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Research Article

Most Effiecnt Factors Affecting Glycemic Control of Type II Diabetic Patients Attending Suez Canal University Hospitals in Egypt Applying Stepwise Regression

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Abstract

Background: Glycemic control is a very important instrument that prevents or delays the complications associated with type 2 diabetes mellitus.

Aim of the study: to assess factors affecting glycemic control among type 2 diabetic patients attending Suez Canal University Hospitals in Egypt.

Design: A cross-sectional analytic design was employed in this study.

Setting: this study was conducted at the diabetic and the family medicine outpatient clinics of Suez Canal University Hospitals in Ismailia city, Egypt.

Sample: included 92 type 2 diabetic patients who were selected using purposive sampling technique.

Tools of data collection: A structured interviewing questionnaire about socio-demographic, diabetes history, and clinical characteristics was used to collect data and measurement of blood glucose control through glycated hemoglobin.

Results: Of the total 92 participants, less than two thirds of the participants had poor glycemic control. The differences regarding age, total socio-economic score, duration of the previous diagnosis of diabetes and body mass index between the two groups were not significant. Presence of hypoglycemic attacks and presence of previous surgical history were associated with glycemic control.

Conclusion: Presence of hypoglycemic attacks increases; it affects the normal values of HbA1c negatively while presence of previous surgical history increases; it affects the normal values of HbA1c positively. Recommendations: applying educational program on managing glycemic control and associated factors for type 2 diabetic patients using understandable methods and further researches should be conducted to improve glycemic control for type 2 diabetic patients.

Keywords: Diabetes mellitus; Type 2 diabetes mellitus; Glycemic control

Introduction

Type 2 Diabetes Mellitus (T2DM) is a heterogeneous and progressive illness, with an underlying mechanism ranging from predominantly insulin resistance with relative insulin deficiency, to predominantly an insulin secretory defect with lesser degrees of insulin resistance. The spread of T2DM is increasing all over the world, probably due to the expectations of population's long life, a sedentary lifestyle and above all, the increasing rates of obesity. There are two sub-divisions of T2DM. The "Non-Insulin Requiring" diabetes, managed by lifestyle measures alone and sometimes oral drugs, and the "Insulin requiring for diabetes control", where insulin is required to control, rather than survival [1].

A recent study proved that the uncontrolled diabetes, particularly elevated blood sugar over a prolonged period of time could lead to a number of short and long-term health complications.

Such complications were divided traditionally into two main subtypes: the diabetes specific micro-vascular complications of retinopathy, nephropathy, and neuropathy; which were caused by injuries to the small blood vessels; in addition the thrombotic macro-vascular complications of myocardial infraction, hypertension, and peripheral arterial disease which were presented due to arterial damage [2].

Glycemic control is extremely fundamental to the management of T2DM. Diabetes management aims to delay, the onset of disease complications, and to hinder its progression, mostly by improving glycemic control and controlling the risk of cardiovascular ailments. Previous studies have provided evidences of the potential of good glycemic control to restrict the micro-vascular and macro-vascular complications of long-suffering diabetic enduring patients [3]. However, majority of the Egyptian diabetic patients cannot maintain their blood glucose at therapeutic and acceptable level. Therefore, there is a need to assess factors affecting glycemic control among type 2 diabetic patients at the local level.

Subjects and Methods

This study was carried out at the Family Medicine Outpatient Clinic and the Endocrine (Diabetic) Outpatient Clinic of Suez Canal University Hospitals at Ismailia city, Egypt. Those two clinics provide research, preventive and curative services according to the patients' condition. A cross-sectional analytic design was employed including 92 type 2 diabetic patients who were selected using purposive sampling technique in which every participant was included by the following criteria: patients Newly diagnosed with type 2 diabetic accepted to participate in the study; aged 30 years or older; treated with diet regimen and /or oral hypoglycemic agents only; and. Data were collected over a period of three months (from November 2018 to January 2019).

