Impact of overweight on Type 1 Diabetes among University Students in Egypt

Gadallah F.A. [1], Gadallah M.A. [2], Ahmed I.Z. [1], El-Sayed E.H. [3]

1- Internal Medicine Department, 2- Community, Environmental and Occupational Medicine Department, Faculty of Medicine , Ain Shams University, Cairo, Egypt
3- Ain Shams University Student's Hospital, Cairo Egypt
e-mail: izomran@yahoo.com

Abstract: Background: Although obesity is not a typical feature of type 1 diabetes mellitus, the world wide trend towards increased body weight is apparent also in these patients. **Aim:** to describe glycemic control, prevalence of complications and the impact of overweight in a sample of Egyptian university students with type 1 diabetes. **Methods**: A cross-sectional study was conducted on 150 university students with Type 1 Diabetes. They were questioned for diabetes duration, control, complications and life style including diet and exercise. Assessment of anthropometric measures, glycemic control, and complications of diabetes were done. **Results**: Obese diabetic students represented ***14%*** of the studied population; ***37.3%*** were overweight and ***48.7%*** were of normal weight. High fasting blood glucose was found in ***74.7 %*** of the studied population, high post prandial blood glucose in ***85.3%,*** high HbA1c levels in ***78.7%*** and, ***63.3%*** were uncontrolled for the three parameters. The microvascular complications were: neuropathy ***(71.3%),*** retinopathy ***(10%)*** and nephropathy ***(13.3%).*** Body mass index >30kg/m2 was an independent predictor of the microvascular complications ***(p<0.01).*** Hypertension was present in ***22%*** while ***14%*** had dyslipidemia. **Conclusion**: The diabetic complications were more prevalent among obese as compared to overweight and normal weight subjects although the glycemic control showed statistically insignificant difference. [Nature and Science 2010;8(8):52-59]. (ISSN: 1545-0740).

Key words*:* type 1 diabetes, overweight, obese, students, young adults, complications.

Introduction: The loss of quality life-years for those with type 1 diabetes is great due to the early onset and great degree of glycemic exposure. The substantial risk of morbidity and early mortality is due to the complications, which are numerous and affect the macro- and microvasculature ***[1]***.

The prevalence of overweight and obesity in most developed countries and in urban areas of many less developed countries has been increasing markedly over the past twenty years ***[2].*** Obesity among young adults has reached alarming levels, 20-25% are overweight or obese **[3].**Obesity is not generally considered a typical feature of type 1 DM (T1DM), but the world wide trend towards increased body weight is apparent in these patients ***[4].*** Although the information about the prevalence of obesity in those with T1DM is limited, the burden of the concurrent problems of obesity and T1DM can have notable medical, psychological, and social implications for both patients and their families ***[5].***The impact of overweight on chronic micro vascular complications in T1DM is of a significant concern**.** The retinopathy & neuropathy are related to glycemic control as well as to high blood pressure and raised body mass index ***[6].***

Extensive data are available on the occurrence of type 1 diabetes in globally diverse populations ***[7].***However, little is known about the geographic variation in complication rates, and little of what is known has been explained ***[1].*** Geographic variation in the complications of type 1 diabetes may reflect the socioeconomic status and health care performance of countries around the world ***[8].***

The aim of this study: is to describe glycemic control, prevalence of complications and the impact of overweight in a sample of Egyptian university students with type 1 diabetes.

Materials and methods: A cross-sectional study was conducted on a group of Ain Shams University students, 150 students known to have type 1 diabetes mellitus, aged from 16-22 years. The study was approved by the Research Ethics Committee at Faculty of Medicine, Ain Shams University. All patients were subjected to a questionnaire for diabetes including duration, insulin dose and timing, complications of diabetes mellitus. A complete medical history was taken with special attention on dietary habits, details of physical activity, and details of patient's life style and the presence of any psychological troubles or complications related to obesity.

