

RESULTS ON THE EPIDEMIOLOGY OF DIABETES MELLITUS

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Abstract:

Diabetes mellitus is a major cause for morbidity and mortality and its prevalence is rapidly increasing at global scale. This fact has led to conduct studies in most countries worldwide to identify the key triggering factors of the disease.

Key words: diabetes mellitus, epidemiology, prevalence

INTRODUCTION

Nowadays, the evaluation of morbidity through different chronic diseases constitutes one of the main concerns for the medical services. The continuous development of the screening methods and their prevalence over large masses of population makes the early detection of serious debilitating diseases possible. Also, early detection is the most important premise for an efficient prophylaxis, a major trend of modern healthcare [1,2]. Diabetes mellitus is a major cause for morbidity and mortality and its prevalence is rapidly increasing globally. The correlation between the occurrence of type 1 diabetes and age has been stressed by studies conducted in different countries. In epidemiological studies, the type of diabetes that is triggered in adults can be considered as type 2 diabetes. Unlike type 1 diabetes, data on the incidence rate of type 2 diabetes are scarce. The referenced data come mainly from the US.[3]

MATERIAL AND METHOD

In the epidemiological study on diabetes mellitus I consider that the results are dependent on several important factors such as: investigation methods, the manner of obtaining the cooperation of the investigated population, the geographic and economic environment from which the tested individuals are sampled, the clustering of the investigated subjects according to gender and age, the assurance of a representative sample.

RESULTS AND DISCUSSOIN

The epidemiology of type 1 diabetes mellitus

Type one diabetes mellitus rarely occurs during the first year of life. Of nearly 10,000 cases of children included in the Finnish Diabetes Register between 1965 and 1966, only in 37 cases (0.4%), diabetes started in the first year of life. The incidence of the disease increases suddenly between 12 and 14 years, then decreases. Data on the incidence of type 1 diabetes with onset after the age of 30 years are limited. In a population study that took into consideration two counties in Denmark, the incidence was 8.2 cases per 100,000, according to the employment of strict diagnostic criteria of type 1 diabetes. Given that in the same study all the patients treated with insulin from the onset of diabetes were considered to have type 1 diabetes mellitus, the incidence rate increased to 35.8 per 100,000 cases, the difference pertaining to the high incidence of the disease in older age.

According to recent data, collected from 100 studies conducted in 50 countries, the lowest incidence rate of type 1 diabetes, in population aged from 0 to 14 years, is encountered in Asia, the Caribbean and Latin America (ranging between 0.1 and 3.5 per 100,000 per year). The highest rate is encountered in the Nordic countries, UK, Canada, New Zealand, Portugal and Sardinia (ranging between 21.2 and 36.8 per 100,000 per year) [9]. The incidence rate of type 1 diabetes within white population in the United States, documented by three studies, ranges between 11.7 and 16.4 per 100,000 per year. This aspect enlists the United States among countries with high-risk populations. For example, in Allegheny, Pennsylvania, the incidence rates during 5 years (1978-1983) reached 16.2 and 11.8 per 100,000 white and Afro-American children [9]. In a similar time range, in Jefferson, Alabama and in San Diego, California, the rates were much lower for the Afro-Americans (4.4 and 3.3 per 100,000), although the rates were similar for the white population in all three locations [4]. The interesting fact is that, more recently, between 1990 and 1994, the incidence rate in Allegheny in the Afro-American population aged between 10 and 14 years equalized the reported incidence rate within white population, while for those aged between 15 and 19 years, the rate within Afro-American population has exceeded the the rate observed within white population (12). The reported incidence rate among Hispanic children aged between 0 to 14 years ranges from 9.7 per 100,000 people in Colorado and 4.1 per 100,000 people in California, while the incidence rate in Mexico is among the lowest in the world [4]. The data collected on the incidence of type 1 diabetes in the past 20 years shows that type 1 diabetes occurs mostly within racial and ethnic groups, but the risk is higher within white population [9]. While genes could determine these differences between races, the rate of change

within the white population is almost as high as that encountered within other races. Therefore, the problem that remains to be solved is to see how much of the variation among and between racial groups is due to genetic differences and how much is due to exposure to different environmental factors.