Data were collected through the use of two tools: first tool: A structured- interview questionnaire which was developed by the researcher and included socio-demographic knowledge such as gender, age, educational level, occupational status, and residence; Socio-economic scale which was developed by El-Gilany et al. [4] which included 7 domains with a total score of 84. Socio-economic level was classified into very low, low, middle and high levels depending on the quartiles of the score calculated to assess socio-economic status; and Diabetes history and clinical characteristics such as Duration of the previous diagnosis of diabetes, family history of diabetes, presence of diabetes related complications, presence of previous surgical history, presence of hypoglycemia, smoking status, following a planned diet, physical activity regularity, glucose monitoring regularity, treatment regimen, medication adherence and regular follow up. Second tool: Physical assessment sheet: This tool included Anthropometric measurements like (height, weight, and body mass index), measurement of blood glucose control through glycated hemoglobin (HbA1c) level.

Data collected were first coded and analysis was performed using the Statistical Package for Social Sciences version 22, (SPSS Inc., and Chicago, IL). Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means & standard deviations for quantitative variables as well as inferential statistics. Stepwise Regression (Forward Selection regression model) was used to select the most essential independent explanatory variables -in participants and under their specific situations- that proved they will affect the best fitted model and consequently the final prediction equation. Hence, the goal is to produce a good prediction equation with least number of explanatory/independent variables (X-variables). The concept of parsimony herein can be explained as the ability to produce the most outcomes with fewer numbers of parameters. The criteria are the higher absolute statistical t-value and presence of significance for the resultant model-chosen-parameters (β-coefficient). The list of X-variables that is thought they make sense (paper hypothesis), but for many reasons they are too many to be included in the final model. Variables Chosen/Entered according to Stepwise Regression analysis were the "Presence of hypoglycemic attacks" (Model 1) and the "Presence of previous surgical history" (both in Model 2). Values are considered as statistically significant at $P\alpha < 0.05$.

Ethical considerations:

I. The researcher has considered all ethical issues.

II. The researcher has informed, verbally, of the consents once elucidative the aim of the study.

III. The researcher assured confidentiality of the data obtained for the participants and confirmed their rights to withdraw at any time they want throughout the study.

Results

More than two thirds of the participants (68.5%) were females, likewise slightly less than two thirds of them (64.1%) were in age group (45-64 years) and their mean age was 49.76 ± 9.19 years. Moreover, about two fifth of them (42.4%) were illiterate, less than two thirds were unemployed (63.0%; non-working) furthermore, more than two thirds (68.5%) came from urban areas (Table 1). However, Figure 1 illustrated that more than half of the participants (56.5 %) were of low socio-economic status level (i.e., their scores was 22 – 42); whereas least fraction (the minority of them) (3.3 %) were of very low socio-economic status level (i.e., their score was ≤ 21).

