EPIDEMIOLOGY OF DIABETES MELLITUS: A CURRENT REVIEW

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Abstract

Diabetes mellitus represents worldwide an extremely important public health problem considering its high prevalence, the serious complications triggered by the disease, the associated rate of mortality and, not the least, the extremely high economic and social costs. In 1995 approximately 135 million persons were affected by diabetes and an increase of 300 million cases was estimated by the year 2025. At the end of 2012 a number of 347 million persons with diabetes was estimated, with a prediction of 552 million cases in 2030, that is 9.9% from the world's adult population. The question asked on an annual basis is: „Diabetes where do we go? Can we stop the dramatic evolution?"

key words: *diabetes, prevalence, mortality.*

1. Introduction

Diabetes mellitus is a complex heterogeneous syndrome, consequence of genetic or acquired defects in the insulin secretion and/or insulin resistance of peripheral tissues leading to deep modifications in protein, carbohydrate, lipid, ionic and mineral metabolisms.

For the study of diabetes mellitus epidemiology, there is no worldwide approved standard research method. The epidemiological studies published so far were made in different places (geographical localization) and in different time periods (chronological extent), investigating either the whole population or a certain age group, following certain nationalities and ethnic groups, which gave immediate results or at a distance from the year/ years of investigations which led to important but very different scientific information.

During the last 40 years, the prevalence of diabetes mellitus has raised in the whole world [1-3], and the tendency for the future is of continuous increase in all ethnic groups, male or female, for all age groups [4,5]. This increase was especially noticed for type 2 diabetes mellitus (T2DM) [4]. The highest amplitude was observed in the countries with emerging economies where self-independent institutions in order to find and label new cases were created, where access to health

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care is no longer limited and where modern food and sedentary lifestyle started to spread across the population [6-8].

In 1995 approximately 135 million persons were affected by diabetes and an increase of 300 million cases was estimated by the year 2025 [9]. In 2011 there were already 336 million persons with diabetes, a number which led to the sudden change of statistics, the new estimations forecasting a dark future, 552 million cases by the year 2030 [10,11].

At the international level, the prevalence of diabetes varies in the same geographical area, depending upon ethnicity. In USA, the Hispanic/Latino population, the African-Americans, the Native Americans and the Asian-Americans have a T2DM prevalence of 2 up to 6 times higher than that of the Non-Hispanic Whites [12,13].

There are also differences between the rural and the urban environment. Some studies showed that diabetes prevailed twice or three times in the urban area in comparison with the rural area, depending upon the geographical area studied [14-16]. Due to the increase of population's access to medicine in the rural and moreover in the suburban areas and the inclusion of these areas in screenings and wide spread studies, new cases of diabetes mellitus were diagnosed, leading to a higher increase in prevalence for the rural area in comparison with the urban one, with a tendency of doubling in the next 20-40 years according to some authors [17,18]. We are giving in Figures 1 and 2 the estimated prevalence of T2DM worldwide in 2003 and 2010, with predictions for the years 2025 and 2030.
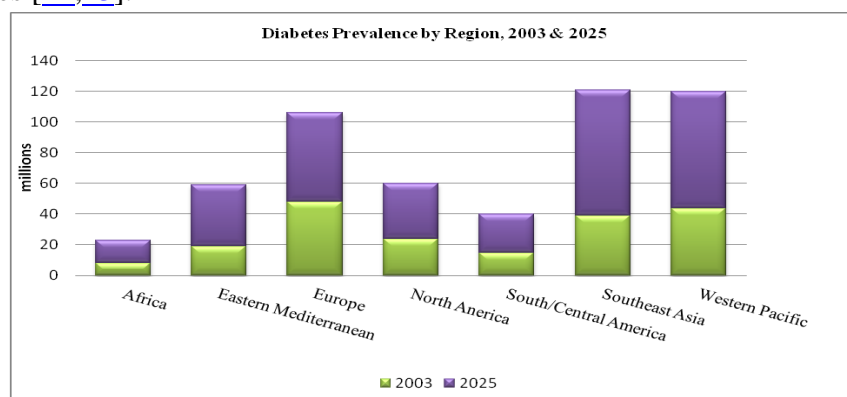

