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RESEARCH ARTICLE

PREVELANCE OF GLYCEMIC CONTROL IN EGYPT.

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Abstract

Background:- Diabetes mellitus (DM) is a metabolic disorder characterised by chronic high blood glucose levels with disturbance of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin resistance or both. The global prevalence of DM among adults aged 20–79years would increase from 6.4% (affecting 285 million adults) in 2010 to 7.7% (439 million adults) by 2030. From year 2010 to 2030, there would be a 69% increase in numbers of adults with DM in developing countries and a 20% increase in developed countries. Studies by **(Porapakkham et al.,2008)** and (**Margaret et al.,2013**) the proportions of population affected by DM were increasing inthe countries, which have higher proportion of ageing societies.

The prevalence of diabetes was lowest (8.5%) in the 30–39age group and increased steadily with age to 22.7% for those who were more than 60 years old. Therefore, the burden due to DM is likely to rise steadily in because of population ageing

Results:- Of all patients the percentage of type 1 DM was 35.5% and type 2DM was 64.5% Of all the patients with DM, 56.4% reported the use of oral hypoglycemic agents,(43.6%) insulin with or without combination therapy Assessment of medical history showed that 18.6% of patients had hypertension , 9.6% of patients had dyslipidemia , 8.5% of patients had liver disease (50% fatty liver -20% hepatitis c positive - and10% cirrhosis) ,4.3% of patients had hypothyrodism .and 59% has no association

Conclusion:- the proportion of patients with poor glycemic control was high, which is nearly comparable to that reported from many countries. Longer duration of diabetes, and not adherent to diabetes selfcare management behaviors were associated with poor glycemic control. An educational program that emphasizes lifestyle modification with importance of adherence to treatment regimen would be of great benefit in poor glycemiccontrol

Introduction:-

Diabetes is a chronic disease associated with significant morbidity and mortality due to specific diabetes-related complications, for examples, microvascular complications (such as retinopathy, nephropathy and neuropathy), macrovascular complications (such as ischemic heart disease, stroke and peripheral vascular disease) and impaired quality of life. **(World Health Organization 2006)**

Diabetes is a major public health problem worldwide. According to World Health Organization, DM is one of the main risk factors for cardiovascular disease worldwide**. (Wild et al .,2004)**.
The number of people with diabetes is increasing as evident from the findings of a series of global estimates of current and predicted future prevalence of diabetes there were 366 million people with diabetes; this was expected to rise to 552 millionby 2030 Most people with diabetes live in low and middle-income countries. International Diabetes Federation (IDF) Diabetes **(whiting etal.,2011).**

Recent epidemiologic study from South East also suggested that that prevalence of DM has increased exponentially in these areas **(Gupta et al .,2008)**

This rising trend is due to many factors such as population growth, population aging, urbanisation and increasing prevalence of obesity and physical inactivity.2 In fact, diabetes is a common illness in the older persons as the prevalence increases with age. Studies by **(Porapakkham et al .,2008)**. the proportions of population affected by DM were increasing inthe countries, which have higher proportion of ageing societies. **(Margaret et al .,2009).**

The prevalence of diabetes was lowest (8.5%) in the 30–39age group and increased steadily with age to 22.7% for those who were more than 60 years old. Therefore, the burden due to DM is likely to rise steadily in because of population ageing **(Rampal et al.,2010)**

Diabetes is amongst the leading causes of death worldwide. in the year 2010, the total number of excess deaths attributable to diabetes worldwide was3.96 million in the age group 20–79 years or 6.8% of global (all ages) mortality. **Roglic et al 2010**

Diabetes accounted for 6% of deaths in adults in the African region and 15.7% in the North American region. Therefore, diabetes is a considerable cause of premature mortality, a situation that is likely to worsen especially in low and middle income countries as the diabetes prevalence increases Diabetes Control and Complications Trial (DCCT).

