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Cyprian KOZYRA
Wrocław University of Economics

Beata ZMYŚLONA
Wrocław University of Economics

Morbidity, Mortality and Health Expenditures from Diabetes in Poland and in the other European Union Countries

Summary: The article presents statistical data on prevalence ratio of diabetes and impaired glucose tolerance, diabetes mortality according to sex and age intervals, and diabetes expenditure ratio. European Union countries are compared, with special attention paid to Poland. Conclusion about growing tendency of diabetic issues in present-day societies are made.
Key words: diabetes, impaired glucose tolerance, diabetes prevalence ratio, diabetes mortality, diabetes expenditure ratio, international comparison

Introduction

Diabetes poses one of the most challenging health problems of the 21st century. It is the forth or fifth cause of death in the most developed countries. Coronary artery, peripheral vascular disease, stroke, diabetic neuropathy, amputations, renal failure and blindness are all the complications from diabetes. They result in increasing disability, reduced life expectancy and enormous health costs. Diabetes is defined as a group of heterogeneous disorder with the elements of hyperglycaemia and glucose intolerance. Those are caused by insulin deficiency, impaired effectiveness of insulin action, and sometimes both. On the basis of aetiology and clinical presentation of disorder diabetes is classified into four types: the first, the second type, gestational diabetes and other specific types.

In the paper we present the statistics and forecasts concerning the prevalence rate, the morbidity or mortality from type 1 and 2 diabetes in Poland as compared to the other European Union countries. We use statistical data taken from International Diabetes Federation and official statistics sources to make more insightful analysis of diabetes in EU zone.

Prevalence rate

An evaluation of precise number of diabetics is difficult due to many undiagnosed cases of diabetes. Apart from epidemiological data, estimation of the number of diabetics bases on some statistical techniques. International diabetes organizations like International Diabetes Federation (IDF) are interested in investigation of type 2 diabetes. This kind of diabetes constitutes about 85% to 95% of all diabetes in developed countries and it is a serious global health problem. The growth of morbidity rate is induced by rapid cultural and social changes, ageing population, increasing urbanization, dietary changes, reduced physical activity and other unhealthy behaviours. As the majority of people who have type 2 diabetes are adults, the reports about type 2 diabetes contain only information about adults.

Two measures of prevalence are distinguished. The first is the national (or regional) prevalence. It concerns the percentage of people with diabetes who live in a region or country. Because the prevalence of diabetes increases with age, it cannot be used for comparing prevalence between countries or regions which have different age structures. That is why we need a comparative prevalence which has been calculated by assuming that every country and region has the same age profile. The age profile of the world population has been used. This flattens the differences of age between countries and regions and makes this prevalence rate appropriate for comparison.

The national prevalence rate is calculated on the basis of reports containing epidemic information from each country. IDF reports only on type 2 diabetes in individuals 20 years of age or older. The demographic database comes from United Nations Population Prospects. People from every country or region are divided into 12 groups with regards to sex and age. There are six age groups are distinguished (20–29, 30–39, 40–49, 50–59, 60–69, above 70). The prevalence rate is estimated for each group. In the same way IDF calculates the comparative prevalence but taking into account the world population age profile.

In Table 1, we present the national and comparative prevalence rate of type 2 diabetes calculated for adults from the European Union countries. Information about prevalence rate for all regions in Europe is given in the last row.

Table 1. Diabetes national and comparative prevalence rate (%) in 2011

Country	Diabetes national prevalence (%)	Diabetes comparative prevalence (%)	Country	Diabetes national prevalence (%)	Diabetes comparative prevalence (%)
Austria	9.08	6.78	Latvia	9.72	8.05
Belgium	6.63	4.92	Lithuania	9.55	8.04
Bulgaria	9.25	6.87	Luxembourg	5.62	4.65
Cyprus	10.12	9.53	Malta	9.53	6.92

Table 1. Diabetes national and comparative prevalence rate (%) in 2011 (cont.)

Country	Diabetes national prevalence (%)	Diabetes comparative prevalence (%)	Country	Diabetes national prevalence (%)	Diabetes comparative prevalence (%)
Czech Republic	6.92	5.46	Netherlands	7.31	5.42
Denmark	7.51	5.72	Poland	10.57	9.23
Estonia	9.06	7.23	Portugal	12.72	9.82
Finland	8.71	6.01	Romania	9.21	7.89
France	7.30	5.56	Slovakia	6.65	5.87
Germany	8.00	5.51	Slovenia	10.26	7.77
Greece	7.02	5.27	Spain	8.14	6.53
Hungary	7.56	6.19	Sweden	5.71	4.36
Ireland	6.07	5.38	United Kingdom	6.84	5.35
Italy	7.80	5.32	Europe Total	8.6	6.9

Source: IDF, Diabetes Atlas, Fifth Edition, 2011.

We can observe that values of comparative prevalence rate are larger than the ones of national prevalence. It is connected with the fact that ageing of populations is observed in each of the European Union countries and the age structure has a large effect on the relative prevalence. In Poland, the national prevalence rate equals 10.57 per cent. A larger rate is only in Portugal.

