Effect of Socioeconomic Factors and Family History on the Incidence of Diabetes in an Adult Diabetic Population from Algeria

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Abstract

Background: Diabetes mellitus is a serious public health problem worldwide and particularly in developing countries. In Algeria, this metabolic disorder occurs with a wide variety or atypical forms that linked to multiple risk factors including local habits and traditions. This study aimed to determine the impact of risk factors (metabolic syndrome, social, cultural, physical activity, family history and the treatment used) on the incidence of diabetes.

Methods: This cross-sectional study was conducted in 2013 on a random sample from a resident population in Tebessa, Northeast Algeria, which underwent a significant expanding of diabetes prevalence conditioned by profound socio-economic changes. The survey included 200 subjects, randomly selected; with 100 controls and 100 diabetic patients, (26 diabetic subjects with type 1 diabetes mellitus 'T1DM' and 74 subjects with type two diabetes mellitus 'T2DM').

Results: Diabetic subjects were significantly affected by all these risk factors, including metabolic syndrome that was higher in women. The most common treatment among surveyed T1DM subjects was insulin, whereas T2DM patients used metformin. In addition, the duration from T1DM onset in the surveyed subjects is older than T2DM onset. The incidence of diabetes is significantly in close relationship between the majorities of these factors of risk.

Conclusion: Subjects with a high socioeconomic status can afford a healthier way of life to avoid the risk of developing diabetes compared to subjects with lower social level.

Keywords: Diabetes, Type 1 diabetes mellitus, Type 2 diabetes mellitus, Risk factors, Diabetes treatments, Algeria

Introduction

Diabetes mellitus is a chronic disease with serious complications. The growing number of patients all around the world and the high cost of their care make diabetes a major issue for public health (1, 2). Indeed, the diabetes Mellitus remains one of the main growing and serious concerns of public health, particularly when it is associated with other diseases (3). The constant increase of diabetes prevalence is epidemic due to severe changes in the environment in developing countries and be-cause of the advanced population aging in industrialized countries (4, 5).

Among the non-communicable diseases in the world such as cancers, cardiovascular diseases, diabetes mellitus, chronic respiratory diseases and other degenerative infections, diabetes is rapidly growing, especially among urban populations who tend to gain weight, change their diet and limit physical exercise (1, 5, 6). WHO estimated the number of diabetics in 1994 to 110.4 million

subjects, this will rise by the year 2010 to 221 million and to 300 million in 2025 (6).

Moreover, non-communicable diseases such as heart disease, diabetes, and cancer have become public health problems worldwide, but with severe consequences in developing countries (7). Algeria, like many developing countries, is undergoing an epidemiological transition regarding diabetes, which represents an alarming situation (8, 9), with important socio-economic consequences because it is the second chronic disease after hypertension (8). The number of diabetics in Algeria has increased from one million in 1993 to more than 2.5 million in 2007, representing 10% of the population in 2010 (9). The carbohydrate intolerance known as T1DM and T2DM or non-insulin dependent diabetes are by far the most common forms (10,11).

The metabolic syndrome is defined as the presence of increased fasting plasma glucose, associated with hypertriglyceridemia or low HDL, arterial hypertension and increased waist circumference. The combination three factors of the mentioned above are associated with an elevation of cardiovascular and T2DM risk (12).

There is a strong familial influence in the genesis of T2DM of which the influence of genetic factors is well established (9,13,14). Other factors such as body mass index (BMI), reduced physical activity and rich-calorie nutrient intakes are also determinants (11,15). Besides, the environmental and cultural factors (5,9), consanguinity, age group, dyslipidemia, geographic and ethnic differences also play an important role in the onset of the disease (9,16-18).

The role of socioeconomic status (SES) in the incidence of T2DM and in the emergence of new cases is little known, particularly in developing countries where a large gradient of stratified society exists. We hypothesized that a low SES, measured by income and/or education levels, may influence the risk of T2DM when associated with high levels of obesity and physical inactivity or in an independent way of these factors (19).

Because this study looks at a question, which has a worldwide audience, and since cultural background is important to answer this question,

conducting such a study in different social economical and ethnic groups may help to design better policy for curing diabetes.

