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Prevalence of Diabetes Mellitus and Affected Factors in the District of Kayseri Health Group Area

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Abstract: The aim of this study was to determine the prevalence of diabetes mellitus and associated risk factors in rural Kayseri in Central Anatolia and to demonstrate whether glucometers can be used in epidemiological studies. This research was performed in Kayseri in 1994. The research population consisted of 3713 people chosen randomly among men and women of 30 years of age and over.

The prevalence of diabetes mellitus was identified as 5.6 %. In addition, the prevalence of diabetes mellitus was found to be higher in men than in women, in people of 50 and over than in people of 49 and under, in secondary educated groups than in lower educated and above groups, in obese people than in non-obese people and in hypertensive people than in normotensive people. According to the results we found a high rate of prevalence of diabetes mellitus in our area. It is believed that it can be reduced by prevention, control and education programs. In conclusion, it is thought that a glucometer can be used in epidemiological studies.

Key Words: Diabetes mellitus, prevalence, adult population.

Introduction

Diabetes is a serious disease that can have a significant impact on health, quality of life, and life expectancy of individuals, as well as on the health-care system. Compared with people without diabetes, diabetic patients have a higher hospitalization rate, longer hospital stays, and increased ambulatory care visits (1). The total annual economic burden of diabetes is believed to approach $100 billion in the United States (2). The World Health Organization (WHO) suggests population-based studies for preventive policies for diseases, including diabetes planning controlling programs and carrying out the management and educational services (3).

Out of total population of some 850 million in the European Region of WHO, including Turkey, it can be roughly estimated that at least 30 million people are affected by diabetes mellitus. Of these, some 4 million will have insulin-dependent diabetes mellitus and 26 million non-insulin-dependent diabetes mellitus. According to estimates by the International Diabetes Federation, the following proportions of diabetic people will present with one or more of the late complications of diabetes during their lifetimes: about 50 % with retinal damage; about 30 % with renal damage; in addition, between 30 and 50 % of subjects with limb amputations are diabetic, and at least 4 million diabetics out of the above total of 30 million have coronary heart disease (4, 5)

Epidemiological studies on diabetes mellitus are difficult in many ways. Screenings conducted especially in rural regions require both a large and experienced team and technical equipment that allows a sensitive determination of blood sugar. Another point that should not be overlooked is the cost of these epidemiological studies.

In recent years, one of the most important advances in diabetes has been the widespread use of a practical and easy to carry instrument, namely the glucometer that allows a patient to determine his own blood sugar (6). Use of these instruments was not recommended in the diagnosis of diabetes mellitus. However, we do not think there are sufficient trials concerning the use of these instruments in epidemiological studies.

The aim of this study was to determine the prevalence of diabetes mellitus and affected risk factors in 30 and over age groups, and to demonstrate whether glucometers can be used in epidemiological studies.

Materials and Methods

This research was carried out in 1994 in Kayseri Health Group Area which had been formed for public health education of medical students. The research area had a population of 47231 during the study. There were eight health centers in the area, two of them located in the urban, and six in the rural areas. A 5% prevalence of diabetes mellitus was supposed in the population aged 30 years and over and it was calculated that at least 3152 people should be included in the research for a 99 % confidence level. For this reason the sample size was established as 4000 people.

The research group was chosen by two steps. In the first step, one of the two urban health centers and three of the six rural health centers were chosen randomly. There were 15114 people who were in the 30 and above age group in the area. From this population, 4000 people were chosen by simple random sampling. The sampling procedure was carried out on the individual health charts in the health centers.

The people included in the sample group were visited at home by the medical students, invited to the health centers and told to come to the health centers following fasting since the evening before. The people coming to the health centers were examined by the physicians and their fasting blood glucose was measured with an Ames glucometer and their urinary glucose was determined with a glucostick. They were given a questionnaire consisting of 20 questions by the trained interviewers and their weight and height measurements were taken.

Approximately 5 % (287) of the people were excluded from the research because they refused to give information (94 people), nobody was at home (120 people), the household was not found (22 people) or the data was incomplete (51 people). As a result, 3713 people (1787 males and 1926 females) were included in this study. The rate of reaching the sample was 92.8 %.

The blood pressures of 160/95 mmHg and over were considered high based on the WHO criterion (7). Body mass index (BMI) was used in the evaluation of the weight. Those whose BMI was under < 25 kg/m^2, 25-30 kg/m^2 and over 30 kg/m^2 were considered non-obese, slightly obese and obese, respectively.