In Figure 1, we present the diabetes national and comparative prevalence rate on the basis of data presented by IDF. The comparison of diabetes prevalence is possible only by using comparative prevalence. The countries are ordered with respect to the values of the comparative rate. Poland belongs to the countries with the largest number of people with diabetes. The prevalence rate in Poland is larger than the prevalence rate calculated for all countries in the world (8.5%) and all countries in Europe (6.9%).

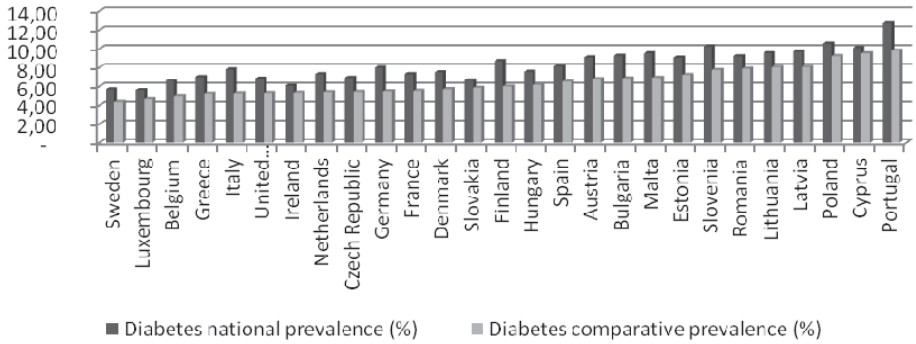

Fig. 1. Diabetes national and comparative prevalence rate (%)

Sources: Own calculations based on IDF, Diabetes Atlas, Fifth Edition, 2011.

The level of prevalence rate among adults with diabetes in the European Union countries does not depend significantly on sex. In all countries in Europe the number of men with diabetes is 1,7 million more than the number of women (15.7 vs. 14.0 million). The influence of age structure on the prevalence rate can be illustated by a proportion of the difference between men and women with diabetes and the number of adults with diabetes. The values are presented in the last column of Table 2. In Poland, this proportion is the samllest (0.23%), in Cyprus it is the largest (38.16%). The parenthetic number means that the number of adult men with diabetes is lower than in case of women.

A verification of the relationship between sex and frequency of diabetes incidence is difficult because of certain factors related to the demografic situation in each country. In many countries the phenomenon of a higher mortality rate for men appears in each age group. We should also take into account the fact that life expectancy is lower for men. Those factors also infuence the proportion in particular age groups between men and women with diabetes.

The most accurate technique to determine the potential influence of sex on diabetes morbidity is a chi-square test for independence. But the knowledge about the precisle number of male and female in each age group is necessary for this tool to be used.

Table 2. The number of diabetes with regards to sex in 2011

Country	Number of adult men with diabetes in 1000's	Number of adult women with diabetes in 1000's	Number of adults with diabetes in 1000's	Proportion of the difference between men and women with diabetes and the number of adults with diabetes (%)
Austria	277.46	293.53	570.99	(2.82)
Belgium	259.85	255.04	514.90	0.93
Bulgaria	294.26	237.29	531.55	10.72
Cyprus	56.53	25.31	81.84	38.16
Czech Republic	288.41	268.98	557.39	3.49
Denmark	159.78	139.69	299.47	6.71
Estonia	45.11	45.60	90.71	(0.54)
Finland	195.47	144.85	340.32	14.87
France	1 733.89	1 503.70	3 237.59	7.11
Germany	2 674.26	2 347.97	5 022.23	6.50
Greece	273.77	329.59	603.36	(9.25)
Hungary	344.11	224.27	568.38	21.08
Ireland	104.27	87.11	191.38	8.96
Italy	1 734.89	1 825.51	3 560.39	(2.55)

Table 2. The number of diabetes with regards to sex in 2011 (cont.)

Country	Number of adult men with diabetes in 1000's	Number of adult women with diabetes in 1000's	Number of adults with diabetes in 1000's	Proportion of the difference between men and women with diabetes and the number of adults with diabetes (%)
Latvia	71.11	95.15	166.26	(14.46)
Lithuania	101.93	133.95	235.88	(13.57)
Luxembourg	12.02	9.08	21.10	13.93
Malta	12.54	17.56	30.11	(16.66)
Netherlands	448.12	433.52	881.63	1.66
Poland	1 532.25	1 525.21	3 057.46	0.23
Portugal	587.18	434.18	1 021.36	14.98
Romania	706.98	799.31	1 506.30	(6.13)
Slovakia	125.73	149.77	275.50	(8.72)
Slovenia	71.84	88.58	160.42	(10.43)
Spain	1 621.95	1 218.16	2 840.11	14.22
Sweden	209.04	177.33	386.37	8.21
United Kingdom	1 790.07	1 273.84	3 063.91	16.85

Source: Own calculations based on IDF, Diabetes Atlas, the Fifth Edition, 2011.

In all countries in Europe the number of adult diabetes in urban areas amounts to 22.5 million, compared to 7.3 million in rural areas. In Table 3, we present numbers and percentage of diabetics with regards to settlement region in 2011. In the EU countries, people still mostly inhabit urban regions which is connected with increasing urbanization. It is responsible for the larger percentage of diabetics in urban areas. On the one hand, we can assume that urbanization is one of the factors influencing the growth of diabetes morbidity rate. But on the other hand, in the EU countries unhealty diet, reduced physical activity, bad habbits, obesity do not depend on settlement only, there are other factors which have more important impact.

