Journal of Diabetes and Metabolism
ISSN: 2155-6156
Belmokhtar et al. J Diabetes Metab 2011, 2:7
DOI: 10.4172/2155-6156.1000148
Research Article
Open Access

Risk Factors Associated With Type 2 Diabetes Mellitus in West Region of Algeria, Maghnia

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Abstract

Background: Type 2 diabetes is one of the most prevalent and costly chronic diseases in Algeria. A multifactorial etiology was identified with important association of environmental and genetic risk factors.

Objectives: The aim of this study was to determine the association of risk factors with type 2 diabetes, among adult subjects recruited from hospital in West region of Algeria, Maghnia.

Method: The case-control study was carried out among diabetic patients and healthy subjects at the Regional Hospital Centre of Maghnia and the survey was conducted from July 2008 to May 2009. The study included 280 cases (with diabetes) and 271 controls (without diabetes). The interviews were based on a questionnaire that includes three sections. Part A was designed to collect demographic information. Part B included the lifestyle data (e.g. smoking habits, BMI, physical activity, etc…) and metabolic characteristics were determined in the last part. Data was analyzed using XLSTAT for Windows. The chi-squared test used for the categorical variables, while the student's T test was used for continuous variables. The logistic regression analyses were used to predict risk factors for diabetes.

Results: The study revealed that low educational level, low economic level, number of children and number of people living at same house, obesity, physical inactivity, irregular food intake and hypertension were the most important environmental risk factors associated with type 2 diabetes. For the persons who had a family history of diabetes mellitus, the risk for developing this disease was statistically significant (OR=0.51, 95%CI=0.36-0.74, P=0.0001).

Conclusion: The present study suggests that low socioeconomic level, changes lifestyle-habits (physical inactivity, irregular dietary intake), obesity, hypertension, hyperglycemia and hypertryglyceridemea have been attributed to an unmasking of genetic defect that presented in subjects of this study. This association has a major impact in the rise prevalence of type 2 diabetes.

Keywords: Adult type 2 diabetes mellitus; Risk factors; Socioeconomic level; Lifestyle; Algeria

Abbreviations: ADA: American Diabetes Association; BMI: Body Mass Index; HDL-C: High Density Lipoprotein Cholesterol; LDL-C: Low Density Lipoprotein; OR: Odd Ratio; SD: Standard Deviation; T2D: Type 2 diabetes; VLDL: Very Low Density Lipoprotein; TC: Total Cholesterol; TG: Triglyceride

Introduction

Diabetes is one of the most frequent metabolic diseases. Widely distributed in various populations, its prevalence appears to be increasing rapidly and it could affect more than 400 million people by 2030 [1]. The Arabic population is however particularly targeted by T2D [2,3]. In the Algerian population, the prevalence of T2D reaches 12.29% of adults aged 35-70 years [4], that is different according to the regions. The last study conducted in 2007 on an Algerian representative sample aged 20 years and over, showed that the prevalence of T2D was 10.5% and was much higher in urban areas (15.3%) compared to rural (12.9%) [5].

Insulin resistance in T2D result in sum of polygenic abnormalities [6,7] and acquired factors. Thus, a family history of diabetes is strongly to T2D [8] and genetic susceptibility of some populations is well documented [9,10,11]. Obesity, physical inactivity, and smoking are implicated in the development of insulin resistance [12] and are also associated with low socioeconomic position [13,14]. The demographic and social transition are producing lifestyle changes that adversely affect metabolism and are thereby causing a large increase in the number of diabetic patients [15]. This notion is supported by studies on the Native American tribe of Pima Indian, who mostly live a sedentary lifestyle and more than half of whom become diabetic [14]. Research on other populations, such as Bedouin Arabs of Southern Israel, who were more physically active and tended to eat more traditional diets, were always considered as having a healthy lifestyle. However, their rapid urbanisation contributed to the emergence of obesity and diabetes [15]. In the same ways, the population of the extreme West Algerian that previously lived in the rural areas had a nomadic lifestyle, rely upon foot walk as transportation means and often have agricultural activities as their main occupation. Because of perturbation, economic and social transition that region know during the last two decades, the population has undergone a rapid process of urbanisation accompanied by lifestyle changes. Many of them now live in urban areas and as result, migratory balance has been rising. This is not the only raison, commercial flows

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Received July 29, 2011; **Accepted** October 17, 2011; **Published** October 20, 2011

Citation: Belmokhtar F, Belmokhtar R, Dali-Sahi M, Charef M (2011) Risk Factors Associated With Type 2 Diabetes Mellitus in West Region of Algeria, Maghnia. J Diabetes Metab 2:148. doi:10.4172/2155-6156.1000148

trans-border and emigrations of clandestine attract persons to coming to Maghnia from different wilayas and neighboring countries also. No information is available on the diabetes and its associated factors among this Algerian group.