Patients were divided into three groups according to their fasting blood sugar levels: patients with fasting blood sugar levels above 140 mg/dl, those between 115-140 mg/dl and those below 115 mg/dl. The first two groups were invited to Erciyes University Medical Faculty Hospital and fasting blood sugar levels were determined. An autoanalyzer used in the Biochemical Laboratory, that works by the glucose oxidize method was used for the determinations. This method allows blood sugar determinations in venous plasma. Those whose blood sugar levels were again found to be 115-140 mg/dl were given the standard oral glucose test. Diabetes mellitus diagnoses were made according to the "National Diabetes Data Group" (8). Individuals who had previously been diagnosed as having diabetes and receiving therapy were considered diabetics regardless of their blood sugar levels.

The data obtained were evaluated using the EPI-Info 5 program. The associations between variables were tested by the Chi square test.

Results

The research was performed on 3713 individuals. The proportion of the residents living in the rural and the urban areas were 74.1 % (2753) and 25.9 % (960) respectively. There were 1787 (48.1 %) men and 1926 (51.9 %) women in this research. Distribution of the research group according to sex and age is shown in Table1.

It was found that diabetes mellitus was present in 5.6 % of 30 and over age groups. Blood sugar levels were normal in 3506 (94.4 %) and in diabetic ranges in 207 (5.6 %) in the population in the research group. Of the 3713 subjects, 156 (4.2 %) had diagnosed diabetes and 51 (1.4 %) undiagnosed diabetes. It was found that 24.6 % of the total diabetes prevalence was made up of newly diagnosed cases. Of the diabetic group 114 (55.1 %) were males and 93 (44.9 %) were females.

The prevalence of diabetes mellitus according to several variables is shown in Table 2. There was a gender difference in the prevalence of diabetes. Men had a slightly higher prevalence than women (6.4 %, 4.8 % respectively). The prevalence of diabetes mellitus increased with age. The prevalence increased from 2.2 % in the 30-39 age group to 8.0 % in the 50-59 age group. There was a difference in the prevalence of diabetes between the urban and rural population ($p<0.01$). The prevalence of diabetes mellitus was 8.8 % in the urban area 4.4 % in the rural area.

The family income of participants was classified as "high" "average" or "low" by their descriptions. Although there was a higher prevalence of diabetes mellitus among people whose income was high and low than the people whose income was average, the difference between them was not significant ($p>0.05$). People with a higher level

of education had higher prevalence of diabetes mellitus than those with lower educational levels, but the difference was not significant (p>0.05). Of the study population, 34.4 % were non-obese, 27.5 % were slightly obese and 38.1 % were obese. The prevalence of diabetes mellitus was significantly high in obese people. The prevalence of diabetes mellitus was three times more common in cases with a family history of diabetes (p<0.01). The prevalence of diabetes mellitus was 6.8 % in the hypertensive group, which was higher than in the normotensive group (p < 0.05).

The values which had been measured with a glucometer were compared with the values obtained in the hospital and the difference between two values was found to be statistically insignificant (p>0.05). When the

Table 1. Distribution of the study group according to sex and age

Age groups	Male		Female		Total	
	number	%	number	%	number	%
30-39	383	21.4	656	34.1	1039	28.0
40-49	392	21.9	473	24.6	865	23.3
50-59	418	23.4	427	22.1	845	22.8
60 and over	594	33.3	370	19.2	964	25.9
Total	1787	100.0	1926	100.0	3713	100.0

Table 2. Diabetes Mellitus Prevalence According to Several Variables.

Variables	n	Subjects with diabetes		p
		Number	%	
Total	37.13	207	5.6	
Sex				
Male	1787	114	6.4	p<0.001
Female	1926	93	4.8	
Age groups				
30-39	1039	23	2.2	
40-49	865	52	6.0	p<0.001
50-59	845	68	8.0	
60 and over	964	64	6.6	
Residental				
Urban	960	85	8.8	p<0.001
Rural		122	4.4	
Educational level				
Under primary school	2035	117	5.7	
Primary school	1449	71	4.9	p>0.05
Secondary school and over	229	19	8.3	
Income				
High	688	42	6.1	
Average	2422	118	4.9	p<0.05
Low	603	42	6.1	
BMI				
Normal	1277	55	4.3	
Slight fat	1020	59	5.8	p<0.05
Fat	1416	93	6.6	
History of diabetes in family				
Yes	387	49	13.0	p<0.01
No	3326	158	4.8	
Blood pressure				
Normal	2629	133	5.1	p<0.05
High	1084	74	6.8	

cut off point limit for blood fasting sugar is taken to be 140 mg/dl, this method was found to have a sensitivity of 92 % and a specificity of 84 % according to the oral glucose tolerance test.