Table 3. The number of diabetes with regards settlement region in 2011

Country/territory	Number of adults with diabetes in 1000's, Rural Area	Number of adults with diabetes in 1000's, Urban Area	Percentage of adults with diabetes, Rural Area	Percentage of adults with diabetes, Urban Area
Austria	165.94	405.05	0.29	0.71
Belgium	11.41	503.49	0.02	0.98
Bulgaria	123.67	407.88	0.23	0.77
Cyprus	21.68	60.16	0.26	0.74

Table 3. The number of diabetes with regards settlement region in 2011 (cont.)

Country/territory	Number of adults with diabetes in 1000's, Rural Area	Number of adults with diabetes in 1000's, Urban Area	Percentage of adults with diabetes, Rural Area	Percentage of adults with diabetes, Urban Area
Czech Republic	126.64	430.75	0.23	0.77
Denmark	34.02	265.45	0.11	0.89
Estonia	24.86	65.85	0.27	0.73
Finland	43.86	296.47	0.13	0.87
France	313.52	2 924.07	0.10	0.90
Germany	1 168.38	3 853.85	0.23	0.77
Greece	216.17	387.19	0.36	0.64
Hungary	190.26	378.13	0.33	0.67
Ireland	63.81	127.56	0.33	0.67
Italy	1 008.95	2 551.44	0.28	0.72
Latvia	47.29	118.97	0.28	0.72
Lithuania	68.31	167.58	0.29	0.71
Luxembourg	2.71	18.39	0.13	0.87
Malta	1.35	28.76	0.04	0.96
Netherlands	129.78	751.85	0.15	0.85
Poland	1 385.81	1 671.65	0.45	0.55
Portugal	359.98	661.38	0.35	0.65
Romania	566.59	939.71	0.38	0.62
Slovakia	114.17	161.33	0.41	0.59
Slovenia	75.13	85.29	0.47	0.53
Spain	417.10	2 423.01	0.15	0.85
Sweden	55.31	331.06	0.14	0.86
United Kingdom	549.28	2 514.64	0.18	0.82

Source: Own calculations based on IDF, Diabetes Atlas, Fifth Edition, 2011.

The prevalence rate depends in the largest degree on age. This is connected with the fact that the diagnosis of the type 2 diabetes usually occurs after the age of 40. The data is presented in three age groups (20–39, 40–59 and above 60). In Table 4, we present the structure (numbers and percentages) of adult diabetics with regards to age. On the basis of the frequencies we can observe that the morbidity from diabetes increases with age. The smallest frequency occurs withhin the youngest group, the highest frequency is observed in the oldest age group. The differences lie in the proportions of frequencies. We used the chi-square test of homogenity to determine whether frequencies are distributed identically between population in Poland and populations in the other countries. We tested 26 hypothesies, for each p-value was equal to 0.000. Of course, those

results depends on the size of groups. We conclude that there exist significiant differences between age distrubution in Poland and in the other countries. On the basis of the values of chi-square statistic test (there are the smallest values) we can find countries with diabetics age distribution most similar to the distribution in Poland. Namely, they are Austria, Estonia, Lithuania and Latvia.

Table 4. The stucture of type 2 diabetics with regards to age groups in 2011

Country	Percentage 20–39	Percentage 40–59	Percentage > 59	Number of adults with diabetes in 1000's (20–39)	Number of adults with diabetes in 1000's (40–59)	Number of adults with diabetes in 1000's (> 59)
Austria	0.1018	0.3850	0.5132	32.52	174.00	364.47
Belgium	0.0158	0.2750	0.7092	29.51	177.10	308.29
Bulgaria	0.0424	0.3519	0.6057	23.95	187.91	319.69
Cyprus	0.1048	0.4595	0.4357	10.81	37.61	33.42
Czech Rep.	0.0658	0.2816	0.6527	30.89	202.33	324.18
Denmark	0.0628	0.3760	0.5612	22.07	109.40	168.01
Estonia	0.0865	0.3458	0.5677	8.44	31.52	50.76
Finland	0.0486	0.3140	0.6374	9.25	109.77	221.30
France	0.0501	0.2906	0.6593	118.38	1 303.38	1 815.83
Germany	0.0870	0.3726	0.5405	176.46	1 661.72	3 184.06
Greece	0.0496	0.2638	0.6866	36.94	196.22	370.19
Hungary	0.0647	0.2855	0.6498	46.69	256.27	265.42
Ireland	0.1913	0.3772	0.4315	13.35	74.51	103.52
Italy	0.0309	0.3116	0.6575	82.01	1 026.14	2 452.24
Latvia	0.0860	0.3467	0.5673	14.46	69.34	82.45
Lithuania	0.0872	0.3611	0.5517	20.47	103.29	112.12
Luxembourg	0.0203	0.3081	0.6716	0.85	8.67	11.59
Malta	0.0107	0.3013	0.6880	0.32	9.79	20.00
Netherlands	0.0164	0.2892	0.6944	45.64	288.31	547.68
Poland	0.0958	0.3752	0.5289	438.89	1 309.90	1 308.67
Portugal	0.1168	0.3512	0.5320	78.30	372.61	570.46
Romania	0.0816	0.3281	0.5903	148.86	639.46	717.97
Slovakia	0.0670	0.4595	0.4735	27.64	118.37	129.49
Slovenia	0.0547	0.3432	0.6021	7.14	61.30	91.98
Spain	0.0757	0.2823	0.6420	147.02	1 045.68	1 647.41
Sweden	0.0697	0.3199	0.6104	25.03	141.30	220.04
UK	0.0815	0.3758	0.5427	212.97	1 088.84	1 762.11

