitus is growing. Some national studies have measured glycemic control in people with type 2 diabetes mellitus. The objective of this study was to measure the glycemic control in obese patients with type 2 diabetes mellitus.*

Methods: *A retrospective study of patients with type 2 diabetes mellitus and body mass index >30.0 kg/m² at the primary health care department and diabetic Centre.*

Results: *A total of 809 participants with T2DM and BMI ≥30.0 kg/m² were studied. The mean age of the study population was 53.1 ± 11.6 years with 54.5 ± 12.5 years for males and 52.5 ± 11.1 years for females, p=0.02. Moreover, the prevalence of males was 248(30.7%) and the prevalence of females was 561(69.3%) with males to females ratio was 1.00: 2.26, p<0.0001. Mean BMI was 35.3 ± 4.7 kg/m² and mean HbA1c was 9.3 ± 2.3. In the study population, 458(56.6%) were obese Grade I, 242 (29.9%) were obese Grade II while 109 (13.5%) were morbidly obese (obese Grade III), p=0.001 was significant compared to non diabetic cases. Obese Grade I have significantly a higher HbA1c compared to obese Grade II and III. Higher HbA1c was significantly correlated with lower BMI, r= - 0.1, p=0.002. Moreover, increased BMI were strongly linked to females; 60.7%, 77.7% and 87.2% respectively and were found to be statistically significant (P < 0.0001), as indicated in table. Summarizes the relationship between mean HbA1c according to obesity categories stratified by gender figure 1. There is a clear no significant separation of the HbA1c line between the males and females where mean HbA1c for males were higher in all obesity categories. There were slopes up of the mean Hba1c with slope down line for mean BMI as age groups advanced with similar pattern for males and females. A better HbA1c goal in BMI (30-34) group and that was true for females. The frequency of Hba1c goal was increasing with increasing age groups.*

Conclusion: *These data indicate that many obese patients with T2DM have poor glycemic control where they will be at high risk of diabetic complications. More national studies are needed to assess glycemic control among obese diabetic patients in Saudi Arabia.*

Keywords: Type 2 Diabetes Mellitus, Glycaemic Control, Obesity

Introduction

Diabetes mellitus is a major cause of excess mortality and morbidity. The prevalence and incidence of type 2 diabetes mellitus (T2DM) are increasing worldwide [1]. It is estimated that 300 million people will have DM by 2025 and it will reach approximately 439 million and the prevelance is estimated as 7.7% by 2030. It is anticipated that 3.96 millions of patients with DM will die annually related to the diabetes and it will compromise 6.8% of all the causes of death. T2DM patients have a higher risk of developing micro vascular and macro vascular disease than the general population [2-4]. The occurrence of these complications depends largely on the degree of glycemic control as well as on the adequate control of cardiovascular risk factors [5-8]. Glycosylated hemglobin (HbA1c) is used to evaluate the glycaemic control of diabetic patients [9, 10]. HbA1c level < 7.0% as the primary glycaemic control target for diabetics is suggested by the American Diabetes Association (ADA) guidelines [11]. The percentage of patients who reach this objective seems to be notably lower (24%) in the case of less-controlled T2DM patients [12, 13]. Increasing HbA1c levels were correlated with macro vascular and microvascular disease whereas decrease in HbA1c level decreases the prevalence of long term complications [14, 15].

Obesity has become a real concern worldwide due to its increasing prevalence and to the associated cluster of diseases that reduce life quality and expectancy. It is already well established that those developing T2DM have a higher body weight than control populations, reflecting the strong epidemiological association

between obesity and the development of diabetes. In the next century more than 100,000,000 individuals will be obese and, of these, more than 15,000,000 will become diabetic [16]. The mechanism through which obesity causes diabetes remains obscure, but it is known that obesity is associated with insulin resistance, and that effective compensatory hyperinsulinemia initially maintains blood glucose levels within normal range. However, after some time, the ability of pancreatic B-cells to compensate for increasing insulin resistance may flag, the so-called B-cells failure [17, 18]. In obese patients, the presence of T2DM is a major risk factor for cardiovascular diseases and is considered to be an independent risk factor for macro vascular complications [19]. Thus, in morbidly obese patients, the glycemic control has to be more intensive. Glycemic control depends mainly on the degree of residual pancreatic beta-cell function and insulin sensitivity [20].

The International Diabetes Federation has confirmed that Saudi Arabia is among the global top 10 countries with the highest diabetes rates among adults aged between 20 and 79 years. Further, the prevalence in Saudi Arabia has risen sharply in recent decades, from 7% in 1989 to 32% in 2009 [21]. Despite this alarming trend, the factors linked to glycemic control among T2DM patients remain poorly understood [22]. At present, the prevalence and impact of obesity on clinical workload and services provided for people with diabetes has not attracted much attention, and comparatively few obese patients with diabetes currently are offered the option of structured weight management as an integral part of their treatment [23]. The primary purpose of the present study was to evaluate whether obesity is associated with a good glycemic control in patients with T2DM.

