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Diabetes Mellitus Type 2 Prevalence, Risk Factors and Complications in the Region of Kardzhali, Bulgaria

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Abstract: The present study was conducted within the CINDI program and covers 1,600 individuals, divided into four age groups. The aim of this study is to investigate the key biomedical and lifestyle factors for the development of type 2 diabetes as well as the cardiovascular diabetes complications in the population aged 25-64 from Kardzhali region, Bulgaria. The results of the study show the existence of behavioral and biological risk factors of health, as well as family history in the studied individuals who suffer from diabetes. The connection between diabetes and certain cardiovascular diseases such as ischemic heart disease, myocardial infarction and cardiovascular disease is confirmed. This requires the development and implementation of intervention activities among the population of Kardzhali, aimed at reducing the level of diabetes risk factors, early identification of risk groups and timely treatment of the diseased.

Key words: Diabetes, genetic risk factors, behavioral risk factors.

1. Introduction

DM (diabetes mellitus) is a serious worldwide medical and social problem, associated with excess morbidity and mortality and a currently estimated overall prevalence of 8.3%. The number of persons with DM is expected to increase to 9.9% in coming 20 years [1]. The disease affects 7.8% of the population of the European Union. 9.1% of Europeans are expected to be diabetic in 2025. Diabetes epidemic poses economic system of European countries at a high risk, and especially the Member States of Eastern Europe [2].

T2D (Type 2 diabetes) comprises 90% of people with diabetes around the world [1, 3]. The estimated prevalence of T2D is relatively consistent across the income grouped countries. Low-income countries showed the lowest prevalence (8% for both sexes), and the upper middle-income countries showed the highest (10% for both sexes). In association with increasing diabetes prevalence, this will inevitably result in increasing proportions of deaths from cardiovascular disease in these countries, as well as increased prevalence and associated consequences of other complications of T2D. Compared with the general non-diabetic population, persons with diabetes have approximately a 7-year shorter life expectancy, an effect directly related to the major diabetic complications [4].

That is why people with T2D require at least two to three times more healthcare resources, compared to people, who do not have diabetes, and diabetes medical care may account for up to 15% of national health care budgets [5].

The global trend of T2D's increasing incidence concerns Bulgaria as well. Its spread becomes endemic and affects 8.3% of the population and accounts for 23.3 deaths per 100,000 [2]. Alarming is

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the fact that about 50% of the population suffering from diabetes are unaware of their condition, because the disease often occurs without any notable symptoms and also because of the irregularity in the conduction of prevention studies in this area [6].

Risk factors leading to the occurrence of type 2 diabetes are obesity, poor diet, high blood pressure, dyslipidemia, low physical activity, family history and more. The disease itself leads to a series of complications affecting the quality of life for diabetics—diabetic retinopathy, diabetic nephropathy, macrovascular disease, cerebrovascular disease, ischemic heart disease, etc. [7].

T2D can be controlled with proper care, training and advanced medical treatment. It has been proven that the early identification, effective prevention and treatment of diabetes and its complications, as well as education of the patients are essential to limit the incidence on the disease and the progression of its complications, disability and mortality. This would improve the quality of life of people with diabetes and significantly lower the cost of the disease [2, 8].

The aim of this study is to investigate the key biomedical and lifestyle factors for the development of type 2 diabetes as well as the cardiovascular diabetes complications in the population aged 25-64 from Kardzhali region—Bulgaria, in order to develop measures for early identification of individuals at risk, and timely treatment of the disease.

2. Materials and Methods

The study was carried out within CINDI Programme and covers a random two-stage representative sample of the population of Kardzhali region—1,600 persons aged 25-64 years (800 men and 800 women), divided into four age decades [9].

To obtain the necessary information, an individual interview was performed with every examined person. A standardized questionnaire by the CINDI-Europe network was used.

Blood pressure check, weight and height measurements, and full lipid profile were conducted on the examined individuals. The subjects were divided into two groups—diabetic and non-diabetic. One person was included in the group of the diabetics based on self-reported diagnosis of T2D and his/her medical records from GP's and endocrinologists. Diabetic risk constellation includes positive family history (first-degree relatives with type 2 diabetes); overweight/obesity, by body mass index (BMI $\geq$ 25 kg/m^2); high blood pressure (BP $\geq$ 140/90 mm Hg); hypercholesterolemia ($\geq$ 5.2 mmol/L); low physical activity (carried out once a week or less).

For statistical processing SPSS 17.0 was used. For comparative analysis a non-parametric test of Mann-Whitney was used, at significance level $P < 0.05$.

