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Analyses of hospitalization of diabetes mellitus patients in Poland by gender, age and place of residence

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Abstract

Aim. The purpose of this study was to analyze the hospitalization of diabetes mellitus patients in Polish hospitals in 2005-2009.

Materials and Methods. Data was taken from a nationwide database, kept at the National Institute of Public Health – National Institute of Hygiene in Warsaw. Data gathered for this work related to patients whose main cause of hospitalization was diabetes.

Results. In the period of five years the number of diabetes-caused hospitalizations increased by nearly 22% – from 172.2 per 100 thousand in 2005 to 209.9 per 100 thousand in 2009. Hospital treatment covered mainly patients suffering from type 2 diabetes (116.4 per 100 thousand in 2009), as well as type 1 diabetes (87.6 per 100 thousand in 2009). Patients under 39 years of age were more often hospitalized because of type 1 diabetes, whereas in the older age groups patients were more often treated in hospitals for type 2 diabetes. Generally, in both types of the disease, older patients required hospitalizations more often than the younger ones. Cardiovascular diseases were the most reported co-morbidity in both types of the disease. In 2005-2009 the hospital mortality rate decreased with regard to both types of diabetes and an average length of hospital stay decreased by one day, reaching 8.1 days in 2009.

Conclusion. It must be emphasized that the growing epidemic of diabetes and its complications are an important challenge to society. The percentage of people hospitalized due to diabetes is increasing every year and consumes significant resources dedicated to health care. Early diagnosis and appropriate treatment of diabetes are imperative, as well as reducing the disparities in access to medical care (ambulatory and stationary) for town and country residences.

Key words

diabetes mellitus, hospitalization, co-existing diseases, fatality rate, urban, rural

The World Health Organization lists diabetes among the top four non- communicable diseases (together with cardiovascular diseases, cancers, chronic respiratory diseases) that represent a leading threat to human health and development [1]. These four diseases are responsible for an estimated 60% of all deaths globally, and diabetes alone may even cause one in five deaths globally, according to the analysis by Roglic et al. [2]. Studies by Wild et al. [3] showed that approximately 171 million people worldwide suffered from diabetes in 2000 and this number will double by 2030. An even less optimistic prognosis can be found on the web pages of the International Diabetes Federation (IDF) [4]. Data published in the IDF Diabetes Atlas indicate that 285 million adults are already sick (6.6% of the adult population) and that this number may even reach 438 million by 2030. In Poland, diabetes is also a serious health problem. According to IDF data, 7.6% of Polish people aged 20-79 suffer from diabetes. An increased incidence of both type 1 and type 2 diabetes is noted in adults and in children [5, 6, 7, 8, 9]. Unrecognized diabetes remains an important problem. Studies conducted in Germany and the USA, among others, indicate that even 40-50% of cases of diabetes remain unrecognized [10, 11]. People with undiagnosed diabetes, as well as those suffering from diagnosed diabetes, face a 2.5-3 times higher risk of death than people with normoglycaemia [12]. Late diagnosis of diabetes or ineffective treatment may lead to many serious complications resulting in increased frequency of hospitalization, disabilities and premature deaths [13, 14, 15]. Studies conducted in some countries on diabetes diagnosis and treatment costs indicated the importance of the problem in many societies [16, 17, 18]. Hospitalization costs due to co-morbidity lead to increase in the cost of diabetes diagnosis and treatment.

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MATERIAL AND METHODS

Data on patients hospitalized in Poland because of diabetes were taken from a nationwide database, kept since 1979 in the Centre for Monitoring and Analyses of Population Health in the National Institute of Public Health – National Institute of Hygiene in Warsaw. This database contains information under the Statistical Research Programme of Public Statistics. Data comes from the great majority of general hospitals in Poland (90.8% in 2005, 92.4% in 2007, 90.3% in 2009). The analyzed data relates to patients for whom the main cause of

hospitalization was diabetes, as classified in the International Classification of Diseases and Health Problems ICD-10: E-10 (insulin-dependent diabetes mellitus), E-11 (non-insulin-dependent diabetes mellitus), E-12 (malnutrition-related diabetes mellitus), E13 (other specified diabetes mellitus) and E14 (unspecified diabetes mellitus) [19].

The hospitalization rates were used to evaluate the 'hospitalized' incidence of diabetes (number of hospitalizations due to diabetes per year by analyzed unit of population). In-hospital fatality was calculated as the percentage of patients deceased due to diabetes among all those hospitalized.

RESULTS

The conducted analyses showed that the percentage of patients treated in hospitals because of diabetes amounted to 1.15 % of all hospitalizations in 2009, and was significantly higher than in 2005 (1.01%) and in 2007 (1.04%) respectively.

In five years, the number of diabetes-caused hospitalizations grew by almost 22% (from 172.2 per 100 thousand in 2005 to 209.7 per 100 thousand in 2009), with a similar rate in men (by 22.2%) and women (21.4%) (Tab. 1). Hospitals mainly admitted patients suffering from type 2 diabetes (116.3 per 100 thousand in 2009) and type 1 diabetes (87.5 per 100 thousand in 2009). In the period under analysis, the frequency of hospitalization due to type 1 diabetes increased by 25.7%, and the frequency of hospitalization due to type 2 diabetes rose by 17%.