All patients were subjected to complete physical examination with special attention to: Body Mass Index (wt [kg] /height [m²]). Blood pressure measurement, hypertension was defined as blood pressure >130/85 mmHg or active antihypertensive medication intake by the patient. Fundus examination was done using ophthalmoscope to detect the presence of diabetic retinopathy. Urine sample was collected from each patient for assay of microalbuminuria, which was analyzed by immuno turbidimetry. Careful examinations of the lower extremities, to detect skin infections and nail diseases. Examination of peripheral sensation was done using 128 MHz tuning fork at the base of the big toe to detect the presence of diabetic neuropathy.

Laboratory studies: Venous blood was collected from each patient. Two ml were taken in a fluoride containing tube for the assay of fasting plasma glucose; 2 ml were taken in another fluoride containing tube for the assay of postprandial blood glucose. One was taken on EDTA containing tube for the assay of glycated hemoglobin and 3 ml were taken in a dry tube for the assay of serum cholesterol, serum triglycerides and serum creatinine. All the analytes were done using 5010 Semi-Automated analyzer. Serum cholesterol and serum triglycerides ware analyzed after 12 hours overnight fasting ***[9].***

Statistical methods

The data was analyzed with the program (SPSS) statistical package for social science under windows version 11. Description of quantitative variables was as mean and standard deviation, qualitative variables as number and percentage. Chi-square test was used to compare groups for qualitative data. Logistic regression model was used to find out the most important independent predictors of certain variables using Backward likelihood method.

Results: The first presentation of type 1 diabetes was ketosis in ***64 %*** of cases and classical symptoms of diabetes in ***36 %*** of cases. Overweight diabetic patients *(BMI 25- 29.99 kg/m²)* represent ***37.3%*** of the studied population, obese *(BMI ≥ 30 kg/m²)* are ***14%*** and the remaining ***48.7%*** are of normal bodyweight *(BMI 18 - 24.99 kg/m²)*. Most of the patients do not follow a proper diet; they depend on high carbohydrate diet and fast food, also they are reluctant to do physical exercise. Only ***13.2%*** of the studied population are on a proper diet for diabetes compared to ***86.8%*** with improper diet ***(x2=13.9, p value < 0.01)***. Also ***15.7%*** of these patients are on regular physical exercise, ***38.2%*** do not perform any exercise while ***46.1%*** are on irregular physical exercise (***x2= 0.8, p value >0.05)***. Of the whole population ***33.3%*** have psychological troubles (anxiety and/or depression) while ***66.7%*** do not have any psychological problems ***(x2= 16.6, p value <0.01)***.

The majority of the students with type I DM are not achieving adequate glycemic control. FBG levels are high in 112 student (***74.7% of the studied population)***, 128 student ***(85.3%)*** show high levels of post prandial blood glucose and 118 student ***(78.7%)*** show high HbA1c levels. All three parameters are controlled among only 9 students ***(6% of studied population)*** in contrast to 95 students ***(63.3%)*** who are uncontrolled for the three parameters. Although FBG and post prandial blood glucose are elevated in ***(90.5%)*** of obese subjects and ***(75%, 87.5%, respectively)*** of overweight subjects compared to ***(69.9%, 82.2%, respectively)*** of those with normal BMI, the difference is not statistically significant ***(x2=3.6, P>0.05 and x2= 1.2, P>0.05, respectively)***. Also HbA1c is elevated in ***(95.2%)*** of obese subjects compared to ***(75%)*** in overweight and ***(76.7%)*** in normal weight subjects, again this is statistically insignificant (***x2=4***, ***P>0.05***)

Hypercholestrolemia is prevalent among ***28.6%*** while hypertriglyceridemia among ***20.8%*** of the overweight and obese subjects compared to ***5.5%*** and ***4.1%*** of normal weight subjects, respectively ***(x2= 13.9, 9.4, respectively)*** with highly significant statistical difference ***(p<0.01)***. The difference between overweight and obese students is found to be statistically insignificant ***(p> 0.05)***. Serum creatinine show elevation in ***13%*** of the obese and overweight subjects compared to ***0%*** of the normal weight subjects ***(x2=10.7, p<0.01)***