The study involves human participants and it meets the ethical principles of the Declaration of Helsinki. It was approved by an institutional review committee of the Faculty of Public Health, Medical University—Sofia and the subjects gave informed consent.

3. Results and Discussion

The results of the study show that 6.3% of the tested subjects are suffering from diabetes type 2 and the proportion of women is slightly higher compared to men, respectively 53.0% and 47.0% ($P > 0$ .05). The average age of individuals with T2D is 53.5 ± 7.8.

With age increasing, the incidence of diabetes increases in both sexes ($P < 0.001$), more significantly in the over 45 year groups. Maximum values were found in the 55-64 year olds (respectively 66.0% in men and 41.5% in women) (Table 1). It is noteworthy

Table 1 Distribution of persons with diabetes type 2 by sex and age (%).

Aged	Men	Women
25-34 г.	0.0%	1.9%
35-44 г.	10.6%	20.8%
45-54 г.	23.4%	35.8%
55-64 г.	66.0%	41.5%

greater ($P < 0.01$).

that women aged 54 and lower have a higher number of diabetics compared to men, while in the 55-64 aged group, the proportion of diabetic men was 1.6 times Our results are consistent with European data which show that the age-specific prevalence of T2D rises with age up to the seventh and eighth decades in both men and women [10]. The most likely reasons for this are related to the deterioration of insulin secretion and insulin sensitivity with age and number of changes associated with aging—increased visceral fat, decreased physical activity, hormonal changes, increased oxidative stress and subclinical inflammation.

The prevalence of T2D in Kardzhali region is greater than those from the DECODE Study Group who show that less than 10% in subjects below the age of 60 and 10%-20% between 60 and 69 years; 15%-20% in the oldest age groups have previously known T2D, and a similar proportion have screen-detected asymptomatic diabetes. This suggests that the lifetime risk of diabetes in Kardzhali region is significantly greater than the 30%-40% risk for target population of 13 European cohorts studied [10].

3.1 Distribution of Some Risk Factors among People Diagnosed with Diabetes Type 2

Benchmarking data on the prevalence of leading risk factors for occurrence of T2DM (overweight and obesity, high blood pressure, dyslipidemia, low physical activity and family history) in diabetic and non-diabetic groups are shown in Fig. 1.

3.1.1 Overweight/Obesity

The results of the study show that 87% of the diabetics have an increased BMI (over 25 kg/m^2, and their share is higher than those who deny to have the disease—61.5% of the respondents ($P < 0.0001$) (Fig. 1). Statistically significant correlation is established in terms of eating habits, such as the consumption of sugar and sugar-containing products and beverages, cereals, and fatty foods, etc..

Data from observational studies of patients with T2DM shows that oobesity rates, based on BMI are more than 30% in 38 of 44 of the studies. In Europe obesity was present in 50.9% to 98.6% of adults with T2DM [11]. In Kardzhali region prevalence (87.0%) is significantly higher than these and is the highest in the Bulgarian CINDI population [12].

3.1.2 High Blood Pressure

The study found that 63% of the diabetics have high blood pressure (above 140/90mm Hg). Their relative proportion is 2.4 times higher than the control group (26.2%) ($P < 0.001$).

As in our study the prevalence rates of hypertension in patients with T2DM are high throughout the world. In their systematic literature review of the prevalence of hypertension in adults with T2DM, Colosia et al. [11],

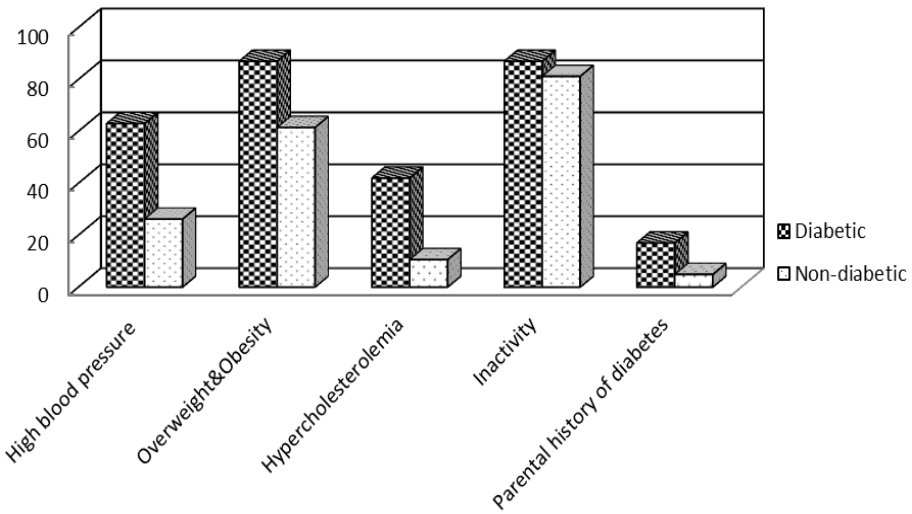

Fig. 1 Prevalence of main risk factors for type 2 diabetes (in %).