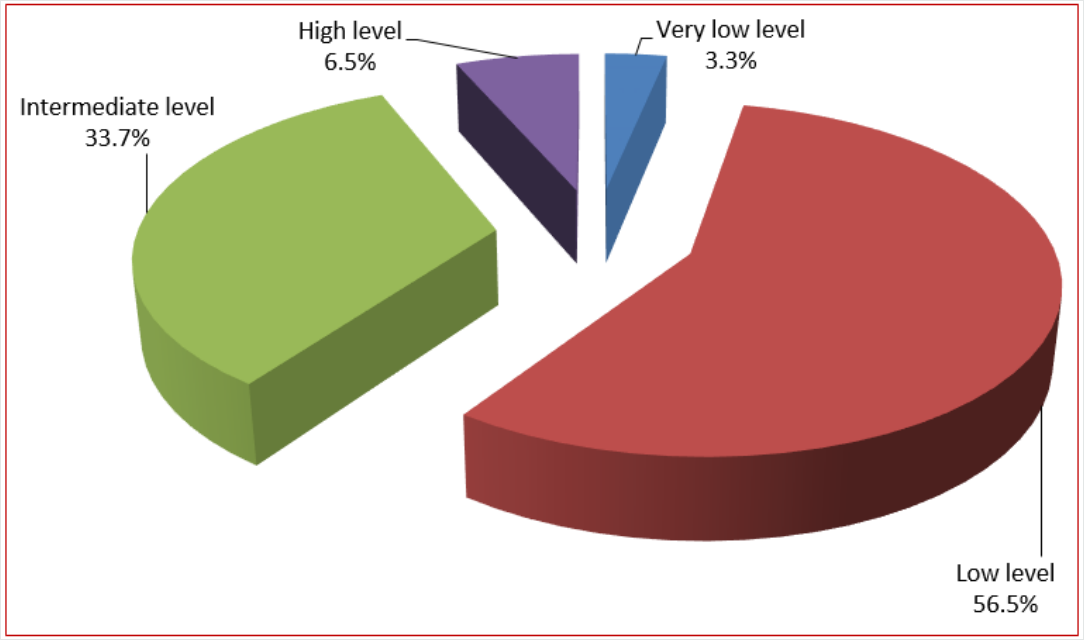

Figure 1: Percentage distribution of the participants by their socio-economic levels (n= 92).
Socio-economic status levels; very low level ≤ 21, low level 22 – 42, intermediate level 43 – 63, and high level 64 – up to 84.

Table 1: Frequency Distribution of the participants according to their socio-demographic characteristics (n= 92).

Variables	No.	%
Gender		
Male	29	31.5
Female	63	68.5
Age groups (years)		
30-	27	29.3
45-	59	64.1
>=65	6	6.5
Mean ± SD	49.76 ± 9.19	
Educational level		
Illiterate	39	42.4
Basic education	8	8.7
Secondary education	19	20.7
Intermediate education	2	2.2
Higher education	24	26.1
Occupational status		
Non-working	58	63
Unskilled	1	1.1
Skilled	1	1.1
Business	11	12
Clerk	14	15.2
Professional	7	7.6
Residence		
Rural	29	31.5
Urban	63	68.5

SD: Standard deviation

As far to distribution of the participants according to their diabetes history (Table 2), half of the participants (54.3%) diagnosed diabetic on or after two years& up to five years)mean 2.58 ± 1.85 years); two thirds of the participants had positive family history of diabetes (66.3%) and less than half of them suffered from diabetic complications(45.7%). In addition, more than half of them (53.3%) had comorbid diseases. Regarding hypoglycemia, roughly two fifth (43.5%) of them had none or rare attacks and more than half (56.5%) of them had previous surgical history. Figure 2 illustrates that less than two thirds (60.9%) of the participants were obese (BMI = ≥ 30 kg/m^2) while the minority of them (8.7%) were normal weight (20- 24.9 kg/m^2).

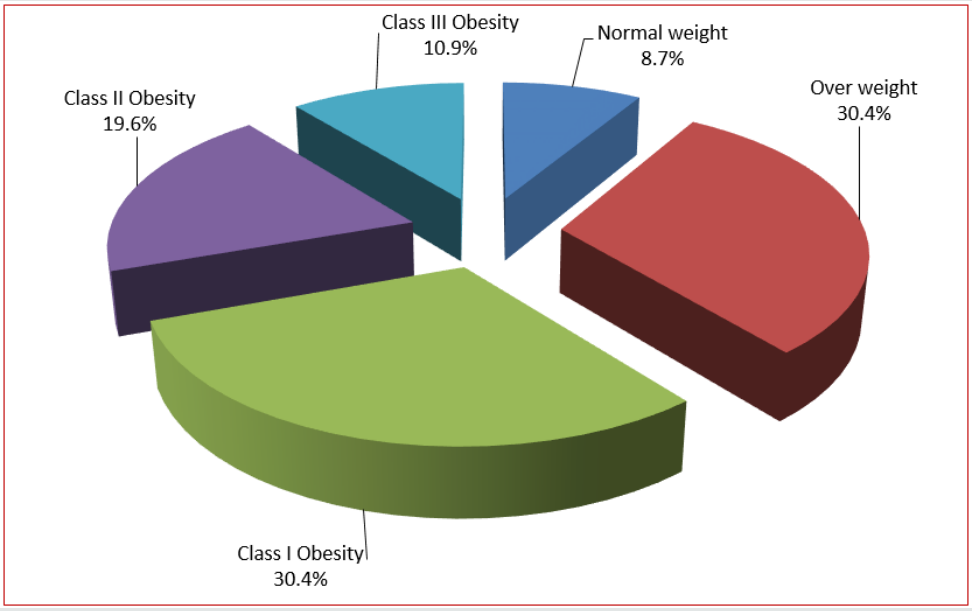

Figure 2: Distribution of the participants according to body mass index (n=92).