It should be stressed that the percentage of patients admitted electively decreased in the analyzed years from 40% in 2005 to 31% in 2009, while the emergency admissions increased from 62% percent in 2005 to 69% in 2009.

Analysis of the age structure of patients hospitalized due to diabetes showed that patients under 39 years of age were more often hospitalized for type 1 diabetes, and the older patients more frequently treated in hospitals for type 2 diabetes (Tab. 2, 3). Generally, however, in both types of disease, patients from the older age groups were more frequently admitted to hospitals than younger patients. A strong increase of hospitalizations due to type 1 diabetes was noted in men from the age group 50-59 and in women in the age group 60-69 years. In the case of type 2 diabetes, a sharp increase of the hospitalization frequency was visible in both men and women from the 50-59 age group.

The biggest increase in hospitalization due to both types of diabetes was noted in children and adolescents. During five years, in the 0-9 age group the hospitalization frequency due to type 1 diabetes rose by 42%, whereas in the 10-19 age group the hospitalization frequency due to type 1 diabetes was higher by 57.5 %, and due to type 2 diabetes – by 29.4%.

Table I. Hospitalization trends in different types of diabetes mellitus in 2005, 2007 and 2009. Hospitalization rates per 100 thousand inhabitants

Type of diabetes mellitus	**2005 –** N=65714			**2007 –** N=70385			**2009 –** N=80013			**Percentage difference* 2005-2009**		
	Overall	M	F	Overall	M	F	Overall	M	F	Overall	M	F
Overall	172.2	170.2	174.0	184.6	183.4	185.9	209.7	208.0	211.3	21.8	22.2	21.4
E10	69.6	74.3	65.2	75.9	80.8	71.4	87.5	93.0	82.5	25.7	25.2	26.5
E11	99.4	91.9	106.5	104.6	97.6	111.2	116.3	108.0	124.0	17.0	17.5	16.4
E12	0.3	0.3	0.3	0.2	0.2	0.3	0.2	0.2	0.2	-33.4	-33.4	-33.4
E13	2.0	2.7	1.2	2.9	3.7	2.2	3.2	4.0	2.5	60.0	48.0	108.0
E14	0.9	1.0	0.8	1.0	1.1	0.8	2.5	2.8	2.2	177.8	180.0	175.0

M – males
F – females
*no sign indicates an increase, minus sign (-) indicates decrease
Codes of diabetes mellitus types by the International Classification of Diseases and Related Health Problems ICD-10:
E10 – insulin-dependent diabetes mellitus (type 1 diabetes mellitus)
E11 – non-insulin-dependent diabetes mellitus (type 2 diabetes mellitus)
E12 – malnutrition-related diabetes mellitus
E13 – other specified diabetes mellitus
E14 – unspecified diabetes mellitus

Table 2. Hospitalization trends in type 1 diabetes mellitus (E10) by age and gender (2005-2009). Hospitalization rate per 100 thousand inhabitants

Age groups (in years)	**2005 –** N=26546			**2007 –** N=28938			**2009 –** N=33402			**Percentage difference* 2005-2009**		
	Overall	M	F	Overall	M	F	Overall	M	F	Overall	M	F
Overall	**69.6**	74.3	65.2	**75.9**	80.8	71.4	**87.5**	93.0	82.5	**25.7**	25.2	26.5
0-9	**35.0**	34.6	35.3	**42.3**	39.8	45.0	**49.7**	47.6	51.9	**42.0**	37.5	47.4
10-19	**66.7**	65.5	68.0	**82.5**	80.3	84.6	**105.1**	102.0	108.3	**57.5**	55.7	59.3
20-29	**30.4**	32.4	28.2	**33.0**	34.7	31.3	**35.6**	34.6	36.7	**17.1**	6.7	30.1
30-39	**36.8**	48.6	24.7	**39.2**	50.6	27.6	**41.5**	50.1	32.7	**12.8**	3.1	32.4
40-49	**50.6**	69.7	31.7	**53.2**	72.6	33.8	**55.7**	74.3	37.2	**10.1**	6.6	17.4
50-59	**88.3**	113.9	64.8	**88.3**	116.1	62.8	**97.8**	129.9	68.1	**10.8**	14.0	5.1
60-69	**126.6**	143.2	113.6	**142.0**	159.2	128.4	**164.4**	190.2	143.5	**29.9**	32.8	26.3
70-79	**188.9**	179.8	194.5	**193.1**	185.5	197.9	**213.0**	217.6	210.1	**12.8**	21.0	8.0
80+	**169.3**	151.8	176.5	**170.6**	153.9	177.4	**219.1**	221.1	218.2	**29.4**	45.7	23.6

M – males
F – females
*no sign indicates an increase, minus sign (-) indicates decease

Table 3. Hospitalization trends in type 2 diabetes mellitus (E11) by age and gender (2005-2009). Hospitalization rate per 100 thousand inhabitants