As regards the diabetic complications, they are prevalent in the studied sample **(figure 1)** and the highest encountered complication is neuropathy which is present in ***71.3%*** of the studied subjects**.** When relating the diabetic complications to BMI, it is found that the complications are more prevalent among obese subjects compared to overweight and normal weight subjects **(table 1 and figure 2).** Moreover, complications of obesity including dyslipidemia, gynecomastia, menstrual irregularities, acne vulgaris, gall bladder and psychological troubles are more prevalent in overweight and obese students compared to normal weight students ***(p value<0.01 which is highly significant except for gall bladder diseases, p value >0.05 which is statistically insignificant)*** **.** Comparing obese and

overweight students only psychological troubles and hypertension are significantly more prevalent in obese ones ***(x2=5.3, 5.2, respectively, p value <0.05)***.

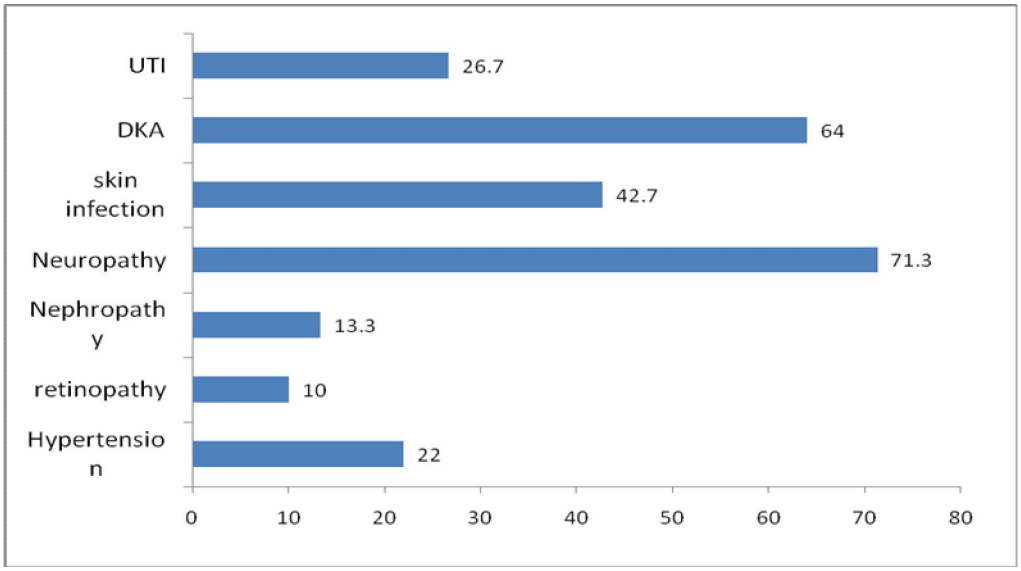

Figure (1): prevalence of complications of DM among studied Patients

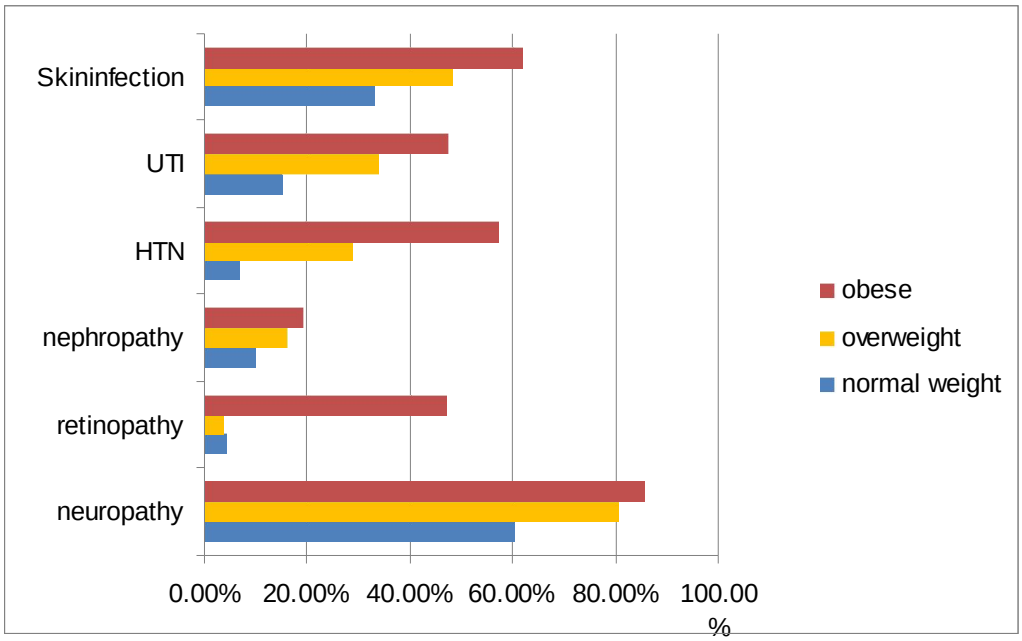

Figure 2: prevalence of complications of DM among studied students in relation to BMI

Table (1): prevalence of complications of DM among students in relation to BMI

	Normal	Overweight	Obese	X2	P value
	n (%)				
Skin infections	24 (32.9)	27 (48.2)	13 (**61.9)**	6.7	**<0.05***
Urinary tract infection	11(15.1)	19 (33.9)	10 **(47.6)**	11.2	**<0.01****