This index was used to categorize participants into: Underweight; < 18.5 kg/m^2, Normal weight; 18.5 –24.9 kg/m^2, Over weight; 25-29.9 kg/m^2, Class I Obesity; 30-34.9 kg/m^2, Class II Obesity; 35-39.9 kg/m^2, Class III Obesity; > 40 kg /m^2.

Table 2: Frequency Distribution of the participants according to their diabetes history (n= 92).

Variables	No.	%
Duration of the previous diagnosis of diabetes (years)		
≤ 2	42	45.7
5-Feb	50	54.3
Mean ± SD	2.58 ± 1.85	
Family history of diabetes		
Yes	61	66.3
No	31	33.7
Presence of diabetes related complications		
Yes	42	45.7
No	13	14.1
Don't know	37	40.2
Presence of comorbid diseases		
Yes	49	53.3
No	43	46.7
Presence of hypoglycemic attacks		
Frequent attacks	17	18.5

Rarely occurrence	40	43.5
Not occurred	35	38
Presence of previous surgical history		
Yes	52	56.5
No	40	43.5

SD: Standard deviation

With regard to the distribution of the participants according to their clinical characteristics (Table 3), more than half of the participants (57.6 %) were nonsmokers; 96.7% taken oral hypoglycemic treatment regimen, and the majority (87.0%) were adherent to medication. As regards to glucose monitoring, more than half of them (51.1%) have had checked their blood glucose level regularly. Approximately and surprisengly, the vast majority (94.6%) of them were not following planned diet regimen, more than three quarters (76.1%) did not practice at any regular physical activities though more than half (55.4%) of them were stand firm by themselves to regular follow up schedule. On the contorary,) illustrated that less than two thirds (65.2%) of the participants had poor glycemic control (HbA1c >7%; Figure 3).

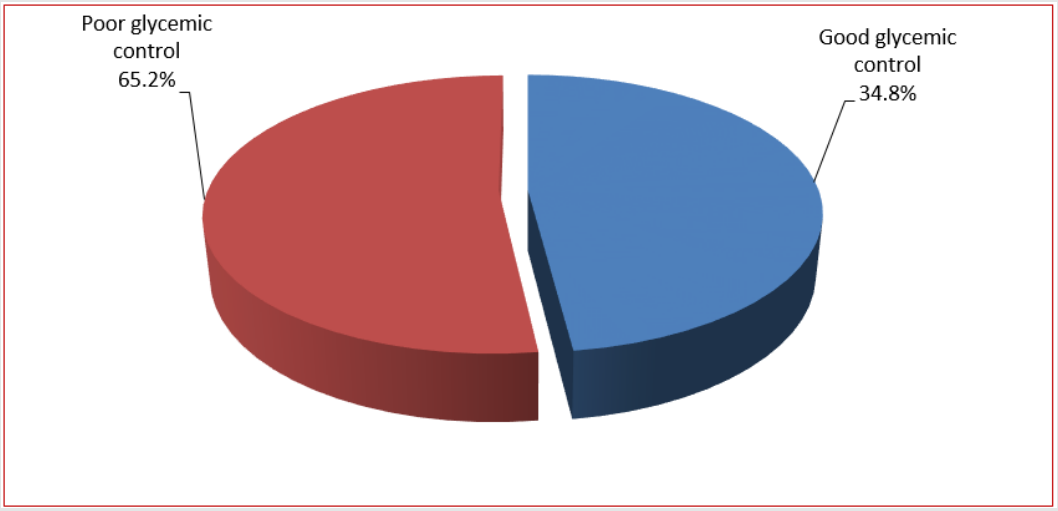

Figure 3: Distribution of the participants according to glycemic control (HbA1c level) (n=92).
Glycemic control; Good control ≤ 7%, while Poor control > 7%.

Table 3: Frequency Distribution of the participants according to their clinical characteristics (n= 92).