Age groups (in years)	**2005 –** N=37947			**2007–** N=39880			**2009–** N=44361			**Percentage difference* 2005-2009**		
	Overall	M	F	Overall	M	F	Overall	M	F	Overall	M	F
Overall	**99.4**	91.9	106.5	**104.6**	97.6	111.2	**116.3**	108.0	124.0	**17.0**	17.5	16.4
0-9	**0.3**	0.3	0.4	**0.4**	0.4	0.3	**0.6**	0.7	0.5	**100.0**	133.3	25.0
10-19	**1.7**	1.4	1.9	**1.6**	1.5	1.6	**2.2**	1.8	2.7	**29.4**	28.6	42.1
20-29	**3.8**	4.5	3.0	**4.5**	5.0	4.1	**3.9**	4.0	3.8	**2.6**	-11.1	26.7
30-39	**15.6**	21.6	9.3	**15.3**	22.2	8.3	**14.3**	20.2	8.4	**-8.3**	-6.5	-9.7
40-49	**59.6**	81.2	38.2	**59.0**	82.3	35.8	**56.2**	76.9	35.5	**-5.7**	-5.3	-7.1
50-59	**167.2**	206.5	131.0	**162.4**	203.8	124.3	**166.4**	209.3	126.8	**-4.5**	1.4	-3.2
60-69	**284.8**	286.9	283.0	**293.9**	307.2	283.4	**329.5**	350.2	312.8	**15.7**	22.1	10.5
70-79	**441.0**	373.4	482.7	**455.7**	393.3	494.7	**494.0**	429.6	534.5	**12.0**	15.1	10.7
80+	**486.8**	435.2	508.1	**504.4**	421.4	538.7	**573.9**	522.6	595.6	**17.9**	20.1	17.2

M – males; F – females. *no sign indicates an increase, minus sign (-) indicates decrease

Table 4. Frequency of predominant co-existing diseases among hospitalized patients with diabetes mellitus in 2009 by gender and type of diabetes

Co-existing diseases	**Type 1 diabetes**			**Type 2 diabetes**		
	Overall	**M**	**F**	**Overall**	**M**	**F**
Diseases of the circulatory system (I00-I99)	**43.0**	40.7	45.3	**58.7**	55.7	61.1
Endocrine, nutritional and metabolic diseases (E00-E90)	**13.5**	12.0	15.0	**11.0**	11.4	10.6
Diseases of the skin and subcutaneous tissue (L00-L99)	**10.9**	13.4	8.3	**4.3**	5.6	3.4
Diseases of the genitourinary system (N00-N99)	**7.5**	6.6	8.4	**7.4**	7.1	7.7
Diseases of the digestive system (K00-K93)	**6.4**	8.0	4.8	**4.8**	5.8	4.0
Diseases of the respiratory system (J00-J99)	**4.9**	5.3	4.6	**4.4**	4.8	4.1
Diseases of the eye and adnexa (H00-H59)	**3.4**	3.1	3.7	**0.8**	0.9	0.8
Other diseases	**10.4**	10.9	9.9	**8.6**	8.7	8.3
Persons with at least one coexisting disease	**53.4**	**52.7**	**54.2**	**75.2**	**73.4**	**76.7**

M – males; F – females
Groups of diseases and their codes by the International Classification of Diseases and Related Health Problems ICD-10

Table 4 presents the incidence of co-morbidities in diabetic patients. Co-morbidities were more frequent in patients hospitalized due to type 2 diabetes (75.2%) than in patients treated for type 1 diabetes (53.4%). In both types of diabetic patients, cardiovascular diseases (CVDs) were the predominant co-morbidity. CVDs were diagnosed in 58.7% of patients hospitalized due to type 2 diabetes and in 43% of patients treated for type 1 diabetes. Other co-morbidities were much less frequent in patients suffering from both types of diabetes.

Table 5 presents in-hospital fatality among patients with type 1 and 2 diabetes in 2005-2009. The five-year analyses showed a decrease in number of deaths in both types of diabetes. Nevertheless, in 2009, 1.6% of men and 2% of women hospitalized because of type 1 diabetes died in hospitals. In-hospital deaths were also noted in 2% of men and 2.4% of women with type 2 diabetes. In both types of the disease the percentage of deaths rose with patients' age.

During the five analyzed years the duration of hospitalization by patients treated for diabetes decreased by one day to 8.1 days in 2009 (Tab. 6). Gender did not significantly influence the length of stay in hospital. It was also noted that hospitalizations were the shortest in the case of young patients and increased with patients' age.

Table 5. Hospital fatality rates (%) due to type 1 and type 2 diabetes mellitus by age and gender (2005-2009)

Age groups (in years)	**Type 1 diabetes mellitus**						**Type 2 diabetes mellitus**					
	2005		**2007**		**2009**		**2005**		**2007**		**2009**	
	M	F	M	F	M	F	M	F	M	F	M	F
Overall	2.3	2.7	2.0	2.5	1.6	2.0	2.2	3.0	2.1	2.7	2.0	2.4
0-9	0	0	0	0.1	0	0	0	0	0	0	0	0
10-19	0	0.1	0	0	0	0	0	0	0	0	0	0
20-29	0.5	0.2	0.2	0	0	0.1	0	1.1	0	0.8	0	0
30-39	1.0	0.6	1.2	0.6	0.6	0.1	0.5	0.4	0.7	0	0	0.4
40-49	2.2	1.7	1.3	0.8	1.0	0.7	1.2	2.1	0.6	0.2	0.5	0.2
50-59	2.0	2.0	1.8	0.9	1.2	1.1	1.0	1.2	0.9	0.8	0.8	0.8
60-69	5.4	5.2	2.9	2.0	2.6	1.3	3.3	2.7	1.9	1.3	1.4	1.1
70-79	4.3	4.6	4.8	4.7	4.1	3.6	3.2	4.2	3.7	2.8	3.5	2.5
80+	2.9	4.3	8.6	9.6	6.2	7.6	3.2	3.0	6.7	6.3	6.3	5.6