The current study aimed to analyze the incidence of T1DM and T2DM in an area of a developing country from North Africa (Tebessa, Northeast Algeria) and its relation with certain factors such as the metabolic syndrome, level of education, socioeconomic status, family history and physical activity of the subject. In addition, it tests the hypothesis about differences between control and diabetic subjects of the two types with considering diabetes duration, type of treatment, and duration of receiving this treatment.

Materials and Methods

Sampling and data collection

This cross-sectional study involved 200 subjects of 100 control subjects and 100 diabetic patients (26 T1DM subjects and 74 T2DM subjects), inhabiting different localities of the region of Tebessa (Northeast of Algeria). Subjects were randomly selected except that control subjects have no apparent diseases, especially diabetes, on the day of the survey. Both control and diabetic subjects included both sexes surveyed regardless of their BMI. The surveys were conducted in 2013 in the laboratory of the Public Health Facility (Department of Health) and in the House of Diabetics, both located in the city of Tebessa.

The study was carried out in agreement to ethics of health establishments we surveyed.

A questionnaire survey was conducted with each patient. Both Arabic and French were used as languages of the survey. We also carried out an anthropometric measurement of waist circumference and measured blood pressure. In addition, a blood sample took place the day of the survey for the determination of some biochemical parameters (triglycerides, HDL cholesterol, LDL cholesterol and fasting glucose; in order to identify the presence or absence of metabolic syndrome. The metabolic syndrome was identified using criteria and guidelines of NCEP ATP III "The National Cholesterol Education Program" (20). In

the case of the simultaneous occurrence of 3 out of 5 proposed criteria at a patient, the latter was considered affected with the metabolic syndrome. These criteria included waist size (men>02 cm, women >88 cm), contents of triglycerides (≥1.50 g/L), HDL cholesterol (men<0.4 g/L, women<0.5 g/L), blood pressure (≥130/85 mmHg), fasting glucose (≥1.10 g/L) (21).

The average age of the study population (100 diabetics and 100 healthy subjects) is 47.44±16.84 yr with a sex ratio of 50%. The average age of T2DM subjects (74%) is 58.34±12.01 yr. Moreover, the average BMI is 31.74±8.35 kg/m² (18).

The following parameters we identified for each subject surveyed (diabetic and control): gender, level of education, level of socio-vocational status, family history with respect to diabetes and other diseases, type of diabetes, duration of diabetes treatment (T1DM and T2DM), duration of diabetes and physical activity.

Regarding educational level, the gathered data provided information on the level of education of the respondents, thereby classified into four levels of education: level 1: university graduate; level 2: high school; level 3: secondary school; level 4: primary school and/or illiterate.

Furthermore, the socio-economic level of surveyed subjects was assessed as the total income of the family, which includes the income of both parents. The average estimate of wage by occupation refers to the salary of the Algerian working chamber of the Algerian Ministry of Labor and Employment.

Occupations were classified by ascending order into six groups according to the average wage: level 1 (>125 USD) refers to the unemployed, casual workers, boarders; level 2 (125–187 USD) includes manual laborers, pensioners, lightweight drivers; level 3 (187–311 USD) contains executive agents, administrative staff, technicians, mechanics, artisans, truck drivers, security agents; level 4 (311–435 USD) includes foremen, engineers, teachers, militaries, veterinarians; level 5 (435–622 USD) is for professors, administrators, businessmen, directors; level 6 (> 622 USD) are the executives and managers, liberal professionals, jewelers, wholesalers, entrepreneurs, etc.

Occupation levels were then classified into three classes according to the average salary of the lowest to the highest, as follows: Class A: includes levels 1 and 2, it corresponds to a low-living level; Class B: includes levels 3 and 4, it refers to a mid-living level; and class C: includes levels 5 and 6 corresponding to a high-living level.

