International Journal of Healthcare Sciences ISSN 2348-5728 (Online)
Vol. 3, Issue 2, pp: (643-652), Month: October 2015 - March 2016, Available at: www.researchpublish.com

Quantifying Diabetes Risk and Identifying Contributing Factors Among Middle Aged Females in Minia District, Egypt

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Abstract: **To quantify problem of DM-II, determine 10 years risk of DM-II occurrence (CANRISK) and to identify risk factors associated with it. Materials and Methods: A cross sectional community-based study was carried-out among peri-menopausal females in Bini-Hassan and Nazlet- Ebeed villages of El Minia district. A self-administered structured questionnaire was used, included socio-demographic data, family, gynecological and obstetric history. CANRISK, blood sugar, Body mass index and waist hip ratio were measured. Results: About one fourth of participants (25.4%) were diabetics by the blood sugar evaluation. Also, near half of participants had moderate risk of diabetes (46.8%) as evaluated by (CANRISK). A significant relation between blood sugar and special habits, anthropometric measurements and reproductive factors. Most important predictors of DM among participants were lack of physical activity, overweight and obesity. Conclusion: Sedentary life style, obesity, early menarche and early menopause were all factors contributing to diabetes occurrence. We need locally adapted diabetes screening risk questionnaire to be applied to female taking into account female reproductive factors.**

Keywords: **Type II diabetes, Risk factors, Peri-menopausal females, El-Minia district.**

I. INTRODUCTION

Diabetes mellitus is a growing public health problem affecting people worldwide both in developing and developed countries, and poses a major socio-economic challenge. [1] In 2000, 171 million people were estimated to have diabetes around the world, and this figure is expected to rise to 366 million by 2030. [2] Type 2 diabetes mellitus (T2DM) is very important in women since it is one of the most common chronic diseases in postmenopausal women and it is an underlying factor for cardiovascular diseases, which is the main cause of death in Western societies. [3]

Family history is an important risk factor for developing T2DM. First-degree relatives of diabetic patients have long been known to have an increased risk of developing T2DM. Recent studies in genetic research have also identified the genetic variants linked with T2DM.[4:5] Family history of diabetes is also used as a predictor of T2DM in population-based screening programs.[6]

However, about half of the risk of T2DM can be attributed to lifestyle, and half to genetics.[7] Lifestyle modification is particularly effective in the prevention, or in the delay of the progression to diabetes among individuals with a family history of diabetes. However, the International Diabetic Federation [8] recommends that diabetes control programs should simultaneously promote lifestyle modification among high-risk individuals, as well as the entire population. Intake of dietary energy in excess of expenditure simply results in weight gain and increases the risk of T2DM.

Physical inactivity has been identified as a risk factor of T2DM independently of its effects on body size, and dietary patterns. Physical activity of moderate to vigorous intensity and duration decreases the risk of conversion of impaired glucose tolerance into diabetes even in the absence of significant weight loss, and independently of other risk factors.[8] Regular strenuous exercise (not the minimal activity of modern day life) is needed to reduce the risk of T2DM among

adults, which works in a dose response manner.[9] Similarly, the 'Western' dietary patterns have been attributed to a significant increased risk of diabetes in several studies.[10,11]

Reproductive events during the life-span of women have been shown to be associated with chronic diseases. Menopause has been associated with an increase in the abdominal fat caused by the depletion of ovarian function.[12] The changes in the body composition may cause disturbances in insulin sensitivity and in glucose metabolism in postmenopausal women.[13]

Females specifically around menoupause and due to exposure to multiple reproductive risk factors are at twice risk of T2DM more than men.[14] Reproductive factors are associated with dysglycemia in middle-aged women from many ethnicities. Reproductive factors can be used to counsel young women about their future risk of dysglycemia, whereas in middle age they may help screen for dysglycemia.[15]

The aim of this study is to quantify the problem of T2DM (by gold standard Random Blood Sugar (RBS) screening test) [16], to determine a 10 year risk period of T2DM occurrence (CANRISK), and to identify risk factors associated therewith among middle-aged females residing rural community in Upper Egypt.