The aim of this study was to determine the association of risk factors with T2D in adult subjects from the west region of Algeria. This study examined the mediators and moderators of potential relationship of diabetes with social, demographic and genetic characteristics.

Ethical Considerations

The study was carried out from July 2008 to May 2009. Ecosystem Management Laboratory, Faculty of Science, Tlemcen University, organized the survey in collaboration with Medical Analysis Laboratory of the Regional Hospital Centre of Maghnia.

Methods

Setting

The study was realised in the Internal Medicine Service of the Regional Hospital Centre of Maghnia on the inpatient clinics.

Population

551 persons were participated in this study (280 type 2 diabetes and 271 control subjects). Two third of all were women (341 women and 210 men). All participants were resident in Maghnia. This region is a medium sized city of the extreme West Algerian on the border algero-morocan. It extends on a surface of 20 km^2 and has more than 125 000 habitants.

Participant selection

Patients with type 2 diabetes were recruited by a simple random method from the Service of Internal Medicine. The diagnosis of diabetes mellitus was made according to American Diabetes Association criteria [16], persons were classified as diabetics if their venous blood glucose values were ≥ 7mmol/l or if they were currently taking medication for diabetes.

The non-diabetic control subjects 271 volunteers recruited from an unselected population undergoing a routine health check-up at the same health centre, they were chosen randomly from the daily appointment list. They were identified from community as healthy if their venous blood glucose values were <6.1mmol/l and if they had never received any diabetic medication.

The health status of participants was assessed by recording previous medical conditions, family history, physical examination, blood pressure, serum glucose, cholesterol total, HDL-C, LDL-C, and triglycerides.

Data collection

A questionnaire was performed for all participants, it contained three sections, A, B and C. Part A was designed to collect demographic information, e.g. age, gender, current marital status, educational level (university, secondary, primary, illiterate), number of children, income level, number of people living at same house and health insurance.

Part B of the questionnaire included the lifestyle data, e.g. smoking habits, current nutrition habits, and family health history, physical activity were completed by asking subject to answer questions indicating their activities over the past year, a list of activities types was developed and detailed information about the frequency and duration of each activity was collected. All anthropometric measurements were made in accordance with World Health Organization (WHO) standards [17]. For participants wearing light clothing with no shoes, weight was measured using a portable scale and height by a metric tape adhered to a wall. BMI was calculated for each study subject using the formula BMI=weight (in Kg)/height (in metres) squared, subjects were classified in to three categories: acceptable weight, BMI<25Kg/m^2, overweight, BMI 25-30 Kg/m^2, and obese, BMI ≥30Kg/m^2, according to the recommendations of the world Health Organization [18].Waist circumference was measured at the horizontal level of the umbilicus by a metric tape. Blood pressure was measured in sitting position after rest by trained practical nurses according to World Health Organization (WHO) standardized criteria [19], subjects with blood pressure equal to or greater than 140 mmHg (systolic)/ 90 mmHg (diastolic) were considered hypertensive according to WHO criteria [19]. The mean value obtained from the three readings was used in the analysis.

In the part C of the questionnaire, we interested to the laboratory analysis, blood samples were drawn from each diabetic patient and control healthy subject after an overnight fast.

The plasma was separated within one hour by centrifugation (3500 rpm/minute for 15 minutes). Fasting plasma glucose was estimated enzymatically using glucose oxidase [20]. Lipids were determined on the same day of collection; total cholesterol (TC) and triglycerides (TG) were measured by using a colorimetric enzymatic method in an automatic analyser. High density lipoprotein cholesterol (HDL-C) was determined by the same method after selective precipitation of low density lipoprotein (LDL-C) and very low density lipoprotein (VLDL), the level of LDL-C was calculated by Friedwal's formula: [21]

LDL-C= CT (HDL-C +TG/2.18) for TG <4.5 mmol/l

Statistical analysis

The data were analyzed using the XL STAT2010 version 12,4,01 Addinosoft™. The Chi-square analysis was performed to test the differences in proportions of categorical variables between two or more groups. In 2x2 tables, the Fisher exact test(two- tailed) replaced the χ^2 test if the assumptions underlying χ^2 were violated namely in case of small sample size or when the expected frequency was less than 5 in any of the cells. The variables were analyzed with logistic regression analyses to predict risk factors for diabetes. Odds Ratio (OR) and their 95% confidence intervals (CI) were calculated. The continuous variables were presented as means ± Standard Deviation (SD), Student's T test was used to test the significance of differences between mean values of two quantitative variables. Statistical significance was considered to be a P-value<0.05.