We investigated for the family history of certain diseases including obesity, diabetes, dyslipidemia, hypertension, and cardiovascular diseases in general. The type of diabetes was identified by questionnaire and subsequently confirmed by the type of treatment taken by the subject. In addition, the duration of diabetes treatment was determined based on names of medicines that patients accurately reported with the medication duration of each drug taken. The duration of diabetes represents the period since subjects have reported the diabetes onset. For assessing sportive activities, we also reported the time of walk per day, means used for displacement, and the practice of any sports activity.

Data analysis

Statistical analyses were performed using Chi-square tests (χ^2) to compare the percentages of parameters we surveyed (level of education and socioeconomic status 'comparison between classes', metabolic syndrome, family history, use of different medical treatments, and sportive activity) between the two types of diabetics and controls. Numerical calculations were performed using the software Minitab 16.

Results

Distribution of surveyed population by metabolic syndrome and sex

The metabolic syndrome was significantly more frequent in diabetic subjects regardless of sex (T1DM: men: 12%, women: 58%, T2DM: men: 12%, women: 53%, controls: men: 2%, women: 10%) and type of diabetes than in controls

(T1DM: $P=0.001$, T2DM: $P<0.0001$). Considering the type of diabetes, no significant difference was observed between T1DM and T2DM subjects. However, when considering the gender of patients, the results indicated that women were significantly more affected by the metabolic syndrome than men ($P=0.001$); in diabetic women 58% and 53%, respectively for T1DM and T2DM, were reported against only 12% of men with each category of diabetes.

Educational level of the surveyed population

The distribution of subjects among education levels of the study showed no significant difference in control subjects between class A representing academics (42%) and class B encompassing illiterate subjects or having the level of primary, secondary or high school (58%). Whereas subjects of the educational class B were significantly more abundant among T1DM (85%)

and T2DM (86%) (Fig. 1A). Whether for T1DM and T2DM, the distribution of educational level of subjects was significantly dependent (T1DM: $\chi^2 = 49.00$, $P <0.0001$; T2DM: $\chi^2 = 51.84$, $P<0.0001$).

Whatever the type of diabetes, diabetic subjects with a low level of education were also significantly more numerous than control subjects (Control vs. T1DM: $\chi^2 = 67.63$, $P<0.0001$; Control vs. T2DM: $\chi^2 = 15.02$, $P<0.0001$).

Socio-economic level of the studied population

The three groups of subjects (controls, T1DM and T2DM) mostly belonged to low social level (Fig. 1B). However, patients with T1DM and T2DM having low socio-economic level were significantly more abundant compared to control subjects (T1DM: $\chi^2=15.78$, $P<0.001$; T2DM: $\chi^2=13.39$, $P<0.001$).
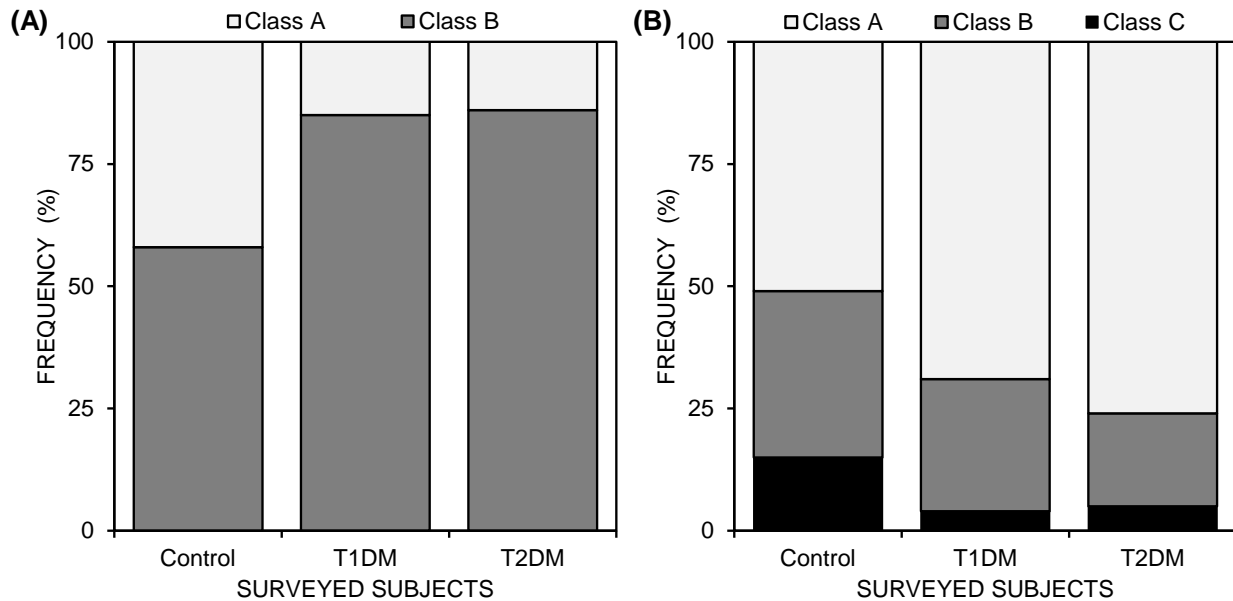