Source: Own calculations based on IDF, Diabetes Atlas, Fifth Edition, 2011.

Using ternary graph, projections of numbers of diabetics from Table 4 in two-dimentional space are presented in Figure 2. We can observe that the points which respresent countries create one group of points with the exception of three points, which present the age stuctures in Ireland, Slovakia and Cyprus. The differences are visible in empirical distributions of age in those countries. In Ireland, the youngest group is larger than in the others (19.13%). In Slovakia and Cyprus the middle-age groups (the 40–59) are greater (45.95%), and the oldest age group is smaller than in the remaining countries (47.35% and 43.57%, respectively).

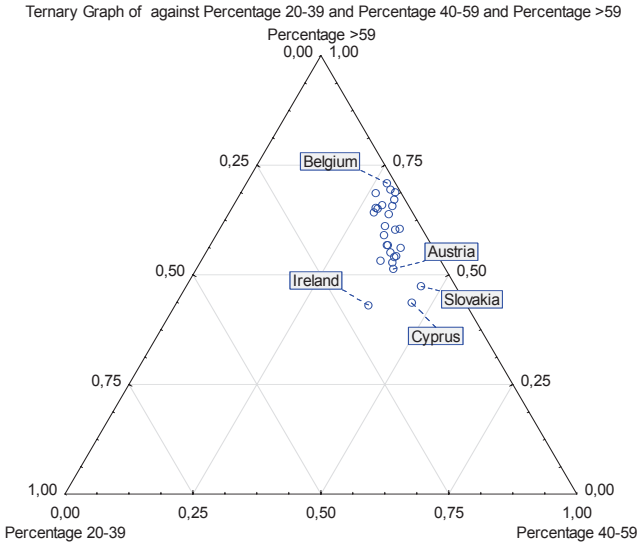

Fig. 2. Ternary graph of age intervals percentage

Sources: Own calculations (Statistica 10.0)

The Impaired Glucose Tolerance impact

The impaired glucose tolerance (IGT) is an asymptomatic condition defined by elevated (though not diabetic) levels of blood glucose two hours after a 75g oral glucose challenge (Diabetes Atlas, Third Edition, 2007). A prevalence of IGT depends on obesity, advancing age and insulin resistance and insulin secretory defect. IGT is recognized as the stage in the transition from normality to diabetes. Although over 30% of people with IGT can return to normal glucose tolerance, IGT is known as a high risk factor of progressing to type 2 diabetes. Therefore, forecasts of type 2 diabetics numbers always take into account the number people of with IGT. The prevalence rate for the world population equals 6.5%.

Because the prevalence of IGT increases with age, we need the comparative prevalence. In Table 5, we present the number of people with IGT, the national and comparative prevalence rate for the EU countries. There are approximately 36.4 million adult people with IGT. To a large extent, abnormal glucose tolerance is a consequence of the relatively old population in the EU countries. In Poland, the IGT rates are the largest in the Europe.

Table 5. The prevalence of IGT in 2011

Country	IGT cases (20–79) in 1000s	IGT national prevalence (%)	IGT comparative prevalence (%)
Austria	573.89	9.13	7.45
Belgium	752.99	9.69	7.80
Bulgaria	126.23	2.20	1.74
Cyprus	52.95	6.55	6.19
Czech Rep.	718.54	8.93	7.50
Denmark	460.60	11.54	10.05
Estonia	93.00	9.29	7.34
Finland	381.71	9.77	6.93
France	4 167.39	9.40	7.66
Germany	5 527.50	8.80	6.31
Greece	779.90	9.07	7.37
Hungary	679.18	9.03	7.44
Ireland	254.55	8.08	7.39
Italy	4 342.57	9.52	7.45
Latvia	192.13	11.24	10.04
Lithuania	274.59	11.12	10.03
Luxembourg	33.00	8.79	7.66
Malta	26.86	8.50	6.85
Netherlands	1 143.34	9.48	7.63
Poland	5 223.87	18.06	16.64
Portugal	1 113.82	13.87	11.40
Romania	1 750.37	10.71	9.76
Slovakia	335.65	8.10	7.29
Slovenia	138.48	8.86	7.23
Spain	2 746.96	7.87	6.95
Sweden	422.32	6.24	5.35
UK	4 119.31	9.19	7.59

Source: IDF, Diabetes Atlas, Fifth Edition, 2011.