Variables	No.	%
Smoking status		
Smoker	7	7.6
Negative smoker	29	31.5
Previous smoker	3	3.3
Non smoker	53	57.6
Treatment regimen		
There is no medical treatment	3	3.3
Oral hypoglycemic agents	89	96.7
Medication adherence		
Yes	80	87
No	12	13
Glucose monitoring regularity		
Yes	47	51.1
No	45	48.9

Following planned diet regimen		
Yes	5	5.4
No	87	94.6
Physical activity regularity		
Yes	22	23.9
No	70	76.1
Regular follow up		
Never	2	2.2
Only when feeling tired	32	34.8
Once every 3 months	7	7.6
Monthly	51	55.4

However, due to sample size eccentricities, statistical analysis revealed non-significant differences regarding age, total socio-economic scores, duration of the previous diagnosis of diabetes and body mass index between the two groups (i.e. good glycemic control and poor glycemic control; Table 4).

Table 4: Baseline characteristics of the participants according to glycemic control (n=92).

Variables	Good glycemic control (n=32)		Poor glycemic control (n=60)		t- test	p-value
	Mean	SD	Mean	SD		
Age (years)	50.09	8.51	49.58	9.6	0.252	0.8
Total Socio-economic score (Total SES)	42.84	13.28	40.33	13.57	0.852	0.4
Duration of the previous diagnosis of diabetes (years)	2.63	1.6	2.56	1.99	0.175	0.86
Body Mass Index (Kg/m^2)	32.53	5.65	32.35	6.01	0.14	0.89

Concerning outputs of stepwise regression analysis, Table 5 displayed the excluded variables (i.e. Gender; Follow-up visits; Smoking status) from the list of X-variables that is thought they make sense (paper hypothesis) in affecting Dependent Variable: (Glycated hemoglobin, HbA1c% level) of type 2 diabetic patients attending the family outpatient clinic and the diabetic outpatient clinic of Suez Canal University Hospitals, Ismailia, Egypt. Results revealed that First: the absolute values of t-test are smaller than those of the chosen variables and second: those excluded variables are not statistically t-test significant. P-value ranged between 0.107 to 0.694). Pertaining to regression diagnostics, it was found that these X-variables have tolerance reached unity or close to unity causing Variance Inflation Factor (VIF) to reach 10 or more. These Variance Inflation Factor (VIF), are far from 5 (optimum VIF value according to data) to be noncollinear. These outputs are evidences of severe collinearity or in other words the omitted X-variables are dependent or they somehow are related to each other, perhaps because they express the opinion of definite/an explicit respondent which makes them express their interconnected specific judgments/outlooks.

Table 5: Excluded Variables a from the list of X-variables that is thought they make sense in affecting Dependent Variable: (Glycated haemoglobin HbA1c% level) of type 2 diabetic patients attending the family outpatient clinic and the diabetic outpatient clinic of Suez Canal University Hospitals, Ismailia, Egypt.

Predictor	Beta	T	Sig	Collinearity Statistics (Tolerance)	Variance Inflation Factor (VIF)
Gender	-0.155	-1.508	0.135	0.99	10.1
Follow-up visits	-0.041	-0.395	0.694	1	10
Smoking status	0.166	1.626	0.107	1	10

a. Dependent Variable: Glycated hemoglobin (HbA1c% level).

However, results of Table 6 could be an interpretation for the entered (i.e. non-expelled qualified) independent variables, as they express no-body opinion (i.e. one of them is a quantitative measure whilst the other is a sort of misfortune/calamity explicitly Presence-Of-Hypoglycemic-Attacks and/or Previous-Surgical-History;-respectively) to such an extent that the effects of these entered variables (models 1& 2) on the percent level of Glycated hemoglobin (HbA1c%) were significant.

Table 6: Analysis of variance of the Entered variables (models 1 & 2) that was realized to influence the percent level of Glycated hemoglobin (HbA1c %).

Model a&b	Sum of Squares	Df	Mean Square	F	p-value	
1	Regression	12.96	1	12.96	4.117	0.04
	Residual	283.329	90	3.148		
	Total	296.289	91			
2	Regression	24.761	2	12.38	4.058	0.02
	Residual	271.528	89	3.051		
	Total	296.289	91			

Table 7: Beta Coefficients Analysis of variance of the Entered variables (models 1& 2) that was realized to influence the percent level of Glycated hemoglobin (HbA1c %) using stepwise regression procedure.

