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LIFE STYLE AND DIETARY PATTERNS AMONG TYPE 2 DIABETES MELLITUS ADULT PATIENTS: A CASE CONTROL STUDY IN RIYADH, SAUDI ARABIA

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ABSTRACT

The sedentary life style and unhealthy dietary pattern are important risk factors in the pathogenesis of Type 2 Diabetes Mellitus (T2DM). The aim of this study to explore the association of sedentary life style and unhealthy dietary patterns with T2DM among adult patients in Riyadh region of Saudi Arabia. This is a survey based case control study conducted in Riyadh region of Saudi Arabia among 75 T2DM patients who were compared with 54 control subjects. Mean weight and mean BMI of patients were significantly more than control subjects ($p<0.01$). For dietary pattern of patients, fried diet was followed by 38.67%, fatty diet was followed by 40%, sugary diet was followed by 36%, sweet energy drinks and beverages was consumed by 76%, oily diet was followed by 14.67%, eating in restaurant was followed by 52%, which all were significantly more than control subjects ($p<0.01$). Regarding physical activities of patients, stairs climbing was practised by 49.33%, household activities was practiced by 48%, standing for some of the time during job was practised by 5.33%, bicycling on daily routine was practised by 2.67%, which all were significantly less than control subjects ($p<0.01$). In conclusion, this survey based study reports the association of sedentary life style and unhealthy dietary patterns as the risk factors

in the development of T2DM. It is recommended that creating awareness about the role of sedentary life style and unhealthy dietary patterns in pathogenesis of T2DM could be helpful in combating this disease among general population of Saudi Arabia.

Keywords: Life style, dietary pattern, type 2 diabetes mellitus, Saudi Arabia

INTRODUCTION

Worldwide, approximately 327 million people aged between 20 and 64 years suffered from Diabetes (Type 1 and Type 2) and approximately 2 million deaths due to Diabetes were reported in 2017 [1]. It is well established that, obesity, unhealthy dietary habits, life style with decreased physical activity and genetic factors are the causative elements for the development of Type 2 Diabetes Mellitus (T2DM). In Saudi Arabia, the socioeconomic growth in past few decades probably contributed to unhealthy life style and dietary habits due to the availability of much luxurious life among the masses. The number of Diabetic cases among adult population (age 18-99 years) in Saudi Arabia were 4,004,877 and prevalence of Diabetes among the adults was 18.2%. Diabetes related deaths among adults in the Saudi Arabia was 15,536 in year 2017 [1].

In earlier studies, it has been reported that there is an association of regular physical activity with muscle and liver insulin sensitivity, overall glycaemic control, muscle glucose uptake and utilization and several beneficial physiological changes [2, 3]. Physically active lifestyle leads to improvements in insulin action and glycaemic control. Physical activity can contribute to the prevention or delay in development of other long-term diabetes complications, such as neuropathy, retinopathy, and nephropathy, and may slow progression of existing complications [3]. For individuals with type 2 diabetes, the multiple metabolic adaptations that occur in response to physical activity can improve glycemic control [4, 5].

In Middle-East countries, unhealthy diets are considered major causes of cardiovascular disease and T2DM, which contributes substantially to the global burden of diseases and mortality [6, 7]. According to a report, in Saudi Arabia, 66% of adult men and 71% of adult women are either overweight or obese which may contribute in insulin resistance causing T2DM [8]. Dietary pattern influences the amount of insulin required to meet blood glucose target goals to maintain optimal blood-glucose levels. The dietary pattern, especially carbohydrate intake could contribute to the pathology of diabetes. T2DM can be prevented or its onset can be delayed by lifestyle interventions, thus it is

critical to delineate which are the best dietary strategies [9, 10].

There are very few epidemiological studies based on the association of life style and dietary patterns with T2DM in Saudi Arabia. There has been a rapid emergence of studies indicating that T2DM risks are also associated with sedentary behaviour and unhealthy dietary patterns. This study aims to explore the association of sedentary life style and unhealthy dietary patterns with T2DM among adult patients in Riyadh region of Saudi Arabia.

MATERIALS AND METHODS

Study design and subjects:

This is a survey based case control study conducted in Riyadh region of Saudi Arabia in year 2016 to 2017 among both males and females T2DM patients to investigate their routine life styles and dietary patterns. This study was conducted among 75 T2DM patients who were compared with 54 control subjects of same socio economic status but had never suffered from T2DM and were medically fit. Study subjects voluntarily participated in this study and their informed written consent was obtained. The survey was conducted by asking the questions to volunteers directly face to face and also through online Survey Monkey website through a well-designed structured questionnaire. This study was approved by ethical committee, Institutional Review Board (IRB) of College of Medicine, Al Imam Mohammad Ibn Saud Islamic University.

