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Diabetes Campaign among University Students in a Higher Top Ten Country

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Abstract Diabetes Mellitus (DM) prevalence is increasing now a day in all countries. It is a major emerging clinical and public health problem worldwide and more specifically in Egypt. Pre-diabetes is a clinical stage before diabetes. Life style changes in this stage could prevent or delay developing of diabetes with its morbid and fatal complications. **Aim of the study**: was to assess pre-diabetes and diabetes frequency and identify associated risk factors among Ain-Shams and Suez university students. **Subjects and Methods:** 854 university students were surveyed by a self-assessment diabetic score followed by measurement of blood pressure, weight, height, waist circumference and random blood glucose. For those with diabetes screening score ≥ 4 or fingerstick test strip levels equal or above 140mg/dL fasting blood glucose were done. **Results:** Nearly quarter (24.8%) of the studied sample were at risk of pre-diabetes or diabetes by diabetic scoring and (8%) of them by random blood glucose testing. Demographic factors as female gender, urban residence and life styles as daily stress exposure, physical inactivity and smoking of cigarettes or shisha, in addition; high blood pressure and obesity were accompanied with high risk of pre-diabetes and diabetes. **Conclusion:** Awareness of university students and other population segments to measure either random or fasting blood glucose and modify life styles risk factors of pre-diabetes is utmost important to prevent or delay developing of diabetes mellitus.

Keywords: *campaign, pre-diabetes, diabetes, screening, blood glucose, lifestyle*

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1. Introduction

Diabetes Mellitus (DM) is rising rapidly in epidemic globally; third world countries show the most striking increase. The global prevalence of DM in the 2010 among adults has been estimated to be 6.4% [1]. Diabetes Mellitus is remarkably increased in Egypt, where Egypt is one of the top 10 countries for numbers of diabetic aged 20-79 in 2019 (8.9 millions) and (11.9 millions) in 2030 using International Diabetes Federation estimates [2]. Pre-diabetes is a condition in which individuals have blood glucose or HbA1C levels higher than normal but not high enough to be classified as diabetes. People with pre-diabetes have an increased risk to develop type 2 diabetes, heart disease and stroke [3]. David state that the major risk factors of Diabetes Mellitus are rapid urbanization and industrialization, increase life expectancy and lifestyle changes as follow: Increase body weight and obesity; increase insulin resistance, which decreases the ability of insulin to move glucose into fat and muscle and to shut off glucose release from the liver [4,5]. There are evidences that an increased level of free fatty acid and more importantly the relative amounts of saturated and unsaturated fatty acids play an important role in development of insulin resistance. Epidemiological studies demonstrate positive associations between intake of saturated fat and hyperinsulinemia [6]. Physical inactivity has been shown to be directly related to obesity and fat distribution, particularly visceral obesity. Studies have shown that physical activity may reduce risk of type-2 diabetes both directly by improving insulin sensitivity and indirectly by producing beneficial changes in body mass and body composition [7]. Luo found a clear evidence of a dose-dependent association between cigarette smoking and diabetes; as well as evidence that removal of the exposure diminishes the risk of developing diabetes [8].

Screening for hyperglycemia would be cost-effective, if screening targeted to high-risk groups than universal screening [9]. There are many reasons to screen for hyperglycemia as: Type 2 DM has recognizable pre-diabetic and long latent diabetic phases. Suitable,

reliable, high-performance, and acceptable tests are available and detect hyperglycemia precisely; such as testing for glucose or HbA1C, which is even simpler, less invasive, and more convenient even in low-resources areas. Risk scores not requiring measures of blood glucose, also hold significant promise for identifying those at high risk. Testing for diabetes does not associated with adverse psychosocial consequences. There are accepted and cost-effective treatments for type 2 DM, as well as for impaired glucose tolerance test [10]. So the main aim of this study was to assess pre-diabetes stage and diabetes by diabetes screening score, random blood glucose and fasting blood glucose testing to prevent or delay diabetes and its complications. Secondary Objectives: To increase awareness of university students about importance of detection of preclinical diabetes and assess the association between unhealthy life styles habits and diabetes mellitus.

2. Subjects and Methods

A cross sectional study was done on 854 university students from two selected governmental universities (Ain-shams and Suez Universities). A convenient non- random sample were chosen. The study protocol approved from Ethical Committee before proceeding in the study. Verbal informed consent was taken from each student before starting of the survey and study measures. Confidentiality and privacy of results were kept.

