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PREVALENCE AND RISK FACTORS ASSOCIATED WITH PREDIABETES AMONG GENERAL POPULATION ASSOCIATED WITH IN RIYADH, SAUDI ARABIA

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ABSTRACT

Background: Pre-diabetes is a state of blood sugar level that is higher than normal, but not high enough to meet the diagnostic criteria of type II diabetes mellitus (3). It occurs either due to 'impaired fasting glucose' or 'impaired glucose tolerance' or both. Aging and obesity are significant risk factors associated with type 2 diabetes (3). The purpose of this study is to evaluate the association between the prevalence and the risk factors of Pre-diabetes among the population in Riyadh, Saudi Arabia. **Method**: Cross-sectional population-based survey was conducted by King Fahad Medical City within the population in Riyadh, Saudi Arabia. **Result**: The prevalence of pre-DM is 14.8% among Riyadh residents. The prevalence of pre-diabetes is significantly higher among males (23%) compared to females (12%). This study found that pre-DM is higher among 30-39 years (24%), married people (20%), high income (27%), and those who work less than 5 hours per day (28%). The prevalence of pre-DM is higher among smokers (30%) than non-smokers (13%). A significant number of overweight and obese people (22%) report a higher prevalence than healthy weight (12%). Participants with a family history of diabetes are about two times more likely to have pre-diabetes. Participants with co-existing disease are approximately 7 times more likely to have pre-diabetes. **Conclusion**: The study shows an increase of the prevalence of Pre-diabetes with a strong association between pr-diabetes and behavioral characteristics of the population.

KEYWORDS: Prediabetes, Type 2 Diabetes, hyperglycemia, risk factors.

INTRODUCTION

Prediabetes is the intermediate state between normal glucose hemostasis and diabetes,[1] According to the National Diabetes Data Group, it occurs either due to 'impaired fasting glucose' or 'impaired glucose tolerance' or both. Therefore, prediabetes can be considered as a stage when the level of the glycemic variables is higher than the normal level of glycemic variables is higher than normal levels but not in the range of diabetes.[1] The global prevalence of diabetes in 2019 is measured to be 9.3% (463 million) people are suffering from diabetes, and it is predicted to continue rising to be 10.2% (578 million) by the year 2030 and 10.9% (700 million) by the end of 2045, worldwide people aged between (20–79) years measured 7.5% (374 million) are living with prediabetes. Out of the (463 million) people, approximately half (50.1%) are living with diabetes, and they are unaware of their illness.[2]. Pre-diabetes is a term that is used when the blood sugar level is higher than normal, but not high enough to meet the diagnoses criteria of type II diabetes mellitus.[3] In Saudi Arabia, the diabetes mellitus prevalence among the adult population had reached 23.7%, one of the highest percentages across the globe.[4] Diabetes can affect anyone, but there are some risks and factors that raise the possibility, several studies found that Aging and Obesity are two factors that have the strongest connection with T2DM.[3] People with pre-diabetes by the time they will have T2DM, study shows approximately 70% of people would develop T2DM within 10 years, The prevalence of pre-diabetes is increasing worldwide and the risk of many diseases and complications are increasing too, therefore it is essential to detect and prevent such progression with appropriate management, many studies show that lifestyle modification and metformin are effective management to prevent the development of T2DM.[5] If prediabetes is left untreated it will affect 37% of individuals with diabetes in succeeding years.[6] Prediabetes also imposes the potential burden of mortality upon the affected individuals due to its association with cardiovascular complications.[1] In a population-based MESA study. Prediabetes was associated with lower right Ventricular mass and smaller RV volume but not with RV systolic function, while RV diastolic function was not assessed.[7] It is worth mentioning that the conditions of up to 10% of prediabetics develop into diabetes each year.[7] One of the most important risk factors for Dm is Ageing, one study was conducted in Jeddah in 2016 to determine the risk of DM among Saudi residents, The study shows that Ageing was the strongest predictor, half of the people aged 50 years and above were diagnosed with DM, while

10–15% with prediabetes, and only a small proportion of participants with this age more than 50years old had normoglycemia.[8] On the other hand, Obesity also has a strong association with prediabetes and diabetes and plays an important role when diagnosis DM. One study was done in Al-Kharj in 2019 to estimate the Predictors of Prediabetes and Diabetic among Saudi Females, the study shows approximately 23% of participants were overweight, and 22.57% were obese, almost half of the participants are having abnormal weight. Obesity is a modifiable risk with high-value prevention and would decrease the rate of diabetes.[9] Results from many studies enlighten the fact that lifestyle modification plays an important role to reverse prediabetes, Physical activity is considered a tangential component of lifestyle modification, and exercise is a subcategory of the physical activity spectrum.[10] The aim of this study is to know the prevalence and risk factors among the Saudi Population within Riyadh, Saudi Arabia.