Questionnaire:

A well-designed structured questionnaire was used for getting information from both patients and control subjects related to general information of age, socio demographic characteristics, education, smoking habits, height, weight, BMI etc.; information for their medical history of T2DM or any other diseases; clinical symptoms of T2DM; dietary pattern; components of daily food items; daily physical activities.

Statistical Analysis:

Descriptive statistics have been generated to compare the parameters obtained T2DM patients and control subjects. Frequencies and percentages have been shown for all the categorical parameters. Students' t test was applied for comparison of the means and standard deviations of the continuous data outcomes (age, height, weight, BMI). Chi-square test has been incorporated for the comparison of the categorical data outcomes (co-morbidities, T2DM symptoms, dietary patterns, physical activities). The calculation of relative risk and odds ratio with 95% confidence interval (CI) for other diseases and T2DM symptoms; whereas only odds ratio was

calculated for T2DM symptoms, dietary patterns and physical activities in respect to potential risk factors of T2DM. The criterion for significance was set at $p<0.05$. All the statistical analysis has been performed using an online MedCalc Software, 2018, Belgium.

RESULTS

Personal and demographic characteristics of study subjects:

Table 1 represents the personal and demographic characteristics of T2DM patients and control subjects. Among 75 patients, 25.66% were males and 74.67% were females whereas all controls subjects (100%) were males. 94.67% of patients were Saudi nationals and 3% were non Saudi, whereas all control subjects (100%) were non Saudi. 13.33% of patients were smokers and 86.67% were non-smokers, whereas 46.30% of control subjects were smokers and 53.70% were non-smokers. Only 1 (1.33%) patient developed type 1 diabetes mellitus and rest of the patients 98.67% were suffering from T2DM, whereas all control subjects were not having any type of diabetes (0%).

Physical characteristics of study subjects:

Table 2 exhibits the physical characteristics of T2DM patients and control subjects. Mean age of patients was significantly more than control subjects ($p<0.01$). Mean height of patients was significantly more than control subjects ($p<0.05$). Mean weight of patients was significantly more than control subjects ($p<0.01$). Mean BMI of patients was significantly more than control subjects ($p<0.01$).

Other diseases (co-morbidities) among study subjects:

Table 3 represents co-morbidities for some other metabolic diseases among T2DM patients and control subjects. Control subjects were not found to be any disease (0%). Among patients, 48% had hypertension (OR- 100.72; RR- 52.82), 5.33% had heart disease (OR- 6.86; RR- 6.51), 88% had lung disease (OR- 763.00; RR- 96.25).

Self-reported symptoms of T2DM among study subjects:

Table 4 exhibits self-reported symptoms of T2DM among study subjects. Control subjects have not reported for any symptom of T2DM (0%). Among patients with T2DM symptoms, 28% reported thirst (OR- 43.00; RR- 31.11), 32% reported dryness (OR- 51.85; RR- 35.46), 28% reported loss of appetite (OR- 43.00; RR- 31.11), 5.33% reported nausea and vomiting (OR- 6.86; RR- 6.51), 6.67% reported abdominal pain (OR- 8.50; RR- 7.96), 41.33% reported polyurea (OR- 77.15; RR- 45.59), 26.67% reported nocturia (OR- 40.26; RR- 29.67),

5.33% reported morning headache (OR- 6.86; RR- 6.51).

Dietary pattern among study subjects:

Table 5 represents dietary pattern among T2DM patients and control subjects in their routine life. Special diet was followed by 41.33% (OR- 77.15) of patients which was found to be significantly more ($p<0.01$) than control subjects who do not follow any special diet (0%). Diabetic diet was followed by 16% (OR- 21.45) of patients which was found to be significantly more ($p<0.01$) than control subjects. Low fat diet was followed by 41.33% (OR- 77.15) of patients which was found to be more than control subjects but not statistically significant. Fatty diet was followed by 40% (OR- 3.83) of patients which was found to be significantly more ($p<0.01$) than control subjects. Low salt diet was followed by 28% (OR- 43.00) of patients which was found to be significantly more ($p<0.01$) than control subjects. Salty diet was followed by 49.33% (OR- 1.94) of patients which was found to be more than control subjects but not statistically significant. Vegetarian diet was not followed (0%) by any patient (OR- 0.72) which was found to be similar as control subjects since no control subject followed vegetarian diet (0%). Non vegetarian diet was followed by 100% (OR- 1.38) of patients which was found to be which was found to be similar as control subjects since all control subjects followed non vegetarian diet (100%). Low sugar diet was followed by 52% (OR- 117.95) of patients which was found to be significantly more ($p<0.01$) than control subjects. Sugary diet was followed by 36% (OR- 1.94) of patients which was found to be more than control subjects but not statistically significant. Sweet energy drinks and beverages was consumed by 76% (OR- 5.83) of patients which was found to be significantly more ($p<0.01$) than control subjects. Fried diet was followed by 38.67% (OR- 69.15) of patients which was found to be significantly more ($p<0.01$) than control subjects. Oily diet was followed by 14.67% (OR- 0.75) of patients which was found to be more than control subjects but not statistically significant. Eating in restaurant was followed by 52% (OR- 117.95) of patients which was found to be significantly more ($p<0.01$) than control subjects.

Physical activities among study subjects:

Table 6 exhibits physical activities among T2DM patients and control subjects in their routine life. Stairs climbing was practised by 49.33% (OR- 0.27) of patients which was found to be significantly less ($p<0.01$) than control subjects. Household activities was practised by 48% (OR- 0.008) of patients which was found to be

significantly less ($p<0.01$) than control subjects. Sitting most of the time during job was practised by 17.33% (OR- 0.92) of patients which was found to be more than control subjects but not statistically significant. Standing for some of the time during job was practised by 5.33% (OR- 0.02) of patients which was found to be significantly less ($p<0.01$) than control subjects. Walking most of the time during job was practised by 10.67% (OR- 0.80) of patients which was found to be less than control subjects but not statistically significant. Doing exercise on daily routine was practised by 18.67% (OR- 2.24) of patients which was found to be more than control subjects but not statistically significant. Bicycling on daily routine was practised by 2.67% (OR- 0.09) of patients which was found to be significantly less ($p<0.01$) than control subjects.

DISCUSSION

Present study explores the role of various risk factors like body weight, BMI, co-morbidities, physical activities and dietary patterns among Type 2 Diabetes Mellitus adult patients. Most of the patients were females and non-smokers. Mean BMI was found to be significantly more as compared to control subjects which is considered as an important risk factor in the development of T2DM. Some of these patients also reported co-morbidities of hypertension, heart disease and lung disease, among which lung disease was found to be most frequent (88%). All the patients were diagnosed with T2DM, so they were suggested for the special diet by their physicians, but still many of them were consuming unhealthy diet. Fried diet was followed by 38.67%, fatty diet was followed by 40%, sugary diet was followed by 36%, sweet energy drinks and beverages was consumed by 76%, oily diet was followed by 14.67%, eating in restaurant was followed by 52% of the patients. These patients were following the unhealthy diet in their routine life even before they were diagnosed with T2DM. Physical inactivity and sedentary life style was practised by many of the patients in their routine life. Sitting most of the time was practised by 17.33%, standing for some of the time was practised by only 5.33%, walking for some of the time was practised by only 10.67%, doing exercise was practised by only 18.67% , and bicycling was practised by only 2.67%. However, most of the patients were suggested to do more physical activity but most of them do not followed it. Most of the physical activity were found to be significantly less than the control subjects.

It is well documented that life style factors, dietary pattern and physical inactiveness are associated with the etiology of T2DM [11]. The primary risk factors associated

with diet for the occurrence of T2DM are nutritional imbalance due to high energy, fat and cholesterol [12]. Dietary carbohydrate influences postprandial blood glucose levels the most and is the major determinant of meal-related insulin levels [13]. Routine intake of red meat was also associated with increased risk of diabetes. [14]. In our study, we found most of the patients even before they were diagnosed with T2DM, consume the oily food and non-vegetarian diet which mostly consist of beef and mutton (red meat) which could be associated with the pathogenesis of T2DM. Some prospective studies documented that dietary patterns favouring fruits, vegetables, wholegrains, legumes and avoiding red meats, refined grains, and sugar-sweetened beverages are beneficial for diabetes prevention [15, 16] which was found to be lacking in the diets of most of the patients in our study.