Model		Unstandardized Coefficients		Standardized Coefficients	t-test	p-value
		B	Std. Error	Beta		
1	(Constant)	8.526	0.3		28.428	0
	Presence of hypoglycemic attacks	-0.773	0.381	-0.209	-2.029	0.04
2	(Constant)	8.191	0.341		24.026	0
	Presence of hypoglycemic attacks	-0.901	0.381	-0.244	-2.367	0.02
	Presence of previous surgical history	0.733	0.373	0.203	1.967	0.05

a. Dependent Variable: Glycated hemoglobin (HbA1c) (%) level.

From Results Stepwise Regression (Table 7- Model 2) the best fitted model includes, apart from Constant, Presence of hypoglycemic attacks (t-value= -2.367) and Presence of previous surgical history Predictors (t-value= 1.967). The Glycated hemoglobin (HbA1c %) B-value with Presence of hypoglycemic attacks was negative (-0.901+0.381; adverse relationship). That means that as Presence of hypoglycemic attacks increases; it affects the normal values of HbA1c negatively and vice versa. As for Presence of previous surgical history the relationship was positive (0.733+0.373; progressive relationship). That means that as Presence of previous surgical history increases; it affects the normal values of HbA1c positively.

Discussion

Diabetes self-care has been defined as an evolutionary process of development of knowledge or awareness by learning to survive with the complex nature of the diabetes in a social context. There are seven essential self-care behaviors in people with diabetes which predict good outcomes which are healthy eating, being physically active, monitoring of blood sugar, compliant with medications, good problem-solving skills, healthy coping skills and risk reduction behaviors. These seven behaviors have been found to be positively correlated with good glycemic control, reduction of complications and improvement in quality of life [5] so, this study aimed to assess factors affecting glycemic control among type 2 diabetic patients attending Suez Canal University Hospitals in Egypt. According to socio-demographic characteristics of the studied sample, the current study revealed that more than two thirds of the studied sample were females. This trend is consistent with a number of universal and territorial reports demonstrating higher predominance of T2DM amongst females. This result is concurred moreover with the study conducted in India by Dussa et al. [6] and Mufunda et al. [7] who found that females represented more than two thirds of their studied sample. The study conducted in Egypt by Mostafa [8] also revealed that more than three quarters of their studied sample were females. From the researcher point of view, this result may be due to female haven't concerned with their health because of their excesssive duties.

The former results were inconsistent with, Al-Aboudi et al. [9] who designated that more than three quarters of their studied sample were males, and Berhe et al. [10] who assigned that more than half of their studied sample were males.

As far to age, less than two thirds of the studied samples were in age grouping ranged from 45 to 64 years (mean age 49.76 ± 9.19 years). This demonstrates that pronounced share of the individuals with T2DM diabetes are of middle-age, this result was in agreement with the study titled "Global estimates of diabetes

prevalence for 2013 and projections for 2035 for the IDF Diabetes Atlas" conducted by Guariguata et al. [11] who found that the larger part of people with DM in Africa are less than 60 years of age with the most elevated extent of those aged 40-59 years old. Moreover, this result was in agreement with Mufunda et al. [7] who found that the mean age of their studied sample was 48 years. On the same context, three quarters of the studied sample by Mostafa [8] were 40-60 years in age group)mean age was 52.3 ± 8.7 years) and more than two thirds of Berhe et al. [10] studied samples were within age grouping of (40 to 69 years), but mean age of Al-Aboudi et al. [9] studied sample was 54 ± 9.2 years. From the researcher point of view, this may be due to this age group (middle age) have the highest percentage of work and stress.

Regarding to the marital status, the majority of the participants were married. In addition, approximately two fifth of them were illiterate, less than two thirds were unemployed additionally, more than two thirds of them came from urban areas and less than two thirds of them were nuclear family, these results were in agreement with Megahed [12] who found that less than three quarters of their studied sample were married, more than half of them were uneducated, the majority of them were unemployed, less than two thirds of them were nuclear family and more than half of them were living in urban areas. These results were also in agreement with Mostafa [8] who found that the majority of their studied sample were married, half of them were illiterate, more than three quarters of them were unemployed. However, Abd El Raziek [13] found that less than three quarters of their studied sample were married, less than three quarters of them come from urban area and nearly two fifth of them were illiterate.