Discussion

The capillary blood glucose level is similar to the arterial blood glucose level and the fasting state arterial blood glucose level is only 2-3 mg/dl higher than the venous blood glucose level. However, when blood glucose is determined following a meal or glucose injection, it is found to be 20-70 mg/dl higher in capillary blood glucose than venous blood (9). Therefore, it can be concluded that the fasting state capillary blood glucose level can be used in diabetes mellitus diagnoses and consequently, in screening. Fasting blood glucose levels we obtained in capillary blood with a glucometer were similar to the values obtained in venous plasma by the glucose oxidize method. The sensitiwity of the values obtained by the glucometer compared with the values obtained with an autoanalyzer was found to be 92 % and the specificity was 84 %. These results show that glucometers are reliable in fasting capillary blood glucose determinations and, therefore, can be used in epidemiological studies.

Approximately 14 million people in the United States have diabetes mellitus. Non-insulin-dependent diabetes mellitus accounts for 90-95 % of all cases of diabetes in the United States, representing about 6 % of the total population (10). The onset of non-insulin-dependent diabetes mellitus is usually after the age of 30, and the prevalence steadily increases with advancing age. It is estimated that nearly 20% of the US population aged 65-74 has diabetes (10).

The prevalence of non-insulin dependent diabetes mellitus has been found to be 7 % in Italy, 10 % in Malta, and 30 % in Finland among the old male population (4,11). In addition, in several countries, diabetes mellitus prevalences are 1.1 % in Israel, 1.6 % Pakistan, 1.6 % in Yugoslavia, 4.5 % in Switzerland, 4.1 % in England and 3.0 % in Turkey (5). In another evaluation, prevalences of diabetes mellitus have been found to be 2.4 % in Finland, 4.4 % in Hungary, 2.9 % in Norway, 6.1 % Portugal, 2.7 % in Romania, 3.0 % in Sweden and 2.7 % in Switzerland (5). The data obtained in this study indicate that the occurrence of diabetes in Turkey is similar to that found in countries such as the US, Italy, Israel, Argentina, and others (12).

At present there is not enough knowledge about the prevalence of diabetes mellitus in Turkey. In 1996, Öker and co-workers reported 1.98 % glucosuria prevalence in Silivri and the surrounding villages (13). In 1973, 23243 individuals were screened and 1.7 % glucosuria was found in Kayseri (14). Akıncı and co-workers in a study conducted in 1982, determined postprandial glucosuria at a rate of 1.53 % and stated that the prevalence of diabetes in Turkey was 1 % (15). In this study, it was found that the prevalence of diabetes is 5.6 %. This rate is quite high compared with the studies mentioned above. In the same region, in a the study carried out among a total of 1774 adults over 30 years old in the urban area of Kayseri in 1996, Keleştimur and co-workers reported 6.9 % type 2 diabetes mellitus prevalence (16).

Our rate of 5.6 % of diabetes prevalence is limited only to a particular region, it does not reflect the prevalence in Turkey. In order to estimate diabetes mellitus prevalence in Turkey, it is necessary to have a multi-center, population-based diabetes screening program according to the model protocol suggested by WHO (17).

Type 2 diabetes mellitus is associated with risk factors that are modifiable (obesity and physical inactivity) and nonmodifiable (genetic factors, older age, race/ethnicity, and positive family history) (18). In our study, it was found that family history of diabetes, hypertension and obesity were significant risk factors for diabetes mellitus. These observations are in agreement with the concept that age, heredity, and obesity are the universal risk factors for type 2 diabetes mellitus (19). There are clear indications of a link between obesity and increased risk of contracting non-insulin dependent diabetes mellitus. In fact, in epidemiological studies, age standardized prevalence (25-64 age group) of non-insulin-dependent diabetes mellitus (WHO criteria) has been calculated as 1.7 % in men and 2.8 % in women. Impaired glucose tolerance tests have shown a prevalence of 3.9 %. From the results, one can estimate that there is a rate of 8 % of carbohydrate metabolism disorder in the Lithuanian population, which means 300 000 people (20).

In this study, the highest rate of diabetes mellitus was found in the urban area where the population have more risk factors. In Malerbi and Franco's study the highest rates were found in the south and southeast, the more economically developed regions of Brazil (21).

In our study, it was found that 24.6 % of the total diabetes prevalence was made up of newly diagnosed cases. In the United States, the prevalence of undiagnosed diabetes mellitus is approximately equal to the rate of diagnosed diabetes. Consequently the actual prevalence of diabetes is twice the rate of diagnosed

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