

Diabetes mellitus and congestive heart failure: the prevalence of congestive heart failure in patients with and without diabetes in Poland

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Abstract

Introduction: Diabetes mellitus is a systemic disease and has a negative effect on the cardiovascular system. This paper aimed to present a retrospective analysis of morbidity associated with heart failure in subgroups of patients with and without diabetes in Poland in 2012.

Material and methods: Data from the National Health Fund were used for the study. In general, 656,937 patients with heart failure, including 281,538 males and 375,354 females, were studied. In this population, additionally, 201,043 patients with heart failure (main diagnosis) and diabetes were studied, including 82,117 males and 118,926 females.

Results: The mean index of morbidity associated with heart failure in the whole subpopulation of diabetes patients was 9.03%; 8.42% for males and 9.50% for females. Morbidity associated with heart failure in the population of patients diagnosed with diabetes in Poland in 2012 was seven times higher compared to morbidity associated with heart failure in non-diabetes patients. Morbidity associated with heart failure in females was significantly higher compared to morbidity in males in the whole population, in both the subpopulations of patients with and without diabetes.

Conclusions: Diabetes mellitus significantly increases risk of heart failure in both women and men. The risk is significantly high after the age of 60 years and higher in females.

Key words: diabetes mellitus, prevalence, morbidity, congestive heart failure.

Introduction

The incidence of congestive heart failure (CHF) is difficult to assess, because of various diagnostic criteria used in many publications [1]. The rates of incidence and morbidity associated with CHF may be underestimated [2]. Data regarding the incidence of CHF are usually taken from epidemiological studies conducted in highly developed countries [3, 4].

Type 2 diabetes mellitus (DM) is a risk factor of cardiovascular diseases [5, 6]. The incidence of CHF in diabetic patients is not only underestimated, but it is also underdiagnosed, therefore more studies are needed [7, 8].

Large epidemiological studies indicate that diabetes mellitus causes increased risk of CHF [9, 10].

The paper aims to present retrospective analysis of prevalence of morbidity associated with heart failure in Poland based on reports of main diagnoses of CHF in two subpopulations: in patients diagnosed with diabetes and in non-diabetic patients. The study included all (100%) reports presented in the database of the National Health Fund in the period between 1.01.2012 and 31.12.2012.

Material and methods

Health services in Poland are financed by the National Health Fund (NHF) based on the act and the regulations of the Minister of Health that result from this act [11–13]. Services are provided as part of outpatient and inpatient (hospital) treatment. The regulations of the NHF president determine the organisation, financing, and settlement of such services [14, 15]. In order to perform an epidemiological analysis of data presented in NHF reports, selection with Structured Query Language (SQL) was performed. The number of PESEL (Common Electronic System for Citizens Evidence) was considered to be a unique patient identifier [16].

The NHF settles and pays for healthcare services provided by healthcare providers to patients. In the NHF database from the period between 1.01.2012 and 31.12.2012 there were reports regarding the number of patients with heart failure coded according to the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10): I50 and I50.0 – congestive heart failure; I50.1 – left ventricular heart failure; I50.9 – heart failure, unspecified.

In the NHF database in the period between 1.01 and 31.12.2012 reports associated with diabetes mellitus with the main diagnosis of “diabetes mellitus” with the following determinants were identified: E10.X – insulin-dependent diabetes mellitus; E11.X – non-insulin-dependent diabetes mellitus; E12.X – malnutrition-related diabetes mellitus; E13.X – other unspecified forms of diabetes mellitus; E14.X – unspecified diabetes mellitus or in this period a patient had a prescription for any medicinal products from the group A10.X (insulins), A10 B.X (oral anti-diabetic agents), and specialised (appropriate) diagnostic tests.

Statistical analysis

Data were obtained and prepared using the following tools: Structured Query Language and SAS software by SAS Institute. Student's *t*-test of independence was used. Differences were considered to be significant at the significance level of 95% ($p < 0.05$).