Fig. 1: Distribution of the studied population following educational level (Class A: university graduate, Class B: illiterate, primary, secondary and high school), B) and socio-economic levels (Class A: low standard of living, Class B: average standard of living, Class C: high standard of living)

Family history of the studied population

Diabetics especially T2DM have more family histories than control subjects (diabetes = 59%, dyslipidemia = 35%, hypertension = 50%).

The statistical study of the presence of family history of patients with both types of diabetes compared with control subjects showed that: the diabetic antecedent was significantly higher among

diabetics compared to control subjects (T1DM: $P<0.0001$; T2DM: $P=0.001$). While the obesity (T1DM: $P=0.024$, T2DM: $P<0.0001$) and cardiovascular diseases (T1DM: $P<0.0001$; T2DM: $P=0.003$) were significantly more frequent in the control subjects.

Considering the type of diabetes, there is a significant difference between the subjects with T1DM

and T2DM. Indeed, the family history regarding obesity and diabetes were more common in T1DM subjects, whereas dyslipidemia ($P=0.049$) and hypertension ($P=0.006$) were more frequent in T2DM subjects. Moreover, cardiovascular disease was also significantly more frequent ($P<0.0001$) in T2DM patients (Fig. 2).
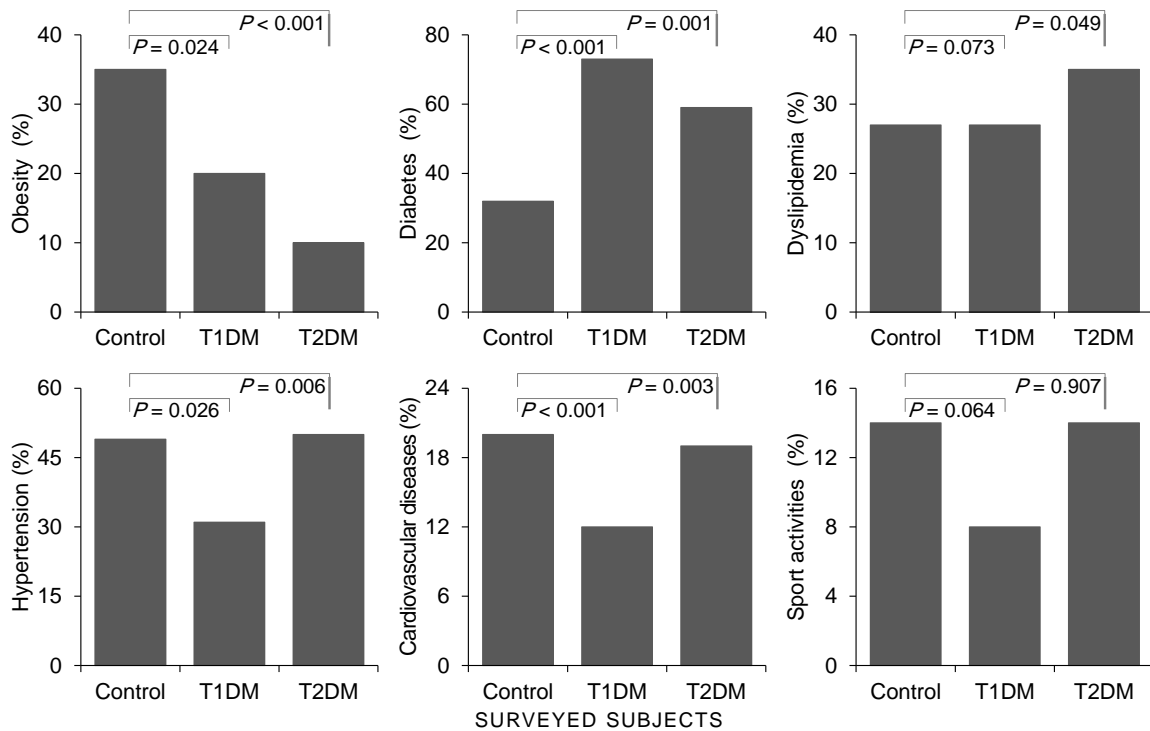