METHOD

Study design: In Saudi Arabia, diabetes mellitus is quickly reaching disturbing proportions and becoming a significant cause of death. This cross-sectional population based survey was conducted by King Fahad Medical City with in the population in Riyadh, Saudi Arabia. The capital of Saudi Arabia and the largest city in the country. It is characterized by its multicultural population and its outgrowing urban. A total of 400 with majority were females, aged from 18-29 years old, unmarried, un employed, white people and middle-income level responded to the study.

Inclusion and Exclusion Criteria

The study included 400 individuals with in Riyadh, Saudi Arabia. Included Gender, age of respondents, marital status, working hours per day, ethnicity, income level, nutrition, alcohol consumption, smoking, physical activity, Body mass Index , family history of diabetes, co-existing diseases such as hypertension or kidney disease, and if there is any episodes of hypoglycemia. Population outside the capital city Riyadh were excluded.

Data collection

The data collection spam was from December 13 to December 16 with a total of 400 individual. Researchers guided the participants to fill out the questionnaires. Only complete questionnaires were selected for final analysis and those were found to be 400.

Sampling Techniques: Participants from both, private and governmental institutions were selected following a multi-staging sample technique and using the cluster sample method. Clusters of participants from every chosen institution were obtained and then randomized sampling was performed from these clusters.

MATERIALS AND MEASURES

All the data that been collected from the participants using a structured questionnaire. Information about sociodemographic (such as age, gender, marital status and income level was obtained. Behavioral characteristics and other body measurements were collected from the participants. It showed that majority of participants have a normal BMI. Furthermore, more than half of the participants have family history of diabetes. The prevalence is significant among male more than female since the p-value in the chi-square is less than 0.5. The prevalence associated with smoking, BMI, family history, co-existing diseases and hyperglycemia were collected. All the procedures were carried out based on the standards for anthropometric measurements. Different genders, weights, association with co-exiting diseases and hyperglycemia levels were collected from the 400 participants in Riyadh population. The number of males and females who completed the study was 87 and 313, respectively.

Data analysis: All data were expressed as mean +- deviation, while the chi-square (x) test and percentage were used in the case of categorical data.

Ethical Approval: Written informed consents was obtained from participants, after explaining about the purpose and procedure of the study. The ethical approval for this study was secured for King Fahad Medical City, Institutional Review board. The confidentiality of the data was maintained.

Multiple logistic regression analyses: In table 1 , Socio-demographics characteristics of study participants summarize the results of the respondents profile in term of their gender, age group, martial status, working hours per day, ethnicity and income level. A total we collected the data from 400 respondents with a majority were females, 18-29 yo, unmarried, un employed, white people and middle-income level. Behavioural characteristics and other body measurements are also collected from the participants as shown in Table 2). 61% of the total participants have unhealthy diet, 65% have 3-4 meals per day including snacks, 1% are alcoholic drinkers, 11% are smokers and 6% are physically inactive. The majority of the participants have normal BMI. More than half of the participants have a family history of diabetes. 91% have co-exisiting diseases such as HTN or kidney disease and 27% have experienced hypoglycemia. (Table 3) shows the prevalence of pre dm is 14.8% (95% CI: 11,8 %-17.5%) as shown in(figure 3). The prevalence of pre dm is significantly higher among 30-39 years old(24%) married people (20%) , high income (27%) and those who work less than 5 hours per day (28%).

In terms of behavioural charactersitics of study participants, the chi square test reveals that the prevalence of pre-dm is significantly associated with smoking, BMI, family history of diabetes, co-existing

diseases and hyperglycemia . The prevalence of pre dm is higher among smokers (Non smoker 13% - Smokers 30%) and obese, People with over weight and obese report significantly higher prevalence 22% than healthy weights 12%. Participants with co existing diseases are approximately 7 times more likely to have diabetes.
Additionally, prevalence of pre dm is found to be significantlt higher among people who ever experienced and episode of hyperglycemia.

Significant factors obtained fom univariate analysis is further considered in a logistic regression model to assess the impact of all combined factors together on Pre dm variable. The Hosmer-Lemeshow test indicates a good fit model since the p-value is greater than 0.05.