As diabetes is an important risk factor for cardiovascular diseases (CVD). therefore, awareness, treatment and effective control of DM are essential for the overall reduction of diabetic complications and to prevent premature CVD morbidity and mortality Diabetes Control and Complications Trial (DCCT)..

Despite the importance and benefits of diabetic control, the control rates of the diabetes patients is still suboptimal. In there are few population based studies, which have been conducted to assess the prevalence, level of awareness, treatment and control of DM among the general adult population. **(Rampal et al .,2010)**

Aim Of The Study:- Assess prevalence of glycemic control in Egypt based on the ADA 2010 criteria and also asses factors associated with glycemic control and how these factors control can rise the rate of glycemic control with subsequent decrease in level of diabetic complication.

Subjects and Methods:- The population of this study consisted of T1DM and T2DM patients who had been taking at least one anti diabetic drug for at least 3 months.

The sampling time frame for this study was 1 year from may, 2013 to may 2015 The minimum sample size for this study was calculated using the Epi Info Program Version 7.0 (CDC, Atlanta, GA, USA). The total number of patients were 2400 and data was available for 2198

Criteria of Selection:-

Inclusion Criteria:-

1. Patients who were diagnosed with T1DM.
2. Patients who were diagnosed with T2DM
3. Patients who were prescribed at least one oral anti diabetic agent and/or insulin.
4. 4.Patients who received anti diabetic therapy for at least 3 months.

Exclusion Criteria:-

1. Patients who received non pharmacological therapy/diet.
2. Gestational diabetes

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- The study which was designed to select a nationally representative sample of the general population, covering major geographic areas of all 28 governates.
- The first level of sampling was stratified by 5 geographic regions (North ,East, South, west, and Central areas) and a governate was choosen to be representive for each region
- The second level of sampling was stratified by urban and rural locations.
- The third level of sampling was stratified by 3 socioeconomic strata at each site, **Social score** was used to assess the socioeconomic status (SES) of included patients . It was calculated according to **(El- Gilany et al., 2012).**
- The final scale included 7 domains with a total score of 84, with a higher score indicating better SES,
- A complex, multistage, probability sampling design was used to select participants who were representative of civilian, non institutionalized egyptian adults.

- The study protocol was approved by the ethical review committee of benha faculty of medicine Written informed consent was obtained from all study participants.
- Data collection was conducted in examination centers at local health A CXAstations or community clinics in the
- participants' residential area by trained staff according to a standard protocol.
- A questionnaire including information on demographic characteristics, medical history, and lifestyle factors was administered by trained interviewers.
- Questionnaire was used to assess Bodyweight and height were measured according to a standard protocol and body mass index (BMI), which is calculated as weight in kilograms divided by height in meters squared.
- Waist circumference was measured on standing Participant midway between the lower edge of the costal arch and the upper edge of the iliac crest. Overweight was defined as a BMI of 25.0 to 29.9, and obesity was defined as a BMI of 30.0 or higher.
- Central obesity was defined as waist circumference 90 cm or more in men and 80 cm or more in women.
- Blood pressure was measured at the non dominant arm 3 times consecutively with a 1-minute interval between the measurements with the participant in seated position and in standing position after standing 5 minutes to asses the presence of postural changes
- Fasting and 2 hour postprandial Plasma glucose levels were measured by taking blood samples and were sent for analysis in laboratories and HB1C was measured Serum total cholesterol, low-density lipoprotein (LDL) cholesterol and triglycerides were measured.
- A stringent quality assurance and quality control program was implemented to ensure the validity and reliability of study data. All investigators underwent a week long training session on the use of standardized protocols and instruments for data collection.
- All data were double entered in a database and then compared and corrected for errors.
- Treatmen was defined as the proportion of individuals taking diabetes medications among all patients with diabetes.
- Control was defined as the proportion of individuals with AnHbA1c concentration of less than 7.0% among patients with diabetes who were treated.
- Demographic and metabolic characteristics of study participants were described in means (95% CIs) for continuous variables and percentages (95% CIs) for categorical variables in the overall population and in subgroups of sex, location (urban/rural), age, stages of economic development, and categories of BMI and waist circumference.
- Age- standardized prevalences of Egyptian with diabetes were also estimated in the overall population and among subgroups
- Standard errors were calculated using the Taylor- linearization method appropriate for the complex survey design.
- A multivariable multinomial logit analysis was used to examine the association of demographic, lifestyle ,and metabolic factors with the odds of diabetes
- AP value <0.05 was considered statistically significant. All statistical analyses were conducted using the SAS system, version9.3 (SAS Institute Inc)