M – males; F – females

Table 6. Average length of stay in hospital (in days) by age groups, among diabetes mellitus patients (2005-2009)

Age groups (in years)	2005						2007						2009					
	Overall		M		F		Overall		M		F		Overall		M		F	
	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD	**X**	**SD**
Overall	**9.1**	**8.9**	**9.1**	**9.4**	**9.3**	**9.5**	**8.6**	**9.6**	**5.2**	**5.4**	**6.1**	**6.3**	**8.1**	**7.9**	**8.1**	**7.8**	**8.2**	**8.1**
0-9	**6.9**	**6.3**	6.6	9.5	6.4	6.3	**5.7**	**5.9**	5.2	5.4	6.1	6.3	**5.2**	**5.3**	5.1	5.4	**5.2**	**5.1**
10-19	**6.4**	**5.5**	6.0	5.2	6.2	5.6	**5.2**	**5.0**	5.1	5.0	5.3	5.1	**4.9**	**4.5**	4.8	4.4	**5.0**	**4.6**
20-29	**6.9**	**4.7**	6.9	4.6	6.9	4.8	**6.7**	**4.3**	6.7	4.2	6.7	4.4	**6.3**	**4.1**	6.5	4.2	**6.2**	**4.0**
30-39	**7.9**	**7.0**	7.8	5.5	8.1	9.3	**7.5**	**9.2**	7.6	10.4	7.3	5.8	**6.9**	**5.2**	7.0	5.3	**6.8**	**4.9**
40-49	**8.4**	**7.4**	8.5	7.9	8.6	7.3	**8.2**	**8.9**	8.2	8.7	8.2	9.3	**7.6**	**6.7**	7.7	7.0	**7.4**	**5.9**
50-59	**8.9**	**9.0**	9.1	9.4	8.9	9.1	**8.7**	**11.2**	8.6	8.3	8.8	14.7	**8.1**	**8.3**	8.2	7.9	**8.1**	**9.0**
60-69	**9.6**	**9.6**	10.4	11.5	9.5	9.3	**9.3**	**9.3**	9.5	9.3	9.0	9.2	**8.7**	**8.4**	8.9	8.8	**8.4**	**8.0**
70-79	**10.0**	**9.7**	10.5	10.6	10.2	10.5	**9.5**	**9.8**	9.9	10.4	9.3	9.4	**8.9**	**7.8**	9.1	8.2	**8.8**	**7.5**
80+	**9.9**	**9.8**	9.8	9.4	10.2	10.4	**9.5**	**10.8**	9.2	8.8	9.6	11.3	**9.3**	**9.9**	9.1	8.4	**9.3**	**10.4**

M – males; F – females; X – Mean; SD – Standard Deviation

Table 7. Hospitalization trends in type 1 (E10) and type 2 (E11) diabetes mellitus by place of residence (2005-2009). Hospitalization rates per 100 thousand inhabitants

Type of diabetes mellitus	2005			2007			2009			Percentage difference* 2005-2009		
	Overall	M	F	Overall	M	F	Overall	M	F	Overall	M	F
						URBAN						
E10	70.9	78.8	63.9	77.7	85.7	70.5	91.8	100.9	83.6	29.4	28.1	30.8
E11	97.4	95.5	99.1	104.2	102.9	105.2	120.3	116.9	123.4	23.5	22.4	24.5
						RURAL						
	Overall	M	F	Overall	M	F	Overall	M	F	Overall	M	F
E10	64.7	64.7	64.7	73.3	73.5	73.1	80.9	81.3	80.6	25.0	25.7	24.6
E11	98.7	82.3	115.0	105.7	89.7	121.6	109.8	94.7	124.8	11.3	15.1	8.5

M – males; F – females; *no sign indicates an increase, minus sign (-) indicates decrease

Codes of diabetes mellitus types by the International Classification of Diseases and Related Health Problems ICD-10:
E10 – insulin-dependent diabetes mellitus (type 1 diabetes mellitus)
E11 – non-insulin-dependent diabetes mellitus (type 2 diabetes mellitus)

Analysis of hospitalizations due to diabetes mellitus (type 1 and type 2) in 2005-2009 showed a significant increase in the number of patients, both among people from the urban and from rural areas (Tab. 7). In type 1 diabetes, the increase of hospitalization for urban residents was 29.4% and 25% for the inhabitants of rural areas. More spectacular differences were observed for the patients hospitalized with type 2 diabetes: the hospitalization rate increased by 23.5% for urban residents and 11.3% for rural residents. In the analyzed period, men from the urban areas were more often admitted to hospitals in a comparison to men living in rural areas. However, among women this trend was reversed. Generally, women from rural areas were more frequently hospitalized due to diabetes.