demonstrate that hypertension rates in subjects with T2DM are high with most studies reviewed present a prevalence rates above 50%, and many—above 75%. Controlling hypertension in these patients is important to limit the morbidity and costs for the health care systems derived from diabetic complications [13].

Globally, hypertension and obesity, separately or together, are common comorbidities in adults with T2DM. As numerous studies have indicated, hypertension and obesity increase the risk of long-term vascular complications of T2DM, including stroke, heart disease, peripheral vascular disease and death [14-16].

3.1.3 Hypercholesterolemia

The results show that 42.0% of the individuals with diabetes have elevated blood cholesterol, as the proportion is almost four times higher than in persons without the disease (10.6%) ($P < 0.001$).

There is a great body of evidence that T2DM affects all lipids and lipoproteins, and dyslipidaemia is a consistent finding in people with type 2 diabetes [17]. Because of the greater incidence of high blood pressure, obesity and high total cholesterol in the diabetic group of our study we can assume a significant risk for the development of CVD (cardiovascular disease) provided from a study of Fox [18]. Further support to our findings is provided from studies showing that apart from being per se a risk factor for CVD, T2DM is often associated with a higher prevalence of a multifactorial condition, often referred as metabolic syndrome, including hypertension, obesity, insulin resistance, microalbuminuria and dyslipidaemia [19, 20] and which is responsible for the high CV morbidity and mortality in those patients.

3.1.4 Inactivity

It was found that more than 80.0% of the people with diabetes have low level of physical activity during their free time ($P < 0.05$). Almost every day physical activity is performed only by 6.0% of the diabetics, 2-3 times a week—by 5.0% of them; once-weekly and less frequently—87.0%; do not conduct such due to illness/disability—7.0% of the respondents.

The physical activity at the work place also shows connection to the occurrence of diabetes in the studied individuals. The results show that 95% of the diabetics have mild or very mild, mostly sitting physical activity at their work place. Moderate physical activity at work is performed by 6.0% of the diabetics. There is no report for performing heavy physical activity. Indicators of physical activity at work in persons without diabetes are as follows: in 77.2% the work is mild and very mild, in 19%—moderate and in 2.8%—heavy ($P < 0.0001$).

Our findings of an association between a low level of physical activity and presence of diabetes are consistent with those of the nationally representative survey of the U.S. population which shows that 61% of patients with diabetes or at highest risk for developing type 2 diabetes do not engage in regular physical activity, with a rate significantly below national norms [21].

Physical inactivity along with overweight/obesity ranks among the leading modifiable risk factors for type 2 diabetes [4, 8]. According to the systematic review of Boulé et al. [22], exercise training reduces glycosylated hemoglobin (HbA(1c)) by an amount that should decrease the risk of diabetic complications, but no significantly greater change in body mass was found when exercise groups were compared with control groups. Either aerobic or resistance training alone improves glycemic control in type 2 diabetes, but the improvements are greatest with combined aerobic and resistance training [23]. More recent data from a 2 systematic review and meta-analysis of randomized controlled clinical trials shows that structured exercise training that consists of aerobic exercise, resistance training, or both combined is associated with HbA(1c) reduction in patients with type 2 diabetes. Structured exercise training of more than 150 min per week is associated with HbA(1c)

declines than that of 150 min or less per week. Physical activity advice is associated with lower HbA(1c), but only when combined with dietary advice [24]. Reduction in HbA(1c) is associated with exercise frequency in supervised aerobic training, and with weekly volume of resistance exercise in supervised combined training. Therefore, exercise volume is a major determinant of glycemic control in patients with type 2 diabetes [25].

Physical activity is a protective factor for health. The regular performance of physical exercise and sport stimulate uptake of glucose by the muscles and thus favorably affects health [22, 23].

3.1.5 Family Predisposition

It was found that 14% of people with diabetes have indicated that a primary relative (mother) suffers from this disease, and their share is 3.4 times higher compared to people who do not suffer from it (4.2%) ($P < 0.0001$). A primary relative (father) suffering from diabetes is indicated by 3.0%, while in the control group this percentage is 0.7% ($P < 0.05$)

Complex diseases like type 2 diabetes have multi-factorial etiologies, with genetic and environmental factors playing roles [4]. Heredity plays a large part (up to 60%) in the development of T2D.