Results

The prevalence of CHF was compared between the diabetic and the general, non-diabetic population. Statistical data from the subpopulation of diabetic subjects and the subpopulation of non-diabetic patients were as follows: In general, in 2012 the Polish population, according to the data of the Central Statistical Office (GUS), included 38,533,789 people, including 18,651,441 males and 19,882,348 females [17]. In the period between 1 January and 31 December 2012 in total there were 2,227,453 patients with diabetes (975,364 males and 1,252,089 females) in the analysed Polish population [18]. The general population without diabetes in 2012 included 36,306,336 people, including 17,676,077 males and 18,630,259 females [19].

Table I shows the numbers of people with the main diagnosis of congestive heart failure in Poland in 2012 taking into account the subpopulation of patients with diabetes and the subpopulation of non-diabetic patients, depending on the sex.

In 2012 in Poland 656,937 patients (281,538 males and 375,354 females) had the principal diagnosis of CHF. Of this population 201,043 people (30.60%) subjects were diabetic (82,117 males and 118,926 females). The number of subjects with diagnosis of CHF without diabetes was 455,894, of whom 199,466 were male and 256,428 were female.

The average age of patients with CHF and with and without diabetes in Poland in 2012 was: in the male group with diabetes: 69.73 ±10.21 ($n = 82\ 117$); in the male group without diabetes: 69.27 ±12.97 ($n = 199\ 466$); in the female group with diabetes: 74.42 ±9.41 ($n = 118\ 926$); in the female group without diabetes: 74.89 ±12.33 ($n = 256\ 428$).

Non-diabetic men were significantly younger than non-diabetic women ($p < 0.001$), and diabet-

Table I. Number of males and females with CHF with and without diabetes in Poland in 2012

Number of patients with CHF	Male	Female	Total
With diabetes	82 117 (40.35%)	118 926 (59.65%)	201 043 (100%)
Without diabetes	199 466 (43.75%)	256 428 (56.25%)	455 894 (100%)
Total	281 583 (43.86%)	375 354 (56.14%)	656 937 (100%)

ic men were significantly younger than diabetic women ($p < 0.001$).

Table II lists the percentages of subjects with CHF with or without diabetes grouped by age.

Among non-diabetic subjects age CHF was observed in 77.40% of males and in 88.57% of females. In the diabetic population aged over 61 years CHF was present in 79.31% of males and in 91.61% of females.

Prevalence of CHF in the total Polish population calculated per 100,000 of the general population and percentage in relation to the total population in 2012 was: in the total male and female: 1704.83/100,000 of the general population, i.e. 1.70% of population; in the male group: 1509.71/100,000 of the general population, i.e. 1.51% of the population; in the female group: 1892.62/100,000 of the general population, i.e. 1.89% of the population.

The prevalence of CHF in the total population was 1.70%, of which 1.51% where males and 1.89% females – significantly higher than males ($p < 0.001$).

The prevalence of CHF for the whole diabetic population was 9.03% – males 8.42%, females 9.50%. For the non-diabetic population the prevalence was 1.26% – males 1.13%, females 1.38%.

The prevalence of CHF in both sexes was significantly higher in the diabetic population compared to non-diabetic ($p < 0.001$).

The prevalence of CHF in male diabetic patients was significantly lower than for the female population, both diabetic and non-diabetic ($p < 0.001$).

The prevalence of CHF in diabetic males was 7.45 times higher compared to non-diabetic males. The prevalence index of CHF in diabetic women was 6.9 times higher than in non-diabetic women.

Among 1000 subjects with diabetes in 2012 there were 90 subjects with diagnosis of CHF, while among 1000 non-diabetic subjects there were 12 subjects with diagnosis of CHF.

In the population of diabetic males over 60 years old in Poland in 2012 there were 595,235 people and in the equivalent population of women there were 923,052 [18]. In the subpopulation of diabetic males over 60 years old there were 65,127 subjects with heart CHF during that period, and 108,960 females [18]. The population of non-diabetic males in Poland in 2012 included 3,069,561 and for females 3,774,509 (Table III) [17, 18].