The temporal increase of type 1 diabetes incidence

There have been identified several types of variation in time: long-term trends, a seasonal cycle and episodic changes over several years.

In the U.S. in the first three decades of the twentieth century, the incidence rate of type 1 diabetes within white population younger than 15 years was relatively constant. However, the rate has almost tripled over the next 30 years. Data from several countries are consistent with those obtained in the United States. The incidence rate of diabetes in children under 15 years in Oslo, Norway, increased from 6.2 between 1925 and 1954 to 10.8 between 1956 and 1965 [16], and then to 20.5 for the period between 1973-1982 [7], values close to those recorded in the U.S. In Finland, where the incidence of type 1 diabetes is higher than in the U.S., a steady increase in the incidence rate in children aged from 1 to 14 years has been documented since 1965, reaching a value of 44.8 per 100,000 individuals in 1996. The highest growth was recorded in the age group 1 to 4 years [15]). During 1989-1994, 44 centers representing the majority of the European countries contributed to a study concerning the time trends of type 1 diabetes incidence rate. The observed average annual incidence was 3.4% (overall proportion), but the rate varied between centers and according to age groups. In the Finnish study, the highest growth was recorded for the age group 0-4 years (6.3% per year) and lowest for the age group 10-14 years [6].

The type 1 diabetes incidence in families

To evaluate the role of genes and environment in the etiology of the disease, studies were conducted on its incidence pattern within the family. *In the case of studies on twins*, the assumption was that monozygotic twins had identical genotypes, whereas dizygotic twins were as dissimilar as siblings that were not twins. A more frequent diabetes concordance in the case of monozygotic twins than in dizygotic twins indicated a more important role of genetic factors. While these results demonstrate the role of genes, they also indicate the major importance of the environment. The concordance rate in dizygotic twins is well below 100%, showing that genes are not a sufficient causal explanation. In addition, the concordance rate was higher for dizygotic twins than for siblings who were not twins [11]. A more useful measure of familial clustering is the rate of recurrence risk among siblings, defined as the ratio between the disease risk among siblings and the disease risk among the general population. A ratio higher than 1 indicates familial clustering. Although such clustering is not solely the result of

genetic factors and may indicate exposure to environmental factors of the family members, it is unlikely that strong family clustering (ratio higher than 6) is due only to exposure to environmental factors [10]. Three studies, two conducted at Joslin Diabetes Center in Boston and one at Steno Hospital of Copenhagen, permit the calculation of a cumulative risk of diabetes up to 50 years for siblings among the subjects with type 1 diabetes. In all three studies, subjects (patients with type 1 diabetes whose families also participated in the study) were diagnosed before the age of 21 years. The three studies have produced about the same estimated values of cumulative risk by age of 50. To make a comparison, the cumulative risk at 50 years within general population was calculated and resulted in 0.5% risk. Therefore, the risk for siblings by the age of 50 is about 10% or 20 times the risk within general population. A report this high (20 times the risk in the general population) is important evidence of the role of genes in the etiology of type 1 diabetes. However, it is important to remember that the major histocompatibility locus (known as IDDM1) of chromosome 6 is only responsible for half of family wise incidence of type 1 diabetes. The rest is probably due to other genetic factors or common environmental conditions.