DISCUSSION

It can be assumed that an increase of hospitalizations caused by diabetes observed in this study, affecting nearly 210 people per 100 thousand inhabitants in 2009, is a consequence of an increasing prevalence of diabetes in Poland, a phenomenon that has been noted in recent years [20, 21]. According to the estimations of the Ministry of Health the present rate of diabetes morbidity amounts to 5-6% [22], lower than the rate cited by the International Diabetes Federation (7.6%) [4]. Probably, the actual incidence of diabetes will be known after the finalization of the Diabetes Register (covering adult patients) and the Developmental Age Register (covering children and adolescents), which has been under implementation since 2009 within the 'Programme of Diabetes Prevention and Treatment in Poland' [22].

Data from Polish Center for Information Systems in Health Care show that in Poland there are 304 in-patient diabetes wards and 2,110 out-patient diabetic clinics. However, studies conducted in Poland within the framework of the 'PolDiab Programme' in 2005 found that over half of the diabetic patients remained under care carried out by primary care physicians or family doctors, and 22% under the care of specialist at a diabetes clinic. Other patients contacted the specialist in diabetology at least once a year. In order to improve care for patients suffering with diabetes, in 2008 the National Health Fund (insurance) under annual contracts (capitation system) allowed GPs and family doctors to care for patients with diabetes.

In 2005-2009, the frequency of diabetes-caused hospitalization among young Polish patients (0-29) increased. A similar situation has been observed in recent years in American young adults and children [23]. Nevertheless, data presented by Wang et al. [24] for the period 1998-2006 indicate, differently from Poland, a decreased frequency of diabetes-caused hospitalizations in the American adult population.

The authors link this decrease to an improved quality of primary health care in the USA. Hospitalization of patients suffering from uncontrolled diabetes, which represents 32% of all diabetic patients admitted to hospitals in the USA in 2004, still remains a problem [25]. According to Kim, the hospitalization rate in the USA could be lower if patients with uncontrolled diabetes, requiring only emergency services, could receive out-patient care instead of hospitalization.

Approximately 98% of all patients hospitalized in Poland due to diabetes were those diagnosed with type 1 and 2 diabetes. However, the structure of hospitalizations related to either type of diabetes differed considerably from the prevalence of those diseases in the general population. Generally, type 2 diabetes prevails in all diabetic patients (85-90% of all cases) [4], but those suffering from type 2 diabetes represents 56% of all Polish hospitalized patients. Patients with type 1 diabetes represents 42% of hospitalized diabetic patients in Poland. It is important to note that in the five-year analysis the number of patients hospitalized because of type 1 diabetes increased more than the number of patients treated for type 2 diabetes. The reasons for this phenomenon are ambiguous. Type 1 diabetes is related to irreversible damage of pancreatic beta cells caused by the autoimmunological process, and affects mainly young people [26, 27]. Recent studies show a big increase in the incidence of type 1 diabetes in children and adolescents [8, 9, 28, 29]. Changes in the environment, an early introduction of cows' milk to childrens' diet and enteroviral infections are listed among many hypothetical reasons for this upward trend [30, 31]. Studies conducted in Poland by Jaworska et al. [32], and the PolDiab Programme showed poor quality of care for patients with diabetes, especially those with type 1 diabetes, which may also affect the increase in hospitalization among these patients [33].

Data from the last few decades point to a significant growth in the number of people suffering from type 2 diabetes [1]. One of the reasons for this diabetes epidemic is linked to the problem in many societies of obesity and increase in the number of people classed as overweight. This process has lasted for decades [34, 35]. Abdominal obesity, related to a substantial accumulation of fat tissue, mostly around the abdomen, is seen as one of the main factors which foster the development of diabetes [36]. Studies by Mokdad et al. [37] demonstrated that people with Body Mass Index (BMI) above 40 are seven times more likely to develop diabetes than people with a correct BMI. A sharp increase of both obesity and type 2 diabetes is noted in young people [38]. This might have an impact on the more frequent diabetes-caused hospitalizations of children and adolescents noted in 2005-2009. However, Spanish studies have reported that the frequency of hospitalizations due to diabetes is higher in adults than children, and increases with age [39].

Long-term hyperglycemia results in many complications, such as micro- and macroangiopathies [4, 40]. Complications occurred less often in patients hospitalized due to type 1 diabetes (53%) than in those hospitalized due to type 2 diabetes (75%). It can be assumed that in type 2 diabetes, hyperglycemia is diagnosed through routine ambulatory examinations or tests carried out on patients during admission to hospital, when complications are often already seriously advanced.

The presented study analyses show that cardiovascular diseases are predominant co-morbidities noted in patients treated for diabetes. These diseases are considered the major cause of premature death of diabetic patients [41]. The occurrence of cardiovascular diseases in diabetic patients increases significantly both the frequency and duration of their hospitalization, as well as the cost of treatment [42]. Moreover, according to studies by Bhansali [43], patients hospitalized because of diabetes died much more often of coronary artery diseases, infections, and chronic renal failure in comparison to the general population of the hospitalized patients.