As regards to socio-economic status, it was noted that more than half of the participants had low socio-economic status level, this result agreed with Megahed [12] who found that more than three quarters of their study group had low socio-economic status level. This result disagreed with Abd El Raziek [13] who found that nearly two thirds of their studied sample belonged to middle socio-economic status level. From the researcher point of view, this is usually a reflection to the fact that more than two thirds of the studied sample were females and their low educational level gave them no chance for work which in turn lowers their month to month pay and this leading to inadequate fund to use in medical treatment and check up.

As concerning to diabetes history, it was noted that half of the participants diagnosed diabetic from two years up to five years with mean 2.58 ± 1.85 years, this result was inconsistent with Mostafa [8] who found that more than half of their studied sample had DM since (5-15 years). This result also was conflicting with Abd El Raziek [13] who found that half of their studied sample influenced by DM from less than two years. From the researcher point of view, the differences in these studies might be attributed to the differences in the patients' populations and residence.

Regarding to family history of diabetes, it was observed that two thirds of the participants had positive family history of diabetes, this result agreed with Mostafa [8] who found that three quarters of their studied sample had a positive family history of DM. This result also was consistent with Abd El Raziek [13] who found that less than three quarters of their studied sample had a positive family history of DM. From the researcher point of view, this reflects a high role of inheritance of T2DM.

With regard to diabetes related complications, less than half of the participants suffered from diabetic complications, this result was in agreement with Ibrahim [14] who found that half of their studied sample had diabetes complications. This result was in contradiction with Berhe et al. [10] who found that as it were the minority of their studied sample had long term diabetic complication affirmed medically. From the researcher point of view, this may be owing to the dissimilarities in healthcare assets, clinical care, diagnostic criteria and way of life variables. Those patients winning a low pay commonly have a low educational level, low information, and less awareness on how to preserve a great glycemic control leading to these complications.

As concerning to treatment regimen, nearly the entire sample has taken oral hypoglycemic agents by themselves, this result concurred with Karaoui et al. [15] who found that the larger parts of patients were taking oral hypoglycemic agents. This result coming on the same line with Inzucchi et al. [16] who mentioned that metformin remains the optimal drug for monotherapy and its low cost, demonstrated safety record, weight neutrality, and conceivable benefits on cardiovascular outcomes have secured its place as the favored introductory medication choice and in any combination not accomplishing an agreed HbA1c target despite intensive therapy, basal insulin considered as a fundamental component of the treatment technique. This result disagreed with, Megahed [12] who found that less than half of their studied sample have taken oral hypoglycemic agents by themselves.

Regarding to following planned diet regimens, the vast majority of the participants were not following planned diet regimens, this result agreed with, Megahed [12] who found that the vast majority of them were not taking after arranged count calories regimens. From the researcher point of view, this might be owing to the low monthly income amongst majority of the participantsmight restrain their availability and reasonableness of a well-balanced diet and sound nourishment.

In accordance with physical activity, the current study revealed that more than three quarters of the participantsdid not practice physical exercises; this result disagreed with, Megahed [12] who found that the minority of their studied sample did not perform physical activity. From the researcher point of view, this might be clarified by progressed innovation since most of the participantsparticularly females went through their times in

watching TV or snacking and most of them depend on the mean of transportation instead of strolling. It appears moreover that patients with diabetes have not had precise and comprehensive data about advantages of regular work -out and may need basic motivators for physical activity.

The current study revealed that the differences regarding age, total socio-economic score, duration of the previous diagnosis of diabetes and body mass index between the two groups were not significant. These results disagreed with Othman et al. [17] who found that poor glycemic control was more common among patients who were older (>50 years) and increased duration of diabetes (>7 years). These results also disagreed with Tabaei et al. [18] found that age, socioeconomic status and BMI were significantly associated with glycemic control. The reason for the diference between this study and other studies may be the variation in clinical characteristics of the participants.

The present study showed that there was negative association between occurrence of hypoglycemia and the glycated hemoglobin. It was clear that expanded recurrence of hypoglycemic attacks would be related with a lower value of HbA1c This result disagreed with Retornaz et al. [19] who found that there was no association between occurrence of hypoglycemia and HbA1c and they proposed that HbA1c wasn't the satisfactory marker for the detection of hypoglycemia risk.

The present study revealed that there was positive association between presence of previous surgical history and the glycated hemoglobin. On te same line, Yong et al. [20] mentioned that there were relationship between poor glycemic control and poor surgical outcomes.

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