Methods: A campaign was held in the two governmental universities, Ain-Shams University and Suez University. The campaign started by orientation health education sessions covering knowledge about prediabetes, diabetes causes, risk factors, onset of symptoms, prevention and early diagnosis and management. Then data collected during 2019 by using self- assessment diabetes score questionnaire. It includes 6 questions with 6 points: age, sex, diabetes family history, hypertension, overweight or obesity and physical activity:

Subjects with total score≥4 was categorized as high risk for pre-diabetes, ≥5 as high risk for diabetes [11]. Food frequency questionnaire, daily stress exposure, physical activity and smoking habits were inquired about in details. Accepted level of carbohydrate and Sugar: considered as 45-65% of food intake/day [12]. Sweet and sugar accepted intake 10% of food intake/day (energy intake/day) or 100 calorie for women and 150 calorie for men [13,14]. Bao refers stress exposure to consequence of failure of human- or animal to appropriately respond to emotional or physical stress, whether actual or imagined [15].

Measurements taken were: anthropometric measures (weight, height, waist circumference) and body mass index (BMI) calculated for each participant by dividing weight on square of height (weight/ height^2), and blood pressure by sphygmomanometer and random blood glucose (RBG) by finger-stick test strip using glucose-meter device. Random blood glucose level from 140-199 mg/dL considered prediabetes. This is sometimes referred to as impaired glucose tolerance (IGT). Blood sugar level of 200 mg/dL or higher indicates diabetes mellitus [16]. For those with higher diabetic score ≥ 4 or Random blood glucose ≥140 mg/dL fasting blood glucose (FBS) was done by 2ml venous blood sample after 8-10 hour fasting samples were allowed to clot then centrifuged and glucose levels determined through spectrophotometric enzymatic measurements of serum glucose using Roche Cobas c311 automated chemistry analyzer (Roche diagnostics, Germany). The standard by which impairment in FBS would be identified was that of ADA, i.e. FBS ≥100 mg/dL, but < 125 mg/dL. FBS ≥126 mg/dL was accounted for diabetes [17].

Statistical analysis: was done using SPSS (Statistical Package for Social Sciences) version 20. Qualitative data expressed and comparisons of numbers and percentages performed using chi square test to detect demographic and life styles risk factors of pre-diabetes and diabetes, statistical significant is considered if $p<0.05$. For quantitative data as waist circumference, BMI, systolic and diastolic blood pressure comparison is done by ANOVA test and results confirmed by post hoc test for multiple comparisons.

3. Results

Table 1 compares number and percentage of university students at risk of pre-diabetes and diabetes using self-assessment Diabetic Score and Random blood sugar with results of fasting blood glucose. Table 2, Table 3 shows that female gender and urban residence whether the current one or the original one were associated with increased risk of pre-diabetes and diabetes significantly. Also life styles habits of eating more sugar, less exercise, daily stress exposure and smoking to cigarettes and shisha all of which associated with higher percentage and risk of pre-diabetes and diabetes. More findings are presented in Table 4 in which clinical measures of obesity manifested by waist circumference and body mass index, high blood pressure the systolic and diastolic blood pressure and higher level of fasting blood glucose ≥100 were associated with high risk of pre-diabetes significantly.

Table 1. Comparing university students at risk of pre-diabetes and diabetes using American Diabetic Score, Random blood sugar and fasting blood glucose tests

	Normal		Pre- diabetes		Diabetes		Mean ± SD	Total
	No	%	No	%	No	%		
American Diabetic Score	642	75.2	129	15.1	83	9.7	NA*	854
Random blood Sugar test	786	92	43	5	25	3	126.9 ± 20.1	854
Fasting blood glucose test	170	83.7	23	11.3	10	5	93.3 ± 25.2	203

NA* = Not applicable*.

Table 2. Number and percentage of university students at risk of pre-diabetes and diabetes according to demographic factors and dietary intake

Demographic factors	No risk		At risk of				Total		$\chi 2$	P value
			Pre-diabetes		Diabetes					
Gender	No	%	No	%	No	%	No	%		
Male	368	92.7%	21	5.3%	8	2%	397	46.5%	12.9	<0.001
Female	274	60.0%	108	23.6%	75	16.4%	457	53.5%		
Current residence										
Urban	336	73.5%	64	14%	57	12.5%	457	53.5%	8.8	.012
Rural	306	77.1%	65	16.4%	26	6.5%	397	46.5%		
Original "previous" residence										
Urban	337	70.6%	81	17%	59	12.4%	477	55.9%	13.3	<0.001
Rural	305	80.9%	481	2.7%	24	6.4%	377	44.1%		
Total	642	75.2%	129	15.1%	83	9.7%	854	100%		
Amount of dietary intake										
Carbohydrate amount	No	%	No	%	No	%	No	%		
AccepTable 45-65% of meal	517	74.8%	102	14.8%	72	10.4%	691	89.3%	1.2	0.88
Over consumption>65%	62	74.7%	14	16.9%	7	8.4%	83	10.7%		
Total	579	74.8%	116	15%	79	10.2%	774	100%		
Amount of sweet taken										
Acceptable	351	76.5%	69	15%	39	8.5%	459	59.5%	5.21	0.52
Over consumption	226	72.2%	47	15%	40	12.8%	313	40.5%		
Total	577	74.8%	116	15%	79	10.2%	772	100%		
Amount of sugar taken										
AccepTable 10% of meal	399	74.9%	81	15.2%	53	9.9%	533	79%	5.46	0.06
Over consumption>10%	94	66.2%	25	17.6%	23	16.2%	142	21%		
Total	493	73%	106	15.7%	76	11.3%	675	100%		