Table 4 shows the estimated regression coefficiants for risk factors of pre dm, indicating the age group,working hours, gender, martial status, smoking and family history of diabetes are no longer significantly associated with prevalence of pre dm taking into account all potential risk factors simultaneously in the model. BMI, co existing disease such as hypertension , and hypoglycemia are significantly associated with pre-dm. The estimated odds ratio (OR) for BMI variable is 2.130, indicating that the odds of having pre-dm for people with overweight is about 2 times than people with healthy weight, controlling other variables in the model. The estimated odds ratio (OR) for co-existing variable is 8.531, indicating that the odds of having pre dm for people with co- existing disease is about 8 times than those without, controlling other variables in the model. The estimated OR for hypoglycemia variable 5.379, showing that the odds of having pre-dm for people with hypoglycemia is almost 5 times than those without, controlling other variables in the model.

RESULT

Table 1 summarizes the respondent profiles in terms of their gender, age group, marital status, working hours per day, ethnicity, and income level. A total we collected the data from 400 respondents with majority were female, 18-29 years old, not married, not working, white people and middle-income level.

Table 1: Socio-demographic characteristics of study participants (n = 400).

Variable	Frequency	Percent
Gender		
Male	87	22%
Female	313	78%
Age of respondents		
Under 18 years	43	11%
18 - 29 years	243	61%
30-39 years	78	20%
40-49 years	29	7%
50 years and above	7	2%
Marital Status		
Married	156	39%
Not Married	243	61%
Working hours per day		
Less than 5 hours	78	20%
Less than 8 hours	157	39%
None	165	41%
Ethnicity		
White	334	84%
Black	23	6%
Asian	36	9%
American Indian	3	1%
Latino	4	1%
Income Level		
High	41	10%
Middle	296	74%
Low	63	16%

Behavioural characteristics and other body measurement are also collected from the participants as shown in Table 2. Of the total participants, about 61% have unhealthy diet, 65% have 3-4 meals per day including snacks, 1% are alcohol drinkers, 11% are smokers, and 6% physically inactive. The majority of the study participants have normal BMI (70%). Furthermore, more than half have family history of diabetes (60%), 91% have co-existing disease such as hypertension or kidney disease, and 27% have experienced hypoglycaemia.

Table 2: Behavioural characteristics and other body measurement results of participants (n = 400).

Variable	Frequency	Percent
Type of diet		
Mixed	1	0%
Healthy diet	145	38%
Unhealthy	233	61%
Number of meals per day including snacks		
Less than 2 meals	139	35%
3-4 meals	261	65%
Alcohol consumption		
Yes	4	1%
No	396	99%
Smoking		
Current smoker	43	11%
Non smoker	357	89%
Physical activity		
High	40	10%
Moderate	200	50%
Low	135	34%
Never	25	6%
Body mass index		
Overweight & Obese	121	30%
Healthy weight	279	70%
Family history of diabetes		
Yes	241	60%
No	159	40%
Co-existing disease such as hypertension or kidney disease		
Yes	363	91%
No	37	9%
Ever experienced episodes of hypoglycaemia		
Yes	1b06	27%
No	294	74%

The prevalence of pre-DM is 14.8% (95% CI: 11.8% – 17.5%) as shown in Figure 1. The prevalence is significantly higher among male (23%) than female (12%) since the p-value of chi-square test is less than 0.05 ($\chi^2(1) = 6.303, p = 0.012$). Other socio-demographic characteristics of study participants also indicate significant different in pre-DM prevalence since all p-values are less than 0.05. The prevalence of pre-DM is significantly higher among 30-39 years (24%), married people (20%), high income (27%), and those who work less than 5 hours per day (28%).

In terms of behavioural characteristics of study participants, the chi-square test reveals that the prevalence of pre-DM significantly associated with smoking, BMI, family history of diabetes, co-existing disease, and hyperglycaemia. The prevalence of pre-DM is significantly higher among smokers (30%) than non-smokers (13%) ($\chi^2(1) = 9.185, p = 0.002$). People with overweight and obese report significantly higher prevalence (22%) than healthy weight (12%). Participants with family history of diabetes are about two times more likely to have pre-diabetes (yes: 18% vs. no: 9%). Participants with co-existing disease are approximately 7 times more likely to have pre-diabetes (yes: 68% vs. 9%). Additionally, prevalence of pre-DM is found to be significantly higher among people who have ever experienced episode of hyperglycaemia ($\chi^2(1) = 55.725, p < 0.001$)

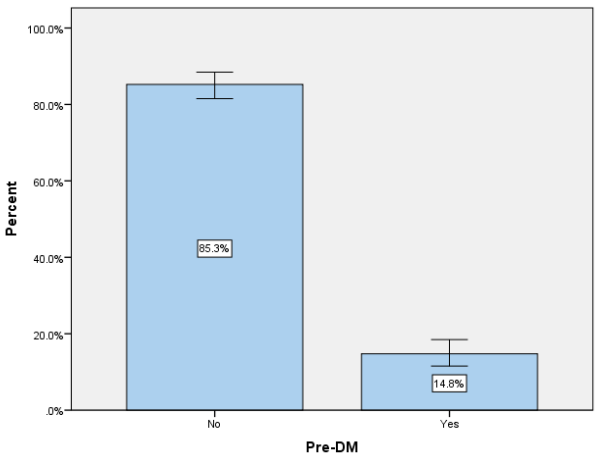

Figure 1: Prevalence of pre-DM (n = 400).