Results

The socioeconomic data obtained in this study are shown in (Table 1). The mean age of the participants was 58.98 years. Difference significance between diabetic and control subjects was marked in the age group 55-70 years. Gender was not differed between the two groups. Significantly more of diabetic had low educational level (85.4% vs 47.6%, p=0,034), married (91.4% vs 96.3%, p=0.021) and had more than 5 children (46.8% vs 12.2%, p<0.0001), more of them lived in house with than five members (66.8% vs 46.1%, p<0.0001), with a low income level (25.4% vs 51.7%, p<0.0001). Significantly, less of diabetic subjects had not the health insurance compared to the control subject (34.6% vs 52.1%, p<0.0001).

The lifestyle habits, clinical characteristics and family history of

		No.(%) of subjects			
Variable	**Total**	**Cases**	**Controls**	**OR (95%CI)**	**P-value**
Age group					
<40	96 (17.4)	39 (13.9)	57 (21.0)	1.00	
40-55	143 (25.9)	60 (21.4)	83 (30.6)	0.94 (0.56-1.60)	0.83
55-70	164 (29.8)	101 (36.1)	63 (23.3)	0.45 (0.27-0.76)	0.003
>70	148 (26.9)	80 (28.6)	68 (25.1)	0.54 (0.32-0.90)	0.02
Gender					
Female	341 (61.9)	176 (62.9)	165 (60.9)	1.00	
Male	210 (38.1)	104 (37.1)	106 (39.1)	1.08 (0.77-1.53)	0.634
Current marital status					
Single	34 (06.2)	24 (08.6)	10 (03.7)	1.00	
Married	517 (93.8)	256 (91.4)	261 (96.3)	2.44 (1.14 – 5.21)	0.021
Education level					
University	07 (01.3)	00 (00.0)	07 (02.6)	1.00	
Secondary	85 (15.4)	11 (03.9)	74 (27.3)	0.43 (0.019-9.81)	0.59
Primary	91 (16.5)	30 (10.7)	61 (22.5)	0.13 (0.006-0.95)	0.20
Illiterate	368 (66.8)	239 (85.4)	129 (47.6)	0.03 (0.002-0.77)	0.034
Income level					
>100.000DZD	165 (29.9)	112 (40.0)	53 (19.5)	1.00	
<100.000DZD	175 (31.8)	97 (34.6)	78 (28.8)	1.69 (1.09-2.64)	0.019
without	211 (38.3)	71 (25.4)	140 (51.7)	4.16 (2.70-6.43)	<0.0001
No. of children					
Without	140 (25.4)	17 (06.1)	123 (45.4)	1.00	
≤5	252 (45.7)	132 (47.1)	115 (42.4)	0.11 (0.067-0.207)	<0.0001
>5	159 (28.9)	131 (46.8)	33 (12.2)	0.03 (0.018-0.066)	<0.0001
Type of residence					
Villa	18 (03.3)	05 (01.8)	13 (04.8)	1.00	
House	457 (82.9)	245 (87.5)	212 (78.3)	0.33 (0.11-0.94)	0.04
Apartment	76 (13.8)	30 (10.7)	46 (16.9)	0.59 (0.19-1.82)	0.35
No. of people living at home					
≤5	239 (43.4)	93 (33.2)	146 (53.9)	1.00	
>5	312 (56.6)	187 (66.8)	125 (46.1)	0.42 (0.30-0.60)	<0.0001
Health insurance					
Yes	313 (56.8)	183 (65.4)	130 (47.9)	1.00	
No	238 (43.2)	97 (34.6)	141 (52.1)	2.04 (1.45-2.88)	<0.0001
Residence					
Rural	191 (34.7)	96 (34.3)	95 (35.0)	1.00	
Urban	360 (65.3)	184 (65.7)	176 (64.9)	0.96 (0.68-1.37)	0.84