Justifications of the study: Globally, the increase in diabetes incidence follows the trend of lifestyle changes. The justification of choosing 40-55 year old women is that women with early menopause were more likely to suffer from T2DM and prediabetes in comparison to women with normal age at menopause.[17] Pregnancy, large BMI, gestational diabetes and menopause play the most important risk factors contributed to T2DM occurrence among females. If risk factors are better known, they could be used to refine screening programs and health education intervention.

2. METHODS

Study Design: This is a cross sectional community-based study which was carried-out in Bini-Hassan and Nazlet- Ebeed villages which were chosen randomly through simple random sample of El- Minia district. Bini-Hassan is an Ancient Egyptian cemetery site. It is located approximately 20 kilometers to the south of modern-day Minia in the region known as Middle Egypt, the area between Asyut and Memphis. This village is inhabited by 4820 population; 2370 (49.2%) were females. However, Nazlet- Ebeed village is inhabited by 12594 population; 5948 (47.2%) were females. Both the villages were contiguous with a similar socio-demographic profile. Before initiating the study, approximate estimation of females' percentage in the age group range between 40 and 55 years was determined using proxy figures of Minia CAPMAS data.

Study Sample:

Inclusion criteria*:* The study population is eligible females in the two villages chosen from alternate houses using systematic random sampling method during the study period and gave an informed consent. All women who residing in the selected village and between 40 and 55 years of age were eligible and participants were chosen at random. Over the study period, the village received home visits by researchers. Response rate was 97%. **Exclusion criteria**: Female less than 40 or more than 55 years, pregnancy, known cancer, refusal of participation and women with history of oophorectomy.

This cross-sectional one point analysis of risk factors for T2DM among rural females was conducted in two villages, Minia district. The houses in each selected village were numbered starting with the first house being closest to a fixed landmark in the village. The investigators covered every alternate house in the locality thus enumerating half of the total houses during the study period. Only one participant was allowed to participate. The head of the family was the first to be contacted and in case there was an eligible candidate, she was then approached and interviewed after explaining the purpose of the study. The subjects who could not be contacted during first visit were tried to be enrolled during second visit, after which they were excluded. Houses which did not have females in that age were excluded from the study. The objectives of the study were explained to the participants and informed consent was taken from them for active participation.

Eligible women were interviewed in their households using a pre-tested and structured questionnaire after obtaining informed consent. A total of 440 participants were listed in the study in which only 402 gave the consent for participation. A total of 482 houses were surveyed. Eligible subjects unavailable during the first house visit were approached on another pre-informed date as per their convenience.

Women were recruited through local announcements (loudspeaker) at community level and by alternate house visits. After recruitment, participants were interviewed and examined clinically at their houses and blood samples were collected from them. Participants with the following conditions were excluded from the study: pregnancy, any acute illness, oophorectomy or any other medications likely to cause elevated plasma glucose, on hormone replacement therapy (HRT).

Women were defined as post-menopausal if they had reported their last menses to be at least 12 months previously; pre-menopausal if they had an unchanged and regular menstrual pattern during the last five years, without typical climacteric complaints and peri-menopausal if last menses to be within or before 12 months and were not regular. A standard questionnaire on health and menopausal status written in the local language was used to identify the pre- and post-menopausal subjects. Assuming a confidence level of 95%, the sample size comes out to be 402.

Ethical Consideration: Official permissions were obtained from the Department of Public health and Preventive Medicine, the director of EL-Minia University, and the scientific ethical committee of the collage. An approval was taken from the mayor of these villages. Written consent was obtained after the participants had been informed about the study objectives.

Data collection:

1- ***Interview-administered questionnaire:*** It included socio-demographic data, family history, gynecological and obstetric history.

2- ***Canadian Diabetes Risk Questionnaire (CANRISK):*** it contains the main risk factors of diabetes mellitus**.** It includes the following questions: Age, Gender, Weight, height, BMI, Waist circumference, Physical activity, Fruits and vegetables. Blood pressure, High blood sugar, High birth weight babies, Family history of diabetes and Education.