Table 3: Association between pre-DM and its factors.

Variable	N	Pre-Diabetes		Chi-square test		
		Yes	no	Value	df	p-value
Age group						
Under 18 years	43	12%	88%	9.618	4	0.047*
18-29 years	243	12%	88%			
30-39 years	78	24%	76%			
40-49 years	29	21%	79%			
50 years and above	7	0%	100%			
Gender						
Male	314	23%	77%	6.303	1	0.012*
Female	86	12%	88%			
Marital status						
Married	156	20%	80%	5.335	1	0.021*
Not Married	244	12%	89%			
Income level						
High	41	27%	73%	5.352	2	0.069
Middle	296	13%	87%			
Low	63	14%	86%			
Working hours per day						
Less than 5 hours/day	78	28%	72%	14.041	2	0.001*
Less than 8 hours/day	157	12%	88%			
None	165	11%	89%			
Diet						
Healthy diet	146	15%	85%	0.482	2	0.786
Moderate	21	10%	91%			
Unhealthy diet	233	15%	85%			
Number of meals per day						
Less than 2 meals	139	12%	89%	1.778	1	0.182
Meals 3-4	261	17%	84%			
Alcohol						
Yes	4	0%	100%	0.699	1	0.403
No	396	15%	85%			
Smoking						
Current smoker	43	30%	70%	9.185	1	0.002*
Non smoker	357	13%	87%			
Physical activity						
High	40	13%	88%	4.713	3	0.194
Moderate	135	13%	88%			
Low	200	16%	84%			
Never	25	28%	72%			
Body mass index						
Healthy weight	279	12%	89%	7.893	1	0.005*
Overweight & Obese	121	22%	78%			
Family history of diabetes						
Yes	241	18%	82%	5.931	1	0.015*
No	159	9%	91%			
Co-existing diseases						
Yes	37	68%	32%	90.454	1	<0.001*
No	363	9%	91%			
Hyperglycaemia						
Yes	106	37%	63%	55.725	1	<0.001*
No	294	7%	93%			

*Significant at 5% level

Significant factors obtained from univariate analysis is further considered in a logistic regression model to assess the impact of all combined factors together on pre-DM variable. The Hosmer-Lemeshow test indicates a good fit model since the p-value is greater than 0.05

($\chi^2(8) = 9.021, p = 0.341$). Table 4 shows the estimated regression coefficients for risk factors of pre-DM, indicating that age group, working hours, gender, marital status, smoking, and family history of diabetes are no longer significantly associated with the prevalence of pre-DM taking into account all potential risk factors simultaneously in the model. BMI, co-existing disease such as hypertension, and hypoglycaemia are significantly associated with pre-DM. The estimated odds ratio (OR) for BMI variable is 2.130, indicating that the odds of having pre-DM for people with overweight is about 2 times than people with healthy weight, controlling other variables in the model. The estimated odds ratio (OR) for co-existing disease variable is 8.531, indicating that the odds of having pre-DM for people with co-existing disease is about 8 times than those without, controlling other variables in the model. The estimated OR for hypoglycaemia variable is 5.379, showing that the odds of having pre-DM for people with hypoglycaemia is almost 5 times than those without, controlling other variables in the model.

Table 4. Results of logistic regression for risk factors of pre-DM.

Variable	Estimate	Std. Error	OR	p-value
Age group *(reference: under 18)*				0.729
18-29 years	0.480	0.615	1.616	0.435
30-39 years	1.085	0.808	2.960	0.179
40-49 years	0.600	0.939	1.821	0.523
50 years and above				0.255
Working Hours *(reference: none)*	0.568	0.468	1.765	0.224
< 5 hours/day	-0.174	0.420	0.841	0.679
<8 hours/day	-19.72	13176	0.000	0.999
Male	0.550	0.452	1.733	0.224
Married	-0.370	0.497	0.691	0.456
Smokers	0.118	0.552	1.125	0.831
BMI: overweight & obese	0.756	0.361	2.130	0.036*
Family history of diabetes	0.396	0.379	1.486	0.295
Co-existing disease	2.144	0.496	8.531	<0.001*
Hypoglycaemia	1.682	0.371	5.379	<0.001*

*Significant at 5% level

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