According to NHF data in 2012 in Poland there were 154,386 men over 60 years old without diabetes with principal diagnosis of CHF and 227,118 of women with this diagnosis [18].

The prevalence of CHF was at least twice as high in men and women with diabetes comparing with non-diabetic and was statistically significant ($p < 0.001$).

Table II. The number and percentage of CHFs in selected age groups in patients with and without diabetes in Poland in 2012, depending on the sex

Age ranges	Patients with heart failure and without diabetes (amount, percentage*)		Patients with heart failure and with diabetes (amount, percentage*)	
	Male	Female	Male	Female
Up to 30 years old	$n = 1815$ 0.91%	$n = 1564$ 0.61%	$n = 90$ 0.11%	$n = 155$ 0.13%
30–50 years old	$n = 9674$ 4.85%	$n = 5667$ 2.21%	$n = 1667$ 2.03%	$n = 939$ 0.79%
51–60 years old	$n = 33,770$ 16.93%	$n = 22,079$ 8.61%	$n = 15,233$ 18.55%	$n = 8872$ 7.46%
From the age of 61 years	$n = 154,207$ 77.31%	$n = 227,118$ 88.57%	$n = 65,127$ 79.31%	$n = 108,960$ 91.62%
Total	$n = 199,466$ 100.00%	$n = 256,428$ 100.00%	$n = 82,117$ 100.00%	$n = 118,926$ 100.00%

*The percentage rounded to 2 decimal places.

Table III. Prevalence of CHF in 60+ people in the subpopulations of males and females with and without diabetes in Poland in 2012

Subpopulation	Male		Female	
	Number of patients	Prevalence (%)	Number of patients	Prevalence (%)
Patients with diabetes above 60 years of age	595,235	10.94	923,052	11.80
Patients without diabetes over 60 years of age	3,069,561	5.02	3,774,509	6.01

In diabetic patients above 60 years old the prevalence of CHF was significantly higher compared to non-diabetics for both sexes ($p < 0.001$).

Discussion

Congestive heart failure is observed in 1% to 2% of the population [20, 21]. The prevalence of CHF depends on the age of the population. In the USA Redfield *et al.* observed a CHF prevalence in the general population of 2.2% (95% CI: 1.6–2.8), and in the age group 45–54 years it was 0.7%, while the 75+ years age group reached 8.4% [22].

Heart failure often coexists with other diseases, such as chronic bronchitis, it is one of the main causes of hospitalisation in the USA. Congestive heart failure accounts for approximately 277,000 deaths annually in the United States and approximately 34% of cardiovascular-related deaths. One in nine deaths in the United States involves heart failure [23].

In a study by Owan *et al.* from Mayo Clinic hospitals the prevalence of CHF in the general population was as follows: age group 55–64 years – 1%; age group 65–74 years – 3%; age group 75–84 years – 7%; and in the age group above 85 years – 10% [24].

Shah *et al.* presented the results of a prospective study lasting 5.5 years of 1,887,062 non-diabetic subjects and 34,198 subjects with type 2 diabetes mellitus demonstrating a prevalence of CHF twice as frequent in the population with diabetes mellitus type 2 [25].

According to Rydén *et al.* increased incidence of CHF in patients with diabetes mellitus type 2 is associated with chronic arterial hypertension, chronic hyperglycaemia, microangiopathy, and other abnormalities [26, 27].

Gottdiener *et al.* showed that the incidence of CHF in diabetic patients was twice as high as in non-diabetic patients [10]. Similarly, in a study by the Kaiser Permanente Centre for Health Research, Nichols *et al.* showed that the prevalence associated with CHF in diabetic patients was more than twice as high as in non-diabetic patients [28].

In another study Nichols *et al.* showed in 2004 that among 1000 patients with type 2 diabetes there were 25–30 cases of CHF per year more compared to a group of 1000 patients without diabetes type 2 [9].

In the Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack trial (ALLHAT) Davis *et al.* demonstrated that there was a significant correlation between the presence of diabetes and heart failure. In diabetic patients hospitalisations and deaths were observed significantly more frequently than in a group of subjects without diabetes and concomitant heart failure [29].