Methods

For the present study, we analyzed participants who are older than or equal to 20 years old. A total of 809 cases with BMI ≥30.0 kg/m^2 were selected to be enrolled for the present study. All patients were from the population of the Primary health and Diabetic Centres at King Fahad Armed Forces Hospital. Participants were defined as having T2DM according to self-report, clinical reports, use of ant diabetic agents and HbA1c (≥6.5). All data were collected by personal interview and on the basis of a review of electronic medical data [11]. Weight (kg) and height (cm) were measured by physician and nurse interviewers and recorded. Obesity was defined as BMI ≥ 30.0 kg/m^2. BMI values of ≥ 30.0 kg/m^2 were sub classified into groups as obese Grade I (BMI=30 – 34.9 kg/m^2), obese Grade II (BMI=35.0 – 39.9 kg/m^2) and morbidly obese Grade III (BMI≥40 kg/m^2). The total number of subjects were separated on basis of age values into 9 groups; <25 years, 25 – 29 years, 30 – 34 years, 35 – 39 years, 40 – 44 years, 45 – 49 years, 50 – 54 years, 55 – 59 years and ≥60 years. HbA1c was expressed as percentage. High performance liquid chromatography was used.

Statistical Analysis

Univar ate analysis of demographic and clinical laboratory was accomplished using one-way analysis of variance (ANOVA) to estimate the significance of different between groups where appropriate. Unpaired t-test was used to analyze univariate analysis when appropriate. Chi square (X^2) test were used for categorical data comparison. All statistical analyses were performed using SPSS Version 22.0. The difference between groups was considered significant when P<0.05.

Results

A total of 809 participants with T2DM and BMI ≥30.0 kg/m^2 were studied. The mean age of the study population was 53.1 ± 11.6 years with 54.5 ± 12.5 years for males and 52.5 ± 11.1 years for females, p=0.02. Moreover, the prevalence of males was 248(30.7%) and the prevalence of females was 561(69.3%) with males to females ratio was 1.00: 2.26, p<0.0001, (Table).

Table 1: Characteristics of patients with type 2 diabetes mellitus stratified by age, gender, BMI and HbA1c

Parameters		Total	Body mass index (kg/m^2)			P value
			30.0-34.9	35.0-39.9	≥40.0	
Number (%)		809	458(56.6)	242 (29.9)	109 (13.5)	0.001
Age (years)		53.1 ± 11.6	54.6 ± 11.6	52.0 ± 11.3	49.3 ± 11.0	<0.0001
Gender	Male	248(30.7)	180 (39.3)	54(22.3)	14(12.8)	<0.0001
	Female	561(69.3)	278 (60.7)	188(77.7)	95(87.2)	
Body mass index (kg/m^2)		35.3 ± 4.7	32.3 ± 1.4	37.0 ± 1.6	44.4 ± 4.9	<0.0001
HbA1c		9.3 ± 2.3	9.4 ± 2.2	9.2 ± 2.4	8.7 ± 2.4	0.02

Data are means ± SD or number (%)

Mean BMI was 35.3 ± 4.7 kg/m^2 and mean HbA1c was 9.3 ± 2.3. In the study population, 458(56.6%) were obese Grade I, 242 (29.9%) were obese Grade II while 109 (13.5%) were morbidly obese (obese Grade III), p=0.001 was significant compared to non diabetic cases. Obese Grade I have significantly a higher HbA1c compared to obese Grade II and III. Higher HbA1c was significantly correlated with lower BMI, r= - 0.1, p=0.002. Moreover, increased BMI were strongly linked to females; 60.7%, 77.7% and 87.2% respectively and were found to be statistically significant (*P* <0.0001), as indicated in table. Summarizes the relationship between mean HbA1c according to obesity categories stratified by gender (Figure 1). There is a clear no significant separation of the HbA1c line between the males and females where mean HbA1c for males were higher in all obesity categories. There was slope up of the mean Hba1c with slope down line for mean BMI as age groups advanced, A and C, with similar pattern for males and females, B and D (Figure 2). A-D showed better HbA1c goal in BMI (30-34) group and that was true for females (Figure 3). The frequency of Hba1c goal was increasing with increasing age groups.