Table 3. Life style of university students at risk of pre-diabetes and diabetes (daily stress exposure, physical activity and smoking habits)

Life styles	No risk		At risk of				Total		$\chi 2$	P value
			Pre-diabetes		Diabetes					
Daily stress exposure	No	%	No	%	No	%	No	%		
No stress exposure	373	74.3%	77	15.3%	52	10.4%	502	61.4%	4.7	<0.001
Stress exposure	225	71.4%	50	15.9%	40	12.7%	315	38.6%		
Total	598	73.2%	127	15.5%	92	11.3%	817	100%		
Physical activity	"At least ≥ 30 minute for five days / week"									
Physical activity	417	85.4%	51	10.5%	20	4.1%	488	57.1%	8.5	<0.001
Lack of physical activity	225	61.5%	78	21.3%	63	17.2%	366	42.9%		
Total	642	75.2%	129	15.1%	83	9.7%	854	100%		
Smoking Habits										
Non smokers	328	75.9%	69	16%	35	8.1%	432	83.6%	5.2	<0.001
Cigarette smoking	29	63.1 %	10	21.7%	7	15.2%	46	6.9%		
Cigarette and Shisha smoking	16	41.0%	12	30.8%	11	28.2%	39	5.3%		
Total	373	74.2%	91	16.9%	53	8.9%	517	100%		

Table 4. Anthropometric measurement and blood pressure of university students at risk of pre-diabetes and diabetes

Measures		No.	Mean ± SD	Minimum	Maximum	F	Significance	LSD test
Waist circumference	No risk (I)	642	82.1±13.5	65	174	8.5	<0.001	III Vs I,II
	at risk of pre-diabetes (II)	129	81.8±12.8	65	122			
	at risk of diabetes (III)	83	88.6±16.9	67	131			
	Total	854	82.7±13.8	65	174			
BMI "Body Mass Index"	No risk (I)	642	23.5±3.7	10.20	44.92	109.2	<0.001	I vs II, III II vs III
	at risk of pre-diabetes (II)	129	25. 9±4.4	14.03	42.97			
	at risk of diabetes (III)	83	30.4±6.2	18.41	54.69			
	Total	854	24. 6±4.6	10.20	54.69			
Systolic blood pressure	No risk	609	118.9±3.5	110	140	3.9	0.020	I vs II,III
	at risk of pre-diabetes (II)	128	119.6±3.2	110	140			
	at risk of diabetes (III)	83	119.6±1.9	110	120			
	Total	820	119.1±3.3	110	140			
Diastolic blood pressure	No risk (I)	609	77.9±6.2	60	90	11.3	<0.001	I vs II,III
	at risk of pre-diabetes (II)	128	80.3±7.4	70	90			
	at risk of diabetes (III)	83	80.7±7.9	60	90			
	Total	820	78.6±6.7	60	90			