In Figure 3, we present the IGT national and comparative prevalence rate on the basis of the data presented by IDF.

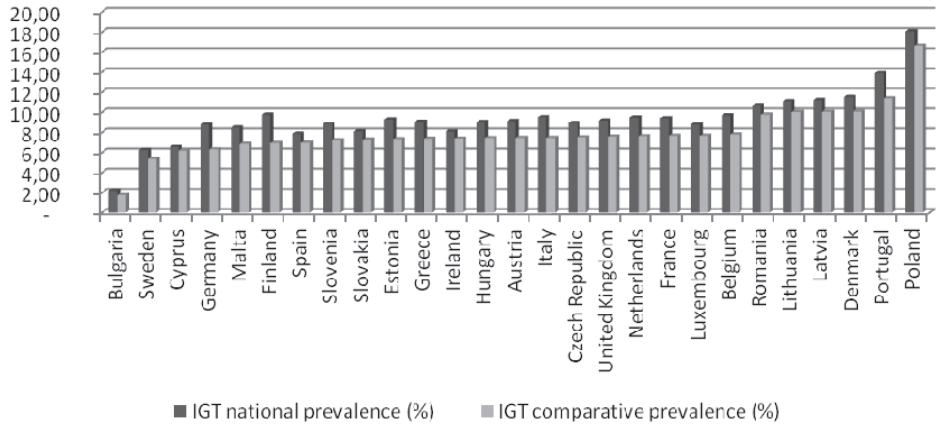

Fig. 3. IGT national and comparative prevalence rate (%)

Sources: Own calculations based on IDF, Diabetes Atlas, Fifth Edition, 2011.

Poland is only the 72nd in terms of the percentage of people with diabetes (on the basis of the comparative prevalence rate). It is the only European country which belongs to the top ten countries with the highest number of people with IGT, though. In Fig. 4, we present the ten top countries in the world with the largest values of IGT prevalence rate. Such a large number of people with IGT in Poland suggests that there will be a very rapid increase in diabetes occurrence in the near future.

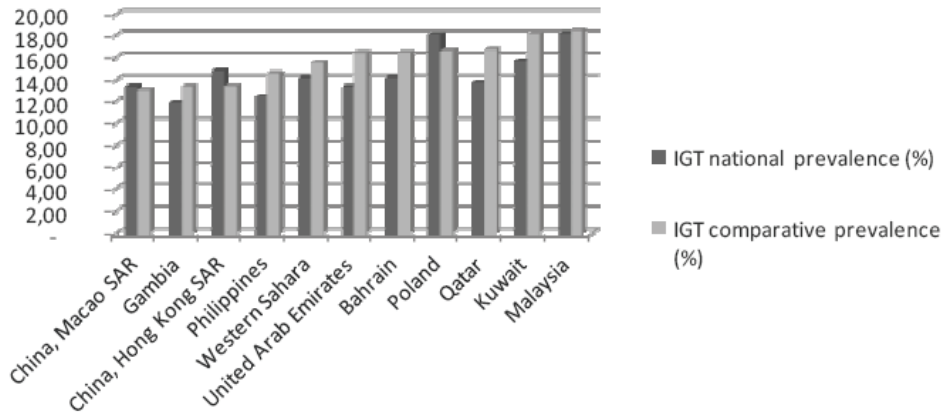

Fig. 4. The ten largest IGT national and comparative prevalence rates (%)

Sources: Own calculations based on IDF, Diabetes Atlas, Fifth Edition, 2011.

The so far testing allows for spotting some dependencies. First of all, we can notice that countries with high IGT national prevalence rate have high mortality due to diabetes. Secondly, there is a relationship between the IGT comparative prevalence rate and diabetes comparative prevalence rate. The high value of one of the indicators entails a high value of the second one. In Table 6, we present the correlation test results.

Table 6. The correlation test results

Dependencies	Value of Pearson correlation coefficient	Value of test statistic	p-value
IGT national prevalence rate vs. diabetes national prevalence rate	0.3903	2.1194	0.04416
IGT national comparative prevalence vs. diabetes comparative prevalence	0.4673	2.6431	0.01398

Source: Own calculations (Statistica 9.0) based on IDF, Diabetes Atlas, Fifth Edition, 2011.

Mortality from diabetes

Health statistics based upon death certification may seriously underestimate mortality from diabetes. It can be so because only a minority of people with diabetes die of a cause uniquely related to diabetic ketoacidosis or hypoglycaemia. However, about 50% of people with diabetes die of cardiovascular disease, and about 15% die of renal failure. Another problem is that only some 30% of deaths worldwide are medically certified. There are differences in the national coding procedures for assigning the underlying cause of death.

We can observe that countries with high diabetes related deaths also have many IGT cases. In Table 7, we present the correlation test result.

Table 7. The correlation test results

Dependencies	Value of Pearson correlation coefficient	Value of test statistic	p-value
IGT cases for adults in 1000's vs. Diabetes related deaths	0.968	19.1802	0.0000

Source: Own calculations (Statistica 9.0) based on IDF, Diabetes Atlas, Fifth Edition, 2011.