Statistical analysis:-

All statistical analyses were performed using the statistical software Statistical Package for Social Science (SPSS), version 20 (IBM SPSS Inc., Chicago, IL, USA). Descriptive statistics such as frequencies, percentages, means, ranges and standard deviations (SD) were used to describe the data.

Categorical data were expressed as the absolute number and percentage, whereas continuous data were expressed as the mean and SD if normally distributed or as the median (interquartile range) if skewed. The Kolmogrov–Smirnov test or the Shapiro–Wilk test was used to test the normality of continuous data.

The Pearson chi-square test with continuity correction was used to examine the association between categorical variables. When the expected cell count was more than 20% or less than 5, the Fisher exact test was used. Cramer's V correlation test was used to examine the correlation between two nominal groups, such as anti diabetic regimens and A1C. The Pearson correlation was used to examine the correlation between two continuous data groups, such as low-density lipid and A1C. The significance level was accepted at P, 0.05.

Results:-

Table 1: Association between demographic characteristics and glycemic control.

Variables		Hba1c level (n,%)		P-value	
		<7.0	>7.0		
Sex					
Male		338 (25.5)	987 (75.5)	0.10	
Female		152 (17.4)	721 (82.6)		
Age groups (years)					
<30	Nonelderly	195 (37)	331 (63)	1856(84%)	0.023
30-60		287 (21.5)	1043 (78.5)		
>60	Elderly	8 (0.02)	334 (0.98)	342(16%)	
Strata					
Urban		247 (32)	518 (68)	0.12	
Rural		243 (17)	1190 (83)		
Social History					
Low		88 (11.5)	681 (88.5)	0.04	
Average		232 (19)	964 (81)		
High		170 (73)	63 (27)		
Educational level					
Low		75(11.5)	575 (88.5)		
Moderate		190(22.5)	740(77.5)		
High		225(36.5)	393(63.5)	0.03	

Age (p –value 0.023) was found to be significantly associated with glycemic control. In our study, the non- elderly group was more likely to have good glycemic control compared with the elderly group

There was a significant positive correlation between socioeconomic state of the patients and glycemic control in high socioeconomic state more than average more than low(p –value 0.04)

There was no significant correlation between sex and glycemic control (p –value >0.05)

There was no significant correlation between location of the patients and glycemic control (p –value 0.12)

There was a significant positive correlation between educational level of the patients and glycemic control in high level more than moderate more than low(p –value 0.03)

Table 2: association of laboratory characteristics with glycemic control.

Variables	Hba1c level (n,%)		P-value
	<7.0	>7.0	
Fasting blood glucose			
<130	490(100)	0	0.001
>130	0	1708	
2 hour postprandial blood glucose			0.001
<180	490(100)	0	
>180	0	1708	
LDL cholesterol			
>100	42 (2.6)	1581 (97.4)	0.04
<100	448 (78.0)	127 (22.0)	
T.G			
<150	206 (25.0)	614 (75.0)	0.014
>150	284 (20.6)	1094 (79.4)	
Albumin creatinine ratio			
Normal	415(24)	1309(76)	0.003
Microalbuminuria	21(16)	111(84)	
Macroalbuminuria	54(15.5)	288(84.5)	

Proportion of adults diagnosed with diabetes mellitus achieving selected American Diabetes Association clinical practice recommendations (n=490) with percentage 22.3%

The percentage of adults achieving HbA1c, blood pressure and LDL-C simultaneously was only 9%.