The five-year analysis of diabetes-related fatality in Poland showed a decline in the deaths of men and women. Reports from other countries indicate that despite an increase in prevalence of diabetes, a clear decline of diabetes-related mortality has been noted in the last few decades [44, 45]. This decline, however, is smaller in the diabetic population than in people without diabetes [41]. The diabetes-related in-hospital fatality ratio continues to grow with age and is higher in women than men.

In Polish hospitals, an average length of stay for diabetic patients decreased in 2005-2009 from 9.1 to 8.1 days. The shortening of hospitalizations is in line with a general tendency of limiting health care costs and improvement of medical technologies. According to the CODIP study from 2002, the overall direct costs of treating type 2 diabetes constituted 8.08% of all health care costs in Poland. The authors showed that the costs of hospitalization for diabetic patients amount to 29.6% of all direct costs incurred in Poland [46]. These costs are lower than in the USA, where they even reach half of all medical costs related to the treatment of diabetes. It is worth emphasizing that the vast majority of these costs are generated not by the treatment of the diabetes itself, but by the treatment of diabetes-related complications [47, 48]. Pagano et al. [48] demonstrated in their studies that complications such as macroangiopathy nearly doubled hospitalization costs, compared to in-hospital treatment of patients suffering from retinopathy or nephropathy. Similar conclusions were drawn by Kanavos et al. [18].

The analysis indicated that within five years (2005-2009) the rates of hospitalization for both types of diabetes have increased. However, for urban residents a twofold increase in hospitalization rates due to type 2 diabetes has been observed in comparison to rural areas (24% vs. 11%). Analyses of the prevalence of type 2 diabetes carried out by Łopatyński et al. in the Lublin region of eastern Poland, estimated the rates for the urban population to be 17.6% and 14.1% for the rural population [49]. However, undiagnosed hyperglycemia presents a considerable problem. According to Łopatyński's research, unknown cases of diabetes occurred more frequently in rural than urban areas (respectively 75% and 56% of newly diagnosed cases of type 2 diabetes). The comparison of patients in whom diabetes was diagnosed before they were admitted to hospital and patients with a recently diagnosed hyperglycemia shows a higher fatality ratio, longer hospitalization and more frequent treatment at Intensive Care Units (ICU) [50]. Also, the study conducted by Łagowska-Batyra et al. [51] in the Lublin region showed no effect of the size of place of residence on the course of type 2 diabetes, despite the presence of significantly higher values of BMI in patients coming from rural areas.

The multicentre epidemiological study (WOBASZ), conducted in the Polish population aged 20-74 years, revealed no significant differences in the prevalence of diabetes among the adult population, depending on residence (the size of a

particular local district, e.g. commune, municipality) [52]. Therefore, it appears that the differences in hospitalization between rural and urban areas may result from disparities in access to medical care (e.g. diagnostic procedures).

The fact that the presented data relate to people discharged from hospital during a calendar year is a certain limitation of this study. A particular patient may have been in hospital several times, either due to the same disease or for other reasons. People hospitalized because of certain chronic diseases, such as neoplasms, require radiotherapy or chemotherapy more than once and are hospitalized many times in the same calendar year. Therefore, hospital statistics refer to some chronic diseases not in terms of the number of people hospitalized, but in terms of the hospitalization episodes.

Unfortunately, in Polish health-related public statistics, there is a lack of personal identification numbers (personal data protection), and therefore the incidence risk and morbidity cannot be easily established. But it is possible to approximately assess the number of people hospitalized in a designated year or in a few subsequent years. This can be achieved through the study of hospital morbidity by taking into account the information about patients' gender, date of birth and residence post code. The accuracy of such estimations may differ depending on the type of disease. In the case of diabetic patients hospitalized once a year, the accuracy is of 67%, twice – 19% and three times a year – 7%, respectively. The lack of fluctuations in the numbers of hospitalizations for diabetic patients in the subsequent years made it possible for the authors to analyze the changes in the frequency of diabetes-caused hospitalizations.

SUMMARY AND CONCLUSIONS

1. The rising prevalence of diabetes (both type 1 and type 2) and associated complications are an important challenge to society. A growing number of people requiring hospitalization due to diabetes causes an increase in expenditures for medical care.
2. Most of hospitalized patients were aged over 50, which may indicate a significant advancement of diabetes in many of people of this age.
3. During the five analyzed years, a faster increase was observed in the number of people hospitalized due to type 1 when compared with type 2 diabetes. Particularly worrying is the increase in the percentage of hospitalizations due to type 1 diabetes among young people. This fact probably reflects the recently observed increase in the incidence of this type of diabetes among children and adolescents, in addition to better diagnosis.
4. An important problem for people with diabetes are co-morbidities, dominated by cardiovascular diseases. The occurrence of complications lead to an increase in mortality of patients and higher costs of treatment of people with diabetes. Therefore, early diagnosis and appropriate treatment of diabetes are crucial for health policy.
5. It seems that shortening the time of hospitalization of people due to diabetes is a result of a general trend to shorten patients' stay in hospitals, not only in Poland, but also in other European countries.
6. Lack of precise data about the prevalence of diabetes and associated costs are a major hindrance. In Poland, great hopes are given to the Diabetes Registers which are under development. A regular analysis of diabetes-related hospitalizations can certainly be an important complementary element of the registers.