CANRISK scores can be easily interpreted by summing up point scores for each of the 11 questions and then comparing the results with threshold scores for each of the 3 risk categories: Low < 21, Moderate 21–32 and High > 32

3- Blood glucose: for screening of diabetes mellitus. Diabetes was diagnosed according to ADA criteria [(15)], which requires fasting venous plasma glucose greater than or equal to 126 mg/dl or two-hour glucose level greater than or equal to 200 mg/dl after a 75 g oral glucose load.

4- BMI.: by determining the weight and height of the participants to scale the degree of obesity.

5- Waist hip ratio (WHR): According to the WHO's data gathering protocol, the waist circumference should be measured at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest, using a stretch-resistant tape that provides a constant 100 g tension. Hip circumference should be measured around the widest portion of the buttocks, with the tape parallel to the floor. The abdominal obesity if the ratio more than 0.85

The investigator visited the villages included in the study and invites the female population to participate for general health evaluation through measuring the weight and height and test for random blood glucose 2 days before the visit. The investigator visited the village to receive participants and transfer to other houses of neighbors to get more participants. The whole number of participants was enrolled in the study after their permission. Each participant was interviewed and the purpose of the study was explained to her, then she was asked to complete the self-administered questionnaire and CANRISK questionnaire. Some participants were illiterate so the investigator fulfills the questionnaire after asking the participant.

Statistical analysis: The collected data were presented by tables and graphs, computerized and statistically analyzed using Statistical Package of Social Science version 19 (SPSS)**.** Data was presented using descriptive statistics in the form of frequencies and percentages for qualitative variables. Chi- square, Z test and t test were used as tests of significance. Logistic regression analysis was also used. The test results were considered significant when p-value **<0.05** while p-value <0.01 and <0.001 were considered highly significant.

Limitations and obstacles of the study

- Lacking cooperation of some of females.
- Hard carrying of weight scale and transmitting it between houses.

3. RESULTS

This study included 402 peri-menopausal females in Nazlet- Ebeed and Bini-Hassan villages in Minia-district. About one fourth of participants (25.4%) were diabetics by the random blood sugar evaluation and (74.6%) were non-diabetic.

Table (1) shows that nearly half of the participants had a moderate risk of diabetes (46.8%) as evaluated by CANRISK. There were highly significant differences between participants as regard CANRISK (P<0.001).

Table (2) shows that the age of the participants was ranged from (40.0 - 55.0) and the mean of the participants' ages was 44.22 ± 2.54 year. Most of them were married (66.7%), about (35.3%) of the participants were illiterate, not-working (53.2%), and of moderate social class (51.9%). There were highly significant relations between random blood glucose levels and old age (50-55 years), married, and illiterate. About 55.9 % of the diabetics were between 50-55 years versus 22.7% of the non-diabetics, 39.2% of the diabetics were illiterate versus 34.0% of the non-diabetics.

There were highly significant relations between random blood glucose levels and passive smoking, drinking tea or coffee, and lack of physical activity. About 95.1 % of the diabetics were between passive smokers versus 75.7% of the non-diabetics, 95.1% of the diabetics were drinking tea or coffee versus 73.0% of the non-diabetics, and about 87.4% of the diabetics were not engaged in physical activity versus 58.7% of the non-diabetics (table 3).

There were highly significant relations between diabetes and earlier age at menarche (before 11 years), premature menopause, CCP, and high birth weight babies (>4kg). About 58.8%of the diabetics their age of menarche were before 11 years versus 24.0% of the non-diabetics, and 32.4% of diabetics had abnormal spotting or bleeding versus 20.3% of non-diabetics. About 69.5%of the diabetics were taking CCP versus 29.5% of the non-diabetics, and 48.3% of the diabetics had high birth weight babies (>4kg) versus 23.1% of the non-diabetics (table 4).

Table (5) shows that there were highly significant relations between random blood glucose levels and waist circumference more than 88cm, and obesity. About 93.1%of diabetics had waist circumference more than 88cm versus 64.3% of non-diabetics.