Parent-child pairs are another first-degree family relationship that can be examined in familial clustering of type 1 diabetes. Several follow-up studies on children with a type 1 diabetes suffering parent can assess the cumulative risk of diabetes in children under the age of 20. As was found for siblings, the risk is much higher than within general population, although, surprisingly, there is a significant difference between the rate found in children of fathers with diabetes and children of mothers with diabetes. In children with a diabetic father, the cumulative incidence of type 1 diabetes by age of 20 is 6%, or 20 times higher than within general population. In children with diabetic mother, the incidence is about 2%, which is only 7 times higher than within general population. In two small studies on children with mothers who have acquired type 1 diabetes only after childbirth [13], the children seemed to have type 1 diabetes risk similar to the risk of children with a diabetic father. These data suggest that exposure to diabetes factors in utero may have a protective effect on the child, probably by induction of immunologic tolerance to the antigen involved in autoimmune destruction of pancreatic β cells. Another factor that seems to alter the incidence of type 1 diabetes in families is *the subjects' age on the onset of type 1 diabetes* [5]. Regardless to the diabetic parents' gender in the studies described above, the risk in children was approximately twice as high if the parent was diagnosed with type 1 diabetes before the age of 11.

The epidemiology of type 2 diabetes mellitus

In the case of epidemiological studies, the diabetes triggered in adults can be considered type 2 diabetes. Unlike type 1 diabetes, data on the incidence rate of type 2 diabetes are scarce. The referenced data come mainly from the US.

The variation of type 2 diabetes incidence according to the age

The occurrence of type 2 diabetes is much influenced by the age. For example, in the 1960s within the white population of Rochester, Minnesota, the incidence of type 2 diabetes increased from 10 to 612 per 100,000 for individuals between 20 and 29 years and for those between 60 and 69 years. Similar findings were made in cohort studies conducted in other populations [17]. The best data on the prevalence of diabetes, both diagnosed and undiagnosed, comes from the NHANES III study (National Health and Nutrition Examination Survey III), conducted between 1988 and 1994. Overall prevalence of diagnosed diabetes in U.S. adults was 5.1%. The prevalence of undiagnosed diabetes was 2.7%.

The variation of type 2 diabetes incidence according to obesity

As early as 1921, Elliott P. Joslin published a report demonstrating that the risk of diabetes (type 2 according to the criteria used) was higher in obese individuals than in those who were not obese [8]. Similar results were obtained in several case-control and cross studies, although the effect estimations varied due to the problems associated with unreliable measurements of obesity, lack of distinction between type 1 and type 2 diabetes, and the unrepresentative selection of the study groups. In the last 10 years excellent data on the risk of type 2 diabetes according to body mass index (BMI) has been obtained. The largest amount of the studies was conducted on a period of 14 years: Nurses Health Study (NHS). The incidence rates of type 2 diabetes adjusted to age continuously increased along with the increase in weight. An association between risk and increasing weight was obvious even in the cases of individuals who were not obese. The incidence rate increased from 13 to 104 per 100,000 comparing women with BMI in the "less than 22" category with women with BMI in the "25 to 26.9" category. Although this was an abrupt variation, the largest absolute increase in risk occurred in the obese category. From the lowest BMI in the obese range "27 to 28.9" up to the highest "35 +," the incidence rate increased from 200 to 1190 per 100,000. The highest level of obesity (35 +) represented only 3% of the population, but contributed with 26% to the number of cases of type 2 diabetes incidence. A large weight before the age of 18 as well as a large increase in weight at maturity (after the age of 18), contributes significantly to increased risk of type 2 diabetes. However, the BMI at the reference level of the follow-up study (30-55 years) had the most significant impact on the

risk of type 2 diabetes.

The variation of type 2 diabetes incidence between races and different countries

Geographic and ethnic differences in the incidence of type 2 diabetes can be considered to assess the environmental and genetic determinants of diabetes. The highest prevalence of Type 2 diabetes occurs among Pima and Papago Indians in Arizona. By age 50, about half of the population suffers from diabetes. This is an extremely high prevalence of diabetes. Most likely, this fact results from the combination of very high prevalence of obesity and frequency of genetic susceptibility to type 2 diabetes. The highest prevalence of type 2 diabetes [2] has been recorded among the Pima and Papago Indians. Following in the U.S. are Mexican Americans living on the border with Mexico. Prevalence among non-Hispanic white population is $\frac{1}{2}$ less than for Mexican Americans, while for non-Hispanic Afro-American population, the prevalence is somewhere between the two. The prevalence of type 2 diabetes in European populations is similar to or slightly lower than that for non-Hispanic white population of the U.S., indicating a similarity of environmental and genetic determinants between the two areas. On the other hand, the prevalence of type 2 diabetes is much lower among the black population in Africa than among the non-Hispanic African Americans in the U.S.. Although these differences are not explained, a recent study shows that much of this variability could be attributed to differences in BMI. The prevalence of type 2 diabetes is very low for the Chinese population in China, average for the Chinese population in Indonesia and very high for the Chinese population in Mauritius Island.