Physical activity and resulting metabolic adaptations has been shown to improve glycemic control for diabetic patients [17]. Physically active lifestyle leads to improvements in insulin action and glycemic control. A cohort study by Frank et al., 2001 [18] found that lack of exercise and physical activeness, unhealthy diet is directly associated with the pathogenesis of T2DM which is in agreement with our findings. Most of the patients in our study do not follow an active life style which could be associated with progression of T2DM. Physical activity contributes positively in delaying or preventing progression towards T2DM either by improving insulin sensitivity or affecting BMI [19, 20].

Some earlier clinical studies [21, 22] found that increased body weight, and BMI are directly associated with the impaired glucose metabolism and insulin resistance which show some agreement with our study. BMI and body weight was found to be significantly increased among patients in our study. Some earlier studies found co-morbidity of hypertension and lung disease among T2DM patients which is in agreement with our findings, since we found lung disease and hypertension as co-morbidities. Rohling et al, 2018 [23] found the role of impaired glucose metabolism among T2DM patients in the pathogenesis of impaired lung functions and Kim et al, 2018 [24] found the increased risk of hypertension among T2DM patients.

In Saudi Arabia, over the last few decades, the tremendous surge in socioeconomic growth probably contributed to unhealthy dietary habits in Saudi Arabia. In addition to the consumption of high-calorie traditional food (e.g., dates), excessive consumption of high calorie and fat based diets (e.g., fast food) is very common in

Saudi Arabia [25]. 66% of adult men and 71% of adult women are either overweight or obese in Saudi Arabia [26]. The prevalence of diabetes in Saudi Arabia as demonstrated by Al-Nozha and colleagues [27] shows a higher ratio in females than in males, with 42%, and 37.2%, respectively which shows some agreement in our study since most of the T2DM patients were females.

Table 1: Personal and demographic characteristics of study subjects

Variables	Control n (%) (N=54)	Diabetic patients n (%) (N = 75)
Gender		
Male	54 (100)	19 (25.66)
Female	0 (0)	56 (74.67)
Nationality		
Saudi	54 (100)	71 (94.67)
Non Saudi	0 (0)	3 (4.00)
Marital status		
Unmarried	25 (46.30)	0 (0.0)
Married	29 (53.70)	74 (98.67)
Divorced	0 (0)	1 (1.33)
Education		
Primary	28 (51.85)	9 (12.00)
Illiterate	5 (9.26)	17 (22.67)
Secondary	21 (38.89)	12 (16.00)
High School	0 (0)	15 (20.00)
Intermediate	0 (0)	21 (28.00)
Smoking		
Smokers	25 (46.30)	10 (13.33)
Non smokers	29 (53.70)	65 (86.67)
Diabetic Mellitus		
Type 1	0 (0)	1 (1.33)
Type 2	0 (0)	74 (98.67)

Table 2: Physical characteristics of study subjects

Variables	Control Mean ± SD (N = 54)	Diabetic patients Mean ± SD (N = 75)	p value
Age (years)	45.52 ± 7.42	55.52 ± 9.72	p<0.01
Height (cm.)	152.42 ± 4.37	157.76 ± 9.66	p<0.05
Weight (Kg.)	54.37 ± 8.24	82.53 ± 17.56	p<0.01
BMI (Kg/m^2)	22.22 ± 4.33	32.22 ± 6.58	p<0.01

Table 3: Other diseases (co-morbidities) among study subjects

Diseases	Control n (%) (N=54)	No. of patients n (%) (N = 75)	Odds Ratio (95% CI)	Relative Risk (95% CI)	p value
Hypertension	0 (0)	36 (48)	100.72 (5.99 - 1690.92)	52.82 (3.31 - 842.34)	p<0.01
Heart disease	0 (0)	4 (5.33)	6.86 (0.36 - 130.15)	6.51 (0.35 - 118.50)	p<0.01
Lung disease	0 (0)	66 (88)	763.00 (43.42 - 3407.71)	96.25 (6.08 -1521.55)	p<0.01