REFERENCES

1. 2008-2013 Action Plan for the Global Strategy for the Prevention and Control of Noncommunicale Diseases (2008), WHO, Geneva. 5-12.
2. Roglic G, Unwin N, Bennet PH, et al. The burden of mortality attributable to diabetes. Diabetes Care. 2005; 28: 2130-2135.
3. Wild S, Roglic G, Green A, et al. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. Diabetes Care. 2004; 27: 1047-1053.
4. International Diabetes Federation. http://www.idf.org (access: 6.11.2010).
5. Greeg EW, Cadwell BL, Yrling JC, et al. Trends in the prevalence and ratio of diagnosed to undiagnosed diabetes according to obesity levels in the U.S. Diabetes Care. 2004; 27: 2806-2812.
6. Dunstan DW, Zimmet PZ, Welbron TA. The rising prevalence of diabetes and impaired glucose tolerance. Diabetes Care. 2002; 25: 829-834.
7. Beard HA, Ghatrif MA, Samper-Ternent R, et al. Trends in diabetes prevalence and diabetes-related complications in older Mexican Americans from 1993-1994 to 2004-2005. Diabetes Care. 2009; 32: 2212-2217.
8. Gale AM. The rise of childhood type 1 diabetes in the 20th century. Diabetes 2002; 51: 3353-3361.
9. The DIAMOND Project Group: Incidence and trends of childhood type 1 diabetes worldwide 1990-1999. Diabet Med. 2006; 23: 857-866.
10. Rathmann W, Haastert B, Icks A, et al. High prevalence of undiagnosed diabetes mellitus in Southern Germany: target populations for efficient screening. The KORA survey 2000. Diabetol. 2003; 46: 182-189.
11. Cowie CC, Rust KF, Ford ES, et al. Full accounting of diabetes and pre-diabetes in the U.S. population in 1988-1994 and 2005-2006. Diabetes Care. 2009; 32: 287-294.
12. Valdes S, Botas P, Delgado E, Diaz Cordorniga F. Mortality in Spanish adults with diagnosed diabetes, undiagnosed diabetes or pre-diabetes. The Asturias study 1998-2004. Rev Esp Cardiol. 2009; 62: 528-534.
13. Sosnowski C, Janeczko-Sosnowska E, Pasierski T, et al. Wpływ cukrzycy typu 2 na miażdżycę tętnic wieńcowych i obwodowych. Diabetol Doświadczalna Klin. 2005; 5: 433-438.
14. Heidemann C, Boening H, Pischon T, et al. Association of a diabetes risk score with risk of myocardial infarction, stroke, specific types of cancer and mortality: a prospective study in the European Prospective Investigation into Cancer and nutrition (EPIC) – Potsdam cohort. Eur J Epidemiol. 2009; 24: 281-288.
15. Greeg EW, Mangione CM, Cauley JA, et al. Diabetes and incidence of functional disability in older women. Diabetes Care. 2002; 25: 61-67.
16. Bolin K, Gips C, Mörk AC. et al. Diabetes, health care cost and loss of productivity in Sweden 1987 and 2005 – a register-based approach. Diabetic Med. 2010; 26: 928-934.
17. Dall TM, Zhang Y, Chen YJ. et al. The economic burden of diabetes. Health Affairs 2010; 29: 297-313.
18. Kanavos P, Aardweg S, Schurer W. Diabetes expenditure, burden of disease and management in 5 EU countries. LSE Health, London School of Economics, January 2012. http://www2.lse.ac.uk/LSEHealthAndSocialCare/research/LSEHealth/MTRG/LSE_Diabetes_EXECSUM_24JAN2012.pdf
19. International Classification of Diseases (ICD-10). http://www.who.int/classifications/icd/en/ (access: 22.08.2010).
20. Wysocki KJ, Zejda JE. Epidemiologia chorób zakaźnych w Polsce w drugiej połowie dwudziestego wieku. Przegl Epidemiol. 2007; 61: 615-628.
21. Zdrojewski T, Bandosz P, Szpakowski P, et al. Rozpowszechnienie głównych czynników ryzyka chorób układu sercowo-naczyniowego w Polsce. Wyniki badania NATPOL PLUS. Kardiol Pol. 2004; 61(Suppl. 4): 1-26.
22. Program prewencji i leczenia cukrzycy w Polsce. http://www.mz.gov.pl/wwwfiles/ma_struktura/docs/program_cukrzyca_22102009.pdf (access: 18.06.2010).
23. Lee JM, Okumara MJ, Freed GL, et al. Trends in hospitalizations for diabetes among children and young adults: United States, 1993-2004. Diabetes Care. 2007; 30: 3035-3039.