The type 2 diabetes incidence in families

With the purpose of studying the incidence of type 2 diabetes in families, a research was conducted at the Joslin Clinic in Boston, Massachusetts, where a random sample of 563 patients was studied in order to obtain information about the incidence of diabetes in their relatives. The research found that type 2 diabetes was more common especially in cases with a parent and a grandparent with diabetes. In addition, if there was a grandparent, an aunt or an uncle suffering from diabetes in the family, not a parent, the risk was similar to the one present in families without a history of diabetes and not far different from the risk in the general population.

The distribution of diabetes mellitus in the general population in Romania

The prevalence of diabetes mellitus in Romania, including both the clinically manifest forms and the subclinical ("impaired glucose tolerance"), vary depending on the geographic area and environment (urban or rural) between 2 and 9% of the population. In Romania, diabetes type 1 represents about 7% of all registered diabetics. Contrary to what many treaties in

diabetes claim, namely that the maximum incidence of this form is recorded during puberty (age 10 to 16), in Romania the incidence of this form of disease is relatively uniform, ie 3-4/100.000 before 12 years; 6-7/100.000 between 12-16 years; 8-10/100.000 between 17-40 years and about 13-15/100.000 between 30 and 60 years. Accurate data on the incidence of diabetes in Romania exists only for the 0-14 age group, due to its participation on the European multicenter study EURODIAB. Actual prevalence of type 2 diabetes in the population of Romania is around 5%, compared to the number of known patients that does not exceed 2% of the population. Most unknown cases are recorded at older ages. This fact is proven by the high rates of type 2 diabetes or impaired glucose tolerance registered in population studies. It explains the high frequency of disease discovery during a major vascular accident: myocardial arrest or stroke. Unlike the quasi-equal distribution of type 1 diabetes during life, type 2 diabetes has a specific pattern. It is very rare before the age of 20, rare between 20 and 40 years, with a sharp increase between 40 and 60 years, reaching a maximum between 60 and 70 years, after which the incidence decreases suddenly.

CONCLUSIONS

- The collected data on the incidence of type 1 diabetes in the past 20 years shows that type 1 diabetes occurs in the majority of racial and ethnic groups, but the risk is higher within white population.
- The large variation in the incidence of type 1 diabetes within and between racial / ethnic groups was clearly demonstrated by population-based studies. The increasing incidence rate in many of these populations indicates the major role of environmental factors in the incidence of diabetes in susceptible persons.
- The incidence of type 2 diabetes in the U.S. has increased in the last 50 years. This represents an increase of 90% in men and 77% women.
- A family history of diabetes, especially concerning parents, is a significant risk factor that can lead to type 2 diabetes. However, it is responsible for only a moderate proportion of cases of type 2 diabetes in the general population.
- The prevalence of type 2 diabetes has increased among the U.S. population, mostly due to the increasing incidence of type 2 diabetes, and not because of increased survival of patients with diabetes. This growth has accelerated in the last 20 years. Although there have been no direct studies, increases in incidence and

prevalence of type 2 diabetes appear to be consequences of increased incidence of obesity in the U.S.

- Research conducted in Romania in the last four decades show a progressive increase in the maximum incidence of type 2 diabetes from 55 to 60 and then 65 years. Unlike type 1 diabetes, in which the Center of Bucharest has not recorded a significant growth in the recent decades, for type 2 diabetes the growth has been impressive.

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