The diabetes mortality depends, first of all, on age and sex. In Table 8 and Table 9, we present distribution of death cases of diabetes with respect to age groups separately for male and female. To specify the empirical age distributions, we take into account the data of 2010 because that of 2011 is not available yet.

Table 8. Percentage of deaths in males in 2010

Country	Percentage 20–29	Percentage 30–39	Percentage 40–49	Percentage 50–59	Percentage 60–69	Percentage > 70
Austria	0.0148	0.0231	0.0528	0.1401	0.3368	0.4324
Belgium	0.0006	0.0051	0.0203	0.0961	0.3129	0.5650
Bulgaria	0.0015	0.0133	0.0453	0.1802	0.3909	0.3688
Cyprus	0.0151	0.0322	0.0517	0.1541	0.3738	0.3732
Czech Rep.	0.0093	0.0093	0.0204	0.1171	0.3825	0.4613
Denmark	0.0008	0.0095	0.0411	0.1617	0.4284	0.3585
Estonia	0.0253	0.0456	0.0698	0.1781	0.3252	0.3560
Finland	0.0065	0.0160	0.0326	0.1412	0.3628	0.4408
France	0.0041	0.0117	0.0290	0.1165	0.3141	0.5245
Germany	0.0083	0.0146	0.0478	0.1280	0.3078	0.4936
Greece	0.0051	0.0155	0.0286	0.0904	0.2617	0.5986
Hungary	0.0062	0.0100	0.0324	0.1594	0.3648	0.4274
Ireland	0.0152	0.0315	0.0412	0.1117	0.3220	0.4784
Italy	0.0013	0.0102	0.0275	0.0949	0.3269	0.5393
Latvia	0.0108	0.0500	0.0651	0.1660	0.3329	0.3752
Lithuania	0.0191	0.0277	0.0448	0.1341	0.3110	0.4633
Luxembourg	0.0213	0.0673	0.1017	0.1908	0.3120	0.3070
Malta	0.0008	0.0061	0.0239	0.1032	0.3331	0.5329
Netherlands	0.0006	0.0046	0.0127	0.0880	0.3588	0.5352
Poland	0.0004	0.0035	0.0148	0.0839	0.3424	0.5549
Portugal	0.0136	0.0398	0.0675	0.2096	0.3115	0.3580
Romania	0.0094	0.0200	0.0862	0.1000	0.3342	0.4502
Slovakia	0.0087	0.0288	0.0502	0.1583	0.3015	0.4526
Slovenia	0.0097	0.0203	0.0349	0.1368	0.2728	0.5255
Spain	0.0103	0.0120	0.0326	0.1493	0.3425	0.4532
Sweden	0.0039	0.0208	0.0719	0.2386	0.3683	0.2964
UK	0.0022	0.0179	0.0449	0.1311	0.3254	0.4784

Source: Own calculations based on IDF, Diabetes Atlas, Fourth Edition, 2010.

We can observe that the risk of death increases with age. We used the chi-square test of homogenity to determine whether the frequencies are distributed identically in population of men and women in particular countries. We test 27 hypothesies, for each one p-value equals 0,000. We conclude that the significiant differences exist between age distrubutions in male and female population in a particular country.

Table 9. Percentage of death in females in 2010

Country	Percentage 20–29	Percentage 30–39	Percentage 40–49	Percentage 50–59	Percentage 60–69	Percentage > 70
Austria	0.0078	0.0118	0.0487	0.1398	0.2570	0.5350
Belgium	0.0003	0.0032	0.0204	0.1059	0.2253	0.6450
Bulgaria	0.0008	0.0057	0.0194	0.0831	0.2207	0.6703
Cyprus	0.0026	0.0133	0.0342	0.1081	0.2214	0.6203
Czech Rep.	0.0031	0.0050	0.0190	0.1035	0.2671	0.6023
Denmark	0.0035	0.0118	0.0379	0.1197	0.2744	0.5527
Estonia	0.0020	0.0083	0.0326	0.1298	0.2319	0.5954
Finland	0.0030	0.0068	0.0270	0.1189	0.2619	0.5823
France	0.0038	0.0135	0.0386	0.1413	0.2277	0.5751
Germany	0.0055	0.0093	0.0434	0.1287	0.2271	0.5861
Greece	0.0016	0.0064	0.0181	0.0633	0.1611	0.7495
Hungary	0.0027	0.0054	0.0239	0.1286	0.2516	0.5878
Ireland	0.0219	0.0372	0.0607	0.1384	0.2326	0.5092
Italy	0.0005	0.0053	0.0244	0.0940	0.2331	0.6428
Latvia	0.0011	0.0085	0.0337	0.1321	0.2521	0.5725
Lithuania	0.0106	0.0152	0.0446	0.1496	0.2471	0.5329
Luxembourg	0.0017	0.0127	0.0454	0.1456	0.2413	0.5533
Malta	0.0005	0.0037	0.0214	0.1045	0.2298	0.6401
Netherlands	0.0000	0.0008	0.0131	0.1156	0.3127	0.5578
Poland	0.0002	0.0029	0.0212	0.1132	0.2701	0.5923
Portugal	0.0013	0.0075	0.0315	0.1668	0.2382	0.5548
Romania	0.0051	0.0122	0.0624	0.0945	0.2572	0.5686
Slovakia	0.0039	0.0147	0.0348	0.1239	0.2127	0.6100
Slovenia	0.0035	0.0102	0.0285	0.1131	0.1900	0.6547
Spain	0.0037	0.0056	0.0223	0.1185	0.2326	0.6173
Sweden	0.0016	0.0103	0.0558	0.2241	0.2811	0.4271
UK	0.0017	0.0106	0.0323	0.0972	0.2103	0.6478

Source: Own calculations based on IDF, Diabetes Atlas, Fourth Edition, 2010.