Table (6) shows that the most important predictors of DM among participants were lack of physical activity, overweight and obesity, early menarche, early menopause, gestational diabetes, hypertension, CCP, high birth weight babies, family history, and illiteracy. O.R (95% C.I) were 4.7(1.7 -13.1) for lack of physical activity, 3.8(1.6 - 8.9) for overweight & obesity, 3.7(1.6 - 8.4) for early menarche, 3.4(1.5- 7.9) for early menopause, for Gestational diabetes 3.2(1.4 - 6.8), for Hypertension 2.6(1.1 - 5.9), for CCP 2.4(1.0 - 5.6), for high birth weight babies 2.2(0.9 – 4.4), for family history 1.9(0.9 - 4.0), and for Illiteracy1.8(0.8 - 3.9).

4. DISCUSSION

The development of T2DM is caused by a combination of lifestyle and genetic factors.[18] A number of lifestyle factors are known to be important to the development of T2DM, including obesity, lack of physical activity, poor diet, stress, and urbanization.[19] Even those who are not obese often have a high waist–hip ratio.[20] Dietary factors also influence the risk of developing T2DM. Consumption of sugar-sweetened drinks, saturated fats and white rice in excess is associated with an increased risk.[21, 22] A lack of exercise is believed to cause 7% of cases.[22] Pregnancy, gestational diabetes and menopause play the most important risk factors contributed to type 2 diabetes occurrence among females.[23]

Nearly half of participants had moderate risk of diabetes (46.8%) as evaluated by CANRISK. There were no available previous studies used CANRISK so; the researcher found difficulty in comparing results. But generally; these results lacked validity, as some diabetic participants had low risk on CANRISK. That was explained that CANRISK has a positive predictive value (PPV) of 14 % and a negative predictive value (NPV) of 99.3 %. So, the tool is most valuable in helping define which patients are very unlikely to have diabetes.[24]

This study showed that age and education had a highly significant relation with blood glucose levels. This result was in coherence with a study which found that diabetes mellitus most prevalent among the older age group (age more than 60 years), those who were retired, and illiterate.[25]

In the present study, there is a highly significant relation between blood glucose levels and passive smoking, drinking tea or coffee and lack of physical activity. This was in agreement with a study which found that healthy diet and active lifestyle may significantly decrease the risk of T2DM in spite of having a family history of diabetes.[26]

Our finding of a significant association between blood glucose levels and earlier age at menarche (before 11 years) was similar to a study which observed that women with history of early menarche had higher risk of T2DM in adulthood. Less than half of this association appears to be mediated by higher adult BMI, suggesting that early pubertal development also may directly increase type 2 diabetes risk.[(27]

As regard to the association between T2DM and menopause, another study suggested that menopause can increase the risk of diabetes, but this is controversial. HRT in post menopause improves the metabolic control of women with T2DM and/or decreases the prevalence of diabetes; therefore, a protective role of ovarian steroids on the risk of diabetes has been suggested.[28] This was in contrast to another study which found that women whose estrogen production ended as a result of having their ovaries removed, and engaged in lifestyle changes, cases of diabetes were extremely low.[29] For every year 100 of these women were observed, only 1.1 women developed diabetes. Menopause itself does not increase the risk of DM, but conversely having T2DM triples the risk of an early menopause.[30]

The current study showed that there are highly significant relation between blood glucose levels and waist circumference more than 88cm, and obesity. About 93.1% of diabetics had waist circumference more than 88cm versus 64.3%of non-diabetics. This in accordance to a study found that overweight and obesity are among the strongest known risk factors for T2DM, risk statements based on anthropometric measurements should be as precise as possible and allow for the complex interactions between these parameters.[31]

Physical inactivity and obesity are the most important risk factors of T2DM in our study population, this is in agreement with two randomized trials each found that lifestyle interventions including 150 min/week of physical activity and diet-induced weight loss of 5–7% reduced the risk of progression from impaired glucose tolerance (IGT) to T2DM by 58%.[32] A cluster-randomized trial found that diet alone, exercise alone, and combined diet and exercise were equally effective in reducing the progression from IGT to diabetes.[33] Therefore, there is firm and consistent evidence that programs of increased physical activity and modest weight loss reduce the incidence of T2DM in individuals with IGT.

5. CONCLUSION

Based on the findings of the present study, it was concluded that: out of 402 participants, 46.8% and 35.3% had moderate or high risk of developing diabetes in the next 10 years respectively according to CANRISK. Nearly ¼ of participants had diabetes when they were screened using blood sugar. Sedentary life style, obesity, early menarche and early menopause were the most contributing factors to diabetes occurrence.