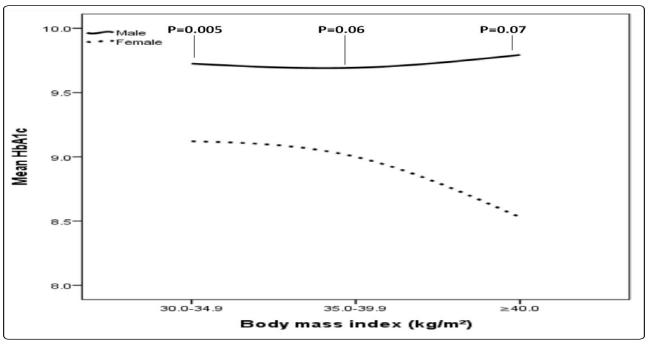

Figure 1 : Description mean HbA1c according to body mass index category

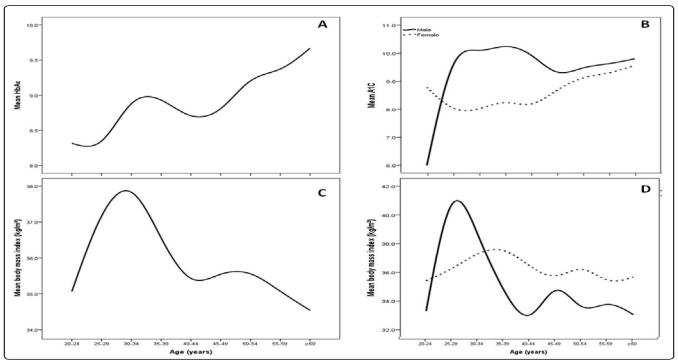

Figure 2 : A-D, Description mean HbA1c and body mass index by different age ranges and according to gender

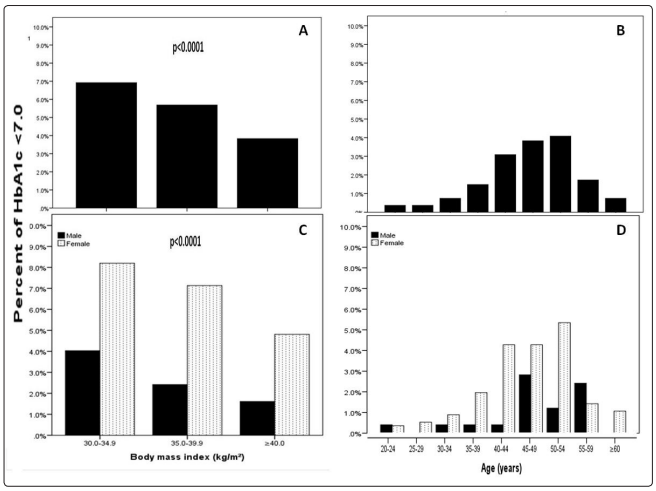

Figure 3 : A-D, Description mean HbA1c < 7.0 according body mass index obesity categories and age groups

Discussion

Higher proportions of T2DM patients are poorly controlled and micro vascular and macro vascular complications continue to persist, despite steps taken for strict glycemic control. Previous studies have provided evidence of the power of good glycemic control to restrict the micro vascular and macro vascular complications of diabetes despite that, between 40% and 60% of patients worldwide still have poorly controlled diabetes. More than half of the patients in the present study were not adequately controlled [24-30]. The results of the analyses indicated that 83.6% of the study sample of patients with T2DM suffered from poor glycemic control in line with prior studies in other regions of Saudi Arabia. The high prevalence of uncontrolled T2DM reported in this research is of concern. A previous study reported that 67.7% of T2DM patients had poor glycemic control in Riyadh. A similar value, 67.9%, was found in Al Hasa, and 74% in Jazan [31]. High prevalence of poor diabetes control has also been identified in other Middle Eastern contexts; 65.0% in Oman, 65.1% in Jordan, 69% in the United Arab Emirates, and 78.8% in Kuwait [23, 32]. In USA, data from National Health and Nutrition Examination Surveys reported that 42% - 50% of people with diabetes met the HbA1c target of 7% [33-35]. In the United Kingdom, a series of retrospective analysis of data found that 79% of patients had HbA1c >7.5% [36, 37].

In Saudi Arabia, published epidemiological data on glycemic control of T2DM using HbA1c values and the factors associated with it are scarce. This represents a serious problem because diabetes is a very prevalent disease (23.7-30 %%) in the Saudi community [38, 39]. This poor control of the disease, will no doubt result in an increasing prevalence of diabetic complications and high morbidity and mortality. Although King Fahad Armed Forces Hospital offers a high standard of medical care, the findings of the present study show that diabetic control is suboptimal. Many factors may account for this, the first and foremost is poor patient compliance with treatment. In addition, others factors are lifestyle modifications and long wait times in the hospital appointment system, because the hospital does not have a well defined population and it offers medical care to all Saudis. Knowledge and application of published guidelines of diabetes management may not be optimal, which may also explain the poor control. Many earlier studies have reported similar findings [40-42].