DKA	45 (61.6)	39 (69.6)	12 (57.1)	1.3	>0.05***
Hypertension	5 (6.8)	16 (28.6)	12 (**57.1)**	26.2	**<0.01****
Retinopathy	3 (4.1)	2 (3.6)	10 (**47.6)**	38.4	**<0.01****
Nephropathy	7 (9.6)	9 (16.1)	4 (19.0)	1.8	>0.05***
Neuropathy	44 (60.3)	45 (80.4)	18 (**85.7)**	8.7	**<0.05***

n: number, DKA: diabetic ketoacidosis, *P<0.05 Significant, **P<0.01 Highly significant, ***P>0.05 insignificant

Table (2): Relation between control of HBA1c and complications of type 1 DM.

HBA1c Complications of DM	Controlled n(32)	Un controlled n(118)	X^2	P
	n (%)			
Skin infection	9 (28.1)	55 **(46.6)**	3.8	**<0.05***
Urinary tract infection	6 (18.8)	34 (28.8)	1.3	>0.05**
Diabetic ketoacidosis	21 (65.6)	75 (63.6)	0.04	>0.05**
Hypertension	5 (15.6)	28 (23.7)	0.9	>0.05**
Retinopathy	3 (9.4)	12 (10.2)	0.01	>0.05**
Nephropathy	2 (6.3)	18 (15.3)	1.7	>0.05**
Neuropathy	21(65.6)	86 (72.9)	0.6	>0.05**

n: number * P<0.05 Significant ** P>0.05 insignificant

Table (3): Relation between duration of the disease and complications of type 1 DM.

Duration DM Complications of DM	**≤8 years n(83)**	**> 8years n(67)**	X^2	P
	n (%)			
Skin infection	40 (48.2)	24 (35.8)	2.3	>0.05*
Urinary tract infection	25 (30.1)	15 (22.4)	1.1	>0.05*
Diabetic ketoacidosis	42 (50.6)	54 (**80.6)**	14.4	**<0.01****
Hypertension	19 (22.9)	14 (20.9)	0.08	>0.05*
Retinopathy	7 (8.4)	8 (11.9)	0.5	>0.05*
Nephropathy	12 (14.5)	8 (11.9)	0.2	>0.05*
Neuropathy	58 (69.9)	49 (73.1)	0.1	>0.05*