Table 4: Self-reported symptoms of T2DM among study subjects

Symptoms	Control n (%) (N=54)	No. of patients n (%) (N = 75)	Odds Ratio (95% CI)	Relative Risk (95% CI)	p value
Thirst	0 (0)	21 (28)	43.00 (2.54 - 727.87)	31.11 (1.92 - 502.77)	p<0.01
Dryness	0 (0)	24 (32)	51.85 (3.07 - 875.00)	35.46 (2.20 - 570.68)	p<0.01
Loss of appetite	0 (0)	21 (28)	43.00 (2.54 - 727.87)	31.11 (1.92 - 502.77)	p<0.01
Nausea vomiting	0 (0)	4 (5.33)	6.86 (0.36 - 130.15)	6.51 (0.35 - 118.50)	p<0.01
Abdominal pain	0 (0)	5 (6.67)	8.50 (0.46 - 157.13)	7.96 (0.44 - 140.99)	p<0.01
Polyurea	0 (0)	31 (41.33)	77.15 (4.59 - 1296.65)	45.59 (2.85 - 729.14)	p<0.01
Nocturia	0 (0)	20 (26.67)	40.26 (2.37 - 682.41)	29.67 (1.83 - 480.14)	p<0.01
Morning headache	0 (0)	4 (5.33)	6.86 (0.36 - 130.15)	6.51 (0.35 - 118.50)	p<0.01

Table 5: Dietary pattern among study subjects

Dietary pattern	Control n (%) (N=54)	No. of patients n (%) (N = 75)	Odds Ratio (95% CI)	p value
Special diet	0 (0)	31 (41.33)	77.15 (4.59 - 1296.65)	p<0.01
Diabetic diet	0 (0)	12 (16.00)	21.45 (1.24 - 370.87)	p<0.01
Low fat diet	17 (31.48)	31 (41.33)	1.53 (0.73 - 3.19)	NS
Fatty diet	8 (14.81)	30 (40.00)	3.83 (1.58 - 9.25)	p<0.01
Low salt diet	0 (0)	21 (28.00)	43.00 (2.54 - 727.87)	p<0.01
Salty diet	18 (33.33)	37 (49.33)	1.94 (0.94 - 4.01)	NS
Vegetarian diet	0 (0)	0 (0.0)	0.72 (0.01 - 36.94)	NS
Non vegetarian diet	54 (100)	75 (100)	1.38 (0.02 - 70.90)	NS
Low sugar diet	0 (0)	39 (52.00)	117.95 (7.0263 - 1980.31)	p<0.01
Sugary diet	12 (22.22)	27 (36.00)	1.94 (0.94 - 4.01)	NS
Sweet energy drinks and beverages	19 (35.18)	57 (76.00)	5.83 (2.7011 - 12.59)	p<0.01
Fried food	0 (0)	29 (38.67)	69.15 (4.11 - 1163.03)	p<0.01
Oily food	10 (18.51)	11 (14.67)	0.75 (0.29 - 1.93)	NS
Eat in restaurant	0 (0)	39 (52.00)	117.95 (7.02 - 1980.31)	p<0.01

*** Not significant**

Table 6: Physical activities among study subjects

Physical activities	Control n (%) (N=54)	No. of patients n (%) (N = 75)	Odds Ratio (95% CI)	p value
Stairs climbing	42 (77.78)	37 (49.33)	0.27 (0.12 - 0.61)	p<0.01
Household activities	54 (100)	36 (48.00)	0.008 (0.00 - 0.14)	p<0.01
Most body posture during job: Sitting	10 (18.52)	13 (17.33)	0.92 (0.37 - 2.29)	NS
Standing	37 (68.52)	4 (5.33)	0.02 (0.00 - 0.08)	p<0.01
Walking	7 (12.96)	8 (10.67)	0.80 (0.27 - 2.3)	NS
Doing exercise on daily routine	5 (9.26)	14 (18.67)	2.24 (0.75 - 6.67)	NS
Bicycling on daily routine	12 (22.22)	2 (2.67)	0.09 (0.02 - 0.44)	p<0.01

*** Not significant**

CONCLUSION

In conclusion, this survey based study reports the association of sedentary life style and unhealthy dietary patterns as the risk factors in the development of T2DM among the patients having symptoms of this disease. The mean BMI of patients was significantly more than the control subjects showing their obese condition which is considered as an important risk factor of T2DM. This study also shows the co-morbidities of lung disease and hypertension among these patients which had been emerged after the progression of T2DM. Less sample size of T2DM patients is the limitation of this study, so there is more such kind of cohort studies are required in a large population of Saudi Arabia to make these results more evident. There is emergence of creating awareness about the association of sedentary life style and unhealthy dietary pattern with the pathogenesis of T2DM among general population of Saudi Arabia. So, it is strongly recommended that national level health stakeholders and primary health care physicians organise many awareness programs and health campaigns especially for less educated and elder population to educate them about the preventive measures by adoption of active life style and healthy dietary pattern in order to minimise the cases of T2DM in Saudi Arabia.

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