As the test results depended on the sample sizes, we also calculate structure similarity index for men and women in accordance with the following formula $\omega_k = \sum_j \min\left(\omega_{1jk}, \omega_{2jk}\right)$, where ω_{1jk} and ω_{2jk} denote the percentage of men and women, respectively, in *j*th age group in *k* country. In Table 10, we present values of the index for each country.

Table 10. Structure similarity index for population of men and women

Country	Index	Country	Index	Country	Index	Country	Index
Austria	0.8975	Finland	0.8585	Latvia	0.8027	Romania	0.8426
Belgium	0.9101	France	0.9132	Lithuania	0.7537	Slovakia	0.8359
Bulgaria	0.6985	Germany	0.9068	Luxembourg	0.8915	Slovenia	0.8694
Cyprus	0.7528	Greece	0.8492	Malta	0.9495	Spain	0.8306
Czech Republic	0.8590	Hungary	0.8396	Netherlands	0.9270	Sweden	0.8388
Denmark	0.8008	Ireland	0.9106	Poland	0.8032	United Kingdom	0.9279
Estonia	0.7607	Italy	0.8965	Portugal	0.8816		

Source: Own calculations based on IDF, Diabetes Atlas, Fourth Edition, 2010.

The smallest value is for Bulgaria (0.6985), it means that the distributions of age are similar in the smallest degree. The largest is for Malta (0.9495), the distrubions in population of men and women are similar in the highest degree.

Estimation of diabetes cost

An estimation of diabetes cost belongs to the most important problems in health economics research. IDF has estimated in 2011 that the diabetes expenditures on all the world posed 11% of total healthcare expenditures in adults (Diabetes Atlas, Fifth Edition, 2011). The calculation of this cost requires estimation besides diabetes prevalence rate also diabetes expenditures ratio and total health expenditures. Diabetes expenditures ratio is the proportion of all medical care expenditures for a person with diabetes to all medical care expenditures for a person without diabetes. Denote by d_{ij} and z_{ij} respectively all medical expenditures for a person with diabetes and all medical care expenditures for a person without diabetes for *i*th and *j*th group according with sex and age. The diabetes expenditures ratio can be written as $R_{ij} = \frac{d_{ij}}{z_{ij}}$ (for i=1,2 and j=1,2,…,6). The expenditure ratio is key parameter in the conversion of per capita health spending caused by diabetes. Basis on empirical analysis and the current evidence we can observe that it is limited and takes the values from the interval between 2 to 3. In order to isolate the part of expenditures only for diabetes the ratio of surplus of expenditures for diabetes for all expenditures is needed to be calculated. It can be written as $\frac{d_{ij} - z_{ij}}{z_{ij}} = R_{ij} - 1$. Taking into account the prevalence rate (P_{ij}), the participation of medical care only for diabetes in all medical care expenditures

for each group has the following form $\frac{P_{ij}\left(d_{ij}-z_{ij}\right)}{P_{ij}\left(d_{ij}-z_{ij}\right)+z_{ij}}=\frac{P_{ij}\left(R_{ij}-1\right)}{P_{ij}\left(R_{ij}-1\right)+1}$. The next measure, which we need, is the total health expenditures in each country. Total health expenditures, according with WHO definition, are all expenditures for public health, programs, water supply, hygiene activities, nutritional support activities, education, training research. The total expenditure of care for diabetes in each country is calculated by using the formula

$$D=C\cdot\sum_{i=1}^{2}\sum_{j=1}^{6}\left(\frac{N_{ij}}{N}\right)\frac{P_{ij}\left(R_{ij}-1\right)}{P_{ij}\left(R_{ij}-1\right)+1}, \tag{1}$$

where:
C – the estimated budget for all healthcare in the country,
N_{ij} – the total population in each sex and age group,
N – the total adult population of country.

The information about the all health expenditures, the structures of people according to age and sex and the participation of the diabetes cost in all medical costs are used. Expenditures are calculated using the formula (1) by assumption that index R_{ij} for each group equals 2 and 3. It demarcates the interval of possible expenditures. The dimension of expenditures depends on a size of population in each country. That is why a better measure to comparison is a mean expenditures per capita. In Table 12, we present the mean expenditures by assumption that the expenditures rate equals two. Expenditures are expressed in USD.