There was a significant Positive correlation between low-density lipoprotein (LDL) and glycemic control (p –value 0.04).

There was a significant Positive correlation between triglyceride level and glycemic control (p –value 0.014).

There was a significant negative correlation between Albumin/creatinine ratio and glycemic control(p –value 0.003)

Table 3: association of clinical characteristics with glycemic control.

Variables	Hba1c level (n,%)		P-value
	<7.0	>7.0	
Type			
I	290 (37)	488 (63)	0.25
II	200 (14)	1220 (86)	
Association			
No	325 (25)	974 (75)	0.02
Hipothyrodism and others	16 (18.0)	73 (82.0)	
Hyperlipidemia	39 (18.3)	173 (81.7)	
Liver disease	26 (13.8)	162 (86.2)	
H.T.N	84 (20.5)	326 (79.5)	
Duration			
<1y	144 (15.4)	791 (84.6)	0.034
1-5y	91 (23.5)	297 (86.5)	
>5y	255 (29.1)	620 (70.9)	
BMI			
<25	167 (36.0)	292 (64.0)	0.039
25-30	145 (25.5)	423 (74.5)	
>30	178 (15.0)	993 (85.0)	
Regular glucose monitoring			
Yes	86 (5.0)	1604 (95.0)	0.046
No	404 (79.5)	104 (20.5)	
Diet Control			
Yes	451 (78.0)	127 (22.0)	0.048
No	39 (2.5)	1581 (97.5)	
Blood pressure			
>140/90	153 (18.6)	668 (81.4)	0.02
<140/90	337 (24.4)	1040 (75.6)	
Complication			
No	129 (27.0)	346 (73.0)	0.16
P.N	55 (20.4)	215 (79.6)	
Nephropathy	139 (21.4)	511 (78.6)	
Retinopathy	106 (22.6)	363 (77.4)	
IHD	20 (14.6)	117 (85.4)	
Others	41 (20.8)	156 (78.2)	
Medication adherence			
Adherent	480(23.6)	1548(76.4)	0.002
Non adherent	10(5.8)	160(94.2)	

Patients with duration of diabetes more than 5 years have lowest rate of diabetic control more than other groups(p –value 0.034)

Patients with BMI less than 25 kg/m2 have highest rate of diabetic control than other groups(p –value 0.039)

There was a significant positive correlation between regular follow up and glycemic control (p –value 0.046)

There was a significant positive correlation between Follow up diet control by dietitian and glycemic control (p –value 0.048)

There was a significant positive correlation between type of medication (injection more than oral more than oral plus injection and glycemic control (p –value 0.014)

There was a significant positive correlation between blood pressure control and glycemic control (p –value 0.02)

There was no significant correlation between type of diabetes, and glycemic control(p –value >0.05)

There was a positive significant correlation between medication adherence and glycemic control (p –value 0.002)

Discussion:-

The prevalence of diabetes was estimated to be 8.3% worldwide in 2012, representing a total of 371 million people living with diabetes**.(International Diabetes Federation. Diabetes 2012)**

The worldwide prevalence of diabetes has increased rapidly in recent decades with a disproportionate burden among young and middle-aged individuals. **(Chan et al .,2009)**

Diabetes is a major risk factor for morbidity and mortality Worldwide. High blood glucose levels accounted for 21% of all deaths from ischemic heart disease and 13% of all deaths from stroke worldwide with 84%of these cardiovascular deaths in low- and middle-income countries. **(Danae et al .,2006)**

Diabetes is the most common underlying cause for chronic kidney disease. **(Danae et al .,2006)**