Figure 1. The prevalence of diabetes mellitus in different regions of the globe. (Adapted after [19])
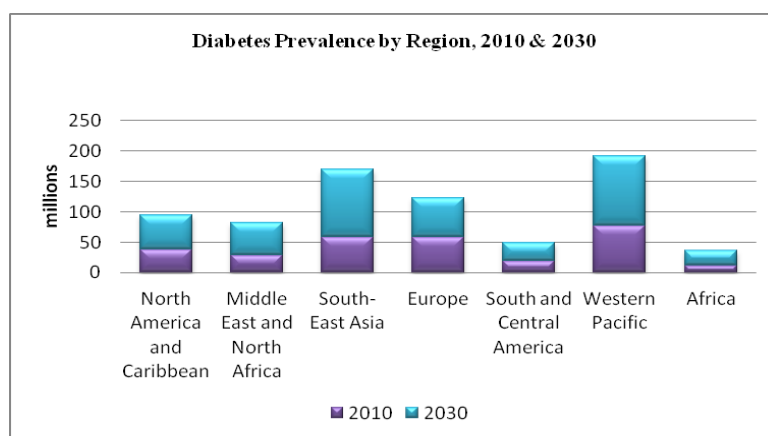

Figure 2. The prevalence of diabetes mellitus in different regions of the globe. (Adapted after [20]).

In 2003, according to the classification of countries with high prevalence, diabetes was dominant in India, China, USA, Russia and Japan [21]. In 2007 the classification order changed, starting with the 5th place, Germany, followed by Russia (Table 1). A few causes for the highest prevalence of diabetes registered in India, China and USA are great increase of population, the increasing proportion of elderly people, low access to medicine and diabetes prevention and/or access to modern food (especially fast-food). On the long run, the forecast for India, China and USA is dark, these countries being the ones left to share the negative top positions.

Table 1. Top 10 countries in number of people with diabetes (20-79 age group). (Adapted after [22])

Country prevalence (millions) 2007			Estimated country prevalence (millions) 2025		
1	India	40.9	1	India	69.9
2	China	39.8	2	China	59.3
3	USA	19.2	3	USA	25.4
4	Russia	9.6	4	Brazil	17.6
5	Germany	7.4	5	Pakistan	11.5
6	Japan	7.0	6	Mexico	10.8
7	Pakistan	6.9	7	Russia	10.3
8	Brazil	6.9	8	Germany	8.1
9	Mexico	6.1	9	Egypt	7.6
10	Egypt	4.4	10	Bangladesh	7.4

Table 2. Prevalence of diabetes in Europe, 2011 (20-79 age group). (Adapted after [23])

COUNTRY PREVALENCE (%)					
No.	Country	Prevalence (%)	No.	Country	Prevalence (%)
1.	Portugal	12.7	7.	Lithuania	9.5
2.	Russia	11.5	8.	Malta	9.5
3.	Poland	10.6	9.	Belarus	9.3
4.	Slovenia	10.3	10.	Serbia	9.3
5.	Cyprus	10.1	11.	Bulgaria	9.3
6.	Latvia	9.7	12.	Romania	9.2

In Europe in 2011, the prevalence of diabetes mellitus in the 20-79 years age group for the first 12 countries is given in Table 2. The prevalence ranges from 9.2% in Romania to 12.7% in Portugal [23].

2. Epidemiology of Type 1 Diabetes Mellitus (T1DM)

The prevalence of T1DM differs, depending upon the geographical area, for the

same population, but also for different populations. The causes of these variations are based upon the different intervention of genetic and environmental factors that act in the aetiology of T1DM. It is estimated that 50% of T1DM cases are diagnosed after the age of 15. During the period 1990-1999, the increase in prevalence was of 2.8% at global level, with higher percentage for young persons (0-19 age group) [9,24,25].

On all continents there were evidences of significant T1DM growth (4.0% in Asia, 3.2% in Europe, 5.3% in North America), except the Central America and West Indies, where the rate dropped to 3.6%. The majority of population, men and women, is equally affected [9,24-27].

The most important studies that analyzed the epidemiology of T1DM were the following:

EURODIAB ACE – project of collaboration between European countries, started in 1989 with 26 partners from 44 centres (including Bucharest, Romania), set up for:

1. evaluation of incidence of insulin dependent diabetes mellitus in children, in Europe

2. checking for a possible North- South gradient

3. picking up new information which can unveil the causes and the pathogenesis of the disease

EURODIAB-ACE investigated 16.8 million children during the period 1989 to 1990. The incidence of T1DM varied between **4.6**/100.000 in the North of Greece and **42.9**/100.000 in Finland. In that time, Romania had a small incidence: **5.1**/100.000 persons. In Northern Europe, the incidence was higher than in Southern and Eastern Europe, except for Sardinia, with an incidence of **30.2**/100.000. In Iceland the incidence of T1DM was similar to that from Sicily and Spain, thus the hypothesis of Northern-Southern gradient was disproved [26,27].