n: number * P>0.05 insignificant ** P<0.01 highly significant

The relation of control of HBA1c and the duration of diabetes to complications of type 1 DM is shown in **tables 2 and 3**, respectively. Multivariate analysis showed that male sex, BMI>30kg/m2 and hypertension are independent risk factors ***(β= 0.12, 0.29, 0.37, respectively, p value <0.05, <0.01, <0.01 respectively)*** of retinopathy, neuropathy and diabetic nephropathy while dyslipidemia was found to be an independent risk factor for retinopathy and neuropathy only ***(β=0.45, p value <0.01)***.

Discussion: Many of the diabetes-related tasks can interfere with the young adult's drive for independence and peer acceptance. Young adults may neglect monitoring, dietary considerations, insulin administration and even visit to the clinic to avoid drawing attention to their illness. These actions can lead to chronically high blood glucose levels that can cause the early onset of complications ***[10]***.In the current study; it was found that the majority of the students with type 1 diabetes (94%), whether obese, overweight or normal were not achieving adequate glycemic control, placing them at high risk of micro vascular complications. This poor glycemic control could be explained by several factors including: 1)Dietary habits: the subjects in this study depend in their diet on high carbohydrate diet and fast food which lead to marked elevation in blood glucose level. **2) Sedentary behavior and lack of physical exercise**. **3) Psychological factors:** young adults with diabetes suffer from serious psychological problems more frequently than their non-diabetic peers. These problems include anxiety, depression and lack of adherence and usually lead to chronically elevated blood glucose levels.

A previous study found that there is an increase in the prevalence of diabetes in developing countries associated with poor control most probably, due to the lifestyle changes ***[11].*** The poor glycemic control may also be due to under insulinization, lack of adherence, depression, or poor understanding of required health care behavior on the part of the adolescent ***[12]***. Moreover, a higher prevalence of uncontrolled HbA1c was noted among overweight cases but the difference was not significant between overweight and normal weight subjects with type 1 diabetes ***[6].***

The current study reveals a high prevalence of acute and chronic micro- and macro vascular complications in students with type 1 DM. The cause is unclear. Although glycemic control did not differ significantly between obese and non obese subjects, there was a higher prevalence of skin infections among cases with high HbA1c

compared to controlled cases.

The prevalence of neuropathy among all studied subjects was 71.3 %, which is higher in relation to the overall prevalence of neuropathy recorded by the EURODIAB IDDM Complications Study, which was 28 %. It was found that diabetic polyneuropathy was related to age, diabetes duration, HbA1c and insulin use ***[13]*** thus the higher prevalence of polyneuropathy among Egyptian students with type 1 DM is most probably due to the high HbA1c (78.7%) of the studied population. The obese students show the highest prevalence of neuropathy (85.7%). Obesity together with dyslipidemia, hypertension and male sex are independent predictors of neuropathy in the current study. Another study also reported in their prospective study that apart from glycemic control, the incidence of neuropathy is associated with potentially modifiable cardiovascular risk factors, including a raised triglyceride level, body-mass index, smoking, and hypertension ***[14]***. In contrast, a study which included studied 592 adults with type 1 DM with a mean age of 41± 12 years, mean diabetes duration of 19±11 years and an average HbA1c of 7.9±1.1percentage showed that diabetes duration and HbA1c remain the main independent determinants of neuropathy but not BMI ***[6].***