Fig. 2: Distribution of the studied population based on frequencies (%) of medical family history (obesity, diabetes, dyslipidemia, hypertension, and cardiovascular diseases) and physical activity. (*P*: *P*-value of the Chi-square test)

Practice of sports activity among the surveyed population

Among the subjects investigated in the region of Tebessa, few people regularly practice a sport. Of 8% of T1DM subjects and 14% of control subjects and subjects with T2DM reported practicing a sports activity (Fig. 2). Comparing physical activity of T1DM and T2DM subjects with controls, results showed no significant difference. However, T2DM subjects practiced more sport that T1DM subjects.

Among the diabetic subjects, sports activity was significantly ($P<0.0001$) more common in men

than women of T2DM, whereas the results showed no significant difference between women and men having T1DM.

Type and duration of diabetes treatment

The duration and various treatments of diabetes among T1DM and T2DM subjects were reported in Table 1. The most common treatment of T1DM was insulin among 92% of respondents, while for T2DM it was the Metformin with 65% of respondents. There is a significant difference between T1DM and T2DM subjects for all treatments ($P<0.0001$). Moreover, the duration of di-

abetes in T1DM subjects was 10.65±7.16 yr, it was about 5.97±4.56 yr in T2DM patients (Table 1).

Table 1: Distribution of the surveyed diabetic subjects according to the type and duration of diabetes treatment (*P*: *P*-values of the Chi-square tests)

Treatment	T1DM (N=26)		T2DM (N=74)		*P*
	%	Period (yr)	%	Period (years)	
Insulin	92	8.42±6.69	0	0	<0.0001
Sulfamid	12	1.31±3.87	46	3.76±4.92	<0.0001
Metformin	24	1.23±3.30	65	3.68±4.62	<0.0001

Discussion

The metabolic syndrome was significantly more common among diabetic subjects regardless of sex and type of diabetes than in healthy controls. The diabetic women are more affected by the metabolic syndrome than men are. The prevalence of metabolic syndrome was found characteristically feminine, in Tunisia (12). Indeed, adult women are more affected by metabolic syndrome compared to men (22). People with the metabolic syndrome are at increased risk of developing diabetes mellitus and cardiovascular diseases as well as increased mortality from cardiovascular diseases and other causes (21).

In Tebessa, diabetic subjects with a low level of education were significantly more likely than control subjects. A decennial health survey was conducted on the prevalence of diabetes and its relationship with the intellectual, socio-economic and the country of origin (23). Diabetes was more common among people with a low level of education compared to those with a higher level of education. In addition, more than half of the French diabetic population had a primary school education and only 8% have a level of education higher that the bachelor (24). Most of the diabetics have low educational attainment associated with an excess of carbohydrate and fat intake (23). Individuals with a higher level of education are likely to take advantage of dietary recommendations and to change their behavior to avoid the risk of developing diabetes (19, 25).

In our investigation, socioeconomic status was assessed by the level of income based on the occupation of both parents. T1DM and T2DM subjects with low levels of socioeconomic status are significantly more likely than control subjects. Diabetes was more common among workers (low living level) compared to managers and liberal professionals (medium and high level of life) (23). In addition, individuals with low incomes were more likely to develop diabetes than those living in households with high incomes (19). Besides, nearly three-quarters of studied diabetics in France are workers or employees against only 9% of executives and persons engaged in a liberal profession (24).