According to From *et al.* diabetes is a significant risk factor for heart failure, which does not depend on coronary artery disease, arterial hypertension, and other potential confounding factors [30].

In Poland, Rywik *et al.* stated that in 2011 the number of people with CHF was approximately 600,000 [31].

So far, there have not been any comparative epidemiological studies on the incidence of heart failure in people with and without diabetes conducted in Poland.

In our studies in Poland in 2012 the prevalence of CHF in both sexes was 1.7%, including 1.51% in men and 1.89% in women, based on the NHF data.

The prevalence of CHF in diabetic patients was 9.03% for both sexes, 8.42% for males, and 9.50% for females. The prevalence of CHF in non-diabetic patients was 1.25% for both sexes, 1.13% for males, and 1.38% for females. The prevalence of CHF in diabetic subjects in Poland in 2012 was seven times higher than in non-diabetics.

In our study there was a higher prevalence of CHF among women compared to men, similarly as in studies by such researchers as Gustafsson *et al.* [32].

In the population of men over 60 years old without diabetes the prevalence of heart failure was 5.02%, and among women it was 6.01%. On the other hand, in the population of 60+ men with diabetes the prevalence of CHF was 10.94%, and among women it was as high as 11.80%.

The prevalence of heart failure in people above the age of 60 years with diabetes was approximately twice as high as in non-diabetic patients, which was also demonstrated by Nichols *et al.* and Gottdiener *et al.* [9, 10]. In the papers of the authors mentioned above the mean age of patients was above 60 years.

Our studies included the whole population of Poland in the period between 1.01.2012 and 31.12.2012.

The studies by Nichols *et al.* and Gottdiener *et al.* included patients with type 2 diabetes mellitus, whereas our studies included patients with all types of diabetes, and this may have been associated with differences in prevalence of CHF that could be observed.

In our studies in 2012 among 1000 patients with diabetes there were 78 patients with heart failure more compared to a group of 1000 people without diabetes.

Among the causes of this phenomenon is the poor metabolic control of diabetes, the treatment of which worsens with the duration of diabetes, and which is an important risk factor for the development of cardiovascular diseases [33].

In patients with diabetes, lipid disorders are common, which are also a very important risk fac-

tor for the development of cardiovascular diseases. The Polish authors showed that the average occurrence of familial hypercholesterolaemia in Poland is 404/100,000 of the general population. Unfortunately, there are no routine tests of familial hypercholesterolaemia (screening) in people under 18 years old [34].

Our studies had limitations and therefore it was not possible to assess the most important risk factors of heart failure, such as the presence of coronary heart disease, arterial hypertension, obesity, lipid abnormalities, duration of diabetes, and compensation of diabetes metabolism, and such factors are emphasised by such authors as Komanduri *et al.* [21] or Rydén *et al.* [26, 27].

In conclusion, studies conducted showed that diabetes mellitus significantly increased the risk of heart failure both in women and men. The risk is significantly high after the age of 60 years and significantly higher in females, based on the following information: The prevalence of CHF in Poland in 2012 in diabetes patients was 1.70% for both sexes, 1.51% for males, and 1.89% for females, based on the NHF data. More than 30% of all cases of CHF were observed in patients diagnosed with diabetes. The prevalence of CHF in the population of patients diagnosed with diabetes in Poland in 2012 was seven times higher compared to morbidity associated with CHF in non-diabetic patients. In men with diabetes it was 8.42%, and in women it was 9.50%. In non-diabetic patients the prevalence of CHF was respectively lower and was: 1.13% in males and 1.38% in females. The prevalence of CHF in females was significantly higher compared to males in the whole population, in both the subpopulations of patients with and without diabetes. The prevalence of CHF in the population over 60 years old with diabetes was more than twice as high in men and almost twice as high in women as in non-diabetic patients. In more than 77%, heart failure was present at the age above 60 years.

Conflict of interest

The authors declare no conflict of interest.

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