It was recommended that health education with behavior & lifestyle modification and weight management could help in prevention and control of T2DM. Preventing over-medicalisation through the formulation of a locally adapted Egyptian diabetes risk assessment. Further researches also needed include a population of women to assess the relation between reproductive life span and the long term use of contraceptive methods and the risk of occurrence of T2DM. We need locally adapted diabetes screening risk questionnaire to be applied to female taking into account female's reproductive factors and this will be instead of CANRISK which was not valid in the setting in which the study was conducted because it did not take into account female's reproductive factors.

ACKNOWLEDGMENT

The authors are very much grateful to all participants of the study for their kind cooperation.

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APPENDIX - A

Table (1): Assessment of diabetes risk among participants using Canadian Diabetes Risk Questionnaire in Nazlet -Ebeed and Bini-Hassan villages in El-Minia district from December 2013 to June 2014

CANRISK	No. (n= 402)	%	Z	p
Low < 21	72	17.9		
Moderate 21–32	188	46.8	76.4	0.0001
High > 32	142	35.3		

Table (2): Relationship between random blood glucose levels and Socio-demographic characteristics of the studied sample in in El Minia rural areas

Socio-demographic characteristics	Diabetic (n=102)	Non diabetic (n=300)	Total (n=402)	X^2 P
	n (%)	n (%)	n (%)	
Age (years):				
- 40 - 44	16 (16.7)	132 (44.0)	148(36.8)	44.2
- 45 – 49	29 (28.4)	100 (33.3)	129(32.1)	0.0001**
- 50 - 55	57 (55.9)	68 (22.7)	125(31.1)	
Mean ± SD 44.22 ± 2.54				
Range 40.0 - 55.0				
Marital Status:				
- Single	5 (4.9)	32 (10.7)	37(9.2)	17.1
- Married	85 (83.3)	183 (61.0)	268(66.7)	0.0001**
- Divorced/widow	12 (11.8)	85 (28.3)	97(24.1)	
Education:				
- Illiterate	40 (39.2)	102 (34.0)	142(35.3)	11.4
- Read & write	10 (9.8)	27 (9.0)	37(9.2)	0.023*
- Primary/preparatory	18 (17.6)	64 (21.3)	82(20.4)	
- Secondary	33 (32.4)	75 (25.0)	108(26.9)	
- Higher	1 (0.9)	32 (10.7)	33(8.2)	
Occupation				
- Not working	55 (53.9)	159 (53.0)	214(53.2)	1.92
- Employee	24 (23.5)	64 (21.3)	88(21.9)	0.589
- Worker	12 (11.8)	29 (9.7)	41(10.2)	
- Professional	11 (10.8)	48 (16.0)	59(14.7)	
Social class				3.84
- Low	42 (41.2)	94 (31.3)	136(33.8)	0.147
- Moderate	45 (44.1)	164 (54.7)	209(52)	
- high	15 (14.7)	42 (14.0)	57(14.2)	

** Highly statistically significant

Table (3): Relationship between random blood glucose levels and special habits of the studied sample in El Minia rural areas

Special habits	Diabetic (n=102)	Non diabetic (n=300)	Total (n=402)	X^2 P
	n (%)	n (%)	n (%)	
Active smoking				
- Yes	4 (3.9)	3 (1.0)	7 (1.7)	3.80
- No	98(96.1)	297 (99.0)	395(98.3)	0.051
Passive smoking				
- **Yes**	97 (95.1)	227 (75.7)	324(80.6)	18.4
- **No**	5(4.9)	73 (24.3)	78(19.4)	0.0001**
Tea or coffee				
- Yes	97 (95.1)	219 (73.0)	316(78.6)	22.1
- No	5 (4.9)	81 (27.0)	86(21.4)	0.0001**
Physical activity				
- Yes	10 (9.8)	124 (41.3)	134(33.3)	34.1
- No	92 (87.4)	176 (58.7)	268(66.7)	0.0001**

Table (4): Relationship between random blood glucose levels and reproductive factors and obstetric history of the study samples in El Minia rural areas