In our study a parental history of diabetes is associated significantly with the presence of diabetes in the offspring. The results agree with findings of other authors, demonstrated that offspring of a parent with T2D have a 40% life-time risk of developing T2D, increasing to 70% when both parents have T2D [4]. On the other hand, in a population-based cohort of twins in Finland, J. Kaprio et al. [26] have found that, building on the best fit models, heritability is 46%, shared environmental effects are 15%, and unshared environmental effects account for 38% of the liability for T2D.

3.2 Cardiovascular Complications in People with Type 2 Diabetes

The data from the study show that 6.0% of people suffering from diabetes have a coronary artery disease (Fig. 2). Their share is 3.2 times higher than the ones in the control group (1.9%) ($P < 0.05$).

The results of the study show that 3.0% of the diabetics have suffered from myocardial infraction compared to 0.7% non-diabetics ($P < 0.05$). 9.0% of the diabetics have heart failure, while this percentage is significantly lower (2.0%) in the non-diabetic group ($P < 0.05$).

Further support to our findings is provided from a study showing that diabetes confers from two-fold up to fivefold excess risk for a wide range of CVD (cardiovascular diseases), independently from other conventional risk factors [19]. Worldwide cardiovascular

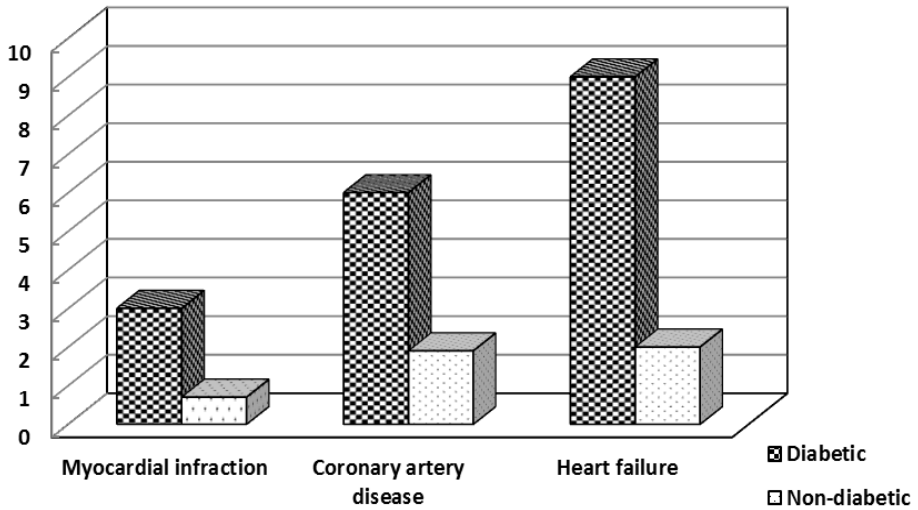

Fig. 2 Cardiovascular complications due to type 2 diabetes (in %).

diseases are the most common cause of death in the general population. As it has been evaluated in the United Kingdom and United States that 60%-70% of the population dies from cardiovascular disease. These data are similar to that found in Bulgaria (65.7%). T2D is responsible to two- to three-fold increase in cardiovascular mortality and for patients with already established cardiovascular disease even higher [27]. According to Cubbon et al. [28], the mortality in diabetic patients with acute myocardial infarction is predicted by age, previous myocardial damage and severity of the diabetic state as indicated by duration of the disease and the need for insulin treatment. In contrast, mortality is not related to conventional cardiovascular risk factor. Main point is on the fact that T2DM impacts similarly upon total and cardiovascular mortality in ischaemic and non-ischaemic cardiomyopathies. In broad terms, that data suggest that diabetes continues to double the risk of death in the setting of chronic heart failure.

4. Conclusions

The results of the present study give the following conclusions:

(1) The high prevalence of some behavioral and biological risk factor–unhealthy diet, low physical activity, high blood pressure, obesity, hypercholesterolemia and family history in the studied individuals with T2D was proven;

(2) The connection between diabetes and certain cardiovascular diseases such as ischemic heart disease, myocardial infraction and heart failure was confirmed;

(3) The results of the study call for development and implementation of intervention activities among the population of Kardzhali region, targeting the type 2 diabetes risk factors, early identification of the risk groups and timely treatment of the diseased.

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