24. Wang J, Imai K, Engelgau MM, et al. Secular trends in diabetes-related preventable hospitalizations in the United States, 1998-2006. Diabetes Care. 2009; 32: 1213-1217.
25. Kim S. Burden of hospitalizations primarily due to uncontrolled diabetes. Implications of inadequate primary health care in the United States. Diabetes Care. 2007; 30: 1281-1282.
26. Definition, diagnosis and classification of diabetes mellitus and its complications. Report of a WHO Consultation. WHO Department of Noncommunicable Diseases Surveillance. Geneva 1999 http://whqlibdoc.who.int/hq/1999/WHO_NCD_NCS_99.2.pdf (access: 21.06.2010).
27. Lammi N, Taskinen O, Moltchanova E, et al. A high incidence of type 1 diabetes and alarming increase in the incidence of type 2 diabetes among young adults in Finland between 1992 and 1996. Diabetol. 2007; 50: 1393-1400.
28. Jarosz-Chabot P, Deja G, Polanska J. Epidemiology of type 1 diabetes among Silesian children aged 0-14 years, 1989-2005. Diabetol. 2010; 47: pg. 29.
29. Barat P, Valade A, Brosselin P, et al. The growing incidence of type 1 diabetes in children: The 17-year French experience in Aquitaine. Diabetes Metabol. 2008; 34: 601-605.
30. Harrison LC, Honeyman MC. Cow's milk and type 1 diabetes. The real debate is about mucosal immune function. Diabetes. 1999; 48: 1501-1508.
31. Graves PM, Norris JM, Pallansch MA, et al. The role of enteroviral infections in the development of IDDM. Limitations of current approaches. Diabetes. 1997; 46: 161-168.
32. Jaworska J, Kulik TB, Rudnicka-Drożak E, et al. Opieka medyczna w cukrzycy w opinii pacjentów z województwa lubelskiego. Zdr Publ. 2004; 114: 515-518.
33. Sieradzki J, Grzeszczak W, Karnafel W, et al. Badanie PolDiab. Część I. Analiza leczenia cukrzycy w Polsce. Diabetol Prakt. 2007; 7: 8-15.
34. Hossain P, Kawar B, Nahas ME. Obesity and diabetes in the developing world – a growing challenge. N Engl J Med. 2007; 356: 213-215.
35. Colditz GA. Willet WC, Rotnitzky A, et al. Weight gain as a risk factor for clinical diabetes mellitus in women. Ann Intern Med. 1995; 122: 481-486.
36. Koning L, Gerstein HC, Bosh J, et al. Anthropometric measures and glucose levels in a large multi-etnic cohort of individuals at risk of developing type 2 diabetes. Diabetologia 2010; 53: 1322-1328.
37. Mokdad AH, Ford ES, Bowman B, et al. Prevalence of obesity, diabetes and obesity-related health risk factors, 2001. JAMA 2003; 289: 76-79.
38. Pinhas-Hamiel O, Zeitler P. The global spread of type 2 diabetes mellitus in children and adolescents. J Pediatr. 2005; 146: 693-700.
39. Carral F, Olveira G, Aguilar M, et al. Hospital discharge records underreport the prevalence of diabetes in inpatients. Diabetes Res Clin Pract. 2003; 59: 145-151.
40. Naslafkih A, Sestier F. Diabetes mellitus related morbidity, risk of hospitalization and disability. J Insurance Med. 2003; 35: 102-113.
41. Sasaki A. Mortality and causes of death in patients with diabetes mellitus in Japan. Diabetes Res Clin Pract. 1994; Suppl: S299-306.
42. Fu AZ, Qui Y, et al. Impact of concurrent macrovascular co-morbidities on healthcare utilization in patients with type 2 diabetes in Europe: a matches study. Diabetes Obes Metabol. 2010; 12: 631-637.
43. Bhansali A, Chattopatadhyay A, Dash RJ. Mortality in diabetes: a retrospective analysis from a tertiary care hospital in North India. Diabetes Res Clin Pract. 2003; 60: 119-124.
44. Jansson SP, Andersson DK, Svårdsudd K. Mortality trends in subjects with and without diabetes during 33 years of follow-up. Diabetes Care. 2010; 33: 551-556.
45. Lipscombe LL, Hux JE. Trends in diabetes prevalence, incidence and mortality in Ontario, Canada 1995-2005: a population-based study. Lancet. 2007; 369: 750-756.
46. Kinalska I, Niewiada M, Głogowski C, i in. Koszty cukrzycy typu 2 w Polsce (Badanie CODIP). Diabetologia Prakt. 2004; 5: 1-8.
47. Dall T, Mann SM, Zhang Y, et al. Economic costs of diabetes in the U.S. in 2007. Diabetes Care. 2008; 31: 596-615.
48. Pagano E, Bo S, Petrinco M, et al. Factors affecting hospitalization costs in Type 2 diabetes patients. J Diabetes Complic. 2009; 23: 1-6.
49. Łopatyński J, Mardarowicz G, Nicer T, et al. The prevalence of type II diabetes mellitus in rural urban population over 35 year of age in Lublin region (Estern Poland). Pol Arch Med Wewn. 2001; 3: 781-786.
50. Umpierrez GE, Isaacs SD, Bazargan N, et al. Hyperlipidemia: an independent marker of in-hospital mortality in patients with undiagnosed diabetes. J Clin Endocr Met. 2002; 87: 3978-3982.
51. Łagowska-Batyra A, Matuszek B, Lenart-Lipińska M, et al. Comparison of the course of type 2 diabetes in village and town inhabitants in the Lublin region. Ann UMCS Lublin – Polonia 2010; 3: 69-77.
52. Polakowska M, Piotrowski W. Incidence of diabetes in the Polish population. Results of the multicenter Polish Population Health Status Study – WOBASZ. Arch Int Med. 2011; 5: 156-162.