WHO-DIAMOND - international collaboration project in 105 centres from 53 countries with the purpose of analysing the seasonality of Diabetes Mellitus Type 1 (T1DM), based on data collected from the World's Health Organisation regarding the incidence for the age group 0 to 14. WHO-DIAMOND showed the existence of a seasonable pattern of appearance of T1DM in children with the age <15, especially in the Northern area. 28 centres had the highest incidence in the period October to January and 33 centres had the lowest incidence during June to August. No country from the Southern hemisphere did show an incidence higher than **20**/100.000/year, in comparison with the Northern hemisphere countries, where an incidence above **20**/100.000/year is widely spread. The T1DM incidence of the 0-14 year age group varies from **0.1** for 100.000 persons in China and Venezuela to **40.9** for 100.000 persons in Finland [28].

SEARCH for Diabetes in Youth Study – project organised by CDC (Centre for Disease Control) in 6 centres across USA, aimed at collecting new information about T1DM in already affected children and young adults. The SEARCH study revealed that during the period 2002-2003, T1DM incidence was higher for the age group 10 to 14 (25.9 for 100.000 persons per year) and lower for the ages between 15-19 (13.1 for 100.000 persons per year). The rate of incidence divided upon sexes is approximately the same. The highest

incidence rates of T1DM are seen in the young non-Hispanic white population, with values between 15.1 – 32.9 for 100.000 persons [25] as shown in Figure 3.
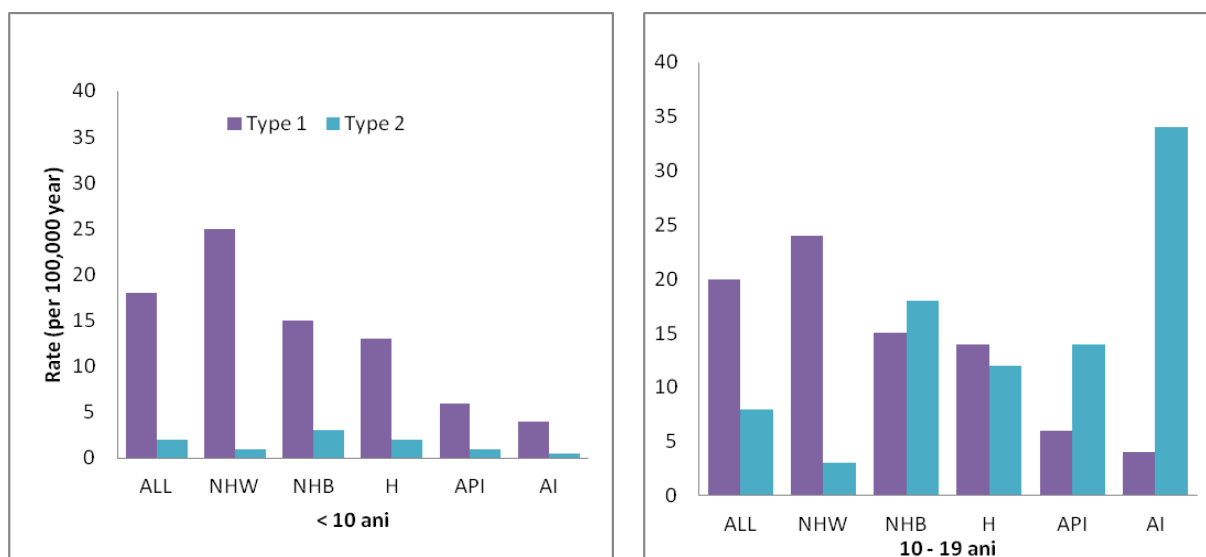

Figure 3. Comparison of incidence between T1DM and T2DM, for age between 0-10, depending upon race and ethnicity, during the period 2002-2005 [25,29]
NHW=Non-Hispanic Whites; NHB-Non-Hispanic Blacks; H=Hispanics/Latinos;
API=Asian/Pacific Islander Americans; AI=American Indians

The prevalence of T1DM in USA was of approximately 0.15% for the year 2000. The prevalence of T1DM was lower for youngsters with ages between 0-9 (0.78 cases for 1000 youngsters) in comparison with the youngsters of ages between 10-19 (2.28 cases for 1000 youngsters) [24,25,29].