The prevalence of retinopathy in the current study was 10 %, which is low in relation to that recorded by the DCCT epidemiological data, which mentioned that retinopathy is present in 34-42 % of adolescents ***[15].***It was confirmed that retinopathy develops in approximately 10% of patients with type 1 diabetes under good metabolic control, whereas > 40% of patients with type 1 diabetes remain free of retinopathy despite poor metabolic control ***[16].*** After adjusting for metabolic control and duration of participation in the study, it was found that previous glycemic exposure (HbA1c) and BMI may provide a possible explanation to such paradoxical clinical situations. This is true in the current study, where the obese students have the highest prevalence of retinopathy (47.6%) compared to overweight (3.6%) and normal weight (4.1%) subjects. Moreover, obesity is an independent predictor of retinopathy in our study ***(ß= 0.29 p value < 0.01)***; hypertension, dyslipidemia and male sex appear also to play independent roles (***ß= 0.37, 0.45 and 0.12, respectively, p value <0.01)***. It was also observed that time to develop retinopathy was related to high HbA1c and high BMI ***[17].*** The patients with retinopathy had longer diabetes duration, a higher BMI, and a worse lipid profile ***[6]***. In a cross-sectional, multicenter hospital-based study, 21% of 347 patients with type 1 diabetes had diabetic retinopathy. The authors found the factors independently associated with diabetic retinopathy after adjustment for other factors were the duration of diabetes and the serum creatinine ***[18].***

In the current study, the prevalence of nephropathy was 13.3 %. It is stated that nephropathy occurs in 15-40%, with a peak incidence around 15-20 years of diabetes ***[19],*** it explains the lower prevalence in our study as the mean of diabetes duration was 8.23 years. Obese students showed higher prevalence of nephropathy than overweight and normal weight subjects but the difference was not statistically significant. In spite of this, obesity is an independent predictor of nephropathy together with hypertension and male sex.

Hypertension was present in 22 % of the studied population. There is a higher prevalence among obese cases 57.1 % when compared to the overweight cases 28.6 % and normal weight cases 6.8 % .The difference is highly statistically significant. This confirms the previous results that stated that hypertension was more prevalent in overweight than normal weight subjects ***[6].*** In type 1 diabetic patients a higher BMI is associated with hypertension and an atherogenic lipid profile ***[20].***

The spectrum and prevalence of atherogenic risk factors in young adults with type 1 Diabetes Mellitus have been studied, in the current study, there is a higher prevalence of elevated cholesterol among overweight and obese students (28.6%) compared to 5.5% among normal weight students. Also, there is a higher prevalence of elevated triglycerides among overweight and obese cases (20.8%) compared to 4.1% among normal weight students. The cardiovascular risk factors were observed in patients with type 1 DM namely obesity, hypertension, dyslipidemia, poor glycemic control and smoking ***[21].***

The high prevalence of micro-vascular complications among obese diabetics is most probably due to the adipocytokines; which are produced by adipose tissues; have biological activities on the vascular system and may affect diabetic microangiopathy ***[22].***

Conclusion: The studied population had overall good educational level, fair socio-economic status,

and the capability of being followed-up by specialists of diabetes, however it failed to achieve adequate glycemic control and there was a high prevalence of complications. The glycemic control did not differ between normal weight and obese or overweight subjects. The diabetic micro and macrovascular complications were significantly affected by elevated BMI.

These results clearly show that major efforts are needed to improve quality of care in Egyptian students with type 1 diabetes. We also suggest that lines of treatment of obesity according to the body mass index should be revised to be at lower values in patients with type 1 diabetes than the non diabetic subjects.

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Correspondence to:
Iman Zaky Ahmed
Endocrinology Unit, Internal Medicine Department- Ain Shams University
Cairo, Egypt
Telephone: 202 24025186 ; 202 44786848
Cellular phone: +2 0145700758
Emails:izomran@yahoo.com;

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Fadila Ahmed Gadallah
Professor of Internal Medicine and Endocrinology, Faculty of Medicine, Ain Shams University, Cairo , Egypt
MD Internal Medicine.
MD Endocrinology and Metabolism.

Iman Zaky Ahmed
Lecturer of Internal Medicine and Endocrinology, Faculty of Medicine, Ain Shams University, Cairo, Egypt.
MD Internal Medicine
First Part Master degree of Endocrinology