Table 12. The mean expenditures per capita of care for diabetes in 2011

Country	Mean diabetes-related expenditure per person with diabetes (USD)	Country	Mean diabetes-related expenditure per person with diabetes (USD)
Austria	5 641.00	Latvia	1 101.00
Belgium	5 862.00	Lithuania	1 093.00
Bulgaria	532.00	Luxembourg	9 341.00
Cyprus	2 162.00	Malta	1 611.00
Czech Rep.	1 690.00	Netherlands	6 119.00
Denmark	6 963.00	Poland	1 143.00
Estonia	1 222.00	Portugal	2 522.00
Finland	4 976.00	Romania	607.00
France	5 632.00	Slovakia	1 764.00
Germany	5 098.00	Slovenia	2 461.00
Greece	3 419.00	Spain	3 319.00

Table 12. The mean expenditures per capita of care for diabetes in 2011 (cont.)

Country	Mean diabetes-related expenditure per person with diabetes (USD)	Country	Mean diabetes-related expenditure per person with diabetes (USD)
Hungary	1 274.00	Sweden	5 442.00
Ireland	6 629.00	UK	4 267.00
Italy	3 541.00		

Source: IDF, Diabetes Atlas, Fifth Edition, 2011.

In Figure 5, the order mean expenditures per capita are showed. The highest expenditures are in Luxembourg, the lowest in Bulgaria. Poland belongs to group of countries with the smallest mean expenditures per capita. This result is very disturbing because of the upward trend in the incidence of diabetes in Poland.

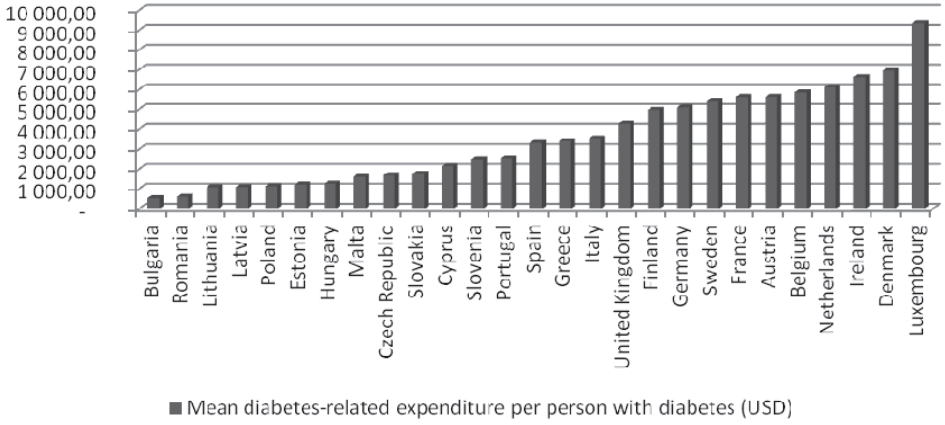

Fig. 5. The mean expenditures per capita of care for diabetes in 2011 (USD)

Sources: Own calculations based on IDF, Diabetes Atlas, Fifth Edition, 2011.

Conclusions

A prevalence rate and expenditure associated with diabetes are difficult to determine precisely. The reasons for this are many. First of all, many cases of diabetes are undiagnosed. This means that the incidence is underestimated. The second reason is that, datasets concerning prevalence and costs are neglected. None of the governments collect diabetes spending accurately. It is not an easy task to take into consideration all direct medical cost for treating diabetes as well as other medical cost, for instance those cost which may not be associated with or caused by diabetes, but their extent can be exacerbated by it. As a result, the true impact of diabetes and its associated complications are likely to be underes-

timated or altogether unmeasured in many countries. That is why comparisons between countries are difficult. Comparisons over time are often impossible, because the organizations carrying out tests often change test conditions, for instance a range of research, the estimation of certain measures and indicators.

Taking into account all the studies and forecasts, both diabetes prevalence and spending appear to be increasing in all countries. Poland is a country particularly affected by the problem of diabetes. According to forecasts the number of diabetics will rapidly increase. The reasons are the aging population and a large percentage of people with IGT.

In order to accurately estimate the number of diabetics and health spending, research should be carried out at the micro level. Without this it will be impossible to follow trends and changes in particular countries and regions.

References:

1. IDF Diabetes Atlas, Third Edition, 2007 (website: www.idf.org)
2. IDF Diabetes Atlas, Fourth Edition 2010 (website: www.idf.org)
3. IDF Diabetes Atlas, Fifth Edition 2011 (website: www.idf.org)

Zachorowalność, śmiertelność i wydatki na leczenie cukrzycy w Polsce i innych krajach Unii Europejskiej

Synopsis: Artykuł przedstawia dane statystyczne dotyczące rozpowszechnienia cukrzycy i upośledzonej tolerancji glukozy, śmiertelności spowodowanej cukrzycą w podziale na płeć i przedziały wieku, oraz wskaźnika wydatków na leczenie cukrzycy. Porównywane są kraje należące do Unii Europejskiej ze szczególnym zwróceniem uwagi na Polskę. Wyprowadzone są wnioski dotyczące rosnącego trendu problemów wywołanych cukrzycą we współczesnych społeczeństwach.
Słowa kluczowe: cukrzyca, upośledzona tolerancja glukozy, współczynnik występowania cukrzycy, śmiertelność spowodowana cukrzycą, wskaźnika wydatków na leczenie cukrzycy, rosnący trend problemów wywołanych cukrzycą