Glycemic control in females was found to be significantly better than males in discordance to other [43]. This feature could be a local phenomenon as other studies found that sex was not associated with glycemic control [44]. Age was another factor that affected diabetic control significantly because the older age group was worse controlled compared to younger age groups. There was a significant correlation between age and HbA1c, r=0.15, p<0.0001.Moreover, older age group had achieved better HbA1c goal.

Optimal glycemic control attainment in clinical practice is difficult and the reasons for its poor control are complex. Both modifiable and non-modifiable factors shape glycemic control's etiology and affect the extent of poor glycemic control in T2DM patients [45]. Factors identified in influencing glycemic control include age, sex, education, marital status, BMI, smoking, diabetes duration, and type of medications [46]. However, it has been proved difficult to confirm exactly which of these factors are most directly associated with poor glycemic control [47]. This is because the prior findings are inconsistent, and have also indicated that glycemic control and the factors influencing it vary across countries and between different ethnic groups [48, 49]. There is, therefore, an obvious need for better understanding of the factors affecting glycemic control so that diabetes management can be improved [50].

The Global Burden of Disease 2010 study found that elevated BMI was the leading risk factor for disability-adjusted life years in the Kingdom of Saudi Arabia. Previous studies in Saudi Arabia indicate an increasing trend in the prevalence of obesity. Data from the late 1980s through mid-1990s show a prevalence of obesity averaging about 20% ranging from as low as 13.1% among men to as high as 26.6% among women. However, all prevalence estimates from 1995 and beyond are above 35% [39, 51-53]. Obesity is another important modifiable factor influencing poor glycemic control and diabetes risk [11]. Prior researches have reported that the glycemic control of patients with T2DM generally deteriorates when they gain weight, and improves when they lose weight [54-58]. Low BMI is associated with lower levels of HbA1c. The present research agrees with previous findings regarding the higher likelihood of poorly controlled T2DM among obese patients [59].

Epidemiological data also show that modest weight loss in patients with diabetes leads to a reduction in mortality [60, 61]. Therefore, it is plausible, not only that obesity is a risk factor for diabetes, but that obesity is also a continuing risk factor for complications in those with established diabetes [62]. Despite insignificant association

between poor glycemic control as reflected by the high HbA1c and higher grade of obesity, in addition, the correlation between HbA1c and BMI was r = - 0.1, p=0.002, the clinical significance of obesity as risk factors for poor glycemic control cannot be excluded because of the small number of patients among the study group and a further study with larger sample size based on prevalence of obesity is recommended. Turner et al. observed that obesity control measures in general practice were not consistent with guidelines. In Australia, 62% of primary health-care outpatients were found to be obese. Therefore, lack of better strategy to manage obesity will further compound the management of these patients [63].

The results of this study have three important implications for national obesity management programs. First, it appears that obesity prevalence rates will almost certainly continue to rise in the Saudi population over the next decade. The rapid aging of the currently very young Saudi population into high-risk older age-groups will maintain the spread between incidence and morbidity into the foreseeable future. Even if incidence rates were flat or declining due to a breakthrough in obesity prevention, prevalence rates would continue to rise. As a result, the health burden due to all types of obesity complications will likely continue. This means that the health care and social service systems should start preparing now to provide the prevention and support services and systems, a large number of adults with obesity are going to require maintaining quality of life. Second, "upstream" population-based primary prevention programs need to be aggressively implemented to ensure that obesity incidence begins to decrease in the future. The dramatically higher rates of obesity in the Saudi population highlight the urgency of this activity. Because obesity appears to be closely related to the adoption by people of many aspects of the modern lifestyle including diet and low levels of physical activity, prevention programs that draw upon Aboriginal traditions and ways of life and that focus on the lifestyle habits of Aboriginal youth need to be implemented. A number of very promising primary prevention programs that draw upon Aboriginal traditions and ways of life have been implemented in our institution. Third, the reason for the higher prevalence of obesity in Saudi women observed in this study also needs to be better understood.

Limitations

The majority of patients who got registered were above 50 years of age. The study sample was not large enough to compute subgroup. Further studies should be conducted in the future with larger sample sizes to allow for subgroup analysis. The study group, also, was derived from one practice in a specific region. Patients seen as potential participants were recruited using convenience sampling, poor recording in the charts which were missing some important variables. Another limitation is that control can be affected by other factors that were not studied here, such as the duration of diabetes. As these data are retrospective it is not possible, from this study alone, to establish causality.

Conclusion

These data indicate that many obese patients with T2DM have poor glycaemic control where they will be at high risk of diabetic complications. More national studies are needed to assess glycemic control among obese diabetic patients in Saudi Arabia.

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