Reproductive factors	Diabetic (n=102)	Non diabetic (n=300)	Total (n=402)	X^2 P
	n (%)	n (%)	n (%)	
Age of Menarche				
Mean12.2±0.37				
Range10-17				
- Before 11 years	60 (58.8)	62 (24.0)	122(30.3)	52.5
- 11-13 years	36 (35.3)	208 (66.0)	244(60.7)	0.0001**
- After 13 years	6 (5.9)	30 (10.0)	36(9)	
Menopause Mean47.8±1.03				
Range 39-53				
No				
Yes	17 (16.7)	170 (56.7)	187(46.5)	91.2
Premature	8 (7.8)	3 (1.0)	11(2.7)	0.0001**
Early	25 (24.5)	6 (2.0)	31(7.7)	
Average	52 (50.9)	121 (40.3)	173(43.1)	
Regularity				
- No	44 (43.1)	82 (27.3)	126(31.3)	8.8
- Yes	58 (56.9)	218 (72.7)	276(68.7)	0.053
Obstetric history	**Diabetic* (n=60)**	**Non diabetic* (n=251)**	**Total (n=311)**	
CCP				
- Yes	47 (69.5)	74 (29.5)	121 (38.9)	48.6
- No	13 (21.7)	177 (70.5)	190(61.1)	0.0001**
Pregnancy complications				
- No	14 (23.3)	30 (11.9)	44(14.1)	5.16
- Yes	46 (76.7)	221 (88.1)	267(85.9)	0.051
Post-pregnancy complications*				
- No	30 (50.0)	57 (22.7)	87(28)	17.9
- Yes	30 (50.0)	194 (77.3)	224(72)	0.053
High birth weight babies (>4kg)*				
- Yes	29 (48.3)	58 (23.1)	87(28)	15.3
- No	31 (51.7)	193 (76.9)	224(72)	0.0001**

* Female participants who had positive history of previous pregnancy and their number was 334 female, the rest of sample were between 37 single female and 31 sterile female.

**High statistically significant

Table (5): Relationship between random blood glucose levels and anthropometric measures of participants in Nazlet -Ebeed and Bini-Hassan villages in El- Minia district from December 2013 to June 2014

Body measures	Diabetic (n=102)	Non diabetic (n=300)	X^2	P
Waist circumference				
- Less than 80 cm	2 (1.9)	39 (13.0)	31.1	0.0001**
- 80 – 88	5 (4.9)	68(22.7)		
- More than 88	95 (93.1)	193 (64.3)		
Body mass index (BMI)				
- Underweight	1 (0.9)	10 (3.3)	43.1	0.0001**
- Normal	5 (4.9)	54 (18.0)		
- Overweight	9 (8.8)	78 (26.0)		
- Obesity	67 (65.7)	142 (47.3)		
- Extreme obesity	20 (19.6)	16 (5.3)		

** High statistically significant

Table (6): Logistic regression analysis; for significant predictors of DM among participants in Nazlet -Ebeed and Bini-Hassan villages in El-Minia district from December 2013 to June 2014

Independent factors*	B	S.E	P	O.R (95%C.I)
Lack of Physical activity	1.6	0.5	<**0.01**	4.7(1.7 -13.1)
Overweight & obesity	1.5	0.4	<**0.01**	3.8(1.6 - 8.9)
Early menarche	1.4	0.4	<**0.01**	3.7(1.6 - 8.4)
Early menopause	1.2	0.4	<**0.01**	3.4(1.5- 7.9)
Gestational diabetes	1.1	0.4	<**0.01**	3.2(1.4 - 6.8)
Hypertension	0.9	0.4	<**0.05**	2.6(1.1 - 5.9)
Contraceptive pills	0.9	0.4	<**0.05**	2.4(1.0 - 5.6)
High birth weight babies	0.8	0.4	**<0.05**	2.2(0.9 – 4.4)
Family history	0.7	0.4	**<0.05**	1.9(0.9 - 4.0)
Illiteracy	0.6	0.4	**<0.05**	1.8(0.8 - 3.9)

B =beta coefficient S.E =standard error R2= 0 .6229

* The dependent factor is diabetes mellitus.

N.B: p- value considered significant if beta coefficient / standard error > 2.64.