4. Discussion

Projected increase in the global prevalence of Type 2 diabetes suggests that its treatment and prevention could become one of the major health challenges of the 21st century [18]. Evidence for diabetes prevention using lifestyle modification has prompted some European countries to initiate national or transnational primary prevention programs [19]. In such; delivery of primary prevention care in the clinical and/or community settings would require identifying high-risk individuals, with the consequential identification of individuals with undiagnosed diabetes [10]. In this study screening of pre-diabetes and diabetes to university students at Ain-shams and Suez University revealed by self-assessment diabetic score that nearly quarter of students 24.8% at high risk of pre-diabetes (score ≥4) and diabetes (score ≥ 5) and 8% at high risk of pre-diabetes and diabetes by random blood glucose test using finger-stick test strip (> 140- 199 mg/dL is at high risk of developing prediabetes and RBG 200 mg/dL or higher considered as diabetes). These students at high risk require periodic fasting blood glucose testing and life style intervention or modification. The US Diabetes Prevention Program study had shown that lifestyle intervention as lose weight and increase physical activity reduced the development of type 2 diabetes by 58 percent during a 3-year period. Physical activity and exercise does not have to be hard or involve a lot of sweat. Even a 30-minute walk five days a week has been shown to significantly reduce the risk of diabetes and heart disease [20]. The reductions of DM with weight loss and physical activity was even greater, 71 percent among adult's ages 60 years or older [3]. The results of Finnish and Chinese studies also suggested that a lifestyle intervention is efficient in preventing diabetes. In the Chinese study, an attempt to determine whether an intervention of diet or exercise was more effective revealed no difference in outcome between the two interventions [21]. In the Finnish study; the average weight reduction achieved was modest yet the decrease in the incidence of diabetes in the intervention group was substantial. Physical exercise counseling included components that improve both cardiorespiratory fitness and muscle strength. It is likely that any type of physical activity, whether sports, household work, gardening, or occupational tasks, is similarly beneficial in preventing diabetes. Many subjects with impaired glucose tolerance are both obese and inactive and therefore the finding of a "dose-response" in correcting these multiple risk behaviors would be expected [22]. Several reviewed studies in the Gulf countries demonstrate high diabetes prevalence and correlation between BMI, overweight and obesity with diabetes or blood glucose concentration [23]. Moreover, the observed prevalence of overweight or obesity and diabetes increased by age. In another large prospective cohort study of older adults; the established DM risk factors include: overweight, obesity, elevated HDL-C, aging and men sex [24]. In the Gulf countries studies, the majority of studies (10) suggested a higher prevalence of DM in women [25,26,27]. Conversely; two studies one presented a higher prevalence of DM in men significantly and the other one demonstrated no sex difference [23]. One study in a Gulf country reported higher prevalence of DM in urban areas [23]. The results of this study similar to the previous results in which overweight, obesity is a significant risk factor for pre-diabetes and diabetes, and women sex were associated with higher risk of pre-diabetes and diabetes; as the same as what reached by the 10 reviewed studies of the Gulf countries. Also urban residence associated with high risk of prediabetes and diabetes similar to Alhyas study. Managing the stress is crucial through training and developing new habits that help to change body reaction to stress, which can in turn decrease risk for diabetes and heart diseases [20]. The finding of this study reached to that daily stress is highly significant risk factor of pre-diabetes and diabetes (P <0.001). Results of longitudinal studies suggest that general emotion including depression, stress and anxiety; anger and hostility all of which associated with an increased risk of type 2 diabetes mellitus development and both acute and chronic stress can reduce the body's ability to regulate blood sugar [28]. In this study smoking to cigarette and shisha was associated significantly with high risk of pre-diabetes and diabetes. Smoking in addition; a risk factor of various heart diseases and one of the most preventable causes of premature death in the United States. Quitting smoking is a goal to transition to a healthy lifestyle [20].

This study revealed that high systolic or diastolic blood pressure is associated significantly with pre-diabetes and diabetes. High cholesterol and blood pressure are other risk factors often related to both diabetes and heart diseases. Blood pressure control need changes listed above as: reduction of weight, exercise, amelioration of stresses and quitting smoking [20]. The Diabetes Prevention Program randomized trial found that reducing systolic blood pressure, diastolic blood pressure, and triglycerides was associated with reversion of impaired glucose tolerance (IGT) to normal glucose tolerance [29].There is also considerable impetus to detect and treat pre-diabetes as early as possible, given the implications with respect to risk of cardiovascular disease. Screening for IGT followed by lifestyle modification or metformin treatment was also cost-effective, with lifestyle modification having a better cost-effectiveness ratio [30].

5. Limitation and Strengths of the Study

Limitations of the study were: University students attended the campaigns may have common features limited to these group, so results can't be generalized beyond the research setting in the two universities. Oral glucose test was not feasible to be done and dietary assessment tool used was subjective and not detailed. Strengths were: Shortage of community based study for screening of diabetes, make this study preliminary study for further wide base designs. Also; there was imperative need of health education sessions held appeared by number of attendees, welcoming and interactive discussions.

6. Conclusion and Recommendations

Although pre-diabetes does precede diabetes, it is an earlier step in the continuum of the disease process, not a

disease-free state. Without weight loss, blood pressure control and lifestyles changes as physical activity, stress management and smoking cessation, pre-diabetes will progress and become type 2 diabetes. Knowing blood glucose level will help in life styles modification necessary to prevent diabetes. Finally; there is no existing diabetic risk score that highly generalizable and widely used, so it recommended that each country have its national guidelines for screening high risk group of diabetes and undiagnosed one.

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