Scientists forecast the doubling of cases of T1DM for children with ages <5 and an increase with 70% for youngsters below the age of 15, during the period 2005 to 2020 [30]. Generally, the incidence of T1DM increases with the age, the maximum peak being achieved at puberty. After puberty, the incidence drops significantly in the case of young women, and it stays relatively high for males until the ages of 29-35 [31].

3. Epidemiology of Diabetes mellitus type 2

T2DM represents 80-90% from the total number of diabetes cases and it is frequently encountered in overweight and obese persons [32]. At international level, the increase of diabetes prevalence is judged mainly taking into account the increase of prevalence of T2DM. The studies showed that in areas with high diabetes prevalence, there is a lower prevalence of impared glucose tolerance (IGT) and the other way around. For 2011 the prevalence of IGT at the worldwide level varies from 1.3% in Saudi Arabia up to 18.4% in Malaysia. In Europe, in 2011, the prevalence ranged from 1.7% in Bulgaria, followed by 5.4% in Sweden, up to 16.6% in Poland. Romania is in the middle of the classification, with a prevalence of 9.8% [23].

Globally it is estimated that for one diabetic person diagnosed, there is one undiagnosed person [33]. Regarding the number of undiagnosed cases, in 2011, at the worldwide level, on the first place there is India, with 31 millions. In Europe, the first 5 positions are occupied as follows: Russia with 4.5 million undiagnosed cases, followed by Germany with 1.8 million cases, Italy with 1.3 million cases, Turkey with 1.2 million cases and France with 1.1 million cases. Romania is in the top 10, with half million undiagnosed persons [23].

4. Diabetes-Related Deaths

Diabetes mellitus is one of the major causes for early death, worldwide. The WHO Report (World Health Organisation) from 2011 shows that diabetes-related deaths worldwide represent 2.2% (1.3 million) of all registered deaths. This report refers to the diabetes-related mortality, mentioned as main cause for death registered on Death certificates [34].

For 2011, the International Diabetes Federation (IDF) predicted a diabetes-related mortality of 1.1 million cases in China, 1 million in India, 200 thousand cases each for Russia and USA, Germany 40 thousand cases, Turkey and Poland 30 thousand cases, France, Spain and Romania approximately 20 thousand each. According to this data, diabetes mellitus occupies the 9th position in the first top 10 death causes [35].

The study of mortality is based on research of data from death certificates. In the death certificate, the first mentioned is the immediate cause of death, which usually is a complication of the disease, thus the prevalence of diabetes and of other diseases is still underestimated [36]. Diabetes mellitus is mentioned as death cause for 41% of patients known with diabetes. In the majority of death certificates a cardiovascular cause is registered as the main cause of death, even if it is just a complication of diabetes [36,37].

Number of deaths attributable to diabetes in age group 20 – 79 years in the year 2010		
IDF Region	Percentage (%) of all-cause death attributable to diabetes in age group 20 – 79 years	Number of deaths attributable to diabetes in age group 20 – 79 years
North America	15.7	313208
South – East Asia	14.3	1042914
Eastern Mediterranean and Middle East	11.5	296037
Europe	11.0	634054
Western Pacific	9.7	1074955
South and Central America	9.5	171303
Africa	6.0	332584

Figure 4. Diabetes mellitus- related deaths in the age group between 20-79, in 2010. (Adapted after [35])

For 2010, the total number of diabetes mellitus – related deaths, for the age group between 20-79, was of 3.96 million, representing 6.8% of the total of world's deaths [35]. Even with professional programs

of estimation, the number of deaths varies with ±20% [35]. The highest number of deaths attributable to diabetes is expected to occur in countries with large populations – India, China, USA and The Russian Federation [34].

The highest proportion of death attributable to diabetes (15.7%) reported in North America ([Figure 4](#)), reflects both a high prevalence of diabetes, a good screening for diabetes and extended life expectancy, therefore a numerous elderly population [35]. The lowest proportion of deaths attributable to diabetes in adults (6%) is reported in the African Region, but even in the African region diabetes accounted for more than 1 out of 20 deaths, representing over a third of a million deaths in 2010 [35].

Studies using highly competitive software programs based upon statistics from WHO, IDF (International Diabetes Federation) and national certified agencies from certain countries, showed that the diabetes-related mortality is much higher than the one presented on an annual basis by WHO [34,35].

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