The current investigation was interested in screening the prevalence of family history (obesity, diabetes, dyslipidemia, hypertension and cardiovascular diseases) within the surveyed subjects in order to understand the origin of diabetes. Most of this family history was significantly more frequent in diabetic subjects than controls. The concordance for diabetes accounts for about 40% of type I diabetic subjects; this proportion may rise with time to reach up 65% after the age of 65 (26). Type II diabetes is also a disease of genetic predisposition (27, 28). When one parent is diabetic, the risk to the offspring is 25 to 30%; it can reach 50% if both parents have diabetes (29).

In the surveyed population, duration of diabetes in people with T1DM is older than T2DM. These results are consistent with the existing literature (30-33). In addition, our findings regarding the treatment and duration of diabetes are in accordance with those of Tunisian diabetics as reported (34); with the average duration of T1DM is 9±6 yr, and the majority of patients (84%) are under insulin treatment.

The most common treatment for T1DM is insulin whereas for T2DM is the metformin and sulfonamides. The most common treatments for

T1DM in America are mostly metformin, then sulfonamides with frequencies less important than metformin (35). In addition, other studies have also found the same results (36). T1DM is characterized by an insulin treatment. Indeed, insulin-dependent diabetes (T1DM) is characterized by the absence of insulin and consequently the translocation signal of GLUT 4 (37). In children, its onset is often quite sudden; but among adults it is progressive and misleading, hence the name of type I latent in adults (LADA: Latent Autoimmune Diabetes in Adults) (38).

Furthermore, glycemic control with an optimized insulin-based treatment (T1DM) prevents microvascular complications and slows their progression. The occurrence and scalability of complications are closely correlated with the duration of diabetes and degree of glycemic control (39). While T2DM subjects are treated with metformin and sulfonamides (oral medications), the T2DM is characterized by either a combination of insulin resistance and relative insulin deficiency or an increasing of insulin production to rich up an effective level; hyperinsulinemia allows initially maintaining a standard blood glucose (40). The more the disease progresses more the insulin sensitivity decreases (41). Metformin is a hypoglycemic drug used in the treatment of T2DM in order to reduce blood glucose levels. It is used when diet, exercise and weight loss fail to sufficiently lower the blood glucose. It helps delay the onset of complications related to diabetes (42). Moreover, the sulfonamides are insulin-secretors used in the treatment of T2DM in adults, when diet, exercise, and weight-loss alone are not sufficient for a glycemic control (43, 44).

T2DM subjects practice more sport than T1DM subjects do. The sport is more common in T2DM subjects because this type of diabetes is often associated with abdominal obesity or metabolic syndrome (45). In this context, regular physical activity significantly decreases the value of blood glucose levels in T2DM subjects (46). Indeed, physical activity protects against the development of T2DM. For every increase of 500 kcal of energy costs per week, there is a 10% reduction in the risk of T2DM (47). The impor-

tance of physical activity was essential in the treatment of non-insulin dependent diabetes mellitus (T2DM) (48). Indeed, the muscular tissue is quantitatively the most important tissue of glucose metabolism. Exercise also increases muscle mass, particularly the percentage of muscle fibers with glucose-oxidative metabolism of insulin-sensitive.

Conclusion

In Algeria in general and Tebessa in particular, diabetes is a serious public health problem, with significant socio-economic and cultural impact. All the results show a clear, robust and significant relationship between the incidence of diabetes and household income, intellectual level, metabolic syndrome, family history and physical activity; as well as a specificity of drugs used by two types of diabetics.

This study suggests that subjects with a high socioeconomic status can allow a 'healthy' lifestyle such as practicing sports activities or following an appropriate diet to avoid the risk of developing diabetes compared to subjects of low socioeconomic level. The attenuation of the association between diabetes and the manifestation of these problems suggests that we should develop more relevant prevention strategies. The control of chronic complications of diabetes imposes on health authorities the implementation of effective screening policy and treatment.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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