*Abbreviations: OR-odds ratio; CI-confidence interval; DZD- Algeria Dinars, 1EUR=96.321 DZD

Table 1: Socio-demographic data of diabetic cases (n=280) and non diabetic controls (n=271)*.

diabetes are given in the (Table 2). Many of diabetics were sedentary (OR=0.11, CI= 0.049-0.27, p<0.0001), these diabetic subjects did not follow a regular dietary intake (OR=1.81, CI= 1.16-2.84, p=0.009), obesity was more common among diabetic patients (37.5% vs 18.8%, OR = 0.39, CI=0.25-0.60, p<0.0001) and abdominal obesity also. Hypertension in diabetic patients had more significantly than the control subjects (OR=0.25, CI=0.17-0.57, p<0.0001), the risk of diabetes was marked in patients with family history of this disease (OR= 0.51, CI=0.36-0.74, p=0.0001).

The baseline physical and the metabolic characteristics of cases and control subjects are showed in (Table 3). Body Mass Index (BMI) and blood pressure mean were significantly higher in diabetes patients than the control subjects. Total cholesterol, LDL-C and triglyceride mean were higher in diabetic subjects.

Discussion

In the present case-control study, we determine the association of lifestyle, socioeconomic and genetic factors with type 2 diabetes. Our choice of Maghnia population is based on the Principe that region know during the last two decades a rapid process of urbanisation accompanied by lifestyle changes, economic and social transition. Theses contributed to the emergence of obesity and diabetes.

In our results there were no differences between male and female, this consistent with previous studies [22,23]. We also observed that older age subjects showed significantly higher risk of T2D compared with younger age [5,24].

The association of many vascular diseases and their risk factors with socioeconomic status has been well described [25,43]. Certain risk factors implicated in the development of diabetes are also known to be associated with socioeconomic status. Obesity, physical inactivity, smoking have all been described as risk factors associated with low socioeconomic status [26]. Thus an increase relation would be expected between the prevalence of T2D and socioeconomic status. However, few publisher studies have investigated this relation [27]. A study of nine English towns, an ecological study, described an inverse relation between the incidence of T2D and relative influence of the towns [28]. Interestingly, we found that marital status of subjects was a positive risk factors for T2D, the majority were married had more than 5 children, low educational level, collective house and income level was not higher than 100.000DZD determined the socioeconomic status in this group of people. It has been suggested that people in deprived areas make more use, on average of primary care services than people in more affluent areas, but this has not been supported in the recent healthy survey. However, it is known that people from social classes IV and V low social class are less likely to attend for routine health checks [29,30], at which urine or blood glucose are measured, this would potentially underestimate the strength of the association between T2D

		No.(%) of subjects			
Variable	**Total**	**Cases**	**Controls**	**OR (95%CI)**	**P-value**
Physical activity					
Yes	49 (08.9)	06 (02.1)	43 (15.9)	1.00	
No	502 (91.1)	274 (97.9)	228 (84.1)	0.11 (0.04-0.27)	<0.0001
Smoking status					
Non smoker	05 (91.7)	251 (89.6)	254 (93.7)	1.00	
Smoker	46 (08.3)	29 (10.4)	17 (06.3)	0.57 (0.31-1.08)	0.086
Dietary intake					
follow-up	119 (21.6)	69 (24.6)	50 (18.5)	1.00	
Average	205 (37.2)	113 (40.4)	92 (33.9)	1.12 (0.71-1.77)	0.61
Not followed	227 (41.2)	98 (35.0)	129 (47.6)	1.81 (1.16-2.84)	0.009
Family history of diabetes mellitus					
No	187 (33.9)	75 (26.8)	112 (41.3)	1.00	
Yes	364 (66.1)	205 (73.2)	159 (58.7)	0.51 (0.36-0.74)	0.0001
BMI group (kg/m2)					
≤25 (normal)	264 (47.9)	77 (27.5)	166 (61.3)	1.00	
25-30 (overweight)	159 (28.9)	98 (35.0)	54 (19.9)	0.30 (0.20-0.45)	<0.0001
>30 (obese)	128 (23.2)	105 (37.5)	51 (18.8)	0.39 (0.25-0.60)	<0.0001
Waist circumference(cm)					
Male †					
<102	119 (56.7)	35 (33.7)	84 (79.3)	1.00	
>102	91 (43.3)	69 (66.3)	22 (20.7)	0.13 (0.07-0.24)	<0.0001
Female‡					
<88	113 (33.1)	35 (19.9)	78 (47.3)	1.00	
>88	228 (66.9)	141 (80.1)	87 (52.7)	0.27 (0.17-0.44)	<0.0001
Hypertension					
No	371 (67.3)	149 (53.2)	222 (81.9)	1.00	
Yes	180 (32.7)	131 (46.8)	49 (18.1)	0.25 (0.17-0.37)	<0.0001