Diabetic retinopathy is the leading cause of blindness in working age adults in many countries. Furthermore, recent studies have reported that diabetes is a risk factor for cancer. Improvement in glycemic control is the key for preventing diabetes-related complications. **(Ali et al .,2010)**

With the rapid economic growth and associated industrialization, urbanization, and lifestyle changes (increased high-calorie, high fat, high-sugar, and high-sodium diets and decreased physical activity), pre diabetes and diabetes have reached epidemic proportions in the egyptian population

Our study indicates that the awareness, treatment, and control rates of diabetes in the general egyptian population may be disproportionately low, raising concern for future high rates of diabetes-related morbidity and mortality.

In our study we found that longer duration of diabetes was associated significantly with poor glycemic control. This finding was consistent with that reported by other studies (**Valle et al., 1999) (Benoit et al., 2005) (Verma et al.,2006) Khattab et al.,2010).(stone et al.,2013 Findings from (GUIDANCE) study) and Viana et al 2015**

Longer duration of diabetes is known to be associated with poor control, possibly because of progressive impairment of insulin secretion with time because of β cell failure, which makes the response to diet alone or oral agents unlikely **(UK Prospective Diabetes Study (UKPDS)Group, 1998**).

In our study we found that, patients with poor glycemic control were more likely to be prescribed combination of oral anti diabetic agents and insulin, which may indicate that physicians are attempting multi therapy to provide better disease control. The association between treatment with combination of oral anti diabetic agents and insulin and poor glycemic control is consistent with other studies **(AL-Nuaim et al., 1998; Valle et al., 1999:Goudswarrd et al., 2004).(stone et al.,2013 Findings from (GUIDANCE) study)**

This finding reflects the fact of deteriorations of diabetes over time, and the need for higher doses or additional mediations increases over time. Therefore, patients who were treated by combination therapy of oral anti diabetic agents and insulin had more progressive disease which required more aggressive treatment to provide glycemic control, but this phenomenon could be attributed to delay in applying insulin in the treatment of patients with poor glycemic control.

In our study we found that nonelderly patients (<60 years) of diabetes were associated significantly with good glycemic control.

This was not consistent with the findings of a number of studies (Nichols et al.,2000 ;EL-Kebbi et al., 2003; Rothenbacher et al.,2003) (stone et al.,2013 Findings from (GUIDANCE) study)(Ho BK et al., 2015) and Viana et al 2015
which reported that younger age was associated with poor glycemic control.

In our study we found that location and residence of patients was not associated significantly with good glycemic control .this was consistant with **(stone et al.,2013 Findings from (GUIDANCE) study) who reported no significant correlation between residence and glycemic control**

And not consistant with (Yanget al .,2010 and Viana et al 2015)
who reported that residence in urban area was associated significally with glycemic control as patients from the rural areas attend primary care units less equipped and with less trained healthcare personnel

In our study we found that body mass index of the patients was associated significantly with good glycemic control .this was consistant with **(Yang, et al 2010) (stone et al.,2013 Findings from (GUIDANCE) study) Viana et al 2015**

who reported that body mass index <25kg/m2 has good glycemic control more than 25-30) kg/m2 than >30kg/m2.and this was not consistant with **Ho BK et al., 2015** who had reported no correlation between BMI and glycemic control

In our study we found that waist circumference of the patients was associated significantly with good glycemic control. this was consistant with **(Yang,et al 2010)(stone et al.,2013 Findings from (GUIDANCE) study)**

who reported that waist circumference <96cm in males and<82cm in females was associated with better glycemic control

In our study we found that patients who were on regular follow up , diet control and medication adherence were associated significantly with good glycemic control .this was consistant with **Khattab et al.,2010(stone et al.,2013 Findings from (GUIDANCE) study) Cynthia et al., 2013 and Viana et al 2015)**

who found that poor glycemic control was more common among patients who were not adherent for medications .Therefore, patients should be motivated to use the medications as prescribed. In spite of the importance of diet and exercise in control of diabetes, only a small percentage of patients with diabetes were adherent to diet regimen and physical activity. Continuous education is recommended to encourage physical activity and diet regimen adherence .and **this was not consistant with Ho BK et al., 2015**) who had reported no correlation between diet control ,regular monitoring and medication adherence and glycemic control