*Abbreviations: BMI-body mass index; OR-odds ratio; CI-confidence interval
†Number of male cases=104; Number of male controls=106
‡Number of female cases= 176; Number of female controls= 165

Table 2: Lifestyle, genetic, and family history of diabetic cases (n=280) and non diabetic controls (n=271)*.

		No.(%) of subjects		
Variable	**Total**	**Cases**	**Controls**	**P-value***
Body mass index(Kg/m²)	26.02±0.26	27.64±0.33	24.35±0.38	<0.0001
Cholesterol(mmol/l)				
Total	4.27±0.04	4.48±0.06	4.07±0.06	<0.0001
HDL	1.06±0.01	1.01±0.01	1.09±0.02	0.003
LDL	2.46±0.04	2.62±0.06	2.31±0.05	<0.0001
Triglyceride(mmol/l)	1.51±0.03	1.66±0.04	1.36±0.04	<0.0001
Serum glucose(mmol/l)	9.43±0.22	10.28±0.28	8.05±0.34	<0.0001
Blood pressure (mmHg)				
Systolic	125.98±0.78	133.07±1.05	118.65±0.99	<0.0001
Diastolic	77.21±0.41	80.62±0.56	73.69±0.54	<0.0001

*Student *t* test

Table 3: Baseline physical and metabolic characteristics in cases (n=280) and controls (n=271).

and socioeconomic status [27]. Recent data from the UK report excess mortality for those who are unemployed or living in council [31]. In the USA, low income was associated with a higher prevalence of diabetes [32].

Urban lifestyle in Africa is characterised by changes in dietary habits involving an increase in consumption of refined sugars and saturated fat and a reduction in fibre intake [33]. Moreover, there is a reduction in physical activity associated with urban lifestyle [34,44]. Rural populations relay upon foot walk as transportation means and often have intense agricultural activities as their main occupation [35]. Rural dwells therefore have a high physical activity related energy expenditure compared to urban subjects [36], thus explaining the higher rates in urban areas compared to rural [36,44]. In our results, we did not find the difference between these two areas, because many people of them emigrate from the rural to the urban areas.

In the present study, most patients with type 2 diabetes mellitus were found to be obese. This complements other recent studies [37-40]. The association between type 2 diabetes mellitus and obesity is probably the result of multiple mechanisms, including rises in plasma free fatty acids and tumor necrosis factor alpha released from ”full” adipocytes [41]. More recently, it has been shown that in the Indian population, general and central obesity was associated with a family history of diabetes [39].

A family history of diabetes may increase the risk of hypertension and hyperlipidemia indirectly through its connection to BMI [38,42].

Furthermore, lack of physical exercise is also associated with diabetes mellitus, which led to the finding, that exercise enhances the action of insulin, although the present study confirmed.

Glucose tolerance test data on 794 first degree relatives of diabetics in pedigrees ascertained through non-insulin dependent diabetes mellitus were used to identify risk factors for diabetes in southeastern Michigan [39]. In the Michigan study, the general risk factors, age

and obesity were important in predicting diabetes at the initial visit, although the predicted risk curves were very different for men and women. Our study in Algeria showed that diabetes was more common among first degree relatives in addition to obesity and environmental factors influencing glucose tolerance among siblings.

Conclusion

In conclusion, the present study was directed to determining the association of risk factors with type 2 diabetes in the adult subjects of West Algerian. The prevalence of diabetes mellitus in this group is on the rise due to urbanisation, westernisation and their associated lifestyle changes (nutritional habits, lack of adequate dietary intake and low physical activity) accompanied by obesity, and low socioeconomic level may combine to cause this disease especially in predisposes persons. These finding suggest that appropriate dietary interventions and education may ameliorate nutritional quality and improve healthy behavioural lifestyles. The design and implementation of a strategy for early diagnosis and appropriate population-based prevention programme is therefore a public health and economic priority.

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