In our study we found that controlled LDL cholesterol ,triglyceride and blood pressure were associated significantly with good glycemic control .this was consistant with **(Pérez et al.,2012)** who reported that Less than half of adults achieved recommended treatment goals for LDL-cholesterol (47.8%), HDL-cholesterol (44.1%), blood pressure (41.2%) and HbA1c (28.7%). The percentage of adults achieving recommended levels of HbA1c, blood pressure and LDL-cholesterol simultaneously was 6.6%. also our finding was consistant with **(stone et al.,2013 Findings from (GUIDANCE) study) Cynthia et al., 2013and Ho BK et al., 2015 and Viana et al 2015** who reported the same results.

Cynthia et al., 2013 reported that The ADA recommends optimal control of blood pressure and lipids and smoking cessation

in addition to glycemic control to reduce the micro vascular and macro vascualar complications in diabetic patients. Their results showed that 41% of those treated for diabetes were in the high-risk range for LDL cholesterol and 87% had suboptimal blood pressure control.

Harris et al found that 33% and 60% of adults with diabetes in the United States did not meet the ADA recommended target for LDL cholesterol and blood pressure, respectively. **Knol et al ., 2011** Stringent control of blood pressure in diabetics has been shown to prevent vascular complications **Inzucchi et al 2012**

The Heart Protection study demonstrated that cholesterol lowering therapy in Those with diabetes led to a significant reduction in the risk of major vascular events .**(National Collaborating Centre for Chronic Conditions Type 2 diabetes et al .,2008**)

The negative association of good glycemic control with systolic blood pressure, diastolic blood pressure, total and LDL cholesterol, and the higher proportion of subjects with diabetes having poor blood pressure and LDL cholesterol control emphasizes the need to actively screen and treat the diabetic patients for lipids and blood pressure control.

In our study we found that patients who has high and average socio economic state were associated significantly with good glycemic than those with low socio economic state .this was consistant with**(Yang,et al .,2010)(stone et al.,2013 Findings from (GUIDANCE) study)**who reported the same results .this was not consistant with **(Ho BK**

et al., 2015) who had reported that glycemic control was significantly associated with low and moderate socio economic state more than high socio economic state

In our study we found that patients who has high and intermediate education level were associated significantly with good glycemic than those with low educational level .this was consistant with **(Yang,et al .,2010)Khattab et al.,2010(stone et al.,2013 Findings from (GUIDANCE) study)**who reported the same results .this was not consistant with **(Ho BK et al., 2015)** who had reported that glycemic control was significantly associated with low and intermediate educational level more than high educational level.

Study strength:-
The present study has several strengths. First, it was conducted in a large nationally representative sample of the general population in Egypt . Second, all 3 glycemic indexes for the control of diabetes—fasting plasma glucose, 2-hour plasma glucose, and HbA1c concentrations—were obtained, which provide a comprehensive estimation of diabetic control in the Egyptian population. The main strengths of the study include population-based sample of different governates of Egypt with availability of multiple SES, educational levels. urban and rural areas

Study limitations:-
Adherence to anti diabetic medications ,following diet control ,exercise and regular follow up cannot be assessed and depend on subjective informations. unless adherence status is recorded in the case notes.

Conclusion:-
The proportion of patients with poor glycemic control was high, which is nearly comparable to that reported from many countries. Longer duration of diabetes, and not adherent to diabetes selfcare management behaviors were associated with poor glycemic control. An educational program that emphasizes lifestyle modification with importance of adherence to treatment regimen would be of great benefit in poor glycemic control

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